Street Railway Journal

VOL. XXIV. NEW YORK, SATURDAY, OCTOBER 15, 1904. No. 16.

PUBLISHED EVERY SATURDAY BY THE
McGRAW PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, ENGINEERING BUILDING, 114 LIBERTY STREET.

BRANCH OFFICES:
Chicago: Monadnock Block.
Philadelphia: 929 Chestnut Street.
Cleveland: Cuyahoga Building.
London: Hastings House, Norfolk Street, Strand.

Cable Address, "Stryjourn, New York"; "Stryjourn, London"—Lieber's Code used.

ST. LOUIS HEADQUARTERS:
Section 1, Electricity Building, Louisiana Purchase Exposition.

TERMS OF SUBSCRIPTION

In the United States, Hawaii, Puerto Rico, Philippines, Cuba, Canada and Mexico.

Street Railway Journal (52 issues)..... $3.00 per annum
Combination Rate, with Electric Railway Directory and Buyer's Manual (3 issues—February, August and November) $4.00 per annum
Both of the above, in connection with American Street Railway Investments (The "Red Book"—Published annually in May; regular price, $5.00 per copy).....$6.50 per annum
Single copies, Street Railway Journal, first issue of each month, 20 cents; other issues, 10 cents.

To All Countries Other Than Those Mentioned Above:

Street Railway Journal (52 issues), postage prepaid..... $6.00
25 shillings. 25 marks. 31 francs.
Single copies, first issue of each month, 40 cents; other issues, 15 cents.
Subscriptions payable in advance, by check or money order. Remittances for foreign subscriptions may be made through our European office.

Entered as second-class matter at the New York Post Office.

The St. Louis Convention

The early date of going to press with this issue prevents us from giving a complete report of or comments on the St. Louis convention. We are able to present in this issue a portion only of the papers, together with a report of the convention proceedings on Monday and Tuesday and a brief statement of those of Wednesday and Thursday. These will show, however, that the convention is being as well attended as any in the history of the three associations. The fear entertained by many that the outside attractions in a World's Fair city would detract from the attendance at the meetings was not justified by the experience at St. Louis. While undoubtedly all of the delegates improved the opportunity to see as much as they could of the Exposition during their stay at the grounds, they arranged their visits so as not to interfere to any material extent with their attendance at the meetings. This was possible because most of those at the convention went to St. Louis with the intention of remaining there throughout Street Railway week. As each association convened for only two to three days, this left the remaining time for sight-seeing. Again, as President Ely suggestively remarked in his address to the Master Mechanics, the progressive and elevating spirit which could not but be inculcated by meeting in such surroundings, assisted in inspiring an interest in the technical objects of the meeting.

We are commenting below on the several papers which were presented at the meeting of the American Railway Mechanical & Electrical Association, so that we need refer here only to the discussions. Those on the technical subjects were to the point and will, we believe, be read with interest by those who were not present, when the official report of the proceedings is published. The outline of the discussion, which we report in this issue, shows that each paper was considered in detail, and that the policy of the association in holding sessions both morning and afternoon was fully justified by the importance of the subjects considered. The action of the association in admitting the way-men to membership was in our opinion a most wise one, as well as was that of not changing the name of the association until the question of amalgamation with the parent association is more fully settled. This subject and its relations to the Accountants' Association will be more fully covered in our next issue.

The Mechanical and Electrical Association Papers

It was a noticeable feature of the papers presented before the Mechanical and Electrical Association convention, that all were very brief, as it was fitting they should be. They might rather, in fact, be termed introductions to the general discussions of subjects mentioned in their titles, which followed.

Mr. John Lindall, in taking up the subject, "Maintenance and Inspection of Electrical Equipment," called attention to a matter concerning which but little has been said heretofore, and which may be profitably given careful consideration by every railway company. The careful selection and disciplining of employees in the operating department has been much discussed; but in the mechanical departments, the human element in shop operations is too frequently overlooked or considered of secondary importance when really it is of first importance. A skillful master mechanic eliminates as far as possible processes requiring special skill in the workman, because such processes are almost invariably expensive and, by reason of occasional poor workmanship, uncertain. That process is best which eliminates the factor of skilled work to as great an extent as possible, but even after we have done this as much as we can, a great deal still depends on the skill and knowledge of the workman—this being especially true in the case of car inspectors and repair men. A little carelessness or bad judgment on the part of these men can do many dollars worth of damage. It is a place where experience and judgment count for much. At best it is not entirely clean and pleasant work, and it is useless to expect the right kind of men to stay in this work unless the surroundings and conditions are made as comfortable as the nature of the work permits. When this is done, and when a system is put in use, as suggested by Mr. Lindall, which places the responsibility for carelessness, and which shows the result

of carefulness, there is some object for the right kind of men to stay in this work. A friendly rivalry to produce the best results is quite certain to follow any system where the results of different men's works are compared, all of which goes to maintain the highest efficiency.

"Wheel Matters," as taken up by Mr. J. Millar, reviews a condition of affairs at Buffalo involving serious wheel troubles, which has probably been experienced in milder form in many another city where interurban equipments are brought in over city tracks with special work not designed for the large flanges used on interurban cars. Mr. Millar comes out unreservedly for rolled steel or steel-tired wheels for interurban cars. He wisely considers that conditions demand a steel wheel for interurban service on the grounds of safety alone, but aside from the consideration of safety, the steel wheel seemed to give much better results for money expended. Few companies have experienced as much trouble as those in Buffalo, but trouble has been plentiful enough, so that it is pleasing to know how well the steel wheels are performing at Buffalo. As regards the difference in wear on two wheels on the same axle, that is an old story in railroading, and it seems to be inseparable from all railroad operation. Steam railroads have been through the same experiences, as it is the universal observation that, whatever the condition in operation, one wheel in time will be found with a sharp flange, the other with extra wide or possibly double flange. Many theories have been advanced at different times to account for this, but the uneven wear goes on just the same. A slight difference in wheel circumference is sufficient to account for it, and is accepted by most experienced railroad men to be the principal cause of sharp flanges, although there are other minor causes. Certain it is that they will occur on trucks which are as square as mechanical skill can make them, and when trucks are not operated always in the same direction.

The "ideal shop" proposed by Mr. Wright follows the general plan of steam railroad repair shops more fully than do the majority of electric railway repair shops. There are a few important electric railway shops in the country very similar in plans to that proposed by Mr. Wright. For a number of years the transfer table in electric railway shops was generally avoided, presumably because of unpleasant memories street railway men had of transfer tables used in crowded city horse car houses, and inherited by electric roads. As far as the repair shops are concerned, there are not the objections to transfer tables that there are in the case of car storage houses where a large number of cars must be operated over a transfer table every day. That the transfer table has an important place in railway repair shops, the practice of steam railroads leaves no room to doubt. Possibly one reason for the unpopularity of the transfer table in recent years when large new repair shops have been erected is the amount of space taken up by the transfer table. If the tracks of the shop are arranged so as to take only one car each, the room taken up by the transfer table is an important percentage of the total room. Most shops are built where economy of space is not by any means of first consideration, although this is probably more true in Western cities than in Eastern cities. Unless ground is very valuable the amount of room taken by the transfer table ought to be secondary to facility of repairs. It might be argued that in the amount of space required by a transfer table, curves and switches could be put in which would permit cars to be run into any repair track without the aid of a transfer table. If we suppose a transfer table to be run alongside of one building only this is true, but if it is to serve two adjoining buildings, as indicated in Mr. Wright's plans, it is not true. Lack of motive power to move disabled cars off a transfer table into a repair shop of this kind has been criticised as a defect of this plan, but when one considers the small per cent of cars that are actually disabled, so that they cannot move themselves, this seems rather unimportant, because if such cars are numerous enough special precautions in the way of motor-driven, cable-winding drums can be easily installed to pull cars from the transfer table into the repair shop.

Insurance and Car Storage

In these days when street railway companies are casting about for ways in which to reduce the insurance on cars, it may be worth while to cite the experience of a certain interurban company which recently made the discovery that by a simple change in the form of its policy it was able to carry about $80,000 more insurance on its cars for the same amount as previously paid in premiums. This company stores the greater part of its equipment in open yards. The cars in car houses are only those being cleaned, inspected or repaired. The insurance rate on cars in car houses is much higher than for cars in a yard. By dividing the insurance so as to make that on cars in car houses cover only the number that can be placed in the repair and inspection shops and making the remainder on cars outside, the great saving mentioned was made. Since it is not unlikely that other companies have overlooked this, the incident is mentioned here. If a company stores all its cars in car houses there is, of course, no chance to save in this way. Whether electric railways will ever go entirely over to the steam railroad practice of storing most of the equipment in yards, rather than in houses, remains to be seen. Those who point to steam railroad practice in passenger car storage in yards would do well to remember that those same steam railroads house their locomotives where they can receive proper attention in bad weather. An open yard can never be a proper place to inspect and make minor repairs on motors and motor trucks in Northern climates. It may not be logical, however, to store all of the motor cars in a house every night because part of them must be inspected.

The Street Railway and the Landscape Gardener

To a practical street railway man immersed in the exacting duties of keeping cars moving and carrying the public upon his system with a maximum of profit and a minimum of expense, there is something grotesque in the suggestion that it would be a good thing now and then to get in touch with that eminently æsthetic soul, the landscape gardener. At first blush it seems little short of ridiculous to think of spending money for mere appearance when there are so many calls for every cent of spare cash in maintenance and betterments upon modern electric roads. Let some heavy spectacled exponent of idealism approach a manager with this question about 9:30 o'clock on some fine Saturday morning when the office force is running at 50 per cent overload for the sake of the golf links and the canoe at 1 p. m., and ten to one the answer will be: "My dear sir, we are not running an art gallery on this road, because we have troubles of our own. We appreciate your interest in our welfare, but just at this time we aren't in shape to consider the matter." And so the interview ends, and the idealist finds himself in the elevator and at the street floor before he has thought out the first three words of a reply.

Let us approach the manager at his club, however, on some summer evening just after dinner when his family is at the mountains, the Board of Aldermen scattered to the four winds, and the ice chest handy on the far side of a push button. The

chances are that æsthetics can have a hearing, if the Mayor doesn't turn up in quest of a friendly game of—Old Maid.

There would be little use in discussing the relation between the street railway and the landscape gardener were it not for the fact that a great deal of good work may be done in improving the appearance of a company's property with very little expense. The further one travels about the world the more one comes to realize that good appearance is counting more in engineering structures of all kinds to-day than ever before. Perhaps the most striking feature of the illustrations of European practice which appear in the technical press these days is the attention paid to artistic designing. There is almost always a certain gracefulness in outline and balance in proportions in Continental structures that commands admiration, peculiar as some of the methods and apparatus employed may be.

In the United States one need cite but a few instances to indicate that the tendency to avoid ugliness in design is fast taking root. Long study was given by the Boston Elevated Railway Company, for example, to the securing of structural steel designs for its overhead division that would be pleasing to the eye, and it was only after protracted consideration that the question was settled. Equal care was given to the design of the elevated stations in Boston, appearance counting heavily in the architectural award. In Minneapolis and St. Paul the new sub-stations and offices in each city are models of architectural beauty, as are the new bridges in some of the Twin City parks. In Colorado Springs the new car house of the street railway company instantly attracts the passerby's attention for neatness in design, while in Denver the new tramway power house probably excels in appearance any city building on the banks of the Platte River. The same harmonious adaptation of means to ends which makes for good appearance may be seen in the General Electric Works at Schenectady and in the Westinghouse shops at East Pittsburg. Innumerable illustrations occur in the steam railway field, from the beautiful stations of the Boston & Albany division of the New York Central to the superb stone bridges of the Pennsylvania and the splendidly kept roadbed of the Lake Shore.

Not only in buildings, but in permanent way can the electric road "straighten out the kinks" in the landscape which it so easily may produce. Call in the landscape gardener and say to him: "We have $50 or $100," whatever the case may be, "which we wish to spend for advice as to the improvement of our lines. Suppose you spend a few days upon our system and then make us a report embodying your suggestions as to how the appearance of things can be bettered. Pay special attention to those changes which can be made at little expense." It is safe to say that in a great many cases the result will surprise even a progressive management.

A great mistake is made in assuming that structures must be designed elaborately in order to produce work of artistic appearance. It is entirely unnecessary to paint clusters of roses upon the wainscoating of power house engine rooms; to embellish the massive frames of engines and generators with fanciful curves and gilt flourishes; to train ivy upon feeder poles and to incorporate rural scenery into the panels of the cars. In a nutshell, the whole question of harmonious appearance consists in an intelligent adaptation of means to ends. The sense of proportion is absolutely necessary. A simple bridge may easily surpass one of complex design, and a few rough seats scattered along a natural woodland path may readily offer more attractions to the nature lover than the most painfully artificial graveled walks amid a hodge-podge of flower beds.

Cleanliness and trimness are vitally important in making the most of appearances. If a road can do nothing else it can at least keep its rolling stock and stations clean, its insulated wires properly strung and its roadbed free from débris. Inconspicuous waste barrels may be placed in its parks, and in numberless little ways the cause of good looks may be conserved. If a new trestle is built the piles can be driven straight; if a substation is put up the joints in the brick work can at least be made smooth and even.

The proportions of all engineering structures should be such as to give them a substantial and permanent appearance. It is hard to give this impression of solidity in some forms of steel work, but even here the sharp eye detects poorly proportioned designs, in the appearance of the completed structure—at least within limits. Good looking designs are very closely related to good mechanical workmanship. Here it is that the growing use of reinforced concrete offers a broad field for the performance of finely appearing work.

It may well be asked: "What is the use of paying any attention to æsthetics, after all?" There is no answer that can be compressed into a single word, but in general, there is a decided financial advantage as well as moral gain in good appearances. A clean car attracts more passengers than a dirty one; a well built and thoroughly lighted plant stimulates the pride of the employees to keep it in good condition; a roadbed free from rubbish makes unusual conditions all the more apparent to the track inspectors; a substantial bridge gives the idea to the public that the company is a permanent fixture in the community, and a well kept overhead system follows a workmanlike installation. The English road which accepted the competitive design of a local art school in building its trolley and feeder poles was on the right track. Not only is the eye satisfied with correct designs; the depreciation charges are pretty sure to be less. These are some of the reasons why it is worth while for a railway to come in touch with a landscape gardener through the entering wedge of the modern park system.

Power Plant Economies

In view of the great attention which is now being paid to the selection of prime movers, it is worth while to consider whether there are not other departments of the power station where important economies can also be effected. Figures on turbine efficiency are being eagerly sought by engineers, but it should be remembered that as yet the turbine has not been applied, to any extent, to the operation of direct-current machinery. And as a large majority of the street railway power stations of the present time, and for some time to come, will be made up exclusively, or even in large part, of direct-current generators, the possibilities for improvement in the reciprocating engine and of the other features in the chain of power generation must not be overlooked.

Certain tendencies in recent power-plant design make it evident that important fields of this kind have hitherto been often neglected. Great possibilities of economy lie in the application of more care in installation and operation of such auxiliaries as the feed-water heater, the damper regulator and other automatic means of taking care of the steam generating equipment in the absence of, or during careless operation, by the attendants. In this connection it is safe to say that the feed-water heater, particularly of the open type, has not received even a fraction of the study that it deserves. There is almost, if not equally, as fruitful a field for securing high economies in other parts of the boiler-room apparatus and in the steam auxiliaries, and their effect on the total economy of the plant should not be forgotten.

THE MANDALAY ELECTRIC TRAMWAYS

A few weeks ago a short announcement was published relating to the opening of an electric tramway system in Mandalay by the Lieutenant-Governor of Burma, Sir Hugh Barnes, K.C.S.I., K.C.V.O. Now that the system has been in successful operation for the last two months, and in view of the fact that Mandalay is the first city in Burma to adopt the very latest mode of transit in the shape of electric cars in place of horse traction, a detailed description of the enterprise will no doubt be of interest.

The Mandalay Electric Company was floated in London in October, 1902, with a capital of £200,000. Work was commenced in December of the same year, and the first electric car was operated on June 17, 1904. The center of the tramway system has been wisely placed at the new Zegyo Bazaar, on which the municipality is spending a large sum of money, and which promises to be, when finished, the largest bazaar of its kind in the East, and a position that will become a center of attraction to the Burmese from all parts of the city. From the Zegyo Bazaar the tramway radiates in three branches. One leads to the shore, where the Irawaddy Flotilla Company's steamers embark their passengers, and so will cater for the traveling public. The second runs to the Arakan Pagoda, and will serve the suburbs which cluster around that famous shrine. The third leads to the Court House, where the daily legal business of the city and district is transacted.

The tramways have a route of 7 miles, double track throughout, and equal, exclusive of cross-over roads, approximately 14 miles of single track. The rails are in accordance with standard tramway practice, 6 ins. deep, with a 1¼-in. groove, laid to a gage of 3 ft. 6 ins., in 45-ft. lengths, with a proportion of shorter lengths to allow for piecing in and closures. The rails are double spiked to hardwood sleepers, which are laid at 2-ft. 9-in. centers, the whole being laid on a ballasted bed, the road surface being made up with macadam in the ordinary way. The joints are of the plain type, and are secured with six-holed fish-plates, and are double-bonded with two 4/0 B. & S. Neptune pin bonds, the usual cross and intertrack bonds being provided.

The overhead equipment is on the span-wire system, a double line of trolley wire being used throughout. The standards are made up of solid drawn, weldless steel tubes, and have an overall length of 28 ft. They are set 6 ft. deep below the upper surface of the rails, the excavation being entirely filled with concrete. The trolley wires consist of hard-drawn copper .364 in. diameter, with a breaking strain of 23 tons per square inch.

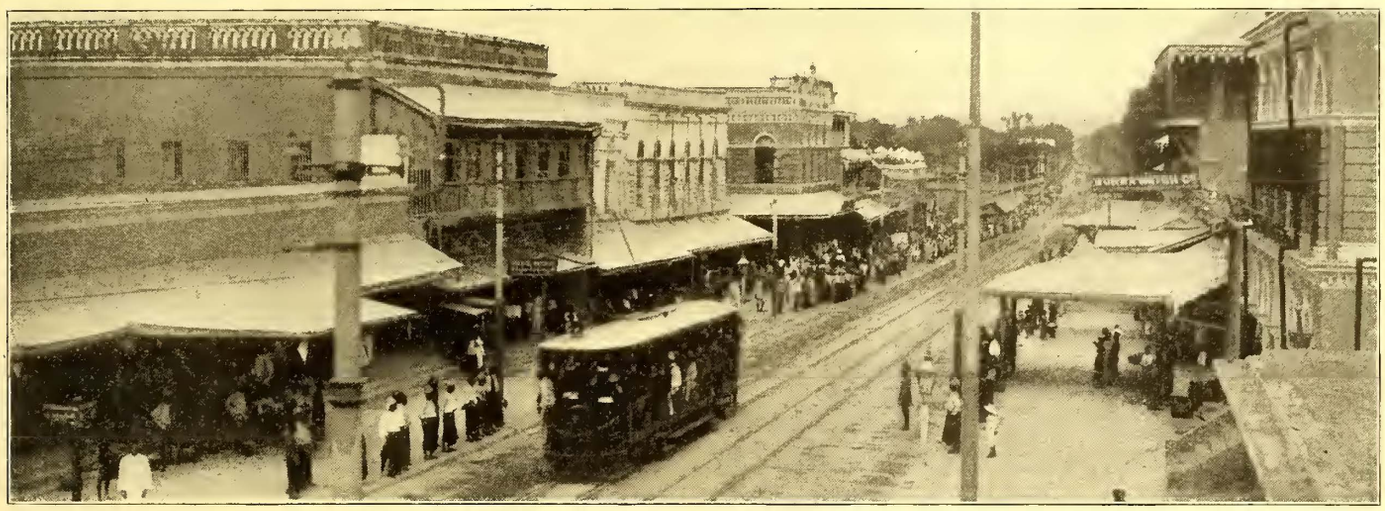
A VIEW OF MANDALAY LOOKING WEST FROM THE POWER HOUSE CHIMNEY

Section insulators are provided, so that each half mile of trolley can be controlled separately if required. Lightning arresters of the Garton-Daniels type have been provided at every half mile of route. The feeder system, which is a somewhat elaborate one for an Eastern tramway, consists of solid soft-drawn copper wire, carried on special high resistance toggle-clamp insulators, which are in turn bolted to substantial malleable iron brackets attached to the poles. At several points along the route of the tramways these feeders are tapped by insulated cables which are connected to the main feeder switches in switch pillars fixed on the sidewalk in a manner similar to underground feeders.

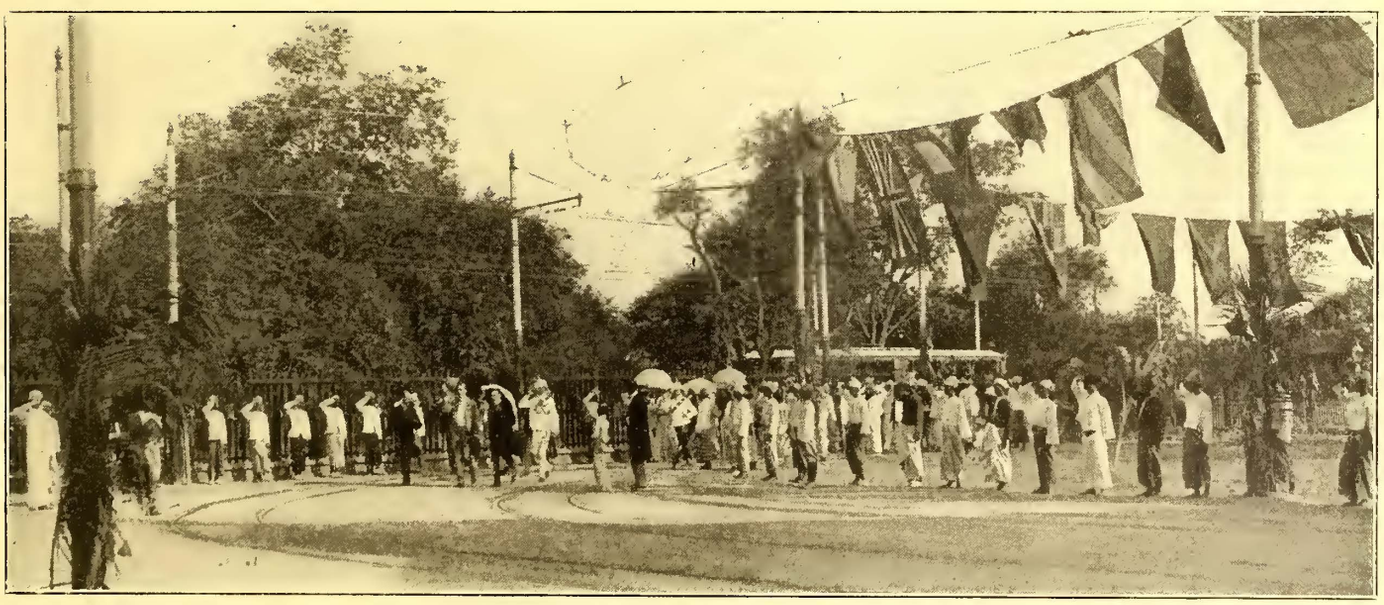
The rolling stock consists of twenty-four electric motor cars of the single-deck, open, cross-bench type. They have all the latest improvements, and were built for Dick, Kerr & Company, Limited, by the Electric Railway & Tramway Carriage Works, Limited, Preston. Special care has been taken in de-

signing the cars to insure the interchangeability of all the important parts entering into the construction of the rolling stock. The car bodies are 35 ft. 4½ ins. in length and about 6 ft. wide, and are designed to provide seating accommodation for forty-eight passengers. The floor frames are built of well seasoned teak, in combination with steel sections of such members and sizes as to insure maximum strength and minimum weight. Openings are arranged in the frame over the motors to afford convenient access to the armature brushes and to all bearings requiring frequent inspection and oiling. The platform floor frames are formed of teak timbers, extending under the main floor frame as far as possible without interfering with the clearance of the trucks, and project out from each end sill 3 ft. to provide room for the brake shaft and controllers. Teak end bars are secured to the outside ends of these timbers, forming sills to which the platform dashes and the entrance steps are secured. The main floor is laid with ⅞-in. matched teak boards and secured at all bearings with barbed-wire nails. To prevent the car from sagging, a substantial truss is provided, supported in the center by two wrought-iron standards. 3-ft. x 5-in. steel angles, and are secured to the ends of the platform to protect them from injury in case of accidents. These are slotted and pins provided to enable hauling of cars

PYAGYI TERMINUS OF THE MANDALAY TRAMWAYS



OPENING CEREMONY ON JULY 2, 1904, OF THE MANDALAY TRAMWAYS, WITH LIEUTENANT GOVERNOR EN ROUTE



ARRIVAL OF THE LIEUTENANT GOVERNOR AT THE OPENING OF THE MANDALAY TRAMWAYS, JULY 2, 1904

The roof frames are composed entirely of teak, the covering being of cotton duck, laid wet in a coat of white lead paint. Storm curtains are provided for each side entrance of the cars, sliding in grooves between the post. The dashes are made up of No. 16 B. W. G. steel plates, furnished with substantial iron rails and wrought-iron post. The collision buffers are made up of in case of emergency. Each car is provided with two circuits of 100-volt incandescent lamps, with change-over switches for putting one of the other headlights in circuit.

The trucks upon which the cars are mounted are of the Brush Company's single type. They are suitably built to support the car bodies and to receive the motors and gearing.

The cars are fitted with a complete set of electrical equipments, each set consisting of two of the Dick, Kerr standard 25-B traction motors, capable of delivering approximately 28 hp, the temperature of the various parts not exceeding 75 degs. C. after running at full load for one hour. The controllers supplied with the electrical equipments are of the same firm's standard D. B. I. form "C" type, especially arranged with resistances for emergency braking, operated by the driving handle, which may be utilized either when the car is proceeding forward or backward.

The power house has been erected on the company's site in Seventy-Eighth Street, together with the necessary offices, car shed and repair shops. The steam plant consists of three Babcock & Wilcox water-tube boilers, with a working pressure of 160 lbs. per square inch. Each boiler is provided with a steam superheater fitted with all the usual accessories; a water storage tank with a capacity of 20,000 gallons of water; a fuel economizer, and two double-acting single-cylinder feed pumps, each capable of delivering 2000 gallons of water per hour. The engines, of which there are three in number, are of the "Belliss" compound two-crank type, mounted on bed plates extended to take the direct-coupled generators; each engine is fitted with a heavy fly-wheel and steam separator, and is capable of giving a normal output of 300 bhp when running at 400 r. p. m., non-condensing, with steam at a pressure of 155 lbs. per square inch at the stop valve.

The electrical plant consists of three direct-current 500-550-volt compound-wound generators, coupled direct to the engines, the output of each generator being 200 kw when running at 400 r. p. m., and they are designed for an overload capacity of 20 per cent for two and one-half hours, with a moderate rise of temperature. The generators are in every respect in accordance with the contractor's standard practice, the magnet frames being of cast iron and the pole pieces of laminated steel and cast into the magnet frame. The commutation is sparkless at all loads and the field windings are so arranged to give a 10 per cent rise in the E. M. F. from no load to full load.

The switchboard was erected by the generator builders, and consists of nine black enameled slate panels 1½ ins. thick, each supported independently on an iron frame. The board consists of three generator panels, four feeder panels, one station lighting and one Board of Trade panel.

A CURVE AT SOUTH MOAT ROAD AND SEVENTY-EIGHTH STREET, MANDALAY

THE PAYAGYR BRIDGE BUILT OF TEAK BY KING MINDOON

Each generator panel is provided with two single-pole switches; one equalizing switch to connect the shunt of the compound-wound dynamo on to the equalizing omnibus bar; one shunt-field rheostat to enable the E. M. F. of the generator to be raised and lowered 50 volts; one field switch, with resistance and pilot lamp; one main ammeter, and an automatic circuit breaker with magnetic blow-out.

Each feeder panel is provided with one main single-pole switch; one automatic circuit breaker, and one ammeter.

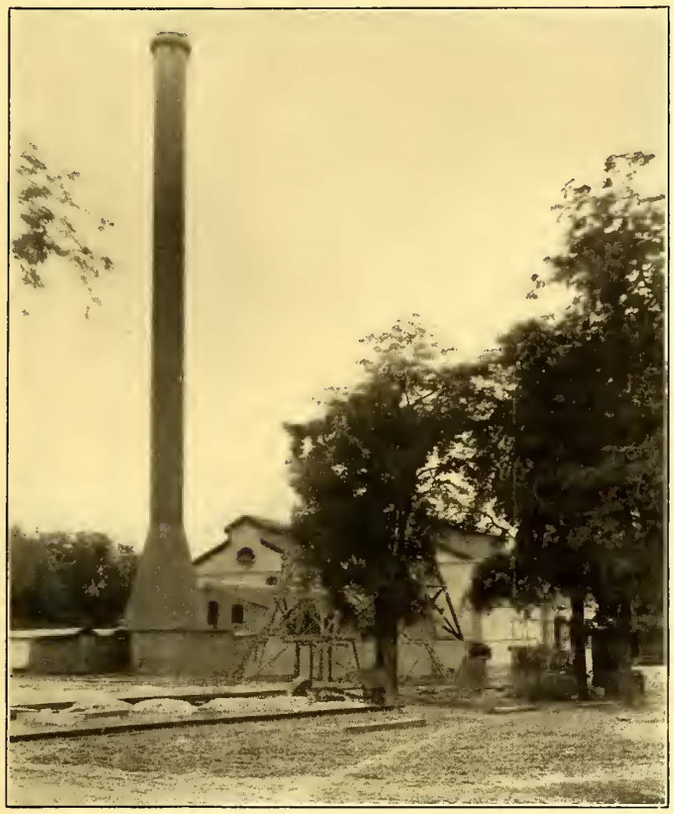
The testing panel has mounted on it all the necessary instruments and switches for recording or measuring the leakage taking place. It also has a voltmeter for recording the difference in potential between the terminus ends of the rails and the negative bus-bar. The station circuit panel is mounted with all the necessary switches and fuses, together with ammeters required for the station lighting and motor circuits.

A Higginbottom & Mannock 10-ton engine-room traveling crane, having a span of 38½ ft. with a lift of 20 ft., has been erected in the power house. The lifting longitudinal and traverse is worked by chains from the engine room floor.

THE MANDALAY TRAMWAYS CAR SHED AND POWER HOUSE

The contractors for the whole of the work and plant were Dick, Kerr & Company, Limited, represented in Mandalay by D. Williamson. The sub-contractors were Nahapiet & Martin,

of Rangoon. The consulting engineers for the work were Kincaid, Waller, Manville & Dawson, of Westminster, who prepared the detailed plans and specifications, and were represented in Mandalay by E. Sellon. The local work was carried out under the able superintendence of Mr. Griffin and A. C. Morgan.



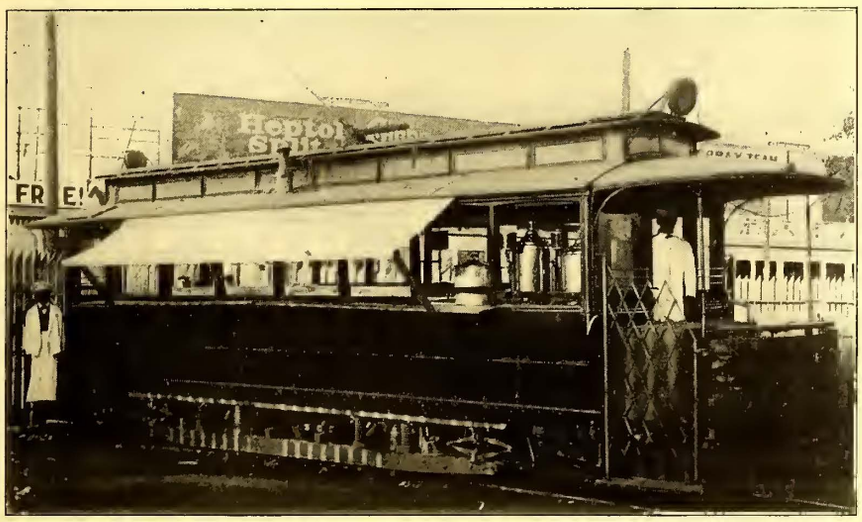
MANDALAY POWER HOUSE AND CHIMNEY

THE ST. LOUIS TRANSIT COMPANY'S LUNCH CAR

The accompanying reproductions from photographs show the lunch car recently put in service by Capt. Robert McCulloch, general manager of the St. Louis Transit Company, and of which mention was made in a recent issue of this periodical. The greater part of the World's Fair traffic falls on the Olive Street and Delmar Avenue lines, these being the most direct routes from the city to the main entrance of the Fair. Every expedient possible has been taken by the management to keep these lines clear. It was found that more or less delay was occasioned by trainmen stopping their cars at different points along the line to run to a neighboring restaurant for a cup of coffee and a sandwich. As the privilege of getting a lunch could not well be denied the trainmen, it was decided by the management to furnish a free lunch at the end of the route, where the lay-over time could be utilized without interfering with the service.

The car shown in the illustration was fitted up for this purpose and put in charge of J. B. Price, purchasing agent of the St. Louis Transit Company. It is supplied with coffee urns, hot-water heaters and ice boxes, and is fitted with the necessary shelves, lockers and other facilities for serving coffee and sandwiches. For the coffee a mixture of half cream and half milk is provided. Several varieties of sandwiches, including corned beef, ham, cheese and frankfurters, are furnished. Mr. Price's instructions were that the best quality of food obtainable was to be provided. Everything is fresh, and the popularity of the lunch car is no doubt largely due to the superiority of the quality of the food furnished over that commonly served in restaurants, as well as to the fact that it is free to the men.

GENERAL ARRANGEMENT OF THE INTERIOR OF THE ST. LOUIS TRANSIT COMPANY'S LUNCH CAR



AN EXTERIOR VIEW OF THE LUNCH CAR

Each afternoon the sandwiches are prepared while the car is at the Park and Vandeventer shops. Coffee is not made until the last moment before serving. On ordinary days the car is run to the Olive Street loop in time to serve food at about 8:15 o'clock, just after the theater traffic is over and before the big rush from the Fair has begun. The car is placed in a gateway, extending half in and half out of the fence surrounding the Olive Street terminal. Men from the Olive Street line are served within the enclosure, while the Delmar Avenue men remain on the outside. The portion given to each man is not limited, he being provided with as many sandwiches and cups of coffee as he desires. Approximately 250 men are served each night. About 600 sandwiches and from 35 to 40 gallons of coffee are required. On special days, however, the consumption is much greater. On St. Louis Day, lunch was served at noon, at 5:30 in the evening and at midnight, requiring 4000 sandwiches and 200 gallons of coffee.

The view of the exterior of the car shows it just within the enclosure at the Olive Street terminal. The lunches are served through the side windows, the side of the car being provided with a shelf for this purpose.

CORRESPONDENCE

INSULATION OF A THIRD RAIL

New York, Oct. 6, 1904.

Editors Street Railway Journal:

In the current issue of the Journal an editorial on the "Status of the Third-Rail System," needs a little correction. In the absence of any comments from those connected with the Consolidated Railroad, it might not be amiss to attempt an explanation of the abandonment of a part of the third-rail system between Braintree and Nantasket Junction.

In the first place the heavy trolley line from Nantasket Junction to Pemberton was built when Nantasket Beach was one of the most popular summer resorts of Boston. The extension of this system toward Boston by a third rail was built to see if the latter were practicable. The whole system accommodated a purely summer travel and was shut down nearly every winter. The steam trains which necessarily passed over the third-rail section were bound from Boston to other distant points having no connection with the Beach line.

A few years ago the city of Boston acquired Nantasket Beach and turned it into a park, removing all hotels and places of amusement. That reduced the summer travel to a little more than that given by the summer residents or cottagers. It then became evident to observers that sooner or later the whole or part of the electric system would either by abandoned or extended into the city of Boston. That the former has been done has probably nothing to do with the technical success or failure of the third rail, but for financial reasons, influenced by the yearly traffic.

Certain reasons, unnecessary to mention here, decided that the third rail should be placed low down in the center of the track. While admittedly this position is inconvenient and has less advantages than an outside conductor, it has had no effect upon the success of the system. Evidence of this is shown in the installation of 24 miles of exactly similar construction in Connecticut, and the announcement of the abandonment of this system will be many years hence if the traffic it has enjoyed since completion keeps up.

The insulators, if such they may be called, have shown up remarkably well, in spite of the fact that they were creosoted wooden blocks, costing only from 15 to 40 cents each, depending upon who made them. The rail was an inverted "V," with a flat top 2½ ins. wide. The rail acting as a roof, kept the contact between the block and rail practically dry.

The leakage rarely exceeded 1½ amps. per mile, and the average was about 1 amp. per mile. In one case 300 ft. of track was submerged in fresh water and the added load was hardly noticed at the power station. In another case over ½ mile was under water, but the service was not interrupted, and the load at the station showed an increase of only about 400 amps., or that of one additional train.

On 3 miles of road from Nantasket Junction to Cohasset, an ordinary 60-lb. T-rail was laid in the center of the track, with 2-in. strips of creosoted wood between it and the ties, and spaced 10 ft. apart. No excessive leakage was noticeable even in wet weather.

The subject of third-rail insulators is an interesting one, and whether the expense to which some have gone in the matter is justified is a question.

Edward C. Boynton.

The Toledo, Bowling Green & Southern Traction Company will purchase two fine passenger coaches which will be used for limited service between Toledo and Findlay. As soon as the new entrance to Toledo is completed they will give a limited schedule of two hours to Findlay. At present the schedule is three hours and ten minutes.

STEEL-TIRED WHEELS AND ELECTRIC RAILROADS

BY KNOX TAYLOR

It is interesting to note how history has a way of repeating itself in the experience of electric roads when compared with that of the steam roads that preceded them; a history, however, that in this case is much abbreviated in the matter of time, for the development that has extended over three-quarters of a century in the steam service, has been compressed into less than a score of years in the electric service. It is natural to expect that the introduction and adoption of new devices should be much more rapid in the newer than in the older system. Attention has already been called to the fears that were expressed as to the probable value of steel-tired wheels on electric cars, and the cast-iron article seemed to be the best solution of the problem.

But the electric car differs from the ordinary car in that it is a locomotive as well as a car, and anything that can add to the length of time between stoppings, demands prompt adoption, almost regardless of the initial cost. In fact, in the case of such an article as a wheel, it would be well worth quite an excess in cost if the car can be kept in service longer periods without necessitating wheel removals. It is difficult to make a true estimate of the value of a steel-tired wheel when considered from the viewpoint of its influence on the other expenses of maintenance.

It is commonly accepted as good business policy to shorten the length of time that cars and locomotives are held in the shop, because of their earning capacity while on the road. For this reason the time allowed for painting, for example, has been shortened by one-half. On the same principle, a wheel that will save a week's time that would otherwise be spent in the shop, will pay for itself many times over in the increased earnings of the car. That the steel-tired wheel will accomplish such results as this there seems to be no room for doubt; so that, from this broader point of view, there seems to be no argument against its adoption.

Still, the equipment of a large road with steel-tired wheels does involve a comparatively heavy outlay, and the matter should not be undertaken without careful consideration, and for this reason the lower priced steel-tired wheels of the fused type, such as made by the Taylor Iron & Steel Company, offer the greater inducement to managers.

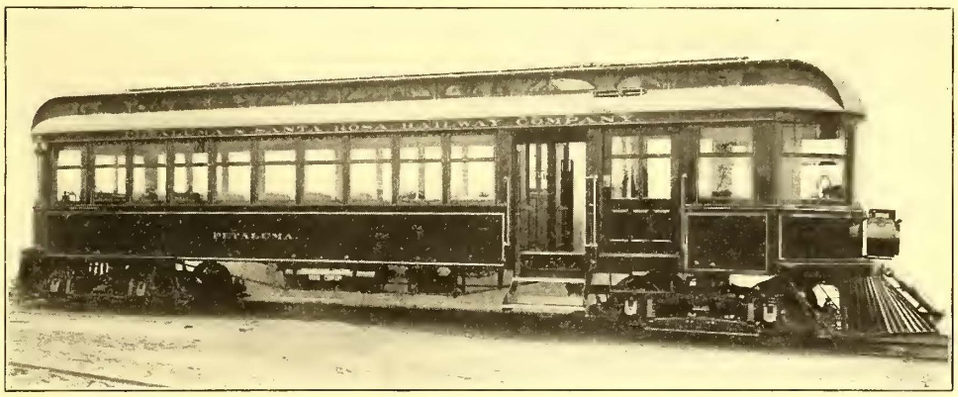
At the present time there is a growing sentiment in favor of this type of wheel, and a number of roads that have put them in service have started to keep accurate and reliable records of all costs in any way related to wheels, so that in eighteen months or two years there will be data available that will enable the most doubting official to arrive at a decision that will stand the closest investigation. The records that are available now go to show that those to come will substantiate the good opinions that have been expressed regarding the value of the steel-tired wheel. It appears that, in what little work has been done on urban roads, the steel-tired wheel promises to be only about 65 per cent as expensive as the chilled wheel at the end of its life, though it will cost much more for the initial outlay.

As to exactly what the increased time service will be, due to the less frequent shopping of the car having steel-tired wheels, is not yet definitely known, but it is a very conservative estimate to place it at ten days, and it is respectfully left to the management to decide as to the money value of ten days' service of a car that would otherwise be idle.

Of course, the steel-tired wheel has established itself for interurban work where heavy cars are to be run at high speeds, and nothing else is receiving much, if any, consideration, and the present outlook is that it will expand and increase until it is the accepted standard of the best practice on all classes of electric roads.

A NEW TYPE OF INTERURBAN CAR

Four handsome interurban cars have lately been delivered by the American Car Company, of St. Louis, to the Petaluma & Santa Rosa Railway Company, of California. As will be seen by the illustrations, the type is a departure from cars as heretofore built for interurban service, the compartment being divided by a vestibule having an entrance at either side. The general design of these cars was suggested by the president of the railway, George A. Batchelder, and the arrangement is not only interesting as a novelty, but also from a practical standpoint, as space is saved and there is no interference with the radiation of the large trucks. The Brill semi-convertible window system is used for the passenger compartment, making the car open and attractive for summer service. This compartment seats forty passengers, and the baggage compartment is handsomely finished in mahogany, which constitutes the woodwork also of the passenger compartment, and folding seats are provided for the use of smokers.



INTERURBAN CAR BUILT FOR THE PETALUMA & SANTA ROSA RAILWAY COMPANY

The interior illustration shows a unique arrangement of partitioning the motorman's cab; this partition consists of heavy glass plate set in ornamental brass and is intended to give the passengers an unobstructed view forward and to beautify the appearance. Mr. Batchelder wished the cars to be unusually handsome, believing that such cars would encourage traffic where those of ordinary appearance would fail.

At the end of the passenger compartment next the vestibule, a water-cooler of special design is placed in such a way as not to interfere with the standing or seated passengers. The arrangement was the idea of the builder. The cooler is held between four bars suspended from the ventilator rail and is supported by a drain pipe. It is readily removed for cleaning and filling. The arrangement is so convenient that it will probably be considerably used in future. The motorman's cab, in the baggage compartment, is placed on the left side and entirely enclosed. When the sliding doors of this compartment are open, net guards may be used to cover the openings, and these guards protect the woodwork when drawn back. This arrangement was the builders' idea and used for the first time in these cars.

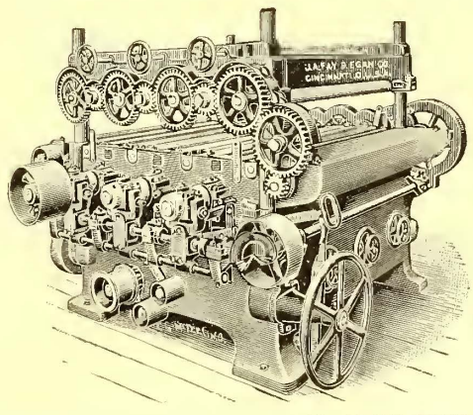
INTERIOR OF THE PETALUMA CAR

The cars are 46 ft. 1 in. long over the vestibule sheathing, and 47 ft. 9 in. over the bumpers; the width over the sills, including the sheathing is 8 ft. 8 in; centers of posts, 2 ft. 8 in.; the side sills are 5 in. x 7¾ ins. and 2 in. x 6 in., with 12 x ⅜ in. sill plates for the full length of the car. The center sills are composed of 7-in. "I" beams, with yellow pine fillers; the corner posts are 3¾ ins. thick, and side posts 3¼ ins. The seats are 36 ins. long; width of aisle, 23 ins. The steps are 16⅞ ins. high and have 14 in. risers. The cars are mounted on high-speed trucks of the Brill 27 E-2 type, having 6 ft. wheel base and 33 in. wheels, and equipped with four motors of 40 hp capacity each.

IMPROVED SANDING MACHINE

The accompanying cut represents a sanding machine especially designed for car shops, made by the J. A. Fay & Egan Company, of Cincinnati, Ohio.

The machine is invaluable where a perfectly smooth surface is desired either for varnishing or painting. It is massive and substantial, and saves the work of several machines for doing this character of work. The three steel polishing cylinders upon which the paper is placed have a vibratory motion to prevent the formation of lines, and are equipped with a device for quickly applying the sandpaper and giving it the proper tension. Each cylinder carries a different grade of paper, the third cylinder giving the finest and smoothest finish.



TRIPLE-DRUM, EIGHT-ROLL, POWER-FEED SANDER

The feed is very powerful, and consists of eight feed rolls, four above and four below, driven by a train of heavy expansion gearing, and will open to receive material 8 ins. thick. The machine is made to work material from 30 ins. to 80 ins. wide, and has a brush attachment which cleans the stock after it has passed through the machine. The pressure rolls are so arranged that the adjustments can be made easily and accurately and the feed started and stopped instantly.

PROCEEDINGS OF THE ST. LOUIS CONVENTIONS

THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

The second annual convention of the American Railway Mechanical and Electrical Association was called to order by President E. W. Olds, Monday morning, Oct. 10, 1904, in the Transportation Building at the Louisiana Purchase Exposition, St. Louis. President Ely, of the American Street Railway Association, and President Smith, of the Street Railway Accountants' Association, were invited to take seats on the platform. President Olds then introduced John I. Beggs, president and general manager of the Milwaukee Electric Railway & Light Company, referring to him as a practical man who had started low in the ranks.

Mr. Beggs then said:

Your president has referred to me in very flattering terms. I may say the most flattering terms that could be applied to me. He has, however, fallen into an error in one of the statements made, and that was that I would make an address. That you will not be tortured with, gentlemen, because I have never prepared an address in my life—I have never had time. I propose to say a few practical words from a practical man to practical men, and as one mechanic to another. I was fortunate enough in my boyhood to have been required by stern necessity to serve an indentured apprenticeship of four years; during the early years of the Rebellion, when I indentured myself for the first year at $2.50 a week, and the second year at $3.50 a week, never dreaming when going through those years of toil that I should be more than a mechanic. I look back at it with pride as the years go on, and I am one of those who have much more to look back upon than I have to look forward to, unlike many of you here to-day, because, this is a field requiring young men. It is a great field for young men to-day and with that degree of fidelity which the younger men are coming into, our various companies recognize the responsibilities that devolve upon them and must continue to devolve upon them, will depend much upon the future prosperity of the great industry of which we are a part, in which we are all engaged, and in which I have been absorbed for twenty years. I am becoming one of the "Old Guard," as it were, and soon, I presume, will be entitled to be retired and put on the honorary list.

Your president is one of the assistant managers of the corporation whose capital I am charged with safeguarding and promoting. Each one of you here who occupies the position of master mechanic on any one of the various roads, be it ever so small, be it ever so large, is practically an assistant manager of that property, and as such I believe you should be treated by the executive officers of these various companies, because much of the success of these properties—which are destined to be much greater than many of you to-day have any conception of—much of their prosperity, much of their advancement, is in your hands; and according to the degree of fidelity which you recognize and assume these responsibilities, will these properties go ahead.

I well recall the day in the early days of this business along in 1886, I was one of the original stockholders in the Sprague Electric Railway Company. I have followed down the lines ever since, as one of the men not only in the front, but as one of those in the pits, and in every branch of the work. Consequently I try to look at things connected with a railway company from the broad point of view and not merely from the point of view of the manager; trying to keep all the ends together, co-ordinating them all into one homogeneous organization, everyone pulling together, no one pulling apart. That is one of the great things, gentlemen, that it is necessary for you to do.

I propose to refer, before closing these remarks, to the necessity of the various branches of this industry being more closely meshed together like a well-geared machine. You cannot stand apart, gentlemen; you must work together with every department of the companies, or we will not have that success which is necessary and which we are entitled to bring about. The time will come, gentlemen, when there will be some crowding out; when it is going to be a question of the survival of the fittest in the railroad industry of this country, and I speak with respect to what has up to the present time been considered the only railroading of the country, namely, our steam railroad interests. But the time is fast approaching, gentlemen, when there will be a combining of the two, and it is going to be a question in many directions which will become the more important, the electric railroad or the steam railroad. Those of you who are keeping abreast of the times can see the movement being made in certain directions—it is being made particularly in the State of New York, where the great New York Central & Hudson River Railroad Company is beginning to absorb and bring around itself certain of the profitable lines operated near its steam railroad system, and the same thing is going on in other parts of the country. It devolves upon you, gentlemen, whether, when these properties come together, the dominant element in the mechanical departments shall come from the electrical branch of the business or from the steam branch of the business.

I have read with a great deal of interest the paper prepared by Mr. Lindall, of the Boston Elevated Railway, to be read at this convention, and I ask for it an earnest perusal and study by every member of this association, and by every man interested in the welfare and the profitableness of electric railroading in general. There is a great deal of meat in that paper, and I think it should be published in large numbers and put in the hands of every foreman, of every division foreman, of every division superintendent, and in the hands of the inspectors and supervisors, or whatever title they may be known by, of every electric railway in this country, because the paper goes to the very essence of much that pertains to the mechanical branch of the business.

Gentlemen, your particular position has much to do with the broader administration of the affairs of a company, concerning points that are not touched upon in Mr. Lindall's paper; points which he does not bring out. While he shows the necessity of systematic, frequent and intelligent inspection of your apparatus, I desire to add another reason for that inspection, which comes up every day in the year and sometimes many times in the day, either to the manager or to the man having in charge the settlement of suits for injuries to persons and damages to property. These cases come up very frequently, and I very frequently call upon our superintendent of rolling stock to know just what he or those under him could testify to, regarding a certain car, upon which a certain class of accident has occured, and my instructions to the lawyers or the claim department taking care of that business depend many times upon what he or the men under him state. In many instances, in connection with a certain class of cases, if you can prove that a car is carefully inspected before it left the shop or car house in the morning, and that it was in proper condition when it started out, it will absolve you from liability. If you are not able to prove that careful, intelligent inspection on behalf of the mechanical branch of the company, many times it is better to settle the case on the best terms possible. It is vital, gentlemen, to know whether your brake rigging was in proper condition, to know whether your controller fingers had been properly inspected and were in proper condition, and so on in regard to other features of the equipment. The laws governing these matters are such that if you can prove that all the care that was possible had been taken, before you put out the equipment, the law will absolve you; whereas, if you are not able to prove that, then there comes against you the charge of a lack of that proper care which is necessary. You then become liable because of the charge of negligence, which you may not be able to disprove; and we know, as a matter of fact, that the attorneys who take up these cases against our roads are very resourceful, very fruitful of statements, and they are willing and ready at times to prove almost anything. That is the great reason why you who are charged with the daily inspection, and with the general condition of the equipment under your charge, are one of the most important factors in our organization; and I cannot too strongly impress upon you the care and labor that is necessary in these matters. Your work is not easy; it is labor, continuous, never any rest. There never can be rest in the electric railway business. When other people are having their time of recreation, that is our time of stress; Sundays and holidays are our busy days, and the time between them requires your entire force on frequent occasions to be worked over-time to take care of the undue strain to which your equipment is put. The degree of intelligence and careful attention which the heads of departments of this very important branch of the business give to the careful inspection and repair of the equipment will have more than anything else to do with the success of the companies. Every other employee down the line, almost, is dependent upon the care which you give to your branch of the business. The superintendent of transportation is absolutely dependent upon you, and unless you give him the equipment in proper condition, no matter how well disciplined his force may be, he cannot give the results or keep up the schedules as he should. At the end of the month, when the financial affairs of the company are gone over,

it will be very gratifying to the officials of the company to find that the expenses have been kept down as they should be, by a proper inspection and repair of the equipment, as true economy always lies in keeping the equipment in first-class condition.

Another point touched upon in Mr. Lindall's paper (and you will excuse me, gentlemen, for referring to it so often, but I would be willing to substitute it for my address, as he has gone into this matter quite fully), is that many of your organizations to-day are weak, and becoming weaker, because you are not training the force to follow you and keep pace with the increase in this great business. You are not training the young men who are coming up as your understudies, as you should. Every foreman ought to have in him the elements of becoming the head of the mechanical department. They require a high degree of intelligence. The master mechanic of an electric railway company is very different from the master mechanic of a steam railroad company, who simply must look after the trucks, etc., of a steam road. You have the most sensitive type of apparatus to deal with, and there are some features concerning it that the best experts hardly know how to cope with. We have been for the last two or three years in serious trouble in every large city in the country with controller difficulties. The best skill in the business, and the best technical knowledge has been applied to try to correct the trouble. By degrees we are eliminating all the troubles incident to the business, and we have been going ahead. It is interesting to me to consider the different subjects that occupy our attention to-day and those that received our attention seven or eight years ago. I remember about eight years ago I stood almost alone, and received some ridicule because I at that time made the prediction that the double-truck car would displace all the single-truck cars in this country inside of ten years. I believe I have lived to see the prediction almost verified. However, you have not kept pace with the great increase of power that we are putting under these cars. In our system to-day, we are running double-truck cars weighing empty about twenty tons. We are putting under these cars four motors with a nominal rating of 40-hp each, for city service; these motors upon a curve, in a state of inertia, exerting three times their normal power. We have expanded the capacity of the motor beyond the other co-ordinate elements necessary to operate with them. We are attempting to run with the same trolley wheel. We have not kept pace in this expansion with the controller at all. We are attempting to control this great impulse of current with inadequate apparatus. I go into a power plant to-day and look at it with perfect amazement. My first power plant was built about twenty-one years ago—it is still running and I sometimes go to look at it. It is a good example of engineering of that day, but it has become one of the antiquities. We then built a power plant switchboard with a few bars of bare copper and few plug switches, and without any methods of measuring our current we were ready at that time to light the world, as we thought. The switchboard was considered a very insignificant part of the plant, and it was not taken account of in the capitalization. To-day, go into a modern power plant, and the most important part in the plant is the switchboard, which serves almost the same purpose as does the controller, the circuit breaker or the fuse box on your car. But these latter have not kept pace with the switchboard, gentlemen, and this apparatus will not be provided until you men in the pit compel the manufacturers to make them, and they will do it under compulsion, gentlemen. That is my experience.

Gentlemen, I wish to touch upon another matter. My friend Mr. Ely and I have been discussing it somewhat this morning. I have been discussing it for a year or two. I feel a certain sense of responsibility for this organization. I believe I was among the early managers who felt it was essential to have the practical mechanical heads of departments get together that they might relate experiences, exchange ideas, and each stimulate the other to better results. Consequently, I feel deeply interested in the sucess of your organization. A year or two ago, I think fully two years ago, I suggested that it was quite as important that the superintendents of construction and maintenance of way should likewise be brought together to discuss the best methods of track and overhead line construction, and a move was made in that direction after the last convention in Saratoga. It was then I began with some others vitally interested in the success of these properties to feel that in creating so many organizations we might lose, to a certain extent their effectiveness, and would get away from what we were hoping to accomplish. It is well enough for the managers of some of these larger properties to feel that their mechanical heads, the superintendent of construction and maintenance of way, the electricians and the auditors, should become members of separate organizations; but we must not lose sight, gentlemen, of the fact that where there is one of these large corporations with this comprehensive organization holding up the hands of the management there are scores of small roads—the responsibility of the management of which is just as great in proportion—where the executive head of the company must be the master mechanic and the superintendent of construction and maintenance of way, and may have under him a $50 or $60 a month clerk. He is the only man in actual authority and, to a certain extent, it is impossible for that man to divide himself between the various organizations. Furthermore, I feel that if I had to neglect the meetings of the American Street Railway Association, which is to convene in this hall on Wednesday of this week—in view of the way it is running to-day—or to neglect the sessions of your association, I would feel under present conditions it was more important for me to attend the meetings you are holding here to-day and to-morrow—because these meetings are of more vital interest to me. You are the men who are spending the money, and without a certain degree of economy which you practice we would not be able to make a satisfactory showing to the investment holders of the company.

That brings me to another thought—you have on your programme certain proposed amendments to your constitution, intended to bring in the superintendents of construction and maintenance of way. That is good as far as it goes, but I think you require in your case, just as the executive heads of this great industry require in their case, that we should get together, and that our meetings should be one homogeneous mass, with a certain time of the association set aside (let it be the first two days of the session, or alternate days of the session), whereby we will say the American Street Railway Association may discuss and consider matters of more general importance, and questions of larger policy. Then, when the mechanical division, as I will call it, of the American Street Railway Association assembles, it may meet as an aggregation of companies, in which would be represented the executive heads, as well as the other heads of departments of these various companies. On another day the superintendents of construction and maintenance of way division would have the floor, and matters pertaining to that branch of the business could be discussed. Another time could be set apart for the accountants, whose work is largely done, I am thankful to say. They have labored for some six or seven years, and the results are very gratifying, indeed. There is not so much left to be done, I take it, except to further standardize and adjust the accounts between the various branches of the company.

Therefore, I would suggest that it might not be advisable to have a committee from your organization appointed to act in conjunction with a committee from the American Street Railway Association and the committee from the Street Railway Accountants' Association of America, both of which associations now have regular organizations, and representatives of the construction and maintenance of way departments that we might bring this organization into one homogeneous mass. I desire to add further that the time is coming when we must have a more concrete organization of the entire body. We are not mendicants any more. We should be able to pay our way and have proper officers to take charge of the affairs of this great industry.

There is an article, gentlemen, likewise prepared for the consideration of your association—I have read these papers hurriedly among the mass of other things—and that is the paper on car wheels prepared by Mr. Millar, of the Buffalo company. That paper brings up a thought and emphasizes what I have been saying to some extent. Mr. Millar sees one phase of this industry in discussing car wheels. I desire to make that paper the text for suggesting that that brings up a much broader question, a question which the executive heads of these companies must consider. The time is coming when we cannot further temporize with this question, as is done in Mr. Millar's paper. He writes this paper as the master mechanic in care of the trucks of the cars of the company in which he has gotten up to a car wheel flange of 7/8 in. I say that the time is coming, gentlemen, when you must have a different class of construction of track in your cities, and you cannot continue to run these high-speed interurbans with trains of cars as we are doing around sharper curves than any steam road would attempt to operate with, and to run them at speeds equal to the best steam road practice in the United States, with a flange 7/8 in. in depth. That brings up the question of a different class of track construction in your cities. It is going to require persistent intelligent work to have the municipal authorities recognize that we are up against a condition of that kind now. You will find by reading Mr. Millar's paper that one of the troubles with the wheel is that when it gets into grooved-rail construction, the flanges are worn by running on the bottom of the groove, and that the flange will continue to wear from time to time. Some of you are not taking into account how much of the head of the rail we expect to wear off in the course of proper wear. Where will that groove be after twelve or fifteen years' use, which amount of use we must get out of the rail if we are to have a proper economy in our investment.

The time is coming when these broad questions of policy must

be taken up. I further add this suggestion in connection with Mr. Millar's paper. There is a particular question of policy which must be considered in connection with the character of the wheel you should use. Of course, to many roads that are running simply the metropolitan service, this question is not so important, but take a property such as I am administering in the city of Milwaukee, where we control everything electrically in that section of Wisconsin, where we are radiating our interurban lines in all directions, keeping up average speeds, all stops counted, of 20 m. p. h. on regular schedule, and these cars coming to the center of the city, it becomes a very important element to the city itself, which it can be made to recognize. We are bringing these people in and doing more to expand the city than all agencies combined, and they must recognize that something must be sacrificed to obtain these advantages. For that reason I say that it is important that when these matters are being discussed, that there should be some of us on the floor of this convention that we may set these things before the meeting, and get the members of the association to think about them. I give instructions in the various concerns with which I am identified, that every complaint is to centralize at the manager's desk. The public has the right to look to the men occupying such positions as Mr. Ely and myself in these matters, because we are supposed to possess that element of administration, that element of management, which has the capacity to select proper men for the different heads of departments, just as it is for your master mechanic to be able to select good men. It is well enough to have a good master mechanic at the main shop; but it is more important to have quite as good a master mechanic at every car house, where supervision and inspection of the rolling stock takes place, and no matter how good the master mechanic may be as a master mechanic, he must have administrative qualities which will enable him to select proper foremen for distant points of the system. These points are becoming more widely spread year by year as the boundaries of the territory in which your properties are located expand, and as it is necessary to have these men further away from headquarters, it is essential that the master mechanic of the road should be capable of selecting efficient men for these outlying places. As I say to my associates, I intend to cover most of Wisconsin with interurban railways, and in such a case it is important to feel that your master mechanic has such an organization under him, that if it is necessary for you to send him away for a week, the work at headquarters will not suffer.

I trust, gentlemen, you will not ignore what I have said about my belief as to the necessity of amalgamating the various branches of our industry. The master mechanics, the superintendents of way, the accountants, and the claim men should all be in one organization in conjunction with the association of managers, all of whom will work together in harmony and to the greatest good. I thank you, gentlemen, for the kind attention you have given me.

President Olds then presented Mr. Beggs with one of the badges of the American Railway Mechanical and Electrical Association, which Mr. Beggs accepted with thanks.

President W. Caryl Ely, of the American Street Railway Association, was then introduced and spoke, in part, as follows:

Mr. President and Gentlemen of the American Railway Mechanical Electrical Association—I am very glad indeed to be with you this morning. I feel that it has been a privilege as well as a pleasure to be here to listen to the remarks of Mr. Beggs, which were most able, instructive and abounding in truth and wise suggestions from beginning to end. As I remarked to him when he took his seat, it was worth the trip to St. Louis to hear that plain statement of truth with reference to our business. Just such statements as these are the very best proof of the wisdom and value of having these organizations. Many a man who works in the departments of the railroad business has vexatious problems over which he works and toils, and sometimes when things are going wrong his mind begins to run in a groove or channel and he gets the blues and cannot see his way out. Everything is dark. He is in the woods, and the woods are so full of underbrush that he cannot see the way. Now the meetings of these associations are the places where a man's mind can be relieved of all these situations by the interchange of thought, the interchange of experience and by the interchange of light that comes from the mind as it gropes its way forward into the future of these great problems. It is here that a man gets real comfort and instruction, and I believe that these associations are worth fostering by the companies whose men are represented in them; and I believe that when we get through the efforts toward reorganizing that Mr. Beggs has briefly alluded to, that we will have some concrete organization with certain co-ordinate co-operative branches, all working together, with the work properly apportioned. When we have finally reached the outcome of it, it will be so valuable to the companies whose officers and men are represented that the expenses of the organizations will be cheerfully paid by the companies. I, for one, acting in an executive capacity in a large corporation, feel that it is almost the salvation of the business that there should be a coming together in the right way of the men who work in the various corporations, from the presidents down, or from the master mechanics down.

I believe thoroughly in organization and co-operation. It is the spirit of modern life. Nowhere could it be exemplified on a grander scale than in the grounds of this magnificent exposition. It is the biggest exposition, without doubt, that has ever been held. It has larger buildings, it covers more ground space than the Chicago World's Fair or the Paris World's Fair or any other that has ever been held; and it represents and typifies in the highest degree the value of co-operative work. I will not elaborate on that thought. I want to go to the expression of something that is very close to my mind and heart.

For some years past it has been evident to all that a change was coming in the affairs and the management and the scope of the work and operations of the American Street Railway Association. Eight years ago the first secession, if you please, was brought about by the accountants, who organized an association which has done excellent work. A year ago at Saratoga the first meeting of this Mechanical and Electrical Association, as an organization, was held, and that was the result of several years' agitation. Now the superintendents of way, or the engineers of way, or the superintendents of way and construction, as they are variously entitled, are knocking upon your doors for admission, after having for a time contemplated the formation of a separate organization for themselves. Now the question arises where will it all end, and it seems to me that the parent association is in much the same situation that the mistress was who had a cook for a good many years, and was informed that the cook was about to leave her. She said, "Why, Bridget, what is the matter, that you are going to leave me after all these years? Have I not treated you like one of the family?" "Indeed, you have," was the reply, " and I have stood it as long as I can." Now it seems to me that there is something wrong in "our family," and it ought to be fixed up in such a way that you could "stand it" a little longer; and I suppose that it must take the form of an organization of some kind, but interdependent in some way and connected with the other associations and the parent organization. The field of work of the parent organization, so far as it looks to me, upon a re-examination of all the facts in the case, has really never been entered upon by the parent organization. It has called itself together once a year and listened to the reading of papers that should be read in the meetings of your association and the meetings of the accountants' associations, and only the policies which spring from these discussions should be considered in the parent organization. Its work should be confined more particularly to matters of national importance and managerial importance. Now as to just how the change will be arrived at, while perhaps I may have thoughts and ideas of my own, I believe in the utmost tolerance and in the wisest agitation and discussion of all these matters. Let us be rather sure than sorry; let us make haste slowly so that when we finally do the thing it shall be such a finished product, such a working organization that it will accomplish the results, and we will all feel that it is of value and be proud of our own work.

Upon that branch of the case which is brought up by the question presented by the superintendents of way and construction, whether they shall be permittd to this association or whether action shall be deferred upon that matter until there have been conferences between committees of the different organizations, I take it that it does not matter much. If you take them in, they are in, and they can go to work and be doing something while the other broader matter is under discussion. I am sure there is going to be the broadest spirit of tolerance and the widest scope of intelligent action, and that we are all going to meet together and not be jealous of prerogatives, but are going to yield where yielding is necessary, and stand firm in a decent and dignified way where we think that things belong to us, but in the end I feel no doubt whatever that we will be able to get together.

I do not know that I have any more to say except to emphasize the general proposition of the importance of your work. You are, indeed, as Mr. Beggs has said, the men behind the guns. Your work is so important that it goes to the very root of everything, and when the balance sheet expressing the result of the year's operation is made up, perhaps the most important part of the whole thing are those figures which tell of the things in which you have played a part. The injuries and damages account is swollen if the apparatus is not properly attended to in your shop and your car houses by the men who are under your control. The quality of the service carrying with it that most important factor, the good will or the ill will of the public, the public officials and the press is dependent largely upon the equipment and its condition of repair. All of these things, to which I will not allude in such length as to

weary you, are of the most vital importance. They are up to you to a very great degree. You have an entirely different work committed to you than is committed to the master mechanic of the steam road, and it differs just as much from theirs as was expressed by the example of Mr. Beggs. I thank you very much for the opportunity of coming here and seeing you.

Mr. Ely then paid a very glowing tribute to the splendors of the Louisiana Purchase Exposition.

F. E. Smith, president of the Street Railway Accountants' Association of America, was then called upon and made a few remarks.

This was followed by the address of President Olds, given herewith, after which the meeting adjourned.

PRESIDENT OLD'S ADDRESS

Gentlemen.—The importance and magnitude of the interests represented by our association impels me to present briefly for your consideration a number of the more important matters. Our meetings being limited to but two days, let us make them interesting and profitable.

A glance at the exhibits in this building must impress you with the rapid progress that has been made in the development of transportation facilities. Not only do we see wonderful development in the steam locomotives, but the street cars of to-day compared with those of but a few years ago are certainly palaces on wheels. Every day we see evidence of progress in the line of more perfect and reliable equipment; there is, however, still room for improvement.

When this association was first organized, it was thought best to confine the membership entirely to mechanical and electrical men. I think this a mistake. It is of equal importance to those having the way and transportation departments in their charge that they be well informed regarding the equipment, its care and maintenance. We find that other departments need to be represented and are knocking at the door for admission to our association; we must realize that our interests are nearly identical with those of other departments. The object of this association is to treat of mechanical and electrical subjects and exchange views and ideas upon the best methods of maintenance and operation. To do so intelligently, we must be well informed regarding the work required of our cars and motors. There is also an agitation upon the part of some of the other departments for reorganization of the parent association, to be so arranged that each department will have its own sub-organization, under the control and direction of the parent body.

I can but feebly voice the feelings of every member of this association when I say that our meeting in this grand old city of St. Louis, surrounded by exhibits from all parts of the world, will be most enjoyable and profitable to us. Our meetings being called upon the first two days of the week, the temptation will be very strong to put in your time sight-seeing rather than attending the meetings. I would personally request each one to take hold of the matter in an earnest manner, and not only be present yourself, but use your influence to have others attend and take an active part in the meetings, remembering that we are here in the interests of the companies we represent. Our meeting at Saratoga last year was a grand success, and under the conditions I have mentioned why should not this be even better?

The public demands and is entitled to the best possible service we can give them, and, to a certain extent, our companies and the public are partners, for the better we please the people, the better they will patronize the company. The proper discharge of our work requires thought and vigilance to keep the rolling stock in as near perfect condition as possible, so that it will be safe, attractive and give reliable service. We must act and work as though we were not ashamed of the business in which we are engaged, it being one which concerns the business and private life of nearly every citizen in the United States and the world.

We all recognize that the work of the Accountants' Association has been and is now of great importance to our companies, making the classification of accounts and reports nearly uniform, they being recognized as standard by the Railway Commissioners. The joint paper upon "Shop Accounts and Records," gotten out by a committee of the Accountants' and our association, we believe is a step in the right direction, not only looking to a uniform system of records and accounts, but to a more uniform system of doing the work. By referring to the records and accounts of the steam road master car builders and master mechanics, we find them very complete, the same rules governing the repairs upon cars in all parts of the country; and it is gratifying to note that a large number of electric roads are following more or less closely their methods.

I wish particularly to urge every member present to carefully consider the report to be submitted to you this morning, each constituting himself a committee to push the interests of our association among those you meet, whether they are members or not. Personal work is what counts in any organization. The man in charge of any branch of railway work who does not give it his earnest individual attention cannot be a success; the same rule holds true with us. We must also realize that to make our association effective it must be placed upon a sound financial basis.

What rapid progress the interurban railways of to-day have made! We need only look around to see them branching off in every direction, very many of them being operated upon private rights of way, running at high speed and doing freight, as well as passenger business. This rapid progress is calling forth the best talent of our manufacturers, as well as of those in charge of the maintenance and operation, to design and construct equipments to meet the ever-changing conditions.

As yet, but little has been done regarding the exchange of freight between steam and electric railways. I fully believe that the time is not far distant when freight will be received by electric roads and delivered to the steam roads in carload lots, the same as is now practiced by all steam roads. This would necessitate the construction of our roadway and track in such a manner that steam cars can be as successfully operated on the electric lines as on the steam railways.

It is also very important that the motormen operating the cars should be well posted and thoroughly understand their equipment. To be successful, there should be a uniform method in their instruction and examination. But a short time ago, should a locomotive engineer wish to change from one road to another, his examination as to ability would have been different in a great many respects from the road he was leaving; at the present time, if he be able to pass an examination upon a road operating in Maine and should he apply for a position in California, the examination would be practically the same, the qualifications for locomotive engineer being the same in all parts of the country.

Our programme is a good one, and those who have had the subjects under consideration have done well. The papers should bring forth a good discussion, which will be of great importance to each of our members. We realize that the majority of active members cannot be present at the meetings. For them to receive the benefits they should, the discussions must be full and to the point. The "Question Box" feature should also prove a very interesting and profitable part of our programme.

The paper by Mr. Wright, of Providence, "The Ideal Shop" is a good one, and I believe will be of great value in bringing out the views of our members. Shop construction and arrangement of departments and tools is of very great importance, making it possible to reduce the cost of maintenance to the very lowest figure. To be effective, the departments must be compact, well lighted and as nearly fireproof as possible, so that the burning out of any one department would not seriously injure any of the others.

Mr. Millar, of Buffalo, will present a paper on "Wheel Matters" that is very complete and instructive. I am fully aware that it is a very perplexing question, requiring a great deal of thought and care to design a wheel that will meet the very severe conditions of street railway service.

The paper on "Maintenance and Inspection of Electric Equipment," presented by Mr. Lindall, of Boston, treats of a subject of vital importance to each one of us, and I bespeak for it your careful consideration.

There are, however, a great many other matters than those previously mentioned that call for our earnest individual attention. The method of conveying the current from the trolley wire to our motors by the use of the present trolley wheel, pole and base is but a make-shift and very unsatisfactory. I realize that it is a very hard problem, but at the same time "Where there is a will, there is a way," and I believe that you will be able, in some manner in the not very distant future, to overcome the troubles with it that we now experience.

All of us are more or less troubled with short-circuits and the reducing of the number is of very great importance. The present method of protecting motors by a circuit-breaker or single fuse is one that I do not consider at all sufficient, and believe that each motor should be protected by an individual fuse.

Very often a short circuit is the cause of a serious accident, and money spent for this purpose to perfect our equipments and reduce the number of short circuits to the very least possible number is well invested and will be the means of preventing a great many serious accidents.

The construction and installation of wiring and cables is also of very great importance. The insurance underwriters have taken hold of this matter, and are doing good work, at the same time, I believe that we who are in the actual work are better able to see and know what is required.

Emergency brakes is a matter that has received but very little attention from street railway operators and is one of great importance.

The design and construction of street railway cars and trucks is more or less crude, and they should be changed to have a maximum amount of strength with minimum weight; at the same time, we must not overlook the fact that they are to be attractive, safe and comfortable for our patrons.

The stock and bondholders of our companies are looking to us to reduce to a minimum the expense of maintenance and operation, and the sooner we arrive at, and adopt methods looking to that end, the better it will be for ourselves, as well as our companies.

Let me again call your attention to the fact that the interests of all are nearly identical, and as success is the goal for which we are striving, it is essential that we become familiar with the work and requirements of all other departments of street railway activity.

Before closing, I wish to thank you for the high honor you have conferred upon me, and shall ever consider my term of office as president of your association as one of the brightest spots in my career as a street railway man. I bespeak for my successor that you accord to him the same generous support that you have given me. Let us ever be aggressive, fair-minded and ready to fight for what is just.

MONDAY AFTERNOON SESSION

The Monday afternoon session opened with a gratifyingly large attendance. The executive committee's report, read by Secretary W. Mower, showed that thirty-six active members (individuals, heads of mechanical and electrical departments), seven companies (associate members) and four junior members had joined during the year. The membership is now 150. The cash on hand is $403.05, the expenses of the past year having been $1,301.30.

The association, after this report, took up the proposed amendments to the constitution and by-laws, including engineers of track and maintenance of way in the membership. F. G. Simmons, superintendent of construction and maintenance of way of the Milwaukee Electric Railway & Light Company, was called upon as the one who had been promoting the movement for an organization of track men.

Mr. Simmons stated that for the past two years he had been very anxious to effect the organization of the way men of the country; that when the Mechanical and Electrical Association had been formed the way men of the country felt that they had been left behind in the running. Mr. Simmons had accordingly undertaken the formation of an association of way men. He had written to some 140 heads of way departments, and the great majority of the answers indicated that there was a decided feeling against a separate organization; the general consensus of opinion being that through the fact that the various societies were separating themselves from the main body, the dues to the companies were multiplying and the amount of time necessary to attend the various conventions was greatly increased; that if the formation of separate associations continued, the transportation men would naturally form an association, who would probably be followed by the claim agents, and there would be such a multiplicity of associations that they would tend to strip the main organization of its effectiveness. Many of the managers of the smaller roads, especially, favored a reorganization within the main association. Mr. Simmons further stated that the idea of forming a separate association of way men had for the present been abandoned and the way men were ready to enter the American Railway Mechanical and Electrical Association if they would be received, and as members of such association they could take up some of the more pressing subjects connected with the way department, pending the decision of the questions now before the parent organization. A large number of the heads of the way department had signified their willingness to become members of the Mechanical and Electrical Association, so that they might proceed to work upon some of the subjects which were of pressing interest. He thought that the committee suggested by Mr. Beggs and Mr. Ely, comprising members from the main association, the accountants association and the mechanics association, was a good idea, and that there should also be on this committee some members representing the way department. It was his opinion that such a committee could proceed to work and that in the course of a year or two some result would follow along the lines indicated by Mr. Beggs and Mr. Ely; and in the meantime the way men could accomplish something in the mechanical association, in threshing out some of the questions in which they were interested.

In discussing the subject of supply men as members, President Olds called attention to the fact that at the last meeting of the association, held at Saratoga Springs, the matter was fully covered. He doubted that any member of the association who might become a supply man would care to occupy an official position, in view of the fact of his connection with a manufacturing company.

The president stated that he did not wish to appoint the committee provided for in the motion of Mr. Baker without an opportunity to consider the matter and consult with some other members, and that he would appoint the committee later and announce to the association the names of the gentlemen appointed.

The following amendments to the constitution and by-laws were then adopted:

MEMBERS—Article III., Section 1.

The heads of mechanical, electrical and way departments of railway companies may be elected active members, and shall be entitled to one vote each, and all privileges of the Association.

MEMBERS—Article III., Section 3.

Employees of mechanical, electrical and way departments, not eligible as active members, may become eligible to junior membership upon the written recommendation of at least one member, and shall be entitled to all privileges, except that of voting.

On motion of Alfred Green, it was voted to have the name of the association remain as it is until the meeting next year.

The president announced the next order of business would be the reading of papers.

W. D. Wright, superintendent of equipment of the Rhode Island Company, Providence, R. I., then read his paper on "The Ideal Shop," which is published in full in another part of this issue.

President Olds announced that there were some novel features in the paper just read and he expected that there would be a very full discussion of the paper.

W. O. Mundy stated that he did not agree with the policy of putting two or three cars on a single track. With only a single car on the track it meant when the car was repaired it could be taken out and another one substituted in its place and the amount of shifting would be reduced to a minimum. The tracks in the paint shop could be longer, as those cars are not shifted so frequently. Another point was whether the equipment should be handled from the pit or not. His personal opinion was that this was a mistake, especially with double-truck cars. He did not think that the equipment would receive as close attention if handled from the pit.

H. J. Lake, of Muncie, reminded the meeting that a year ago the same question in regard to working at cars and trucks from above, or in the pit, had been discussed. It appeared to him that before a standard could be adopted as to where a mechanic could work on a truck, the manufacturers would have to adopt a standard truck that would allow the mechanic to work either above or below, whichever was desired.

Mr. Wright agreed with Mr. Mundy that better work can be done above the floor level wherever possible to do it; but it was necessary to meet existing conditions. The plan of one car on a track was an ideal one, but with a large equipment it would mean a very long car house.

H. H. Adams, of Baltimore, thought that the winding room should be nearer the machine shop and that the stock room should be as near the center of the shops as possible.

J. S. Doyle, of New York, noticed that the space occupied by

the transfer table is about 33 per cent of the entire equipment. He thought in a thickly congested district that would be rather prohibitive.

Mr. Wright, in replying to suggested changes in the location of the winding room, said that it had been placed in the corner at the end of the building to get good light, as windows would be on two sides of the room. The method of winding employed by the Rhode Island Company was such that it does most of the lathe work in the winding room.

Another member recommended the use of transfer tables for each track, taking the truck out at the side of the car instead of taking it out at the end of the car. He gave several reasons in favor of this course. William Pestell agreed with this plan.

W. H. Evans, if Minneapolis, asked Mr. Wright how many cars the shop could handle.

Wr. Wright answered that the shop was not designed for any special number of cars. It depended upon their length and other considerations.

Mr. McAloney, of Denver, asked whether it would be feasible, on account of fire insurance risks, to have the transfer table as a part of the enclosure. It would also seem better on account of the insurance to have the shops separated by an open space.

C. F. Baker, of Boston, remarked that he imagined it depended on local conditions, but that an open space was better on account of the light. He then outlined at some length his own idea in regard to the arrangement of the different departments.

A member suggested that the closed transfer way was a desirable advantage where snow had to be contended with.

President Olds remarked that he would like to hear further discussion brought out by Mr. McAloney regarding fire protection. As the members would recall, in his address of the forenoon session he remarked that the shop should be so constructed that any one of the departments could be burned out without serious injury to the other.

D. F. Carver, of Jersey City, stated that the company with which he is connected was building a shop on that principle; they leave quite a ground place between the shops. That has very decided advantages and decreases the fire risks. It also has the advantage that there is track storage room around each shop.

W. H. Evans stated that in Minneapolis they have a round-house for a car house, a relic from the steam motor days. The round-house only accommodates fifteen cars; but, as suggested by one of the members, the advantage of getting one car out without disturbing the other is frequently quite a saving in time. He thought it a mistake to provide too short transfer tables between walls, as the present tendency is to increase the length of cars. Another matter he would criticise in the plan presented would be in having only 13-ft. track centers. It is especially important when the repairs are conducted above the truck to have sufficient room between the tracks so that the workmen can get around.

M. O'Brien, of St. Louis, suggested the desirability of having the armature room directly above the storeroom, on the second story of the shop.

Vice-president Green, in the chair, requested some member to take up the question of the construction of the building itself as regards the fire risks, whether the mill construction or steel construction of the shop is better.

H. H. Adams, of Baltimore, said that he was rather partial to the mill construction. He saw no great objection to the posts in the repair shop, and if overhead hoisting apparatus is desired it can easily be installed.

Mr. Patton, of Topeka, then described at considerable length some new shops which his company had recently completed. The buildings were constructed of monolithic cement blocks, 12 ins. x 12 ins. x 24 ins., one part cement and three parts sand; there was no crushed rock used. The roofs were built on a light steel truss, with an inch layer of sheething and composition roof. They have a total car house area of 4000 sq. ft. and a standard division fire wall 12 ins. thick, running down the middle and enclosed with double fire doors. The car house has two openings, enclosed by double standard fire doors. On that building the basis rate is $1, and the only differentiation of charge they got was 5 cents per $100 on the modern sheathing under the roof; there was no differentiation for the steel truss. The rate on the carpenter and paint shop had not yet been given. The shops are equipped with a fire hydrant, 2-in. hose connection.

An Eastern member remarked that mill construction as used in New England is employed on buildings three and four stories high with the floors 3 ins. and 4 ins. thick. He understood that insurance men did not like steel columns, as they are liable to buckle in case of a fire; they prefer wood or cast iron.

H. A. Johnson suggested that it would be a good plan for the members to have photographs made of the various structures they know of, and to bring them to the next meeting, with a statement of the troubles that they had met in them. This suggestion was agreed to.

President Olds then announced that the next business was the reading of the paper by J. Millar, superintendent of rolling stock, International Railway Company, Buffalo, N. Y., on "Wheel Matters." Mr. Millar read the paper, which is published on another page.

President Olds stated that although the time at the disposal of the convention was short, he desired a complete discussion of the paper.

William Pestell remarked that the question of steel tired or cast iron wheels is one of great importance at this time, not only on interurban roads but on city roads. The cast iron wheel manufacturer says it is the old story—the roads are again trying the steel tired wheels and will soon be back to the first love, the old cast iron wheel. This may be so, but there is much evidence in the last two or three years which shows that the steel tired wheel has many advantages, not only for interurban and high-speed work, but also for city service. The restrictions placed upon the companies by municipalities do not allow them to get a sufficient depth of flange and sufficient width of tread for safe operation with cast iron wheels on high-speed lines which must necessarily run into the city, and the remedy seems to be to put on steel tired wheels. The speaker has seen steel tired wheels running on 40-ton cars which were worn down to a little more than to ¼ in. in thickness of flanges, and these wheels have never given any trouble. He would not say it is common practice on the road in question, but they had some cars upon which it was necessary to run these wheels on account of not receiving wheels to replace them. The matter of the time to turn a steel tired wheel is one of importance. It is stated, and it is proved by experience, that as the section of the wheel where the flanges join the tread, when the radius of that section assumes the same shape as the rail, the flange wear is much more rapid, and it would seem that the time for Mr. Millar to turn the flange is about at this time, as the wear will be greater from that time on. It would take very little turning to renew the flange to almost the original section and put the wheel in good shape for future service. The steel tired wheel is comparatively expensive in first costs, running about four or five times the cost of cast iron wheels. The cost of turning a steel tired wheel is probably as great as that of pressing on and off a pair of cast iron wheels, so that the factor determining the economy of the wheel, outside of the question of safety, is not altogether that of the cost of turning against the cost of pressing on and off the other wheels. The life of the steel tired wheel, from what evidence the speaker had gathered in interurban service, runs

from 140,000 to 180,000 miles. In lots of cases after turning steel tired wheels, they get a mileage of 50,000 to 60,000, so that they can compare the relative economy between the steel tired and cast iron wheels. As yet the speaker had not sufficient experience to determine how far the economy of the steel tired wheel extends, but many roads are now using steel tired wheels in city service, notably the New York City Railway Company and the Fitchburg & Leominster, just outside of Boston. They are to be used in Manila, and the speaker hoped to get experience there which would be valuable.

Other speakers gave their experience with wheels. One suggestion as to the unequal wearing of two wheels on the same axle was that they were not mated or else the journal brasses were not mated. This condition could be produced by running the car continually in one direction. One speaker, who uses single-end cars running continually in one direction, said that about once every two or three months, if he found a wheel wearing more on one side than the other, he turned the truck around and put it on the other end of the car. If the wheel continued to wear on the same side, he used an emery shoe and ground the larger wheel.

After a very interesting discussion on wheel troubles and remedies, the president requested that the members would supply data on the service of steel tired wheels and cast steel wheels and furnish it at the next meeting.

Owing to the lateness of the hour, the discussion of the Question Box was deferred until the meeting on Tuesday. The meeting then adjourned.

TUESDAY MORNING SESSION

President Olds called the meeting to order at 10:45 o'clock, and announced that he had appointed as the committee to confer with the executive committee of the American Street Railway Association, on the subject of a reorganization of the associations, the following gentlemen: C. F. Baker, H. H. Adams and F. G. Simmons.

The convention then proceeded to the consideration of the paper on "Maintenance and Inspection of Electrical Equipment," by John Lindall, general foreman of shops, elevated division, Boston Elevated Railway, Boston, Mass. As Mr. Lindall was not present at the meeting, the paper was read by Alfred Green. Mr. Lindall's paper is published in another part of this issue.

William Pestell remarked that he hardly agreed with Mr. Lindall on a great many points in connection with the paper, especially in connection with the education of motormen and others who are not directly connected with the mechanical department. He agreed as to the keeping of men in line for promotion, in accordance with the suggestion brought out by Mr. Beggs on the preceding day. There should be men who can take the place of the master mechanic or engineer whenever the latter should be away for some length of time. The only difficulty he experienced was that about as soon as they had a man educated, so that he was really valuable, he would usually leave the company's employ to take a better position with another company. They could not pay him money enough to keep him, but even then there was some advantage in that, as some road got the benefit of his education. In his opinion, the reporting and tabulating of defects are very essential to the successful maintenance of equipment—he did not think he could dwell any too strongly on that point. He had found, for instance, in the case of a road where the cars are kept at a number of shops, that one man who takes care of one kind of trouble has practically none of it, and another man has a great deal of it. By tabulating the defects it is possible to find out the weaknesses of the foreman and those of the equipment. Perhaps this weakness may be due to conditions under which the equipment is operated. This tabulation of defects gives the master mechanic a chance to learn the conditions, and finally to remedy the trouble. Mr. Pestell said that Mr. Beggs had stated in his address on the preceding day that the work of the Accountants' Association was practically ended. In his opinion, the accountants have a great deal to do—it is quite likely that in the general arrangement of accounts for the operation of the road, the caring for statistical reports and general reports of operation, that much work will be required, and the master mechanics have only just started on this work in connection with the accountants. This work is destined to be very important, and it is one in which the accountants can help the electrical and mechanical engineers to a very great extent; they know what they want in a sense, but the accountants are better able to give advice as to how to keep the accounts in proper shape so as to be easily compared and kept with the least possible labor. The speaker believed that if the shop accounts and the power station accounts were taken up in connection with the Accountants' Association, better results would be secured than are secured to-day. The matter of shop arrangements, especially facilities given the men for cleanliness, are also very important.

The speaker thought that the suggestion in that paper about supplying technical literature, such as the Street Railway Journal and "Electrical World and Engineer," for the use of the shop men a very good one, and a practice that ought to be followed up more than it is. The technical papers are very generally found in the motormen's and conductors' rooms, but the shop men, unless they buy such publications, rarely see them. Mr. Pestell thought there should be a place provided where the men can get these things—perhaps they could be kept on file and a catalogue made of them, giving the men a card, making it a sort of a library system, so that every man connected with the shop could be put in possession of the latest literature in connection with the work upon which he is engaged. A man cannot know too much about his work. He thought the most important thing that the Mechanical and Electrical Association was organized for was to put knowledge within the reach of the men, to bring about an interchange of ideas, but if the association does not furnish the information which is developed in the meetings to the men generally, it does good to but a very few. He believed the members should work to get publications on file for the men to read. These should be accessible to the mechanics in the pits, even the car washers; they do not want to wash cars all their lives, and they should be given an opportunity to advance themselves.

The inspection of electrical equipment, whether on the mileage or time basis, the speaker thought, is one that in many cases must be governed by local conditions. Some roads are able to put a man on a car for the purposes of inspection only once in two or three days, even for the purpose of inspecting the brushes and for greasing. Mr. Pestell then considered the subject of controller troubles, and pointed out some of the objections of the present form of platform controller. The multiple type of control, or a type of control remote from the platform, using only a master controller of small size on the platform, seemed to him to be the proper solution for the controller troubles. He believed that the companies should demand from the electrical manufacturing companies a control of this type for motors even as small as 40 hp, four to a car, and get all material underneath the car, off of the platform. This was especially desirable on open cars, where passengers ride immediately behind the motor. Most roads have accidents occurring from it during the summer months, and they cost a great deal of money. The method pursued by the Boston Elevated Company, that Mr. Lindall referred to, of renewing only the tips of contact fingers, had been examined on its system by the speaker, and he believed it a good one to follow. He thought that a good deal of money could be saved, even with K types and other types of control used on the platform. The controller finger item is quite a large one on a big system, and but very little of the controller fingers are actually gone when they have

to be renewed. Mr. Pestell then considered the flashing over of motors.

W. D. Wright, of Providence, said that he wanted to express himself in regard to the value of reports from motormen when they turn the car into the car house. This is a great help to the men taking care of the apparatus, but sometimes it is hard to get a written report from a motorman which can be easily understood. Sometimes slips are used, on which are printed different numbers, which apply to the apparatus liable to give trouble, and if the motorman notices some trouble in these parts he checks off the number. The speaker thought it better to go further than this, and to require the motorman at all times in bringing the car into the house to make some kind of report; in other words, he must O. K. the car or note the defects which exist. They had found the O. K. report to be of great value in practice.

G. J. Smith, of Kansas City, inquired if the members had ever heard of a motor flashing over when comparatively new. In the flashing over of motors on a road he was formerly connected with, 90 per cent of the troubles were from that cause. It was found that a comparatively new motor never flashed over. If it did flash over within three or six months of the time that it was installed, leaks, break-downs, etc., were found out. When these troubles were reported, the flashing over stopped.

J. S. Doyle, of New York, said that on the Interborough Rapid Transit Company new motors flash over as well as old motors, and the remedy is the splitting of the field coils. The cause of motor flash overs is due to partially or wholly interrupted circuits. The field saturation does not correspond with the magnetic effect of the armature. The result is there is an increase of potential across the armature, causing the motor to flash over.

Alfred Green discussed the desirability of how far a motorman should be educated concerning the handling and the maintaining of the electrical equipment. In the speaker's opinion, that was one of the most important points in the practical operation of electric street railways to-day, fully as important as the same question applied to the steam engineer, and more so. A motorman, in the first place, is taken from the ranks. He is given apparatus which costs a great deal of money and is expensive in maintenance. It also frequently happens that two and perhaps three men handle the same car during the eighteen or twenty-four hours of its operation. The point which the speaker desired to raise was how much of an education the motorman should have.

D. F. Carver, of Jersey City, replied that he believed, theoretically, that the motorman should have all the education he could get. On the Public Service Corporation of New Jersey, apparatus was installed about a year ago to give the motorman a pretty thorough education in the handling of the machinery on the car, but the practical difficulty was that the employment department could not keep the road supplied with men fast enough, so that the time could not be taken to give the men as thorough an education as desirable. The corporation adopted the usual practice of sending a new man out with an old employee for several days, until he was broken in. It no longer experienced the trouble it had some years ago, because many four-motor equipments were being put on, using four 40-hp motors under comparatively light cars, which have plenty of resistance, so that the motormen are not able to do the equipment so much harm as formerly. If the motormen feed too fast it makes a jolt on the car which is not only uncomfortable for the passengers, but for the man as well, and he gets plenty of notice if he is doing what he should not do. The corporation's troubles from that cause are decreasing right along. The speaker said that the mechanical and operating departments are very much pleased at the way the men take hold of new things. The Public Service Corporation also finds that its men, as a general proposition, are with the company in every movement which it desires to make for the improvement of the service and equipment, and instead of the heads of departments having to go around and drum the new propositions into the men, the latter talk to some of the shop men or those around the depots, and in this way secure full information about any new plans. His experience was that on all of the roads the average motorman tries to get the information required. The speaker said that on one of the South Orange lines the saying among the men is that a man would rather be kicked than turn a car in off the road, the consequence of which is that the number of cars turned in in the course of a week is very small. Printed blanks are given to the motormen, containing a list of some fifteen different kinds of trouble that might occur in the car, and when the car is turned in at night, if there is any defect, the conductor punches out the part relating to the particular trouble. The company does not care particularly whether the motorman hits the cause of the trouble right or not, but if there is some trouble the conductor punches the number indicating what he thinks the trouble is. He may punch out the number indicating trouble with the motor, and it may really be the controller, the field or the trolley pole, but the fact that he punches the slip indicates that there is something wrong with the car, and the mechanics overhaul the car to see what it is. The speaker said that brought up another question which had been mentioned at the meeting in regard to damage suits. In two cases he remembered that by that nightly record the company was able to prove that the equipment was not defective and thus to save itself from serious loss. There was one case which happened about six weeks ago, involving an unfortunate accident with one of the cars. In the morning the motorman who had the accident, had a car, on the stovepipe of which had been put a new kind of locomotive black. Noticing this, the motorman went into a drug store and telephoned that this car was out with wet paint on the smokestack, and asked for another car. He received another car. In the afternoon he had a serious accident with that car, and the company discovered the next morning that the druggist in the store from where the motorman had telephoned for another car had stated that the accident was caused by the company's negligence in putting out a car which was in bad order, as the motorman had come into his store in the morning to telephone for a new car. By showing the records of the transaction, the company completely absolved itself from negligence. Mr. Carver did not know what the claim was settled for, but it was probably very much less than if the company had not been able to show records which proved that it had complied with the motorman's request for another car. The company had the conductor's slip of the night before, showing that the car on which the accident had occurred had been turned in "O.K." After the accident the company took the car and was able to demonstrate that it was in good order at that time. If a conductor turns in a car as being crippled, and the mechanics go over it and cannot find anything wrong with the car, there is nothing said about it; there is no penalty for making an erroneous report. The company desires the criticism of its employees in regard to the condition of its equipment, and gives them every facility for making the criticism.

A. M. Patten, of Topeka, stated that a scheme had been tried on the Topeka Railway which had proved quite satisfactory. The motormen are required to make a daily report, with the different troubles liable to occur to the car listed on the report, and there are columns for the different motormen to sign "on" and sign "off;" in other words, in passing the car from one motorman to another, they O. K. the car in all essential particulars. These reports and other means are used in the education of the men. Of course, there are many times when the motorman does not locate the trouble correctly. When this occurs the company takes up the matter and explains why the motor-

man did not locate the trouble correctly. The company is securing more accurate reports from the motormen in regard to these troubles since adopting this practice.

J. S. Doyle, of New York, stated that the Interborough Rapid Transit Company provides two school cars for the education of the motorman, and issues a book of instructions, containing a description of the apparatus on the car, with a list of questions and answers. Upon the school cars all the apparatus employed, including the air brakes and multiple control, are so designed that motorman can readily see their operation, one piece in each part being sectioned. The questions and answers pertaining to failures of apparatus are devised with a view of reducing the detention to service. In other words, when anything occurs, he goes through the list of questions and answers pertaining to failures, and going through this list he finds the trouble and reduces the detention. It is the intention of the company to require a motorman to pass a yearly examination to determine his knowledge of the apparatus. The book of instructions is very complete.

W. K. Evans, of Minneapolis, said that he was glad to know about the experience being had with instruction cars. The Twin City Rapid Transit Company had contemplated something of that kind; in fact, it had a system of instruction under which the men met in groups each week and went over questions such as have been considered in the discussion; but from the discussion which had been had on the subject it occurred to him that the companies were working at the wrong end of the proposition. All of the discussion that had proceeded depended entirely on the motorman to eliminate the trouble. His experience had been that the company cannot get motormen fast enough to educate them, and the consequence was that the superintendents of transportation had to put the men out on the car a considerable time before they have any extensive knowledge of the apparatus. It was his opinion that a great deal of time can be wasted in educating the motorman, because about the time the motorman was educated in many cases he would have left the employ of the company. While it was a very good thing to have a well-posted man—there was no question about that—there is no line in the country that can afford to tie up the system long enough to allow a motorman to repair the car. If there was a little trouble in the controller or something of that kind, the motorman could fix it and get his car in. He would like to hear more discussion from the other end of the question. In his experience, motormen's reports have been very misleading as to what the trouble really was. Mr. Evans said that it will have to be admitted that the motorman is not thoroughly educated concerning the apparatus in his charge, but he ought to be able to detect ordinary trouble. There is one peculiarity about educating men in a knowledge of the apparatus which they handle. It is a well-known fact that some of the best air brake men on the steam roads know practically nothing of the construction of the apparatus; they simply know how to shut off the engine to make an even stop at the station. They have that down to a nicety, but can tell very little about the intricate construction of the air brake apparatus. It was his opinion that if the companies are going to depend altogether on the motormen for information relating to car troubles on the road, they are working at the wrong end. The motorman can give a great deal of assistance, but it would not be advisable to depend entirely upon him. Mr. Evans thought the paper a very good one, and he would like to hear it discussed very thoroughly. Mr. Lindall had mentioned the tabulating of defects and recording them, and the Twin City Rapid Transit Company had found that practice to be a very great advantage; but one point had not been touched upon, which, in the opinion of Mr. Evans, was very important, namely, that the defects should be tabulated so that not only the master mechanic but everybody interested in the equipment could see just how it was running. He had been surprised to find out the interest such a practice had generated even in the ordinary repair men at the station, when they found out that the company was keeping a check of this kind. Some of the repair men whom he thought were not interested at all, had come to him and told him that their reports would be better than they were the preceding month.

Alfred Green said that what he had in mind, in asking the question, was not the matter of repairing a car on the road, but the question of sending out a man who would keep the road open. He said he had known of a case where a motorman did not know, when he was cut out, where the fuse box was, and he stood there until another motorman came along. He knew of another case where a motorman went to start up and got stuck in a curve because he forgot to let his brake off. The question was how far a man must be educated to keep the car going until it comes back and not block the system—that was what he was after. It is a good point to find out why the master mechanic has to assume all the responsibility on account of incompetent handling of the car. The speaker had seen a motorman run a car for 3 miles, leaving the brake off, and when he wanted to stop the car he simply turned the controller handle around. In his opinion, much of the trouble for improper handling was due to the motorman.

J. S. Doyle, of New York, said that in regard to the inspection of electrical equipment, the Interborough Rapid Transit Company had a system which might prove interesting. The company published each month a schedule showing the cost of daily inspection, and also the cause of all delays. There was a competitive merit system among three different inspection shops. Each shop takes care of about 700 cars and inspects each car every three or five days. The shops started out a year ago to see which had the best foreman, with the understanding that the man who saved the most money would receive a certain percentage of it. In the first year the company saved a considerable sum of money. A schedule was issued showing every delay that occurred and the cause of it. The company found that at the end of the first year the reliability of the service was improved 30 per cent and the expenses largely cut down.

H. A. Johnson, of Camden, N. J., remarked that the same system had been tried in the Southern Division of Public Service Corporation and had produced very satisfactory results; that is, giving each shop force a certain class of equipments to take care of. It resulted in considerable competition among the men, and very excellent results followed.

William E. Rolston, of Tippecanoe, Ohio, inquired what was the experience of the members and what they gained by the use of the ammeter in instructing motormen, as applied to large cars on interurban roads. It had been the practice of the Dayton & Troy Railroad Company to take a voltmeter and ammeter on the front end of the car, and at that same time use a wattmeter on the car, to make a record of the consumption of current on the line and compare that with the power used by the older men in the service. He gave the advantages to be derived from this practice, and asked for an expression of opinion from the members as to their experiences along that line.

William Pestell described an arrangement which had been put into effect for checking the records of cars taken in for various troubles. Such a schedule shows at a glance which motormen were having the most trouble on the street, as well as what particular cars were giving trouble, and initials were provided which showed what trouble the car had been pulled in for. This is particularly valuable on small roads having anywhere from 25 to 200 cars.

W. H. McAloney, of Denver, thought it was important on small roads, up to 200 cars, to show how many cars were taken out of service per day, week or month, and a comparison made for certain periods. He gave the percentage of cars taken off the line for repairs per week in Denver.

Mr. Evans said that as to the statement about tabulating the

number of failures, that the Twin City Rapid Transit Company had been trying something of that kind and had tabulated the failures—that is, cases where the cars were pulled out of service—and reduced it to a mileage basis, to show that each station had so many pull-ins for the month and so much mileage per pull-in. A record is kept also of the motormen who have the pull-ins, and if they find any particular man has too great a number, he is called to account, which has the effect of reducing the trouble. The speaker was still a little inclined to think, in opposition to Mr. Green, that the meeting was working at the wrong end of the proposition. He did not wish to appear to contend that there is any disadvantage in educating the motormen, but that it appeared to him to be a practical impossibility to get the motormen educated to that point where they can be thoroughly relied upon to take care of the equipment.

J. S. Doyle answered Mr. Evans that his company did not find that to be the case. He then gave some of the conditions and results attained in educating motormen on the Interborough Rapid Transit Company's lines.

Mr. Evans said that his company did not have any trouble with the preferred men on the system. It is upon the extra man who takes a car out that the superintendent must depend on to fill out the service. Under the conditions Mr. Doyle spoke of, they had no trouble, because in the case of such men the company knows that when they get a report the trouble is what they state it to be.

Mr. McAloney inquired if the Interborough school car is run over the lines. Mr. Doyle replied that they had two school cars, one for the subway road and one for the elevated road. He gave the amount of time taken for instruction for each man and for divisions.

D. F. Carver said that his company had put two 40-hp motors, with a 22-pinion, on each nine-bench car, making the cars pretty lively. The new motormen in handling these cars could not keep them on the line and keep the fuses in. The company hit upon the experiment of having a few of the brightest men on the division take such cars out, letting them run the cars for one trip, in the presence of the new men, in the way in which they usually handled it. Then they put ammeters in the cars, allowed the new men to handle them in the same way, and showed the current consumed at various points on the controller by their way of running the cars. The current went up to 350 amps. when swinging from series into parallel. They then showed the new motormen how it should be done. The motormen went around the club rooms and told the other motormen what they had seen. In a few days the trouble vanished, the cars were kept on the line in proper shape, and in a week or so the men would not have anything else than the fast cars. The company has not had any trouble in the last two months, no cars being turned in, where formerly they had eight or nine cars a day turned in, the men saying they could not operate the cars and keep the fuses from blowing.

J. S. Doyle remarked that was quite an important engineering question, and he thought the solution was to resort to the multiple-unit system, automatic control, especially in four-motor equipments. As Mr. Pestell had said, the roads were coming to it, and the automatic feature is one of the best features of the control. As to training the men how to do it, it may be done for a day, or for a week, but unless watched continually they will go back, and he thought, after all, the automatic control would give the best results.

Mr. Olds said he was a thorough believer in giving the motorman, especially on the interurban lines, a comprehensive apparatus in their charge, and that they should be required to pass an examination.

H. J. Lake, of Muncie, Ind., considered that the matter of instructing motormen is of vital importance to every electric railway system. He should have sufficient knowledge of the apparatus to prevent a tying up of the system, and if the sidings are two or three miles apart, or less, he ought to be able to get his train to a siding.

President Olds then appointed the following named gentlemen as a committee on nominations: W. O. Mundy, Alfred Green, J. Millar, W. D. Wright and W. K. Evans. The meeting then adjourned until 2:30 o'clock.

TUESDAY AFTERNOON SESSION

President Olds called the meeting to order at 2:30 o'clock.

The president stated that the first business of the session would be the consideration of the Question Box. The secretary read the printed questions and answers, and there was a very spirited and valuable supplementary discussion by the members generally of the questions contained in the Question Box.

After concluding the discussion of the Question Box, during which much had been said about the burning out of controllers with four-motor equipments, Mr. Carver, of Newark, suggested the appointment of a standing committee for the coming year to investigate this trouble and its remedies and report at the next meeting. Mr. Pestell, of Worcester, thought such committees should be appointed to take up not only controllers but also various other topics. Mr. Evans, of Minneapolis, thought the association should work in the direction of developing a set of standing committees on important matters that should be continued over several years. Mr. Pestell then moved that it be the sense of the association that the executive committee establish committees on the following subjects: cars and car equipment, shops and shop equipments, power stations, track and maintenance of way, and block signals. This was carried.

Various other members expressed themselves as favorable to including the way-men in the association, and the amendments to the constitution were passed which provided for this.

REPORT OF REORGANIZATION COMMITTEE

Chairman Simmons, of the committee appointed the previous day to meet the executive committee of the American Street Railway Association, reported the results of the meeting held at the Southern Hotel that morning. A resolution was read which had been passed by the executive committee of the American Street Railway Association. This, in effect, recommended that the American Street Railway Association take immediate action toward a reorganization by amending its by-laws at its coming convention in St. Louis so as to make the presidents of the three associations an executive committee for working out the details of a plan of reorganization which would include all the present associations in the American Street Railway Association and give each department of electric railway work a part in the association convention work. It was the understanding, however, that the executive committees of the subsidiary organizations should during the convention meet with the executive committee of the American Street Railway Association to assist in this work. Mr. Simmons moved the acceptance of the terms of this resolution, which was carried.

C. F. BAKER

ELECTION OF OFFICERS

The nominating committee then made a report, which resulted in the election of the following officers for the ensuing year: President, C. F. Baker, of Boston; first vice-president,

H. H. Adams, of Baltimore; second vice-president, John Millar, of Buffalo; third vice-president, F. G. Simmons, of Milwaukee; secretary and treasurer, Walter Mower, of Detroit; executive committee, D. F. Carver, of Jersey City; J. S. Doyle, of New York; C. C. Lewis, of Schenectady, and W. H. McAloney, of Denver. After a few announcements the president-elect took the chair and spoke a few words, followed by the vice-presidents. Mr. Simmons, in particular, expressed appreciation of his election to the office of a vice-president, because it was given him as a recognition of the part the track and maintenance of way men will play in the organization in the future.

A very heartfelt rising vote of thanks was given to retiring President Olds.

THE AMERICAN STREET RAILWAY ASSOCIATION

WEDNESDAY MORNING SESSION

The first session of the American Street Railway Association was called to order Wednesday morning, Oct. 12, at the Transportation Building, World's Fair grounds, by President W. Caryl Ely, of Buffalo, N. Y. He introduced President D. R. Francis, of the Louisiana Purchase Exposition, who made an interesting address. Among other things, President Francis took occasion to praise very highly the efficient management of the St. Louis street railways. He drew attention to the fact that the management has in its treatment of the public gained public sentiment favorable to it—that, he stated, was the first important step to be gained in carrying on any great public enterprise.

President Ely then spoke eloquently of the glories of the Exposition and the greatness of the achievement that it represents. He then introduced Prof. W. E. Goldsborough, chief of the Department of Electricity, who gave an outline of the principal exhibits of interest to street railway men in the different buildings, and also spoke briefly of the work of the Electric Railway Test Commission.

President Ely next delivered the annual presidential address. In this, he referred to the recent progress of the traction industry in several important particulars. The recent acquirements of electric interurban lines by the New York Central, and the work of that company and the Pennsylvania Railroad in New York City were spoken of at length, as well as the great subway system just completed in New York City. The gains of the Manhattan Elevated system in New York by the introduction of electricity were quoted as an example of advantages to be derived from that system of traction. An increase of 33 per cent in train service had been made possible by this change of motive power; the traffic has increased 30 per cent and the operating expenses reduced from 55 per cent to 45 per cent of the gross receipts.

He stated that the time had come when conditions demanded a radical change in the method of conducting the association, and outlined a scheme suggested to organize different departments within the association. The organization of the manufacturers' committee to take charge of exhibit matters was also noted and indorsed.

Mayor Wells, of St. Louis, was then introduced and welcomed the convention as a street railway man. His father built the first line in St. Louis in 1859. He had been general manager of his father's road, and consequently felt kindly toward street railways, particularly because he had seen communities benefited so greatly by them.

Secretary T. C. Penington then read the executive committee's report, which included a recommendation that the by-laws be amended so as to include on the executive committee the presidents of the mechanical and the accountants' associations. This amendment would be intended as the first step toward a general reorganization.

J. C. Hutchins, of Detroit, introduced a resolution rescinding the action of the convention of last year which was unfavorable to the publication of daily reports of the proceedings by the technical press. Consideration of this was postponed, after much discussion, to Thursday. A censorship committee, consisting of Messrs. Hutchins, Beggs and Mailloux, was appointed to pass on all matter given out for publication.

THURSDAY MORNING SESSION

At the session of the association on Thursday morning the report of T. C. Penington, the secretary and treasurer, was presented. After this had been approved, a resolution was offered modifying the resolution of J. C. Hutchins at the session on the previous day to disapprove of only daily verbatim reports of the proceedings. The recommendations of the executive committee regarding the reorganization of the association were then approved, after which W. E. Harrington, the chairman of the standard rules committee, reported. Then followed the reading of the paper by R. H. Rice on "Steam Turbines;" this was discussed by Messrs. Mailloux, Hopkins and Abbott. The paper by J. R. Bibbins on "Steam Turbine Plants," and that by E. D. Meier on "The American Diesel Engine," were then read and discussed. The paper by Leon Jewell on "Transfers; Their Uses and Abuses," which followed these, was read by title; it was actively discussed at length by Messrs. Vreeland and Beggs. All of these papers are published in full in this number. Next followed the report of the committee for carrying United States mail, of which Mr. Grant is chairman. The election of officers resulted in the following selections: W. Caryl Ely, of Buffalo, president; E. C. Foster, of New Orleans; John I. Beggs, of Milwaukee, and Richard McCulloch, of St. Louis, vice-presidents; T. C. Penington, of Chicago, secretary and treasurer; J. J. Stanley, of Cleveland; H. F. Grant, of Seattle; F. G. Jones, of Memphis; W. E. Harrington, of Camden, executive committee. The plans proposed for the reorganization of the American Street Railway Association will be worked out by the executive committee and the officers of the other associations during the year. The resolution of C. F. Baker, the new president of the American Railway Mechanical and Electrical Association, on Monday afternoon covered the appointment by his association of a committee on the proposed reorganization conference.

AMERICAN ASSOCIATION OF STREET RAILWAY CLAIM AGENTS

The American Association of Street Railway Claim Agents was organized Wednesday, Oct. 12. The officers selected are: W. A. Dibbs, of New York, president; E. W. O'Conner, of Savannah, vice-president; B. B. Davis, of Columbus, Ohio, secretary-treasurer; Messrs. Rinaug, of New Orleans; White, of Chicago; Davis, of Columbus; Feeney, of Newark, executive committee. The time and place of meeting was left to the executive committee, but it is probable the association will convene in August. The dues are merely nominal, being fixed at $5 a year for the present.

THE STREET RAILWAY ACCOUNTANTS' ASSOCIATION

ABSTRACT OF THURSDAY AFTERNOON'S SESSION

The Street Railway Accountants' Association convened on Thursday afternoon at 3:30. President Smith in his address referred to the joint meeting on Friday between the Accountants' Association and the American Railway Mechanical and Electrical Association—the first meeting of the kind held by these bodies. He then referred the street railways and the steam railroads to the standard form of report of the Internationa. Street Railway Association, and quoted part of the recent editorial on this subject in the Street Railway Journal. He recommended the appointment of a committee to confer with the International and the British associations to adopt a stand-

ard form of report. Mr. Smith closed his remarks with the statement that the association had gained twenty-eight members and lost sixteen during the year. Mr. White then read his paper, which was accompanied by sixteen large books, with loose index leaves, containing the forms collected. The full proceedings of this session will be published in the Street Railway Journal for Oct. 29.

THE RE-ELECTION OF PRESIDENT ELY

The information comes by telegraph from St. Louis as this issue goes to press that W. Caryl Ely, of Buffalo, N. Y., president of the International Traction Company, has been re-elected president of the American Street Railway Association.

This action by the association is a deserved tribute to the tact and ability with which Mr. Ely administered the duties of the office for the year just closed. The coming twelve months will probably be the most important ones in the history of the association, as during them working plans for the reorganization of the parent body and the allied associations must be devised. The desirability of these changes was clearly brought out in President Ely's address, and the advisability, even the necessity, of a reorganization is admitted by all if the several associations are to accomplish the most good. The members of the association were a unit in their indorsement of the re-election of Mr. Ely, to whom they feel can safely be left the details of the proposed changes. That this is a considerable task no one can doubt. But with the co-operation of the executive committee, aided by such suggestions as may be obtained by Mr. Ely from members of the association, there is no doubt that a satisfactory plan will be devised.

CONVENTION NOTES

The badges provided by the manufacturers' committee were extremely tasteful and were universally admired. They were made of German silver and represented a modern electric car surmounted by an eagle, while below a scroll bore the words "American Street Railway Association, St. Louis, 1904." Attached to the badge were ribbons of different colors. Thus the delegates to the American Street Railway Convention were provided with blue ribbons, members of the American Railway Mechanical and Electrical Association wore a brown ribbon, and the Accountants were given a yellow ribbon. The supply men were designated by red and the ladies by a white ribbon. The badges of the officers of the different associations were gold. Each badge bore a small, numbered, celluloid tag, so that it was possible from the lists kept by Secretaries Penington, Brockway, Mower and Meade to identify any one at the convention.

The address of Mr. Beggs before the Master Mechanics on Monday should be read by everyone connected with the mechanical department in electric railroading. Mr. Beggs spoke extemporaneously, and referred to his speech as a series of remarks only, as he had not had time to prepare an address and never had had. Nevertheless, he outlined in the clearest possible way the relations between the managerial and mechanical departments. As he forcefully put it, the master mechanic is an assistant manager of the property, upon whom depends in a large degree not only the comfort and safety of the passengers, but even, to a considerable extent, the financial success of the company with which he is connected. His work is one which is constantly growing in responsibility and importance and which calls for the highest degree of care and intelligence. Mr. Beggs was heartily applauded at the termination of his address.

The St. Louis Transit Company had printed and distributed to all in attendance at the convention an extremely tasteful ticket book. Each book contained twenty-eight tickets, good for fare upon any of the lines of the company during the week ending Oct. 15. The tickets were beautifully engraved and printed and were bound in a tasteful cover. One side shows an emblematic female form above the World's Fair buildings; the other side represents Monroe, Livingston and Marbois executing the famous treaty in 1803, by which the Louisiana Purchase was completed. Capt. Robert McCulloch, general manager of the St. Louis Transit Company, received many congratulations over the attractive form of this ticket book.

The Pennsylvania Railroad special train which left New York at 10 a. m. Saturday carried about 150 passengers and was run as a section of the St. Louis Limited. In addition to the sleepers, there were two dining cars, a buffet and library car at the head of the train and an observation car at the rear. A car conveying a number of delegates and others attending the convention from Boston was attached to the special at Philadelphia. A number of delegates to the convention from Baltimore, Washington and Harrisburg boarded the train at the latter city, while others took the train from Pittsburg and other intervening points. In spite of the heat, those on the "special" enjoyed the trip, and the monotony was relieved by frequent concerts from Reeves' Band, which was on board. Other "specials" were run from Chicago, and by the Big Four and Central Railroads from the middle of New York State.

The meetings were held on the second floor of the Transportation Building, and at the entrance were displayed some of the results of the tests conducted this summer by the Electric Railway Test Commission. Prof. Norris and Prof. Swenson were present and explained the charts exhibited. The charts showed the detailed observations of the air brake tests, described in the Street Railway Journal for Aug. 27; also the tests on the impedance of steel rails at different frequencies. These tests were also mentioned in the Street Railway Journal for Aug. 27. Another interesting print shown was of the plan adopted for testing air resistance, to be tried on the lines of the Indiana Union Traction Company later.

A meeting of the manufacturers' committee was held Monday morning at 11 o'clock to elect officers for the ensuing year. The resignation of Scott H. Blewett, of the American Car & Foundry Company, was announced, and that John W. Nute, president of the St. Louis Car Wheel Company, had been appointed in his place. It was then decided to continue the committee for another year, but to enlarge it by the addition of five more members. Four of these were elected at the meeting Monday, viz.: Wm. Wharton, of Wm. Wharton, Jr. & Company, of Philadelphia; C. K. King, of the Ohio Brass Company, Mansfield, Ohio; Frank C. Randall, of the National Electric Company, of Milwaukee, and W. H. Whiteside, of the Allis-Chalmers Company. The fifteenth place was left vacant.

Monday evening the members of the committee met at the Southern Hotel and re-elected Daniel M. Brady chairman. It was also decided to divide the terms of office of the members so that the terms of five members would expire in one year, five others in two years and the remainder in three years. The selection was made by lot and the following were found to be in the one-year class: Daniel M. Brady, James H. McGraw, W. J. Cooke, W. H. Whiteside and F. S. Kenfield. The two-year men are: John W. Nute, J. R. Lovejoy, F. C. Randall, Calvert Townley and George J. Kobusch.

The new by-laws adopted by the manufacturers' committee provide that the name of the association shall be, American Street Railway Manufacturers Association.

PAPERS READ AT THE ST. LOUIS CONVENTIONS

REPORT OF THE JOINT COMMITTEE OF THE AMERICAN RAILWAY MECHANICAL & ELECTRICAL ASSOCIATION AND THE STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA ON BLANKS FOR SHOP RECORDS AND ACCOUNTS

By mutual agreement, the American Railway Mechanical and Electrical Association and the Street Railway Accountants' Association of America appointed a joint committee to prepare a report on "Blanks for Shop Records and Accounts," to be presented at one of the sessions of the eighth annual convention of the Street Railway Accountants' Association to be held in St. Louis, Oct. 13, 14 and 15, 1904; the members of the American Railway Mechanical and Electrical Association attending.

The necessity and importance of a system of shop records and accounts for carefully recording work of repairs and mechanical changes, is recognized by all master mechanics, and as the accountant's duties bring him in close touch with all departments he is naturally interested in the adoption and installation of a system in the mechanical department by which he can report the relative usefulness of changes or improvements over previous methods.

Your committee, in preparing this paper, thoroughly realize that local conditions control, to a degree, the operation of street railway properties, and that it would be difficult to submit a set of blanks which would meet the needs of all companies, and in preparing the accompanying blanks they were prompted and governed by the desire to cover in a general way a system which could be adapted with slight changes to the requirements of small companies having somewhat limited office facilities, as well as the larger with a more complete organization.

The report, for convenience, is arranged in three sections.

The first section contains the forms pertaining to reporting the condition of equipments while in service and under repairs, viz.:

Form 1. Trainmen's Report of Condition of Cars.
Form 1-A. Summary of Trainmen's Report of Condition of Cars.
Form 1-B. Trainmen's Report of Condition of Car.
Form 1-C. Summary of Trainmen's Report of Condition of Cars.
Form 2. Car Inspector's Daily Report.
Form 3. Car Tag.

The second section contains the forms pertaining to the accounting for work done by the mechanical department, viz.:

Form 4. Shop Order.
Form 5. Inter-department Order.
Form 6. Master Mechanic's Order.
Form 7. Individual Time Card.
Form 7-A. Daily Report of Time.
Form 8. Application for Change in Pay Roll.
Form 9. Requisitions on Storekeeper for Material and Supplies.

The third section contains the forms pertaining to shop records, viz.:

Form 10. Record of Car Repairs.
Form 11. Wheel Report.
Form 12. Wheel Record.
Form 13. Armature Report.
Form 14. Individual Armature Record.
Form 15. Individual Car Record.

SECTION ONE

It is a well-known fact that most, if not all, troubles and defects in cars and equipments are first noticed in the operating department. Proper reports as to the condition of the cars should therefore be made daily by the trainmen, to enable the mechanical department to trace and take care of the troubles with a greater degree of accuracy and promptness; having this in mind we submit herewith Form No. 1.

TRAINMEN S REPORT OF CONDITION OF CARS

When a car is turned into the car house a report as to its condition is made by the trainmen on this form, which is arranged to include information regarding the "Time In," "Car Number," and the "Defects" found to exist in the operation of the car. When no defects are noticed, the cars are reported "O.K." The trainmen then sign in the proper place as a certification that the cars are in the condition stated. When the cars are inspected the car house foreman notes in the column provided the "Action Taken," and affixes his signature. It is then carefully checked by the man in charge of the car house and a report made therefrom, daily (on Form 1-A.) to the master mechanic. The report is then forwarded to the superintendent of transportation, who, after approving, passes it on to the claim department for permanent file. This report is followed by Form 1-A.

SUMMARY OF TRAINMEN'S REPORT OF CONDITION OF CARS

This summary is practically a recapitulation of defects reported by the trainmen. It is made in duplicate by the man in charge of the car house, and indicates the disposition of the troubles reported. The original is sent to the master mechanic daily and the duplicate remains at the car house for future reference.

Some companies may prefer to have the trainmen make a separate report for each car. To meet this requirement we present herewith another style of report blank, Form 1-B.

TRAINMEN'S REPORT OF CONDITION OF CAR

This form is suggested as a possible substitute for No. 1, and has the advantage of requiring but very little writing, as it contains the classification of troubles most likely to occur. As a rule, a check mark only is needed opposite the defect reported. It may, however, be necessary in some cases in order to more fully describe the trouble to add a word or two before the check mark. The trainmen report in space provided the "Length of Detention," "Place of Trouble" and give other detailed information regarding the troubles encountered.

The report is made in duplicate and both copies are sent to the despatcher, who immediately forwards the original to the shop foreman. When the defects are not sufficient to render the car unfit for service, the report is handed in by the trainmen upon arrival at the car house.

It will be noted that no provision is made on this form for the action taken by the car house foreman; neither is it intended to form any part of the records in the claim department. The original should be filed, however, in the master mechanic's office where it may be obtained by the claim department, if desired. The size and shape of the blank can be altered to meet the demands, and the trouble classification can be made more in detail. It is recommended that this form be made in manifold paper, with a carbon back to the original. In filing the original it should be folded in the center, and the carbon side of the sheet folded on itself to prevent its coming in contact with other sheets.

It is necessary to follow up this report with a summary of troubles, which is provided for in Form 1-C.

SUMMARY OF TRAINMEN'S REPORT OF CONDITION OF CARS

This blank needs no lengthy explanation; as the note thereon indicates, it is made in duplicate by the man in charge of the car house and contains a recapitulation of the troubles reported by the trainmen on Form 1-B. The original is sent to the master mechanic and the duplicate forwarded to the superintendent of transportation.

The two systems for the reporting of defects by the operating department have been traced to their destination, and we pass on to Form 2.

CAR INSPECTOR'S DAILY REPORT

This form is divided into two sections, one for "Cars in Good Condition" and the other for "Cars Needing Repairs." It also contains, on the back, a classification of most of the troubles pertaining to cars and their equipment. In reporting a car in good condition, the inspector places the car number in the column provided. If he desires to report a defective car, the number pertaining to the particular defect is obtained from the back of the blank and inserted in the proper column.

The various troubles enumerated on the back of this form illustrate the principle and are not offered as definite terms or numbers.

The column headed "Foreman's Column, Action Taken," is used by the foreman in noting whether the "Repairs were made," "Car held in," "Car sent to shop," or whatever action was taken in the matter. Provision is also made for reporting cars lubricated. When defective cars are sent to the shops for repairs, a notice or report should be forwarded to the mechanical department. A tag is suggested for this purpose, Form 3.

CAR TAG

The man in charge of the car house fills out one of these tags for each defective car sent to the repair shops. It is attached to the car, and contains the "Car Number," "Line," "Date," "Time," "Trouble Numbers," and remains with the car until the repairs are made, when it is detached, and on the reverse side full in-

BLANKS ACCOMPANYING REPORT OF JOINT COMMITTEE OF AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION AND STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA, ST. LOUIS, OCT. 14, 1904.

Form 14 .... Company Size 8"X11"

Individual Armature Record

Armature No. .... Type .... Date New ....

Note. — Mark with an x in the Column or Columns the repairs to be recorded, on the Line opposite the proper dates; whenever possible place a number in the Column instead of the x to note the number of repairs to each item.

formation given regarding the "Repairs Made," "Date Completed" and "Names of Repairmen." It is then examined and signed by the shop foreman, who turns it over to the master mechanic for his record.

SECTION TWO

The mechanical department is frequently called upon to manufacture material and make repairs of an extraordinary nature and, as it is essential to know the exact cost and have a record of the work, it is important that a system be installed so that the cost and other data can be readily obtained. The first blank suggested for this system is Form 4.

SHOP ORDER

This order is made in triplicate; the first sheet, stating what is required, is forwarded to the master mechanic with instructions to have all labor performed and material furnished in connection with the order charged to Shop Order No. ——, and notify the auditor when the work is completed. The second and third sheets, which are carbon copies of the first in so far as the description of the order is concerned, are sent to the auditor and contain columns in which to note the cost of labor and material. In case the order is to manufacture material, the third sheet is forwarded to the storekceper, who inserts in the proper columns the "Date" and "Quantity Received." If the stock ledger is kept at the storeroom, the storekeeper can obtain the cost of labor and material from the auditing department.

The master mechanic can also obtain the total labor and material cost from the auditing department, and if desired, the first sheet can be made the same size as the second and third, and columns provided thereon in which to insert the labor and material cost.

We have also prepared a form of order for use between departments, Form 5.

INTER-DEPARTMENT ORDER

When a department desires labor or material from another department, this form is suggested. The names of the departments are listed, and it is only necessary to underline the one desired to fill the order. The account to be charged is inserted and a full description of what is required given. It may be made in duplicate if desired.

The next blank to be considered is the master mechanic's order to his shop foremen, Form 6.

MASTER MECHANIC'S ORDER

When the master mechanic receives a shop order (Form 4), he fills out one of these blanks for each foreman interested. All of these orders bear numbers identical with the shop order. The foreman after completing the order makes a full report, in the space provided, to the master mechanic. This form is made in duplicate and the report filed by the master mechanic as his record. If desired, the back of the blank can be arranged for labor and material cost.

In taking up the subject of time cards, two forms are suggested, the first being Form 7.

INDIVIDUAL TIME CARD

This card has printed thereon the "Account Names" and "Numbers" most likely to be used in distributing the time. Blank spaces are left for miscellaneous work or accounts not printed on the card and the employee's name.

The master mechanic, by referring to the time card, can note the total time worked by employees and the exact time charged to each account. These cards are turned over by the foreman to the timekeeper. If a time clock is employed, these slips can be readily checked against the clock record.

The second form of time card is provided with spaces in which to report the time of a crew, and is covered by Form 7-A.

DAILY REPORT OF TIME

As stated above, this blank is intended for use in recording the time of a crew. It contains spaces for the "Names of the Employees," "Hours Worked," "Rate," "Total Amount Due" and the "Account Number" to which the time is charged.

Space is left to the right of the blank for miscellaneous charges. The next blank to be considered is Form 8.

APPLICATION FOR CHANGE IN PAY-ROLL

It often becomes necessary to change the rate of employees or to increase the working force. When this is done the auditing department should be notified to enable them to check the pay-roll. The above blank is intended for such notice, and is provided with lines for "Date," "Officer to Whom Addressed," "Name of Department Requesting the Change," "Date when the Change Becomes Effective" and additional lines for full explanation as to why the change is desired. It is signed by the head of the department requesting the change, approved by the proper officer and forwarded to the auditing department.

We now come to the requ[illegible]r m[illegible]erial and supplies, Form 9.

REQUISITION FOR MATERIAL AND SUPPLIES

In preparing this blank reference was made to the "Report of the committee on standard blanks and accounting for material and supplies," approved at the Detroit convention of the Accountants' Association in October, 1902, but no blank was submitted to cover this requirement. The committee, therefore, recommends this form for use in drawing material and supplies from the storeroom as and when required by the shop department. It is made in duplicate by the foreman and approved by the master mechanic. The original is sent to the storekeeper and the duplicate retained by the master mechanic.

SECTION THREE

The blanks submitted in this section illustrate the method the committee has to suggest for keeping the records of various parts of the equipment, with the report forms necessary for making the record.

The first blank in order is Form 10.

RECORD OF CAR REPAIRS

This form is prepared for the purpose of recording the repairs made to each car. It will be noted that the blank has printed thereon the principal parts of a car. The repairs made are indicated by placing an "X" in the proper columns opposite the date; whenever possible, the number of repairs made should be recorded, omitting the "X." This blank can be enlarged or reduced to meet any requirements.

The next blank in order is Form 11.

WHEEL REPORT

As the name implies, this form is used in connection with placing and replacing wheels, and is arranged to indicate the "Car Number," "Date," "The Numbers and Circumference of the Wheels Taken Out and Put In" and the cause of removal, together with other information needed to make a complete report. It is filled out by the foreman, turned over to the master mechanic and recorded on Form 12.

WHEEL RECORD

This blank may be in book or card form. It is provided with spaces in which to record the "Wheel Number," "Car Number," "Date In," "Circumference," "Date Out," "Cause of Removal" and "Mileage." Provision is also made for several removals and replacements. Mileage is quite an essential feature of the report, especially to the companies purchasing wheels under a guaranteed mileage. The committee recommends that the master mechanic be given a statement of the mileage made by the individual cars under his care. It should be kept in a mileage book and used in connection with the various records. This blank is followed by Form 13.

ARMATURE REPORT

This report is in the form of a tag and is attached to each armature when removed from the car, where it remains in its entirety and the repairs recorded thereon, as made. After the repairs are completed, and as the armature is sent from the shop, the lower portion of the tag is detached from the stub and passed to the master mechanic's office. The stub remains with the armature until placed in the car, when it is filled out, signed and turned into the master mechanic's office by the foreman. As the tag is liable to become soiled, it will be more legible if written in red ink. The data on this tag furnishes the information for filling out Form 14.

INDIVIDUAL ARMATURE RECORD

This record is arranged on the same principle as the record of car repairs, and in noting the repairs made the same rules apply. This record will be more convenient in card form.

The last blank under consideration is Form 15.

INDIVIDUAL CAR RECORD

This blank is in card form and, if properly filled out, will become one of the most important records in the mechanical department. Spaces are provided for the "Car Number," "Type of Car," "Builder" and other detail information.

The committee desires to thank the members of the above associations for their kind and prompt co-operation in sending blanks when requested. Respectfully submitted,

H. H. ADAMS, Superintendent of Shops,
The United Railways & Electric Company, Baltimore, Md.
H. E. FARRINGTON, Superintendent of Car Repairs,
Boston & Northern Street Railway Company, Chelsea, Mass.
For the American Railway Mechanical & Electrical Association.
H. M. PEASE, Auditor,
International Railway Company, Buffalo, N. Y.
W. G. MCDOLE, Auditor,
The Cleveland Electric Railway Company, Cleveland, Ohio.
For the Street Railway Accountants' Association of America.

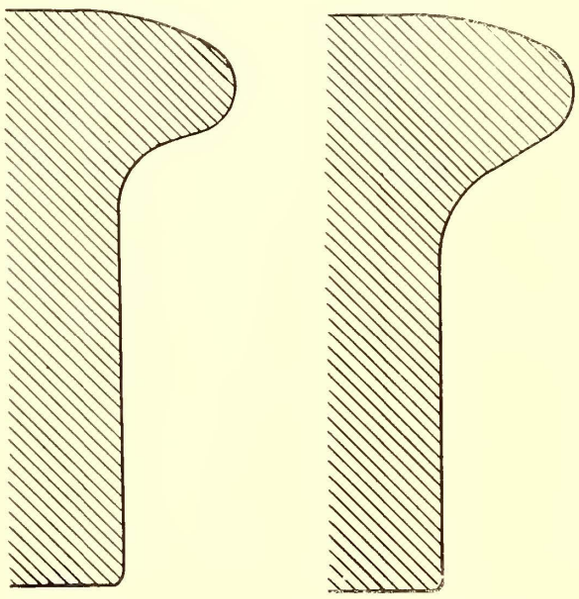
WHEEL MATTERS

BY J. MILLAR
Superintendent Rolling Stock, International Railway Company, Buffalo, N. Y.

The question of the proper type and maintenance of wheels used under interurban cars which are operated over city streets for any considerable distance, also over more or less special work, has developed into a problem of great importance to the master mechanic.

The ordinary chilled iron wheel with 1-in. flange is ruinous to special work in the city. We formely used a 500-lb. chilled iron wheel with 2½-in. tread and ¾-in. flange on our Lockport division, and a 450-lb. wheel with the same tread and flange on the Niagara Falls division. With both of these wheels we had an unlimited amount of trouble with chipped flanges, having to remove many of them for this reason before they were half worn out, and in several instances, after making but a few trips. As a matter of precaution, I found it necessary to have all wheels carefully examined each trip at both ends of the lines.

We are now using two types of wheels under our interurban cars; steel tired and rolled steel wheels, with 2½-in. tread and ⅞-in flange. The rolled steel wheels have given very fair results, with the exception of a few which have had to be removed on account of defective plates. As to flange wear, the results with both have been very good. The rolled steel wheels made an



A COMPARISON OF FLANGES SHOWING WEAR

average of 35,000 miles before they were taken out to be turned up for the first time, and a few have been turned up the second time with an average of 25,000 miles for the second run. We have only one car equipped with steel-tired wheels that has been in service long enough to get any definite data as to wear of flange and tread. These wheels have been in service about five and a half months and have made 34,960 miles. The flange wear is very satisfactory, as can be seen by the following sketches showing section of tread and flange when new and after making the above mileage.

You will notice that the flange is lower after having been in service than it was originally, although I use a brake-shoe that does not wear on the flange. This I attribute to the special work inside the city limits, the depth of the groove not being enough to maintain a ⅞-in. flange. However, we now have no more broken or chipped flanges and, as a factor of safety, they are far better than the chilled wheels. The only examination necessary now is for flange wear, which is done in the car stations, whereas, as is stated above, chilled wheels had to be examined each trip at both ends of the lines.

With both the steel tired and rolled steel wheels, I find that the flanges wear thin on one side of the car, while on the opposite side they are in good condition, necessitating their removal to be turned up sooner than the natural wear would warrant; this I attribue, to a large extent, to the constant running of the car from the same end, which is well known to cause irregular wear.

There are two arguments strongly in favor of the steel tired and rolled steel wheels; first, the factor of safety; second, their freedom from flat spots. During the fourteen months we have had them in use I have not had to remove a single pair on account of being flat.

In summing up steel tired and rolled steel wheels, I will say that the additional safety obtained from their use is of itself enough to warrant their adoption by all roads using high-speed interurban cars.

As to "chilled wheels," in following up the evolutions of cast-iron chilled wheels from the time of the old horse car days when with many—"a wheel was a wheel," it has been very interesting to note the changes in size, shape and weight, and it has convinced me that the changes have been a betterment to all matters pertaining to rolling stock. We are to-day using far better wheels than ever before; the mileage derived from cast-iron chilled wheels has in the past few years more than doubled itself. This is evident from the fact that the manufacturers have, during the past decade, raised their guaranteed mileage from 20,000 to 40,000 miles, which in itself indicates that progress in wheel manufacture has kept pace with other improvements pertinent to electric railroading.

I have had the mileage taken of 1458 cast-iron wheels (of the 400-lb. type, standard for our city cars) which were removed during the past two years. These wheels made a total of 58,340,578 miles, or an average of 40,014 miles per wheel. Of this number, 24 were removed on account of having been broken, 186 for chipped flanges and the balance, 1248, were worn out.

In regard to flat wheels, if, when first noticed, a good wheel-truing shoe is applied, much trouble can be warded off, but if too flat for a wheel-truing shoe, grinding down on a grinding machine is the only remedy.

My experience with the grinding of chilled wheels, and after considerable study, prompts me to state that I strongly advocate their being reground, providing the regrinding is done in time, though I am aware that quite a number of heads of mechanical departments are of an adverse opinion. It is impossible for me to give accurate figures here as to the length of time required to grind flat spots out, owing to the variance in the flats themselves; however, on averaging the time, I can safely say that to regrind a pair of wheels on account of "slid flat" with a spot about 1½ ins. long, it will take about 30 minutes actual grinding.

In pressing wheels on axles, a competent man is an absolute necessity, as the result of carelessness is obvious to all acquainted with the work. He must be accurate in the mating of wheels applied to an axle, and as nearly so as possible, the four wheels in a truck.

The pressure required to press wheels on the axle depends entirely on the quality of metal used in the wheels, also on the axles. The average pressure I use, however, is thirty tons.

In the above I have set forth a few matters which have developed in my experience, and hope that they will provoke comment and discussion which will of themselves be of material benefit to all interested.

TRANSFERS—THEIR USES AND ABUSES

BY LEON JEWELL

It is the constant endeavor of street railway companies to provide the best service and all transportation facilities possible, under the conditions met with in the operation of their roads, as well as to offer every inducement to the people to ride on the cars, in order to create and develop the traffic to the mutual advantage and benefit of the companies as well as their patrons. Primarily, this is the first and all important "Use" of the transfer. Its purpose is not to lengthen the ride, but to obviate the necessity of making trips on different routes by direct through lines, so that passengers may be carried directly and quickly to their objective points for one fare.

A few years ago, when the electric cars were first being introduced, the people were inclined to take the longest ride possible for one fare, but the novelty soon wore off, and the tendency changed to taking the shortest possible route to their destinations.

The issuing of a transfer does not, in all cases, necessarily mean that the rate of fare has been cut in two, but that there has been created, between certain sections, a traffic which did not formerly exist prior to the introduction of a transfer system. Without transfers, each line practically serves only its immediate neighborhood, as the people upon whom street railway companies depend for patronage cannot afford to pay more than a single fare in going to or from their various destinations.

By the use of transfers the necessity of direct lines of cars for different destinations is eliminated; travel in opposite directions is established which does not require an increase of car mileage; the traveling public is offered an attraction in the way of cheap

transportation for short distances over zig-zag routes not covered by direct lines of cars; the habit of street car riding is acquired from carrying passengers, for one fare, around two sides of a section, when such journeys were formerly left out, or walked, on account of the required two, three, and even four fares, which were considered too great an outlay for the distance covered.

"Abuses" in the operation of a transfer system will constantly arise. Different methods, remedies, safeguards, restrictions, etc., for the correction of these abuses have been adopted in different cities, by which some degree of protection has been secured in a majority of cases.

The principal and most odious abuses of a transfer system are the exchange, brokerage and transferring of transfers. These abuses can be fairly well controlled and kept within due bounds at ordinary transfer points, but at downtown common centers the brokerage in transfers becomes a different proposition and a menace to the company.

The damage claims that may arise from the transferring of passengers constitute one of the disadvantages of a transfer system and a strong argument against an extension of transfer privileges.

The abuses perpetrated by employees have been reduced, to a great extent, by removing from the transfers their cash value to the conductor. Employees, as a general rule, are very timid, or conscientious, in regard to giving away transfers, or otherwise disposing of them, illegitimately. Of course, there are employees of another nature, but they do not consider the returns of sufficient value to warrant the risk of losing their positions. They are also restrained through fear of the necessary confederates.

The abuses by employees, in improperly punching, issuing and honoring transfers, demand and require the closest surveillance and the strongest safeguards. The correction of these abuses is often neglected and, as a consequence, the public are not only encouraged in their abuse of the use of transfers, but are led to believe that the unwarranted privileges permitted by employees are just, and eventually claim them as a right.

My experience with transfers dates back to the fall of 1880. At that time the transfer system of our company was in its infancy and was confined to one transfer point until 1884. During that period the transfers were issued by agents who were stationed at the transfer point. At hours when business was heavy the agent could not possibly avoid being imposed upon by people who mingled with the passengers and demanded transfers.

At first, a small card punched so as to indicate the number of transfer passengers, was passed from the agent to the conductor. Under this system it was impossible to tell who were entitled to ride on the transfer and who should pay cash fare.

Next in order came the small individual transfer slips, which were dated but unlimited as to time and direction. These transfers were issued by agents and were honored and registered by the conductors the same as cash fares. The company lost heavily from the frauds of its conductors under the registration of transfers as cash fares. In order to stop these frauds we stopped the "ringing up" of the transfers.

In 1884, upon the opening of an additional cross-town line, the agent system was abolished and the one-hour time limit transfers were introduced and placed in the hands of conductors for distribution. From all information that I could gather the time limit transfers were, at that time, used only in San Francisco, Cal.

The transfer system was confined to a limited section of the territory covered by our lines until July 5, 1888, at which time we voluntarily established the transfer system over our whole territory. The following extract is from a notice given the public at that time:

"* * * By this arrangement residents in all portions of the south division of the city, Town of Lake and Hyde Park carried by the lines of this company, will be enabled to reach Washington and Jackson Parks, or the center of the city, for one fare * * * and is attempted by the management in the hope that the territory will be rapidly developed, and the volume of travel be sufficiently increased to warrant this experiment being made permanent, and that many of the lines not now paying operating expenses be rendered self-sustaining * * *"

The experiment was made permanent and the lines self-sustaining. New lines were established and extensions made to additional territory. The increase of traffic over the normal increase was principally for short distances which were formerly walked, as well as from the fact that the people were not backward in appreciating the one fare system and in locating their homes accordingly.

Previous to July 5, 1888, we collected as high as four cash fares from a passenger for one continuous ride for which we now receive only one cash fare. At that time our territory extended into three different townships, but at the present time it is all within one township, brought about by annexation.

Our transfer system from 1888 to 1902 allowed a passenger to transfer from the trunk lines upon a cash fare or transfer, but from the cross-town lines a passenger would be transferred only upon payment of a cash fare.

On Dec. 7, 1902, we inaugurated our present transfer system, under which a passenger, on the payment of one cash fare, may ride in any one general direction as far as the cars of our company will carry him. For instance, a passenger on a southbound car will, upon request at time of paying cash fare, receive a transfer, good, within a limited time, to any intersecting east, west or south line. If the passenger takes a westbound car, whereby he establishes his general direction of travel, the conductor will honor and issue in exchange for this transfer one entitling the passenger to ride south or west, and the passenger may then exchange that transfer for one good on south or westbound cars, to the extreme southern or western limits reached by the lines of this company. This enables our patrons to travel from one to any other side of a section reached by our lines on payment of one cash fare. It would be impracticable, without the use of our transfer system, to do this.

The following data of the Chicago City Railway Company, with respect to the operation of its transfer system, as representing the growth and development of the use of transfers over a period of twenty years, 1884 to 1904, may be of interest:

	1884	1904
Number of distinct lines of cars operated	7	20
Number of distinct routes operated	19	182
Number of transfer points	2	94
Maximum possible number of transfers issued for one continuous ride in one general direction	1	19
Average number of transfer passengers carried daily	4,000	207,728
Percentage of transfer passengers to fare passengers	4.6%	50.7%
Percentage of transfer passengers to fare and transfer passengers	4.4%	37.0%
Average fare per passenger (fare and transfer passengers)	$0.0478	$0.0313
Length of longest line, miles	4.59	9.78
Average length of all lines, miles	3.38	5.37
Longest transfer route possible, miles	4.39	15.74

From what has been said in this paper, it would appear that the "Uses" and "Abuses" of "Transfers" could be summarized briefly, as follows:

USES

(a) To increase the transportation facilities, whereby passengers can be carried in different directions, by shorter and more direct routes.

(b) To offer additional inducements to ride, thereby creating and developing increased traffic.

(c) To better serve the traffic of each individual line. To reduce the number of direct through lines and increase car mileage.

ABUSES

(a) The improper and fraudulent acts of conductors in connection with the handling of transfers.

(b) The brokerage or trafficking in transfers, especially by newsboys.

(c) The improper transferring and exchanging of transfers by passengers.

(d) The possible increase of damage claims, arising from the operation of a transfer system.

As to whether the advantages of the "uses" of transfers outweigh the disadvantages of the "abuses," or vice versa, depends on the specific conditions that each company operates under.

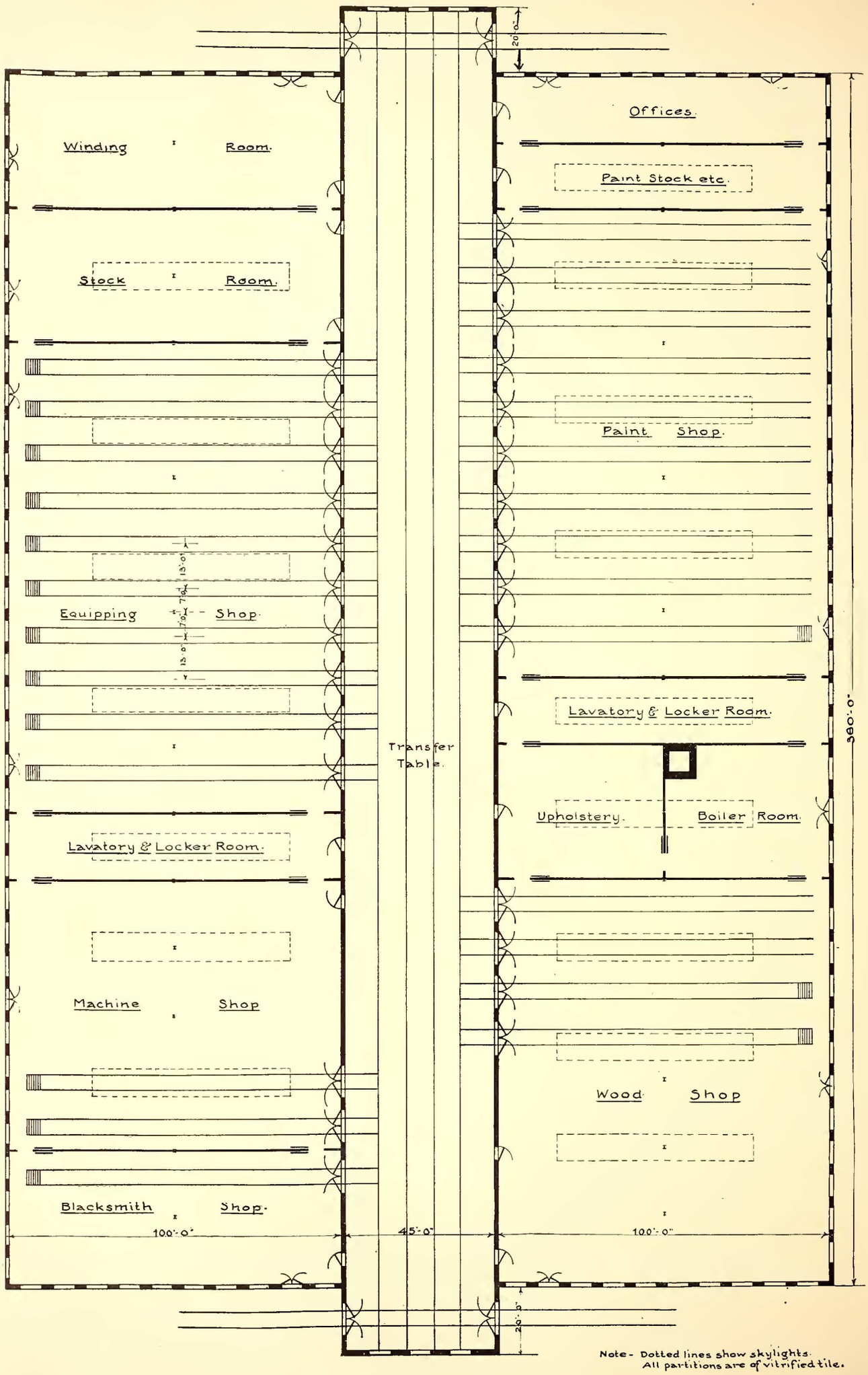
THE IDEAL SHOP

BY W. D. WRIGHT

Superintendent of Equipment, the Rhode Island Company, Providence, R. I.

The writer wonders if it would ever be possible to build an ideal shop for street railway work to meet all conditions. Local surroundings must necessarily govern to a certain extent the plans and construction of such a building, and the details of arrangement for the various departments and the necessary apparatus and fittings, must vary according to the different methods employed in doing the work on different roads. So it appears that in the face of these varying conditions, we can only consider under the head of "The Ideal Shop" a general plan for its lay-out, subject to changes which the local conditions would make necessary. In fact, the subject of this article might have been more properly: "A Few Suggestions for an Ideal Shop."

In the first place, "Let there be light," as it was in the beginning. This matter should have due consideration from the beginning to the end of the plans. Daylight is one of the greatest blessings we enjoy. Why shut it out? It costs nothing, and we



PLAN OF MODEL SHOP

cannot have too much of it in our shop if it is of the right quality. Men can do more work and better work because of it, and any extra expense incurred to obtain abundance of good light in a workshop is money well spent.

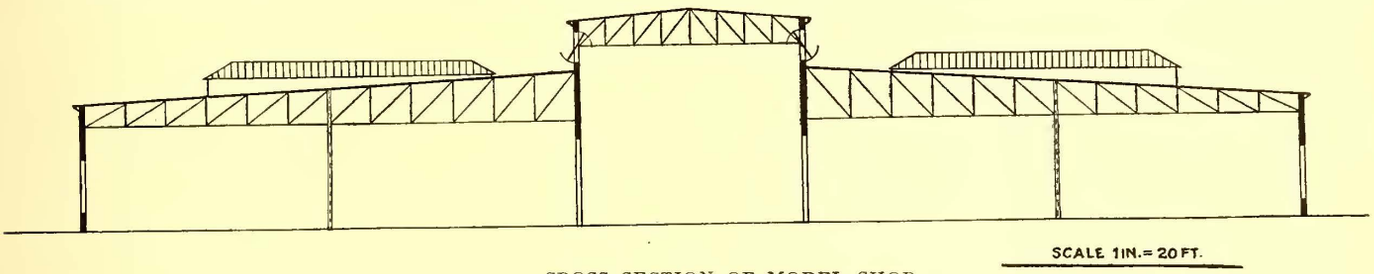
To this end, I think all will agree, that the ideal shop should consist of a building or buildings one story high.

As shown in the accompanying general plan and section of an arrangement of buildings which appeals to me as one that would be convenient, light and reasonable in cost, and which I submit for your consideration and criticism, the shop consists of two one-story buildings on either side of a transfer track. This plan is laid out regardless of size or shape of lot, although this condition we will probably never enjoy in actual practice. I should prefer a depth of building sufficient to accommodate two double-truck, or three single-truck cars on a track, which would permit of shifting a car without disturbing more than one or two others.

For the main buildings, I would advise brick construction, with a plank roof, covered with tar and gravel. The roof covering the transfer track can be built entirely of metal, in which case the two main shop buildings would not be connected by any inflammable material.

Granolithic cement makes a good, clean and durable floor. The only objection that I know of is that workmen, when obliged to stand on it all day, complain that it affects their feet and legs. Grooved rails should be used with this floor to prevent chipping by the wheel flanges. Tracks should be well spread, to give plenty of room between cars. I have found 13-ft. centers to be very comfortable.

Partitions separating the different departments can be built of a single layer of four compartment vitrified building tile, which can be taken down easily, as changes and extensions become necessary, and used over again.



CROSS SECTION OF MODEL SHOP

Swing windows, operated from the ground floor by a system of rods and gears, as shown in the plan, will give both light and ventilation to this portion of the building. I find swing doors with two truss rods to be most serviceable and durable. They take up room when open, however, and no doubt for this reason many would prefer the metal shutter.

Heating, I think, can best be accomplished by steam, unless the climate is mild, when a hot-air circulating system might be preferable. A good sprinkler system should be installed in the shop buildings, with a hydrant system for hose in addition.

Of course, our ideal shop would be fitted with the most approved types of cranes, air hoists and general machinery for doing good work expeditiously, and a storage yard adjoining will be found quite necessary for wheels, scrap iron, etc., and should contain a good platform scale.

MAINTENANCE AND INSPECTION OF ELECTRICAL EQUIPMENT

BY JOHN LINDALL
General Foreman of Shops, Elevated Division, Boston Elevated Railway, Boston, Mass.

The difference between success and failure in the "Maintenance and Inspection of Electrical Equipment" very often means dividends or no dividends. Therefore, it behooves the responsible head of this department to give much thought and careful study to this part of the work, ever bearing in mind the old maxim, "A stitch in time," etc., which is never better applied than in the care of electrical equipment.

I realize that the time allowed for the preparation of this paper will not permit me to go into details of inspection and repairs of electrical equipment, even if I were capable of so doing, and it would be presumptuous indeed for me to attempt to tell the members of this association what is the best practice in this line, as climatic and operating conditions vary to such an extent that what is good practice in New England might be very poor policy in New Orleans or San Francisco. Therefore, I will venture to suggest only a few points which I think may be applicable in general and all important to the successful maintenance of electrical equipment, together with a brief description of methods of inspection and repairs of electrical equipment on the Boston Elevated Railway.

The education of the motorman may not be considered as within the scope of this paper. It is, nevertheless, a fact that the manner in which the car is handled has a very material bearing on the maintenance of the electrical equipment; therefore its care should begin at this point. The mechanical department should work hand in hand with the operating department for the proper education and discipline of the motorman, and the running down of ignorant and careless handling of equipment. The advancing of controller too quickly, running on resistance points, unnecessary reversing, failing to cut out defective motor, the substitution of "any old thing" for a fuse, improper closing of switches, running at high speed through water, and running with both power and brakes on, are a few of the things that bring trouble and expense to the electrical equipment. Money expended for the instruction and inspection of motormen is, in the opinion of the writer, well spent.

Defects in the equipment, however slight, should be promptly reported to the proper authority, and in such a manner that they cannot be overlooked. This can best be accomplished by a system of written reports, and instead of the motorman or conductor turning in a car with the verbal report that "This car is on the bum; it was no good when I took it," they should be required to report on a form, provided for that purpose, the nature of the defect, and in case of serious trouble, the location on the line at which it occurred, with a brief statement of the conditions of operation, etc., at that time. This report not only has a morally beneficial effect upon the motorman or the conductor, but when sent to the mechanical department with the defective car, it is of material assistance in locating and determining the cause of the trouble. When evidence of improper handling or carelessness of men is found, the report, with foreman's statement to that effect, should be forwarded to the superintendent, where the question of instruction or discipline is decided.

The proper recording and tabulating of defects is very essential to the successful maintenance of equipment. Simply recording the various failures each day is not sufficient, as the value lies in being able to make quick comparisons, by week, month or year, and to see at a glance whether the various failures are on the increase or decrease, and calling attention to the points which are the most in need of improvement. The history and record of defects of a piece of apparatus should also always be at hand and consulted by the man whose judgment determines the course of treatment. I am very sure that the report prepared by the joint committee of Accountants and Master Mechanics will contain timely and valuable information along this line.

One of the most important factors that we have to deal with in this problem is the education of electrical inspectors and repairmen. The writer is of the opinion that sufficient attention has not been given to obtaining, instructing and retaining in the service competent men, and when we consider that about two-thirds of the cost of maintenance is chargeable to labor account, it certainly seems that too much consideration can not be given to this point. The development of good men to care for the equipment has not kept pace with the development of the equipment itself. Therefore, greater inducements should be held out to attract reliable and capable young men to the service. This is not merely a question of wages—congenial surroundings are necessary. I have recently had occasion to visit certain shops and car houses, the equipment of which was comparatively new, yet the conditions were such that no self-respecting man would stop in them. Shops should be properly laid out for the work, kept clean, well lighted, and heated in cold weather. The work necessarily being dirty, lockers for clothing, as well as ample toilet accommodations, should be provided, which would enable the men to leave the shops appearing clean and respectable. These are not luxu-

ries, but actual necessities, which no well regulated company can afford to be without. They mean a better class of men, better work and more of it. Work should be laid out in such a manner that defective or careless work can be traced back, without any question as to what man is responsible. The men should understand this, also that a record is kept of the cost of work performed by the different men, and that they will be held responsible for results. They should be brought to realize that advancement does not depend merely on length of service, but on their record for obtaining good results at the least cost.

Master mechanics and foremen in figuring to accomplish the greatest amount of work to-day, should also consider the question of making men for the needs of the future, and should make it a point to have men fitted for any vacancy that may occur. They should realize that there is even more credit in turning out good men than there is in turning out good work, and a man who will not impart knowledge to his subordinates, for fear that they will know as much as he himself knows, is not worthy of the position which he holds. Men should be taught why—as well as how—to do work, and to work from cause and effect. They should read the effects to find causes, and not guess at them. A controller which has flashed shows, just as clearly as if photographed, the position of the cylinder at the time of the trouble (if care is taken to note the evidence before it is destroyed) and it is then easy to determine whether it is a case of hot-touch, insulation breakdown, or lack of current-handling capacity.

The practice of some companies of supplying railroad literature to lobbies, for the use of motormen and conductors, can not be too highly commended, but I would suggest that if this privilege were extended to inspectors and repair men, it would be appreciated and bring good returns. Of course the periodicals would not be read during working hours, but should be made to some extent circulating—one man taking a paper to his home for a day or two, then pass it along to another man. In this manner an opportunity would be afforded for men to keep posted on the latest improvements and practices, and it would also stimulate an interest in their work.

The inspection of electrical equipment, whether it be on a time basis or mileage plan, should be systematic, and not considered as something to be done when it is convenient and let go undone when it is not. The question of how often to inspect depends entirely upon the equipment and conditions of operation and can best be determined by experiment. It is possible to do too much inspecting, and a great deal of money can be wasted in this manner, but with careful tests to determine how long the different parts of equipment will run successfully without attention, and a system which insures the necessary attention being given at the required time, the chances of failure in service and cost of inspection are reduced to a minimum. We must, not, however, lose sight of the fact that the primary object of inspection is to prevent failure of equipment in service, and that we should weigh the cost of inspection against the direct loss in revenue, wages of trainmen while handling crippled cars and loss of patronage due to interrupted service. I might also add the loss caused by the line becoming blockaded during snow storms on account of failures in electrical equipment of cars or plows; and we would not have to go farther back than last winter to find a number of cases where the line would not have become tied up if that car or plow had not "laid down" at a critical moment, thereby causing a blockade which might have been prevented by proper inspection.

Under the system of inspection on the Boston Elevated Railway surface lines, trolleys, switches, controllers and motors are inspected after three days' service, with the exception of brushes and armature grease-cups of some W. P. motors, which are in severe service, and are inspected every day. In general, this inspection is as follows:

Trolleys; to see that pole is straight and securely fastened, that the harp is tight in the pole, and that there are at least three days' wear in the wheel; that contact springs, washers, bushings and spindles are not seriously worn and are properly lubricated.

Controllers; to see that they are clean and properly lubricated, that contacts make and break at proper points, that fingers and tips are sufficient for at least three days' wear and that they are not rough and cutting; that cut-out switches work properly, and that wires are firm and show no evidence of heating at terminals.

Main switches, fuse boxes and lightning arresters; to see that contacts are sufficient and in good condition, and that wires are secure in terminals.

Resistance; to see that they are not seriously burned, that they are secure, and connections firm.

Motors; to see that connections and leads are secure and not chafing, also that brushes are not broken and are good for three days' wear, that the brush holder insulation is clean, and that there is sufficient tension in springs, that commutators are clean and smooth, that bearings are properly lubricated, that there is sufficient clearance between armatures and pole-pieces, that pinion and gears are tight, that motor gear case and axle collar bolts are tight, and that the casings are not cracked.

The monthly inspection consists of opening up motors for inspection and cleaning, lubricating and cleaning trolley stands and trolley catchers. Controllers are taken apart yearly, thoroughly cleaned and painted and insulating material shellaced. The wires are also inspected yearly for insulation weakness.

The inspection of the electrical equipment on the elevated trains differs from the surface car inspection but slightly. Contact shoes, switches, controllers and motors are inspected twice a week—no inspection work being done on Sunday. The inspection of controllers with the multiple-unit system includes the inspection of master controllers, pilot motors and relays, and testing them. The motor compressor is inspected weekly.

I have already suggested that the best system of inspection is one that is frequent enough to take care properly of the equipment with the least inconvenience to the service. This requires that when a train is due for inspection it should be complete and all parts requiring inspection should be attended to promptly, so that the train may be returned to service and other trains due for inspection taken off without interference with train schedule. It frequently occurs that an inspector finds a part of the equipment which would require considerable time to repair properly, and in order to avoid the necessity of hurried or make-shift repairs or inspection, the system in vogue on the Boston Elevated does not require the inspector to do anything but inspect and make very light repairs. Equipment requiring extra attention is reported to the foreman, who details repair men to that work, therefore no excuse is accepted from inspectors for allowing equipment to go by which is in need of attention. They are held strictly responsible, and are required to report over their signatures the numbers of the cars inspected each day—which practically amounts to a written guarantee of their work. The inspection is made by two crews, each crew being responsible for an equal number of cars; in this manner accurate comparisons can be made and quite a healthy competition aroused, each man trying to make his record just as good or a little better than the other fellow's.

The manufacturing companies have evidently given the question of inspection considerable thought, particularly in their latest types of multiple-unit control, where necessary inspection has been reduced very materially.

No repairs are made to electrical equipment at the car houses of the Boston Elevated, except the changing of defective parts. Switches, rheostats, control cylinders, armatures and fields are sent to the Albany Street shops for repairs; where also are manufactured for the company's use, field and armature coils, commutators, motor bearings, brush holders, trolley wheels, contact fingers, plates, bases, etc.

It may not be out of place to mention at this time a change which we have made in the usual type of contact fingers and cylinder plates. It is not necessary for me to call your attention to the very small percentage of copper which is actually consumed from plates and fingers of the cylinder type of controllers, as compared with the amount which is scrapped, on account of the necessity of maintaining the points of contact at their proper degree for the successful operation of the controller, or to the serious proportion in which this expense grows with the increase of current to be handled. I will, however, ask you to consider this in connection with a very simple but effective means of reducing this cost, which has been found in the adoption of tips for both contact plates and fingers, making it necessary to renew only that part which is consumed or damaged by the arc in breaking current. The fingers are made of cast bronze of about the usual shape and are recessed on the inside, at the end, to receive the copper tip which is secured by two C. S. machine screws. The tip copper is drawn in bars of the required cross section, and the only work necessary is the cutting in proper lengths and drilling and tapping for the two machine screws. The application of the plate tip is still simpler. New plates are not required, as the old plates with the ends worn to the limit are put in a milling machine and the ends cut off and a groove cut for interlocking with the tip, which is drawn of proper shape and cross section, so the only work necessary on it is the cutting off in the required lengths, the same kind of tip being used on all controller plates. This device has been in successful operation for nearly a year and has been patented.

To the men responsible for the maintenance of motors, there is probably nothing which has given more worry, or been so thoroughly non-responsive to local treatment, as motor flash-overs. In the writer's experience, this trouble developed with multipolar motors and the higher speed and voltages, and has been present more or less in all motors of this type under the above mentioned conditions. Elevated service with multiple-unit system and third-

rail feeders, etc., is particularly favorable for producing conditions which contribute generously to the combination effecting flash-overs, and it frequently occurs that motors on all the cars in a train flash-over at the same time. Engineers are at present giving this matter thorough study. The principal remedy appears to lie in increasing the size of the motor so as to render it less sensitive, and we trust that in the near future motors will be manufactured which will not flash-over. This will surely effect a considerable saving in their maintenance, as burnt brush holders, springs, armature and field coils, resulting from flash-overs, is not a small item.

STEAM TURBINES

BY RICHARD H. RICE

The field of usefuless for the steam turbine as a prime mover is not confined to large units. The first turbines of Parsons and of Curtis were small, but on account of the improvement in economies to be effected by the mere increase in capacity, development rapidly proceeded in this direction. The small units have not been neglected, however, and various sizes of small units directly connected to generators have been produced and placed in commercial operation. The problems of design which have to be solved in the small units are of a somewhat different character from those inherent in the large sizes. In order to keep the dimensions and cost of apparatus at a proportionate figure the diameters of bucket wheels must be kept small, and this leads to a comparatively high speed. These speeds must be chosen with reference to the possibilities of generator design in order that the units may be direct-connected. Therefore, a proper balance must be struck between the requirements of the turbine and those of the generator. The speed necessary in the small units (from 1800 to 5000 r. p. m.) give rise to a set of conditions not met with in large units and certain differences in design have arisen from this fact.

The Curtis principle is useful in keeping speeds of rotation down, and all the Curtis turbines are made without gearing for connection to generators. The accompanying table gives the sizes developed below 500 kw rated capacity with the principal particulars of the design. A number of these small units are in commercial operation and giving good satisfaction and a still greater number are in course of manufacture.

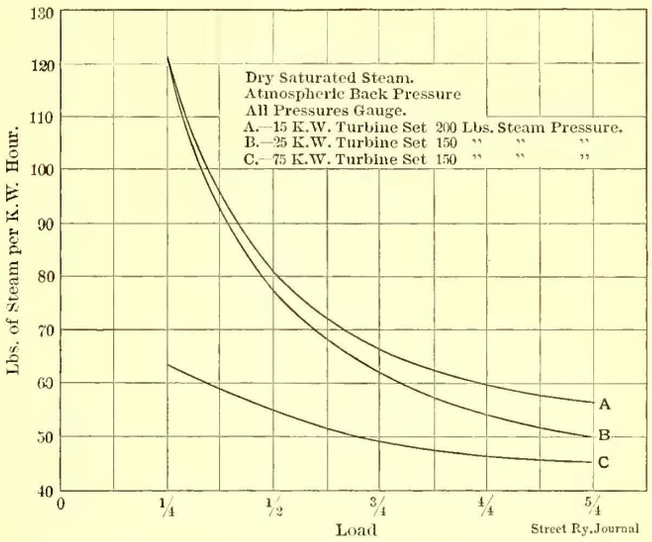
TABLE

Rated Capacity, Kw	Speed of Shaft, R. P. M.	Condensing or Non-condensing	No. of Stages	Current	Poles	Voltage
1½	5,000	Non-cond.	1	Dir. Cur.	2	60
15	4,000-4,500	" "	1	" "	2	80–125
25	3,600	" "	1	" "	2	125–250
75	2,400	N-c. & Cond.	2	" "	4	125–250
100	3,600	Cond.	3	Alt. Cur.	2	2,300
150	2,000	N-c. & Cond.	3 & 4	Dir. Cur.	4	125–250
300	1,800	N-c. & Cond.	3 & 4	D. C. & A. C.	4	250,500 & 2,300

It will be noted that attention has been devoted to the development of both non-condensing and condensing types, the three smaller sizes being for non-condensing service solely.

Some of the special problems which require solution on these sizes are balance, construction and lubrication of bearings, flexible couplings between turbine and generator for sizes of 75 kw and above, and the commutator construction on direct-current apparatus. It is possible to balance the turbine parts statically with success, to operate at the speeds given, since the wheels may be balanced individually and collectively, and the metal of each wheel is disposed in the form of a flat plate. With the generator, however, this condition is not present, and, furthermore, we have the liability of the generator or winding undergoing some change after being put into service, due to heating and other causes. For this reason it is necessary to balance the generator parts by rotating them in a vertical position and suspended by a flexible shaft. The rotating parts in this system of balancing take up rotation about the center of gyration of the system and by the addition of balancing weights at various points this center is made coincident with the center of rotation of the shaft. Two balancings of generator parts are usually necessary; one before, the other after the generator has been subjected to a heat-run and a high speed run, the latter being made at speed which is somewhat higher than the normal running speed of the unit. Due to the symmetrical shape of the Curtis buckets a very small amount of end thrust has to be taken care of; whatever thrust exists being due to accidental variations in bucket or nozzle shapes, and this is easily taken up by hardened steel thrust washers placed on each end of one of the bearings. No balancing pistons are necessary.

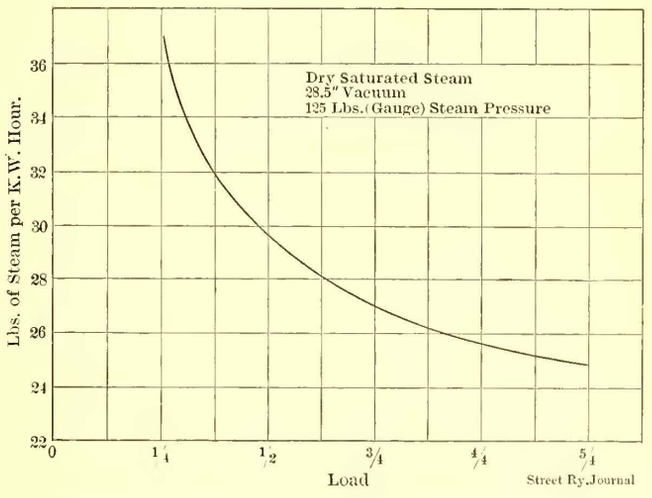
The question of bearings is, of course, a very important one and has been made the subject of a great deal of investigation. The bearings now in use are supported on spheres, so that the bearings are self-aligning. The linings are made in two parts and lubrication is effected by forced feed from a pump which is geared to the main shaft of the turbine and supplies oil at a pressure of from 3 lbs. to 6 lbs. per sq. in. The circulation of the oil is constant, passing from the pump to the bearing, thence to a reservoir in the pump chamber, from which it again goes to the



ECONOMY CURVES OF NON-CONDENSING TURBINES

pump. It has not been found necessary to provide any cooling arrangement for the oil, and a very small amount of make-up oil is necessary.

The 15 kw set was first used for train lighting service and a number are now in use for this purpose. Some are placed on the buffer beam of the locomotive, and others are installed in the baggage car. The latest forms are also so equipped as to be capable of being but on top of the boiler just in front of the steam dome when desired. The conditions of service are widely different on the locomotive and in the baggage car. In the former case the turbine is supplied with steam at 175 lbs. to 200 lbs pressure and exposed to great variations of temperature. Some trouble was experienced last winter with the sets mounted on the buffer beams, due to congealing of the oil circulation, but this was overcome by the use of a special oil. It is not expected that this trouble will be met with in the sets which are mounted on top of



ECONOMY CURVE OF 100-KW CONDENSING TURBINE

the boiler. Dust and cinders are very troublesome on the locomotive, and the machine is enclosed as much as possible to prevent their access to the vital parts. It is, however, necessary to take in a large quantity of air for the purpose of cooling the generator, and this air necessarily carries with it a certain proportion of fine dust, which, however, does not prevent satisfactory operation.

In the baggage car the turbine is normally supplied with steam at 80 lbs. pressure, but for various reasons the pressure actually realized varies from this figure down to 40 lbs. While the turbine can be kept cleaner and is less exposed to temperature changes it

must be cared for by entirely unskilled attendants. The most of the train lighting sets now installed are placed in this manner, and the fact that their operation is satisfactory is good evidence of the small amount of care needed.

Some of the 25-kw sets are also used for train lighting in the baggage car, and both these sets are well adapted for the excitation of the fields of large generators, as well as for general purposes. The floor space required is small, the regulation is equal to that of reciprocating engines, and the sets are automatically lubricated and require little attention.

The 1½, 15 and 25 kw turbines are governed by throttle valves, these being of the piston type, moved directly by a very sensitive and powerful centrifugal governor with spring. The nozzles are therefore supplied with steam at pressures varying with the load. The governor joints are supplied with knife edges and do not require lubrication. All of these machines are of the single-stage type, having a single group of nozzles with single sets of buckets, consisting of three rows of moving buckets with corresponding rows of stationary buckets.

The larger sizes are multi-stage and have only two rows of moving buckets per stage. The method of governor control on these larger sizes is somewhat different from that just described. One or more nozzle groups are supplied with steam from a single poppet valve and a sufficient number of poppet valves is supplied to furnish the total number of nozzles necessary for developing the capacity of the turbine. Each poppet valve is therefore the means of controlling the admission of steam to one or more nozzles and the governor, by means of an intermediate mechanism, opens or closes a succession of poppet valves as the demands of the load require.

Two types of intermediate mechanism for operating these poppet valves have been developed and constructed. The 75-kw turbine is supplied with one of these types, consisting of a hydraulic cylinder the controlling valve of which is directly actuated by the governor. A movement of the controlling valve caused by a change in the speed admits oil to one side or the other of the piston of this cylinder and a movement of the cylinder results, through the intermediate mechanism, in the opening or closing of corresponding poppet valves. While the governor remains in any given position the hydraulic cylinder is also stationary and is locked in its position by confining the oil in both ends of the cylinder. A movement of the governor produces a corresponding movement of the hydraulic piston, and when this movement has taken place the parts come to rest. There is sufficient lost motion and spring in the parts to ensure that the valve, when opening or closing, will be moved suddenly a sufficient amount to prevent too much throttling at the valve, and the nozzle works therefore at high efficiency at all times.

The 150 kw turbine is supplied with a mechanical valve gear, the valves being actuated by gearing which derives its motion from the main shaft. The governor control operates a mechanical device which produces the same effect on the poppet valves as that above described.

It will be noted from the table that nearly all these machines are constructed with direct-current generators with a comparatively small number of alternating-current sizes. Other sizes of alternating-current sets will be constructed in due course. The operation of direct current commutators at the speeds in question has necessitated the development of various special features in the commutator. Carbon brushes are used throughout, the best form of brush being one which has been treated without lubricant, and with this form of brush commutation is very satisfactory. On account of the high speed and great length of the commutator bars they are provided with nickel steel shrink rings at the ends and middle of their lengths to prevent deflection. These rings are shrunk on over insulation and provide a very effective means of supporting the commutator bars and also have the advantage of giving a greater wearing depth of copper than the usual construction. The steam consumption curves of these small turbines differ somewhat in characteristics from those of large turbines of the same type, in having a comparatively high steam consumption at light loads. This is because the fixed losses, such as bearing friction and windage of the wheels are a greater proportion of the total output.

All of these turbines are of the horizontal type, the vertical type commencing with the 500 kw and proceeding upward. The three smaller sizes given in the table have two bearings. The turbine wheels are overhung on the end of the shaft and the shaft is in one piece, with the turbine and armature both mounted on it. Beginning with the 75-kw size and upward the shafts are in two pieces and the sets have four bearings.

In the small sizes, where the wheels are overhung the front end of the case may be taken off to obtain access to the wheels and intermediates, and in the larger sizes where four bearings are provided the upper half of the casing is removable for the same purpose.

In the four-bearing sets the generator and turbine shafts are united by a flexible coupling which permits some little inaccuracy in the alignment of the two shafts without affecting the operation of the set. After extended experience with various forms of these couplings a construction involving the use of metal parts only has been found to be the most satisfactory. This coupling is a modification of the Oldham coupling, the necessary flexibility being secured by the use of links turning on pins.

Some progress has been made in the application of turbines to driving other forms of apparatus than electric generators. This problem involves the finding of satisfactory methods of speed reduction to fit the turbine for coupling to slow-moving apparatus. Some of our small turbines are in operation with a belt drive with a fair amount of satisfaction. Other forms of gearing are under construction and experiment, and it is safe to predict that we shall soon be able to couple the smaller sizes at least of our turbines to slow-moving apparatus with satisfaction.

The demand for small units is large and in cases where electricity is to be generated the steam turbine, judging from experience with the turbines described, seems to fill the requirement better than any form of reciprocating engine in general use. While these machines are by no means perfected, they are practical and satisfactory machines and will carry any character of load, variable or steady, with good regulation and economy.

Under variable loads these turbines undergo no deterioration in economy. The steam consumption for average load falls upon the curve obtained by testing with steady loads, while it is well known that reciprocating engines fall off in economy under these conditions. The steam consumption of reciprocating engines has reached about its lowest point, while that of the turbines is constantly being improved. The performances given in this paper must be regarded simply as starting points from which improvements already in sight will proceed in the direction of better efficiency.

STEAM TURBINE POWER PLANTS—NOTES ON THEIR EQUIPMENT AND OPERATION.

BY J. R. BIBBINS

The steam turbine has long ceased to be a novelty—it is an established factor in modern power undertakings, particularly those of great magnitude. Since its introduction to this association in 1902, several forms varying more or less from the Parsons have been announced—the Curtis, Rateau, Riedler-Stumpf, Zoelly and others. The construction of these several forms has recently been presented in more or less detail before the several engineering bodies, so that this phase of the subject may be passed over in favor of the more practical questions arising in power plant work. Owing to the limitations of space and time available for preparation, it has been possible to consider only a few of the more important subjects, and to this may be attributed the topical nature of this paper.

TURBINE CHARACTERISTICS

The service requirements of a prime mover in electric railway work are in many respects more severe than any other power service outside of the rolling mill. The fluctuations in load are so sudden and severe that the ability of the prime mover to regulate its speed is tested to the utmost. The simultaneous starting of many cars frequently creates an inordinate demand for power which can only be met by the prime mover possessing a large overload capacity. Furthermore, a high average or "all-day" plant economy must be maintained under these disadvantageous conditions.

The steam turbine seems to be almost ideal for fulfilling these conditions:

Its high speed constitutes an important regulating force.

Its overload capacity is large.

Its economy under fluctuating loads is exceptional.

First—As it employs simple rotary motion, the rotative inertia of the moving element becomes enormous at the usual operative speeds and automatically assists in the maintenance of uniform speed of rotation under wide variations in torque. Thus, the heavy fly-wheels necessary for reciprocating engines to obtain the identical results are avoided. Independent of the inertia effect, the turbine governor has been brought to such a state of perfection that a normal speed variation can be obtained close enough to meet any commercial requirements, although a comparatively wide range is usually employed in alternating current work to facilitate parallel operation. In a recent test upon a 750-kw turbine at East Pittsburg, a load of 2014 hp was abruptly removed and it was found that the speed variation was but 3.07 per cent with this severe overload. Turbine No. 41, 1250 kw, was tested under similar conditions by instantly throwing on and off 1300 kw

to 1340 kw by means of an oil switch. The speed variation was found to be 2.09 average for three tests.

Second—High overload capacity may be secured by two methods. A turbine may be built with a maximum governing capacity of 1500 kw. It may then be rated at 1000 kw, with 50 per cent overload capacity. But for normal loads it is evident that it will be largely underrated, and, furthermore, its economy will be less at normal loads than at overloads, as the economy of the turbine increases progressively with the load. A more efficient method—and that employed in the Westinghouse-Parsons turbine—involves the use of a secondary admission valve identical in every respect with the primary admission valve, but which operates only when a predetermined degree of overload has been placed on the turbine. The secondary valve admits high pressure steam to a later point in the expansion range of the turbine, thus for the time being increasing its capacity, with, however, a slight loss in economy. But its most important feature is that while enabling large overloads to be carried at a lower though still excellent economy, the best economy of the turbine is secured under normal loading, which condition prevails a large percentage of the time the machine is in operation. Thus the turbine formerly rated at 1000 kw may now be rated at 1500 kw or more, depending upon the overload capacity desired.

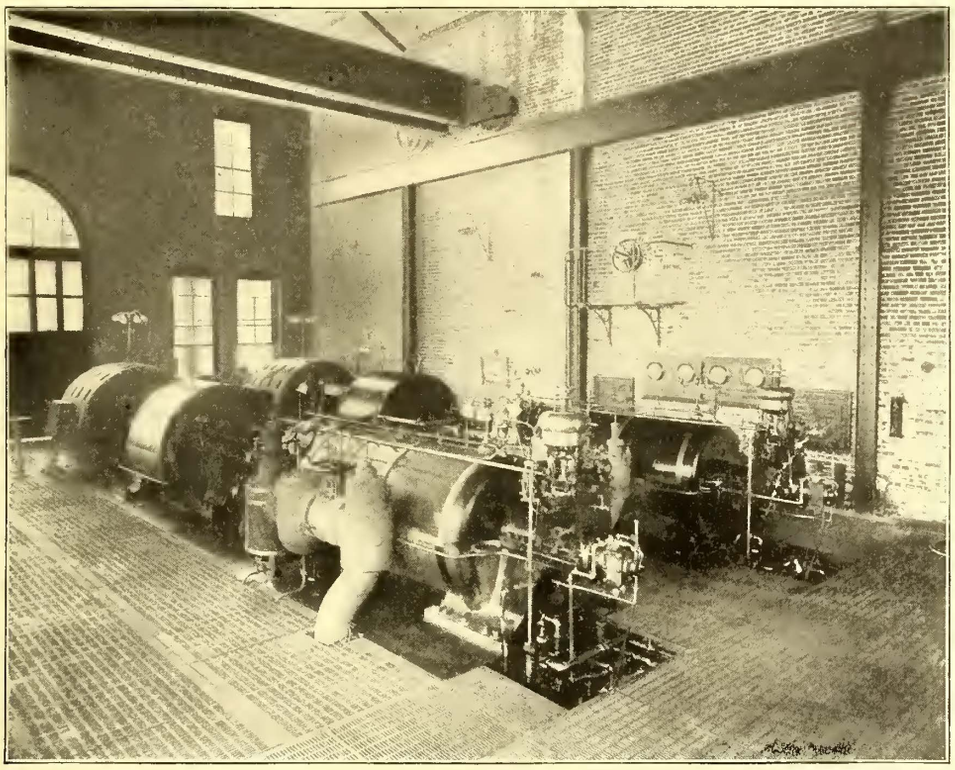


FIG. 1.—5500-KW WESTINGHOUSE-PARSONS STEAM TURBINE, BUILT FOR PENNSYLVANIA, NEW YORK & LONG ISLAND RAILROAD

The curves, Figs. 3 and 4, indicate the practical range of overload capacity. In the case of the 400-kw machine the speed curve shows clearly the point at which the secondary valve "took hold" and prevented further drop in speed. In this test the overload was only carried to 75 per cent, while in the test of the 750-kw turbine it was carried to 2147 hp, or over 100 per cent.

An important difference is apparent between the character of the water-rate curve for the turbine and for a reciprocating engine with cut-off valve gear. In the engine the point of maximum economy usually occurs at about ¾ or .8 full rated load. The turbine, however, reaches its maximum efficiency at about full load. As the rating of turbine and generator are identical, both may be operated at their respective efficiencies at or near full load. The entire capacity of the turbine is thus made available for most efficient working. On the other hand, if the engine is running most efficiently, the generator is 25 per cent below rating, and vice versa. Expressed in practical terms, this means that with turbines less power machinery is required for a given plant load, i. e., the effective capacity is greater.

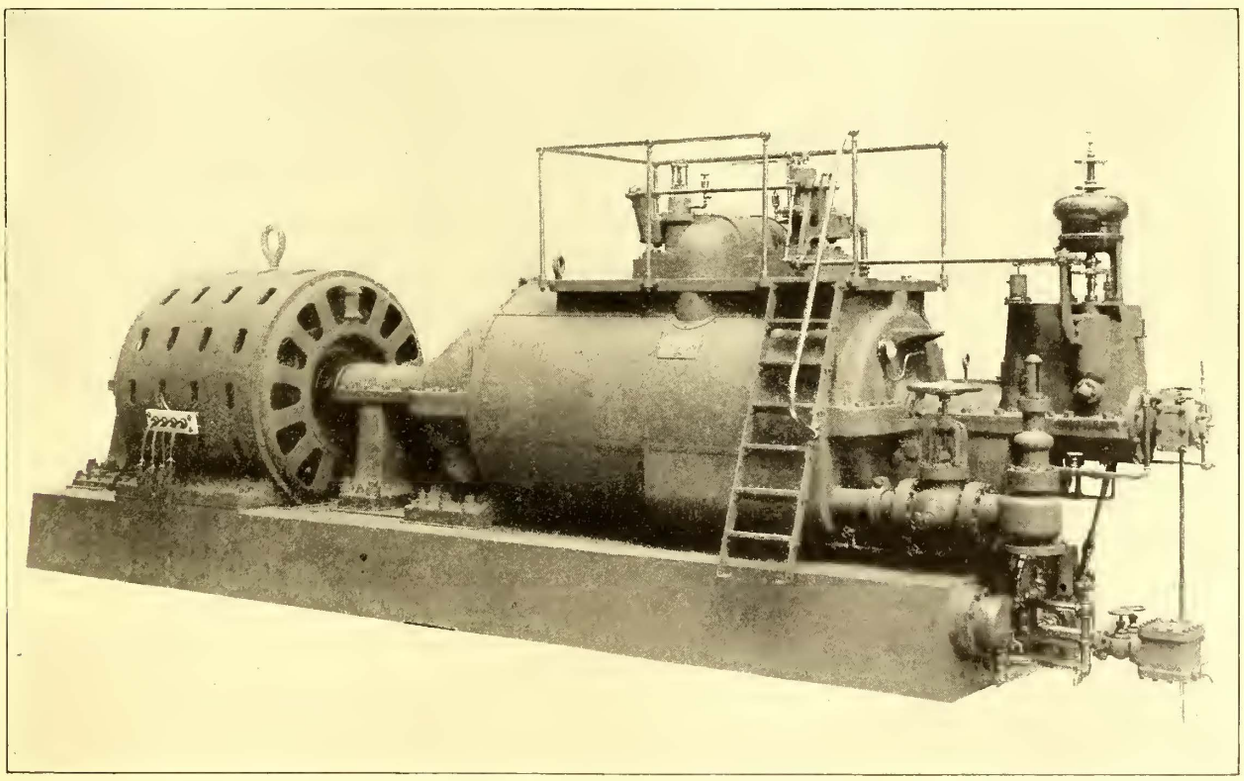


FIG. 2.—750-KW WESTINGHOUSE-PARSONS TURBINE AND GENERATOR ERECTED COMPLETE. RESULTS OF TESTS UPON THIS UNIT ARE REFERRED TO IN TABLE I.

Third—Economy: Many interesting discussions have lately appeared in the technical press relating to the comparative efficien-

cies of steam turbines and reciprocating engines, and in the end the general opinion seemed to be that each type of prime mover for some time to come will have a wide sphere of usefulness. There is no doubt that up to the present time no steam turbine has shown economies quite equal to those reported to be obtained with a European multiple-expansion reciprocating engine tested under high vacuum and extremely high superheat. This fact is continually brought to our attention as a proof that the steam turbine is entirely without the pale of competition with the steam engine; but this is, indeed, a secondary consideration. Laboratory economies are interesting from a speculative point of view, but the prime consideration is the comparative economy of the steam turbine operated under its normal conditions with the average steam engine equipment now employed in power work and under the average conditions obtaining therein. A point to be borne in mind is that it is perfectly legitimate for comparisons of economy to be made between two prime movers under conditions which may be considered the most suitable and generally applicable. It is, therefore, held to be distinctly unfair to confine the turbine to a vacuum of 25 ins. simply on account of the inability of the reciprocating engine to take advantage of higher vacuum; similarly with superheat. It is later shown that higher vacuum can be obtained in the case of the turbine at such small cost as to insure a handsome return under most conditions. The turbine is so constituted as to utilize the utmost benefits from this condition, and it should obviously be associated therewith.

As to actual economies obtained, results speak for themselves, and it is unnecessary to institute comparisons for the sake of proving the superiority of any particular type of prime mover. The engineer and power plant manager are thoroughly acquainted with modern engine performance and they have been quick to appreciate and to adopt every commercially practicable means for further decreasing the cost of power at their station switchboard.

The range of economies obtained under definite conditions is well indicated by the following tests:*

The data from Test A in Table I. represent the results upon a 750-kw Westinghouse-Parsons turbine** tested under both excellent and poor conditions of service. With 28-in. vacuum and 100 degs. superheat, a steam consumption of 12.99 lbs. per bhp was observed at slight overload. A series of tests were run with superheat and without vacuum, and vice versa. It is interesting to observe that an economy of 13.77 lbs. was obtained with 28-in. vacuum and no superheat, 23.46 lbs. with no vacuum and 100 degs. superheat, and 28.26 lbs. without either vacuum or superheat. The non-condensing results are excellent in view of the fact that the turbine was designed entirely for condensing service, and indicate what may be accomplished under conditions which are liable to obtain at any time in any power plant owing to loss of vacuum from accidents to the condenser or other causes. With the help of the secondary valve, an overload of 44 per cent was carried during non-condensing runs, and over 100 per cent condensing.

These results are in relatively close agreement with those obtained from the high-pressure cylinder of a 1250-kw two-cylinder turbine running non-condensing and tested independently of the low-pressure cylinder. During normal operation of the complete machine, the receiver pressure approximates atmospheric at full

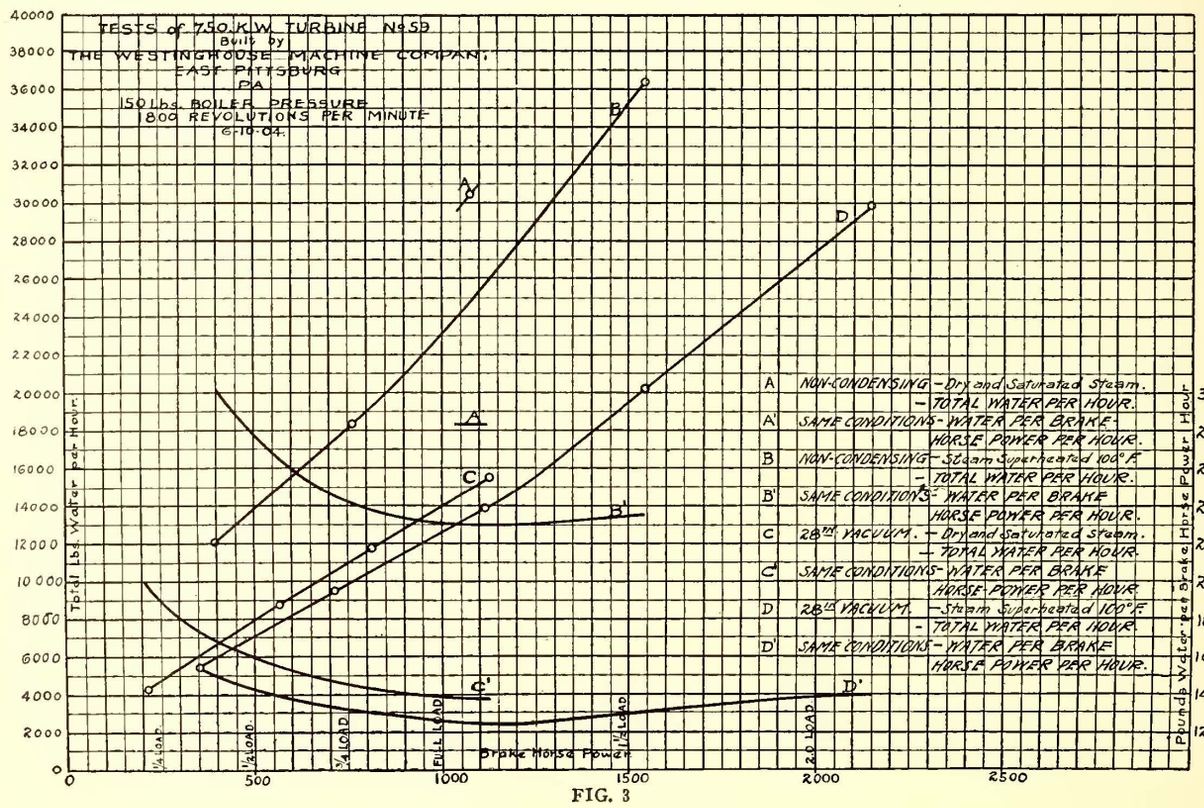


FIG. 3

TABLE I.—TEST OF 750-KW. TURBINES, BUILT FOR BOSTON NAVY YARD AND MANILA TRAMWAYS

	Load B. H. P.	Steam Pressure Lbs.	Vacuum Inches*	Superheat deg. Fahr.	Speed, R. P. M.	Water per Hour, Lbs.	Steam Consumption per B. H. P. Hour
			28 inches	100°			
	354.96	154.7	28	100.11	1,791.7	5,439	15.32
	712	150.8	28.07	102 62	1,797.5	9,450	13.27
Test A	1,151.1	151.4	28.01	99.07	1,804.35	13,808.4	12.38
	1,554.3	150.9	27.85	99.72	1,787.8	20,202.4	12.99
	2,146.78	150.7	26.42	92.9	1,769.8	29,874	†13.91
			28 inches	150°			
	520.1	151.4	27.89	153.7	1,829.4	7,194	13.85
	1,066.5	148.6	27.99	153.9	?1,827.4	12,580	11.79
Test B	1,345.8	149.9	27 99	152.2	1,807.8	15,370	11.42
	1,529.3	149.2	27.76	153.5	1,792.9	17,592	11.50
			0 inches	100°			
	761.06	153.5	----	98.94	------	18,303	24.06
Test C	1,544.56	149.2	----	85.33	------	36,248	‡23.46
			28 inches	0°			
	811 04	149.8	28.01	2.34	------	11,779	14.49
Test D	1,126.1	149.5	27.97	2.54	------	15,506.8	13.77
			0 inches	0°			
Test E	1,074.7	190.1	----	7.18	------	3,037.1	28.26

* Vacuum referred to 30-inch barometer = sea level. † Vacuum 1½ inches lower in this test. ‡ Superheat 15° lower in this test.

* It may be well to state for the benefit of those unacquainted with the methods of testing Westinghouse turbines, that every turbine before leaving the shop is subjected to rigid tests for workmanship, adjustment, endurance, efficiency and speed regulation under contract conditions. Three testing floors are in use, accommodating respectively, four 500-kw, four 2000-kw and two 5500-kw turbines. Steam consumption is determined by weight after condensing in a surface condenser; vacuum by mercury column reduced to the standard sea level condition of 30 degs. mercury; steam pressure and superheat by calibrated gages and thermometers; and horse-power output by special water friction brake or by measuring electrical power absorbed in a water rheostat. The equipment comprises a boiler plant, a gas-fired independent superheater, and four surface condensers, ranging from 1600 sq. ft. to 10,000 sq. ft. in surface. It should be borne in mind that all power measurements are based upon useful horse-power, either brake or electrical, and not indicated horse-power.

** Built for the Boston Navy Yard.

load, and the high-pressure cylinder may therefore be considered a non-condensing turbine.

TABLE II.—TEST OF 1,250 KW STEAM TURBINE, BUILT FOR INTER-BOROUGH COMPANY, NEW YORK

NON-CONDENSING—HIGH PRESSURE CYLINDER ONLY

Load, B. H. P.	Steam Pressure, lbs.	Vacuum in Referred 30-inch Barometor	Superheat, ° Fahr.	Water per hour, lbs.	Steam Consumption per B. H. P. Hour, lbs.
660	146 2	None.	None.	18,672	28.3
889.9	145.5	"	"	23,261	26.15
1,261	150.7	"	"	30,338	24.05

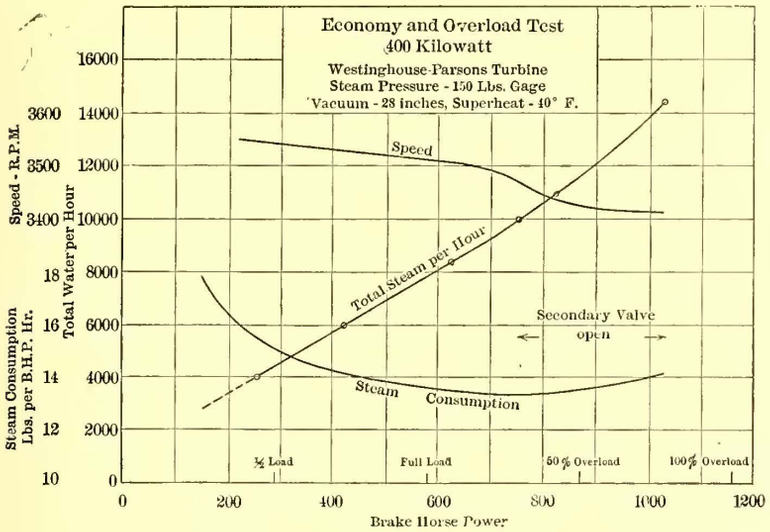


FIG. 4

Subsequent tests (B, Table I.) upon a 750-kw turbine* of identical design with that above mentioned, showed a steam consumption of 13.05 lbs. per bhp-hour with 26-in. vacuum and 140 degs. superheat at full load. At approximately full load, 28-in. vacuum and 150 degs. superheat, the steam consumption was reduced to 11.5 lbs. These two machines are of the single-cylinder type and identical in general design with the 5500-kw machines now nearing completion for large New York and Philadelphia power plants. They are illustrated in Figs. 1 and 2.

That these excellent economies are not alone obtainable in machines of considerable size is shown by tests conducted by Dean & Main upon a 400-kw turbine.** With 28-in. vacuum, a steam consumption of 12.06 lbs. per bhp-hour was obtained with 104 degs. superheat, and with 182 degs. superheat, 11.17 lbs. These results are shown graphically in Fig. 5. Reduced to a basis of engine indicated horse-power by the method indicated, this is equivalent to 10¾ lbs. per ihp-hour, and is approximately constant throughout a wide range of load. Another turbine of the same size (x) was purposely tested under extremely unsuitable conditions: with 125-lb. pressure, 26-in. vacuum and no superheat, a steam consumption of 15.41 lbs. per bhp-hour was observed at full load.

Considered impartially, these performances are excellent and indicate the ability of the turbine to operate under almost any condition arising in power plant work. To the practice of thorough testing—practically inaugurated in America by the Westinghouse Company—may be attributed its success in eliminating the difficulties which have from time to time arisen, and the confidence which has been placed in its perfected produce.

MODERN PRACTICE

A good index of merit or demerit is found in the general trend of engineering practice. It is, therefore, of interest to observe present practice in regard to three important points in turbine work—steam pressure, superheat and vacuum. Data obtained from forty-six turbine plants, varying from 400-kw to 40,000-kw capacity, have been conveniently tabulated in Table A. These data in Table B are further arranged under three broad groupings, comprising electric lighting, power and electric railway plants, in order to observe whether practice differs in different fields. All of the plants are equipped with Westinghouse-Parsons turbines and are either in operation or building, and the list comprises almost every form of power application:

Heavy railroad traction.
Elevated and subway traction.
City and suburban traction.
High-tension transmission traction.
High-tension transmission lighting.
Combined railway and lighting.
Municipal lighting.
Private lighting.
Mine haulage, light and power.
Industrial works and mills.
Copper rolling mills.
Railroad shops.

TABLE A.—DATA ON TURBINE PLANT EQUIPMENT

WESTINGHOUSE-PARSONS TURBINES

A — B = inc. A, exc. B

PRESSURE				SUPERHEAT				VACUUM			
No. Plts	Per Cent. Plants	Per Cent. Capc'y	Pressure Lbs. per Sq. In.	No. Plts	Per Cent. Plts	Per Ct. Capacity	Sup'heat Degree Fahr.	No. Plts	Per Cent. Plants	Per Ct. Capacity	Vacuum Inches
6	13.	36.3	165	14	30.4	38.4	100	2	4.3	35.1	26.5
5	10.9	32.3	175	3	6.5	26 1	150	4	8.7	26.7	27.5
23	50.	19.8	150	21	45.6	20.2	0	17	37.	18.2	27.
3	6.5	3.5	160	1	2.2	7.3	180	16	34 8	14.1	28
1	2.2	3.1	140	2	4.3	5.7	75	5	10.9	2.2	26.
3	6.5	1.7	125	3	6.5	1.4	125	1	2.2	3.1	24.
2	4.3	1.39	155	1	2.2	.6	10-20	1	2.2	0.56	25.
1	2.2	1.1	130	1	2.2	.3	50	1	2.2	0.56	0*
1	2.2	0.56	135	--	--	--	--	--	--	---	--
1	2.2	0.28	200	--	--	--	--	--	--	---	--
SUMMARY											
34	79.	61.	150-175	17	37.	39.8	100-150	21	45.6	44.9	27-28
5	10.9	32.3	175-200	4	8.7	33.4	150-200	7	15.2	37.3	26-27
6	13.	6.5	125-150	21	45.6	20.2	0	16	34.8	14.1	28+
1	2.2	0.3	200+	4	8.7	6.6	0-100	2	4.3	3.7	26—
--	--	--	125—	--	--	--	------	--	--	--	----

* Part of time

TABLE B.—TURBINE PLANT EQUIPMENT

A — B = inc. A, exc. B

LIGHT AND POWER PLANTS

General Summary				Pressure		Superheat		Vacuum	
Limits of Capacity	No. Plts.	Kw Capacity	Per Ct. of Tot'l Capcy.	Per Ct of Capacity	Limits of Pressure.	Per Ct. of Capacity	Limits of Superheat	Per Ct. of Capacity	Limits of Vacuum
0 to 1,000	4	2,100	12.5	72.1	150-175	40.1	100-150	87.5	27 to 28
1,000-2,000	4	4,900	29.3	22.4	175-200	37.	0	7.1	28+
2,000-4,000	3	9,750	58 2	5.4	125-150	22.4	0 to 100	5.4	26 to 27
	--	------	----	----	200+	----	150+	----	26—
Total....	11	16,750	----	----	------	----	------	----	------
Average..	1	1,523	----	----	------	----	------	----	------
POWER PLANTS									
0 to 1,000	14	7,550	38.2	59.6	150-175	47.8	0	37.6	27 to 28
1,000-2,000	4	5,750	29.0	38.4	125-150	28.7	0 to 100	35.6	28+
2,000-3,000	1	2,000	10.1	2.	200+	23.5	100-150	22.7	26—
3,000-5,000	1	4,500	22.7	----	175-200	----	150-200	4.	26 to 27
Total	20	19,800	----	----	------	----	------	----	------
Average..	1	990.0	----	----	------	----	------	----	------
ELECTRIC RAILWAY PLANTS									
0 to 1,000	5	3,000	2.8	59.4	150-175	41 8	150-200	48.6	26 to 27
1,000- 2,000	2	2.700	2.5	39.8	175-200	42.8	100-150	39.6	27 to 28
2,000- 5,000	2	4,000	3.7	0.75	125-150	12.5	0	11.2	28+
5,000-10,000	2	11,000	10.3	----	200+	----	0 to 100	0.75	26—
10,000-25,000	3	46,500	43 4	----	------	----	------	----	------
25,000-50,000	1	40,000	37.3	----	------	----	------	----	------
Total.....	15	107,200	----	----	------	----	------	----	------
Average..	1	7,150	----	----	------	----	------	----	------

Total number of plants 46
Total capacity ..... 143,750 kw
Average capacity ..... 3,125 kw

TABLE III.—TEST OF 400-KW STEAM TURBINE, BUILT FOR ROCKLAND LIGHT AND POWER COMPANY, NYACK, N. Y.

LOW VACUUM, PRESSURE AND NO SUPERHEAT

Load B. H. P.	Steam Pressure, Lbs.	Vacuum in Referred 30 Inches	Superheat, Deg. Fahr.	Water per Hour, Lbs.	Steam Consumption per B. H. P. Hour
326	130.6	26.03	None	5,834	17.89
457	124.9	26.02	"	7,481	16.36
580	125.6	26.00	2.54	8,939.5	15.41

* Built for Manila tramways.

** Now operating at the S. D. Warren plant, Cumberland Mills, Maine.

(x) Now operating in the plant of the Rockland Light & Power Company, Nyack, N. Y.

The total capacity of the forty-six plants is 143,750 kw, or an average of 3125 kw. Comparative results are expressed in the tables below, both in per cent of total plants and in per cent of total capacity under consideration. The latter evidently is of greatest importance.

In all plants the limits are found to be:

Pressure	125 to 200 lbs.
Superheat	0 to 180 degs.
Vacuum	24 to 28 ins.

It is evident from the table of general average that practice in the average plant is far different from that upon a basis of total capacity—thus the former indicates no superheat; the latter, 100 degs.

In the special fields, practice differs somewhat from that given in the table of general averages.

Comparing with the general average, it is evident from agreement with the latter that electric railway practice has greatly influenced the general practice, and averages the highest in all particulars, excepting, perhaps, vacuum. The values representing "second majority" show the general tendency toward higher operating conditions.

Electric lighting plants, although beneath the average on pressure and superheat, excel in the matter of vacuum.

Power plants also exceed the average in the matter of vacuum. The second majority pressure is lower than the first, which is presumably due to the fact that steam turbines have been largely applied to factory driving in the form of extensions to power systems already in use, while the majority of lighting and railway plants have been designed with the use of turbines in view. The comparatively low average vacuum in railway plants (26.5 ins.) is due to two important stations now building for heavy traction. Outside of these a higher vacuum is generally used.

THE ECONOMICS OF HIGH VACUA AND SUPERHEAT

Much uncertainty seems to exist at the present time concerning the relative value of high vacua and superheat. By the term relative is here meant—not a specific gain in steam consumption per se, but the net saving to the power station at the coal pile. Is high vacuum or superheat essential to economical performance, and if not, why employ them? The reason is not far to seek: In steam turbine work a distinctly new problem has arisen in the shape of enormous steam velocities and correspondingly high surface and peripheral speeds. If left unchecked, the fluid friction results in much lost power and more or less rapid depreciation. In some forms of turbines, more particularly the Parsons, these speeds have been reduced through compounding to such a point as to largely reduce the effects of steam friction. In all forms the loss from this and other sources may be greatly reduced by employing high vacuum and superheat. The former permits the low pressure section of the turbine rotor to move in a more rarified atmosphere, and the latter serves to defer the "dew point" or beginning of condensation of steam during its expansion, thus eliminating to a large degree the detrimental effects of friction due to entrained moisture at high surface speeds.

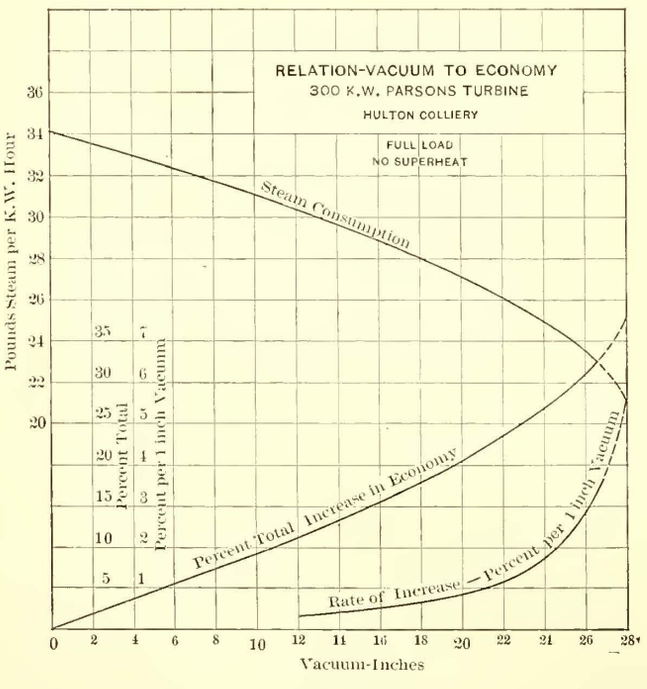


FIG. 6

But, although essential in some types, it is by no means so in the Parsons turbine, as is evidenced by the several installations working under 25-in. and 26-in. vacuum and no superheat, and with excellent economy. The principal reason for the almost universal adoption of these economic expedients is the ease with which the turbine avails itself of these advantages. In a reciprocating engine, an attempt to expand below 5 lbs. or 6 lbs. (abs.) back pressure might readily result in negative economy, the increased friction and thermal losses overbalancing the small gain in steam consumption. The turbine, however, expands its working steam to within 1 in. of the barometer with as great facility as to atmosphere, and the increase in bulk is scarcely comparable to that which would be unavoidable in a reciprocating engine. Moreover, the heat losses are infinitesimal and there results a clear gain in economy.

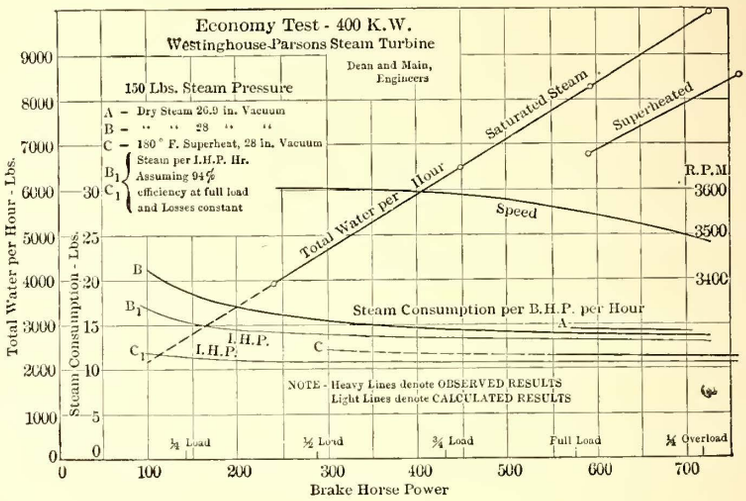


FIG. 5

GENERAL AVERAGE

	1st Majority				2d Majority	
	Basis of Per Cent of Total No. Plants		Basis Per Ct. of Total Plant Capacity		Basis, Per Cent Capacity	
		p. c.		p. c.		p. c.
Pressure most generally used	150 lbs.	50	165 lbs.	36	175 lbs.	32
Superheat most generally used	0°	46	100°	38	150°	20
Vacuum most generally used	27"	37	26.5"	35	27½"	27"
Pressure most generally used (25 lb. range)	150–175	79	150–175	61	175–200	32
Superheat most generally used (50° range)	0–100	54	100–150	40	150–200	33
Vacuum most generally used (1" range)	27– 28	46	27– 28	45	26– 27	37

	1st Majority		2d Majority	
		p. c.		p. c.
ELECTRIC RAILWAY Basis capacity only				
Pressure most widely used	165 lbs.	47	175 lbs.	40
Superheat most widely used	100°	42	150°	35
Vacuum most widely used	26½"	47	27½"	35
Pressure most widely used (25-lb. range)	150–175	59	175–200	40
Superheat most widely used (50° range)	150–200	45	100–150	43
Vacuum most widely used (1" range)	26– 27	49	27– 28	40
LIGHT AND POWER				
Pressure most widely used	150 lbs.	38	160 lbs.	25
Superheat most widely used	0°	37	100°	32
Vacuum most widely used	27"	88	28"	7
Pressure most widely used (25-lb. range)	150–175	72	175–200	22
Superheat most widely used (50° range)	0–100	59	100–150	40
Vacuum most widely used (1" range)	27– 28	88	28+	7
POWER				
Pressure most widely used	150 lbs.	46	140 lbs.	23
Superheat most widely used	0°	48	100°	24
Vacuum most widely used	27"	36	28"	36
Pressure most widely used (25-lb. range)	150–175	60	125–150	38
Superheat most widely used (50° range)	0–100	87	100–150	24
Vacuum most widely used (1" range)	27– 28	38	28+	36

The nature of the saving due to vacuum and superheat has been revealed by tests. Figs. 6 and 7 show the effects of vacuum. In the former the test covers vacua from 0 in. to 26.5 ins.; the latter from 25 ins. to 28 ins. The drooping of the curve of steam consumption at the right, Fig. 6, clearly shows the relative advantages of the last few inches of vacuum. The curve, "rate of increase per 1 in. of vacuum," shows this still more clearly. With 21-in. vacuum the gain is but 1 per cent per inch; at 26½-in. it is

3½ per cent; and at 28-in., 5½ per cent, the last point being, however, estimated.

A test upon a large Westinghouse-Parsons turbine between 25 ins. and 28 ins., shown in Fig. 7, indicates somewhat different characteristics, viz.: a proportional relation. This, however, might have been the case with the above results if plotted to a larger scale and carried up to the same limits. Here the benefit from vacuum at half load is considerably greater than at a slight overload, viz.: 5 per cent per 1 in. in the one case and 3 per cent in the other.

The effect of superheat on economy is as striking as that of vacuum. In Fig. 8 the steam consumption was reduced 23 per cent—from 16.45 lbs. to 12.66 lbs. per ehp at full load by raising the vacuum 3 ins. and superheat 140 degs.

The series of tests upon a 400-kw turbine by Dean & Main give

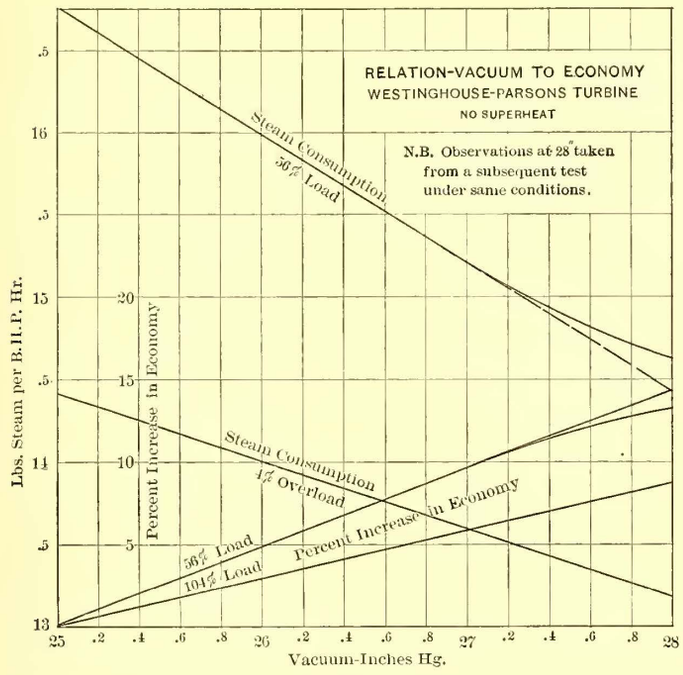


FIG. 7

curves of slightly different character, but of close agreement. The relation is a direct proportion and a uniform gain of 10 per cent to 11 per cent per 100 degs. superheat is observed, this gain being practically the same at all loads, as the steam consumption lines are parallel. (Fig. 9.)

From these curves and other data on Westinghouse-Parsons machines it is apparent that, although wide variations exist, in round numbers 100 degs. superheat will insure an increase in economy of about 10 per cent, and 1-in. vacuum (between 25 ins. and 28 ins.) 3.5 per cent to 4 per cent, depending somewhat upon the load.

Upon this assumption, we may estimate the net saving resulting from the use of high vacuum. In Table IV. three cases have been calculated embracing possible or typical conditions of service and cost of fuel. A 2000-kw plant has been chosen, containing two 1000-kw units. By raising the vacuum 2 ins.—from 26 ins. to 28 ins.— a saving in coal results amounting to 3.5 tons, 2.6 tons and 1.3 tons per day in the three respective cases. The extra cost of high vacuum condenser equipment will, however, be about $2 per kilowatt capacity, or $4,000. Deducting the interest and depreciation (12½ per cent) on this investment from the fuel savings, a net saving is determined which represents an interest rate of 115 per cent, 27 per cent and 3 per cent, respectively, on the increased investment in high vacuum. The increased power requirements of the new equipment will presumably reduce these per centages by 1 per cent to 5 per cent, according to the price at which power is charged, but the estimates, although largely tentative, certainly point to high vacuum as an excellent investment where high plant economy is imperative.

These relations, which cover for each case a wide range of fuel cost, may be presented in graphical form. With cheap coal there is evidently a point where the high vacuum ceases to be a source of economy. This is shown under the conditions assumed to correspond to coal at 40 cents, 62 cents and $1.36 per ton, respectively. On the other hand, the annual

TABLE IV.—RELATIVE ECONOMY OF HIGH VACUUM

Case	I	II	III
Conditions of operation	Good Coal Continuous Service	Med. Coal Continuous Service	Poor Coal Day Service.
Capacity plant, kw	2,000	2,000	2,000
Daily run, hours	24	24	10
Yearly run, days	365	300	300
Average load, kw	1,500	1,000	1,000
Price coal, per ton (2,000 lbs.)	$4.00	$2.00	$1.00
Evaporation (actual), lbs.	9½	8	7
Average economy, lbs. water per kw hour	23	22	22
Raise vacuum, inches	26 to 28	26 to 28	26 to 28
Water saved per kw hour, lbs.	1.84	1.76	1.76
Water saved per day, lbs.	66,240	42,240	17,600
Coal saved per day, tons	3.49	2.64	1.26
Gross saving per day	$13.96	$5.28	$1.26
Gross saving per year	$5,095.00	$1,584.00	$378.00
Extra cost of condenser	$4,000.00	$4,000.00	$4,000.00
Interest 5 per cent., depreciation 7½ per cent.	$500 00	$500 00	$500.00
Net saving per year	$4,585.00	$1,084.00	$-122 00
Net saving per year, capitalized at 5 per cent.	$91,900.00	$21,680.00	$-2,444.00
Net saving as interest on increased investment in 2" extra vacuum	114.9 per ct.	27.1 per ct.	-3.05 per ct.

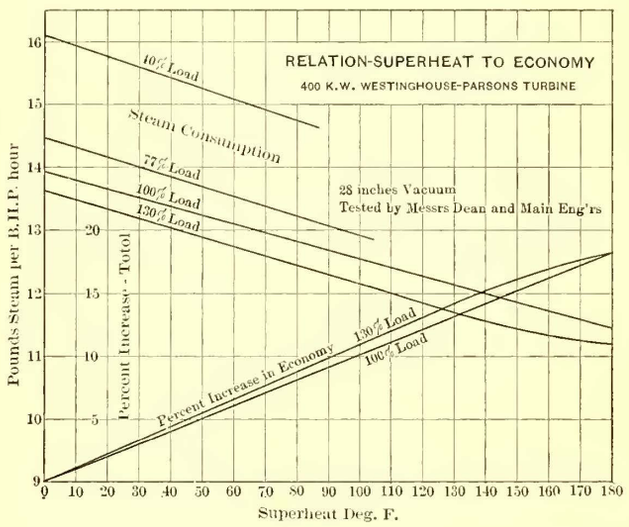


FIG. 9

saving in cases 1 and 2 is sufficient to equal the original cost of the improvement with coal at $3.55 and $5.20, respectively.

With superheated steam the same method of arriving at the net saving may be employed. At the present time the superheat usually specified in turbine plants ranges in the neighborhood of 100 degs. F., which is easily within the limits of various forms of apparatus suited for mounting within the boiler setting in the

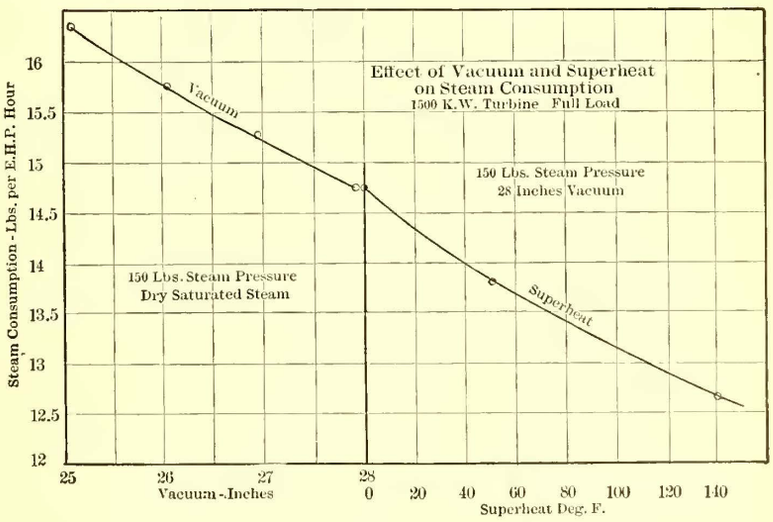


FIG. 8

path of the flue gases. An increase in economy of 10 per cent is thus effected, and at an investment cost of fully 25 per cent less than that for the 2-in. extra vacuum. The net saving should therefore be even greater. Superheat cannot, however, be obtained for nothing, and the net saving is evidently affected largely by the

cost of heat supplied. In the case of the independent superheater this comprises fuel and stoking; in the case of the boiler superheater, the fuel value of heat delivered by the flue gases.

POWER CONSUMPTION OF AUXILIARIES

Granted the beneficial effects of high vacuum, do the auxiliaries require excessive power to render them commercally impracticable? Fortunately, we are able to present results from two plants which throw some light upon this subject. At the Broad Street

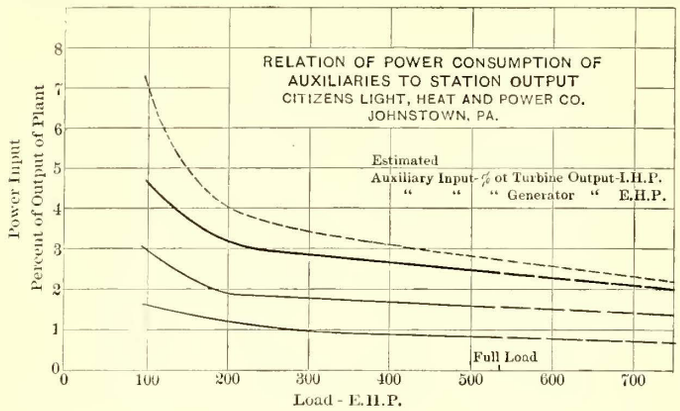


FIG. 10

station of the Citizens' Light, Heat & Power Company, Johnstown, Pa., the condenser auxiliaries are driven from a single steam cylinder—that of the rotative air pump. By indicating this cylinder at normal speeds, the total power input was obtained as given in Table V.

TABLE V.—TEST OF POWER CONSUMPTION OF AUXILIARIES. CITIZENS' LIGHT HEAT & POWER COMPANY, JOHNSTOWN, PA.

Load		Vacuum	H. P. Auxiliaries			Per Cent Total Power		
E. H. P.	I. H. P.	Inches, Hg.*	Steam, I. H. P.	Air, I. H. P.	To Water, I. H. P.	Steam Cyl., Per Cent	Air Cyl., Per Cent	To Water, Per Cent
97.8	150.8	27.8	7.08	2.45	4.63	4 7	1.63	3.07
167.5	220 5	27.7	7.75	3.00	4.75	3.5	1.36	2.14
185.0	238.0	27.6	7.66	3.02	4.64	3.22	1.27	1.95
207.5	260.5	27.6	8.38	3.16	5.22	3.21	1.21	2.00
238 0	291.0	27.3	8 98	3.46	5.52	3.09	1.19	1.90
241.0	294.0	27.4	8.75	3.21	5.54	2.98	1.09	1.89
404.0	457.	....	12 77	4.35	8.42	2.8	.95	1.85
536.0	589.	....	14.57	5 03	9.54	2.47	.85	1.52

* Referred to 30-in. barometer. Turbine indicated horse-power based upon no load losses, which are assumed approximately constant throughout the test. Condenser—Weiss, 32-in. elevated jet, 800-kw capacity. Air pump—Weiss, single stage rotative type. Circulating pump—Bibus rotary type. Three-quarters and full load values estimated from data taken. Tests conducted and computed by company's consulting engineer.

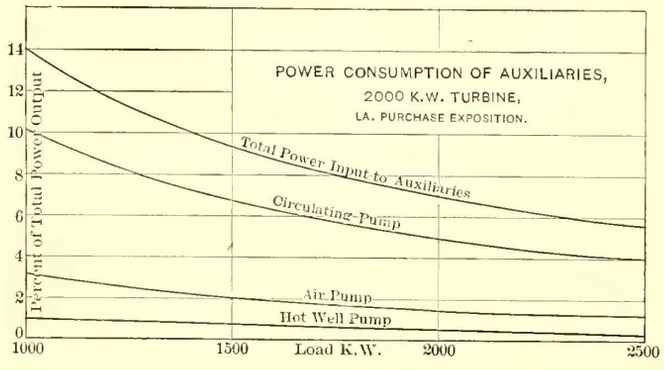


FIG. 11

These results are shown graphically in Fig. 10, plotted to station load. Although observed in indicated horse-power, the results were reduced to a basis of equality with turbine output in order to obtain commensurate percentages. At less than ¼ load, the total power consumption was less than 5 per cent of the station output, and it progressively decreased to 2½ per cent at full load. From the curves it may be inferred that at a load of 800 kw, which is the full rating of the condenser, the power consumption will approximate 2 per cent of the turbine output. And it must be borne in mind that even this percentage is not entirely chargeable, as all steam auxiliaries exhaust into an open feed-water heater in which the heat of the exhaust steam is regained. The upper curve in Fig. 10 expresses:

Indicated horse-power input to auxiliaries.

Electrical horse-power output of turbines.

Similar observations casually made on a 2000-kw Curtis turbine equipment at the Louisiana Purchase Exposition indicate the same relations, although a higher power consumption. All auxiliaries are driven by constant-speed induction motors supplied from the high-tension bus-bar through step-down transformers. The curves, Fig. 11, are based upon observations varying from half to full load, and the power input is assumed constant for all loads, as this is approximately the case. At full load the auxiliaries required 7 per cent of the total power output, 5 per cent for the circulating pump and 1.6 per cent for the air pump. It is probable that the percentages might be largely reduced were it possible to more closely proportion the speed of auxiliaries to the turbine load, as may be done in the Johnstown plant. The equipment is also laboring under unexpected high temperature of cooling water, frequently 85 degs., which renders it difficult to obtain the high vacuum which could be held under normal conditions. The most important point is, however, well brought by the curves, viz.: that the power consumption of turbine auxiliaries is moderate and constantly decreases with the load.

CONDENSERS

An important requisite in the maintenance of a high vacuum is the absolute exclusion of entrained air. This air may find its way

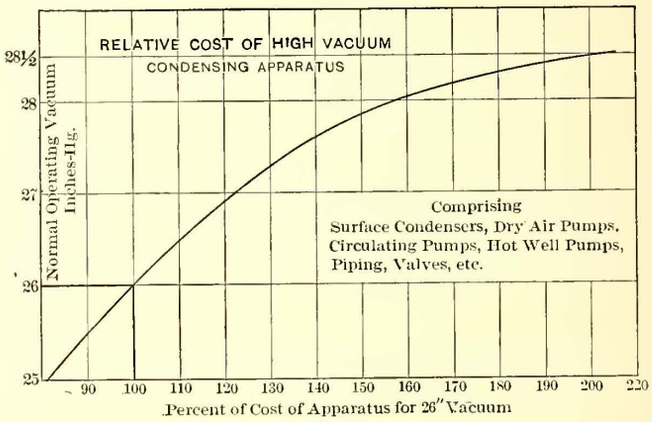


FIG. 12

into the condensing system from many sources—through the feed-water and steam—through air leaks in piping, and through packing glands improperly sealed. A minute opening will have a remarkable effect in lowering the vacuum unless the air is removed before reaching the condenser. This is usually accomplished by a single or double-stage "dry" air pump. Charles A. Parsons has made successful use of a small steam ejector which removes entrained air from the condenser casing, discharging into a small auxiliary condenser. By this means he has succeeded in raising the vacuum 2 ins. with about 4½ per cent net gain. On account of this trouble from entrained air entering through the feed-water, the surface condenser has found particular favor for turbine work. It, in addition, enables the condensed steam, which is pure distilled water, to be returned to the boilers, thus not only saving water, but the cost of purifying it and a considerable proportion of the maintenance cost for cleaning and repairs of the boiler equipment.

It is frequently thought that an air pump requires the maximum power at the highest vacuum. This is found to be not strictly the case, but rather that the maximum occurs when the amount of air to be handled is greatest. Obviously, if there are no air leaks to lower the condenser vacuum, the pump vacuum is equal to that of the condenser, and the pump will require no power outside of that to overcome its own friction.

Another effective means of reducing the power requirements of a surface condensing plant is to balance the circulating water columns leading to and from the condenser by sealing both ends beneath the same level of water. A syphon is thus formed, and it is only necessary to move the circulating water against the friction of pipes, valves and condenser tubes.

A limitation to high vacua, of course, exists in the temperature of cooling water, and unless sufficient difference in temperature exists between water and steam—20 degs. to 30 degs.—the amount of circulating water per pound of steam becomes much greater than that with normal water temperature of, for instance, 70 degs. F. This, of course, entails increased power input to pumps. High water temperature, therefore, forms a practical barrier to higher

vacua. But with ordinary water temperature and a closed steam cycle and circulating water system, the power requirements may be kept at a low point, as shown in the tests at Johnstown. In the turbine plant at Elyria, Ohio, where the circulating pumps are motor driven (see Fig. 13), the power input to the motors at ¾ load on the turbine and 27-in. vacuum was found to be but 3.36 per cent, including a 15-ft. lift. As this was introduced for the purpose of making weir measurements, the power chargeable to the condenser, including the friction in over 550 ft. of cast-iron piping, was but 2.33 per cent of the turbine output.

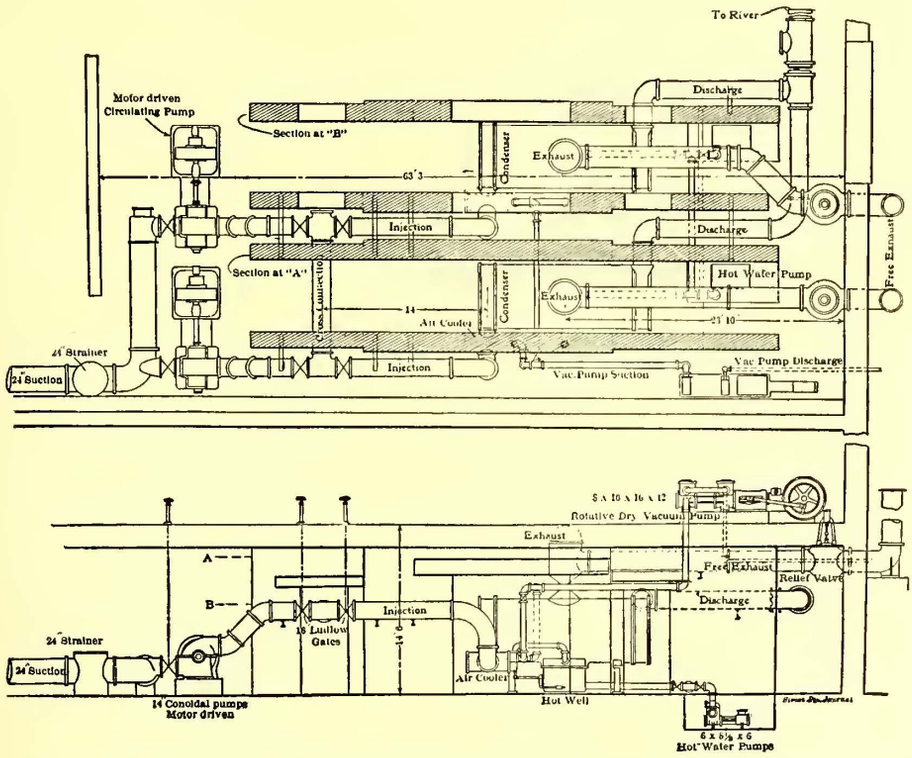


FIG. 13.—ARRANGEMENTS OF FOUNDATIONS AND CONDENSING APPARATUS. 2000-KW TURBINE PLANT OF THE CLEVELAND & SOUTHWESTERN RAILWAY, ELYRIA, OHIO

The cost of high vacuum apparatus is not proportional to the vacuum, but increases much more rapidly, as shown in Fig. 12. Increasing the vacuum 1 in. above 26 ins., increases the cost about one-fourth, another 1 in. raises it nearly one-third, and ½ in. above 28 ins., about one-half of the cost at 26 ins. These estimates are, of course, averages and intended to show relative, not specific, costs.

CONDENSER ARRANGEMENTS

Another important factor in securing a high-working vacuum is the elimination, as far as possible, of friction in the exhaust piping leading from turbine to condenser. As is well known, the volume of steam increases with great rapidity at high vacua, thus requiring extremely large exhaust piping. Considerations of convenience, however, frequently outweigh those of engineering precision, thus tending to decrease the size of exhaust piping, although at the expense of considerable increase of friction and resultant loss of vacuum. An instance where this matter has been given attention is the replacement in the Manhattan station of the former jet condensers by those of the barometric type connected directly to the engine exhausts. Although this arrangement was adopted partly on account of the height of the engine exhaust, it nevertheless is reported to have resulted in higher engine vacuum.

In turbine work where 28-in. vacuum is employed, the volume of steam is from 50 per cent to 100 per cent greater than with the usual engine vacuum. This fact emphasizes the necessity of locating the condenser as near as possible to the turbine, and the desired arrangement has been accomplished by placing the condenser immediately beneath the turbine, an arrangement which has never before been possible with any other form of steam engine. As is well known, the absence of vibration or external thrusts permits the employment of any kind of foundation of sufficient strength to sustain the dead weight. In numerous instances, steel beams with concrete arches sprung in between them are employed solely for this purpose. The basement may therefore be employed for accommodating the condenser instead of the massive foundations required for reciprocating engines. The turbine exhaust may then be conducted straight downward through a few feet of exhaust piping, which may be proportioned as liberally as desired, as no valuable space is being taken up. This is practically equivalent to the location of the condenser directly at the turbine exhaust and obviates the undesirable features of mounting the turbine directly on top of the condenser, as has been proposed. A good illustration of this arrangement is offered by the turbine plant at Elyria, Ohio, shown in Fig. 13 and accompanying views. The cross-hatched areas represent the sections of the concrete walls constituting the foundation piers. The exhaust extends straight downward into the condenser, which, as shown, is located between the piers. This vertical exhaust leg is of sufficient length to accommodate a fluted copper expansion joint, a free exhaust branch to atmosphere and a gate valve.

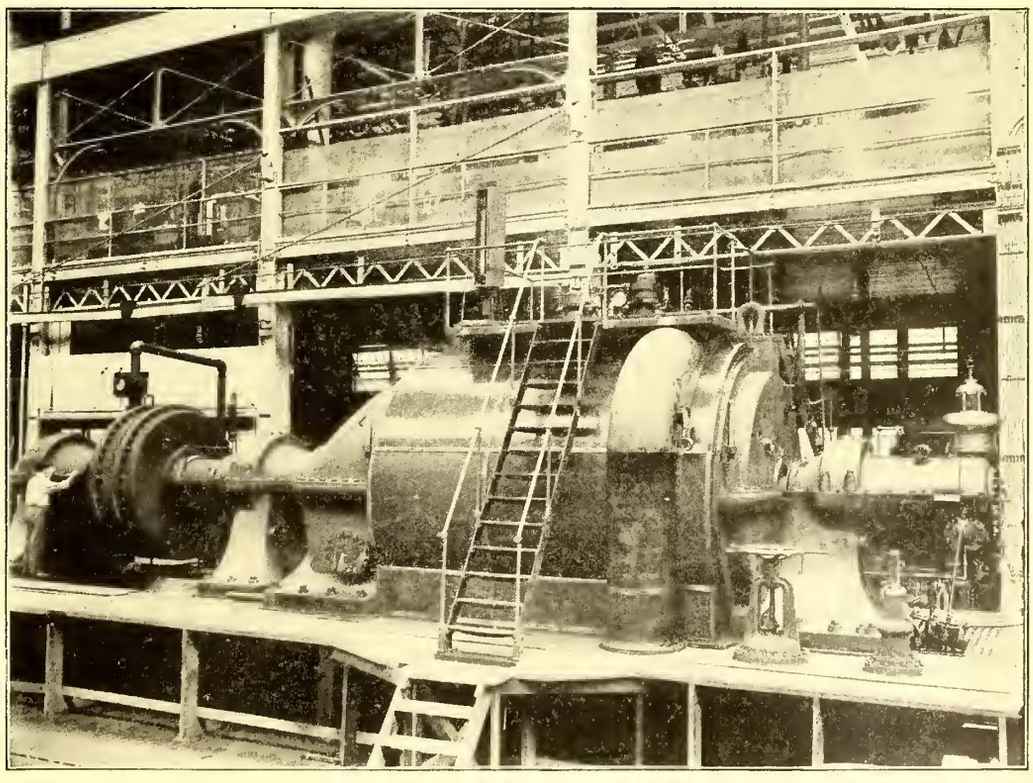


FIG. 13-A.—2000-KW ELECTRIC RAILWAY TURBINE PLANT OF THE CLEVELAND & SOUTHWESTERN RAILWAY COMPANY, ELYRIA, OHIO. TWO 1000-KW WESTINGHOUSE-PARSONS TURBINE UNITS OPERATING INTERURBAN ELECTRIC RAILWAY SYSTEM, WITH HIGH-TENSION TRANSMISSION

Following out the ideas previously mentioned, a number of plants with various sized units have been drawn up for the purpose of indicating the possibilities of compactness in arrangement of

condenser and auxiliaries. Three sizes of turbine have been chosen for illustration—viz.: 400 kw, 1000 kw and 5500 kw—four units being included in each plant as constituting a typical and desirable arrangement in a modern power station.

In the 400-kw plant, Fig. 14, a central condenser is employed with rotative two-stage dry air pump and a centrifugal circulating pump driven by a small high-speed steam engine. The sketches illustrate the counter-current type of condenser, which, however, is merely incidental and not essential to this arrangement. A gate valve in each turbine exhaust permits independent control of each unit, and at light loads the circulating water can be readily decreased in proportion by throttling the pump engine. A small reciprocating hot-well pump returns the condensation directly to the boiler feed. The vertical loop in the circulating water outlet pipe serves to keep the condenser full of water and the tubes covered at all times.

In the 1000-kw plant, Fig. 15, independent condensers are employed, with, however, practically the same arrangement as in the smaller plant, with the exception that a single air pump serves two units. By cross connecting the air piping the two air pumps may be arranged for relay service. Each condenser is provided with its own circulating water pump. By locating the several condensers alternately at one side or the other of the line of exhaust outlets, sufficient space is available for withdrawing and replacing condenser tubes, which would evidently not be the case if all were located upon the same side.

In the 5500-kw plant, Fig. 16, concrete piers are employed, supporting the bed-plate of the turbo-generator unit at points beneath the three journals. As before, the condensers are located directly beneath the turbine, whose outlet in this case, for convenience and compactness, is of approximately rectangular cross-section. By placing them at the angle shown, space is left for the removal of condenser tubes. In plants of this size, concrete-lined conduits would presumably be used to convey cooling water to and from the condensers.

TABLE VI.—COMPARATIVE DATA ON TURBINE PLANT ARRANGEMENTS

Normal capacity of units, kw	400	1,000	5,550
Number of units	4	4	4
Capacity of room, kw	1,600	4,000	22,000
Size of engine room, feet	26 x 35	59 x 36	100 x 61
Length of turbine units (over all)	18 ft. 11 in.	29 ft. 11 in.	47 ft. 3 in.
Width of turbine units (over all)	3 ft. 11 in.	5 ft. 3 in.	14 ft. 0 in.
Height of turbine units (over all)	7 ft. 6 in.	8 ft. 4 in.	14 ft. 0 in.
Center to center distance between units	7 ft. 10 in.	13 ft. 0 in.	22 ft. 6 in.
Width of passage ways, feet	4 ft. 0 in.	8 ft. 6 in.	8 ft. 6 in.
Depth of basement	14 ft. 6 in.	18 ft. 0 in.	25 ft. 0 in.
Vacuum, inches	28	28	28
Condenser cooling surface, feet	7,000	16,000	80,000
Condenser cooling surface, per unit, feet	1,750	4,000	20,000
Condenser cooling surface, per kw, feet	4.37	4.00	3.14
Area of operating room, square feet	910	2,124	6,100
Turbine capacity, per square foot of operating room, kw	1.76	1.88	3.60
Area of engine room, per kw capacity	0.57	0.531	0.277
Area of engine room, per E. H. P. capacity	.425	.396	.207

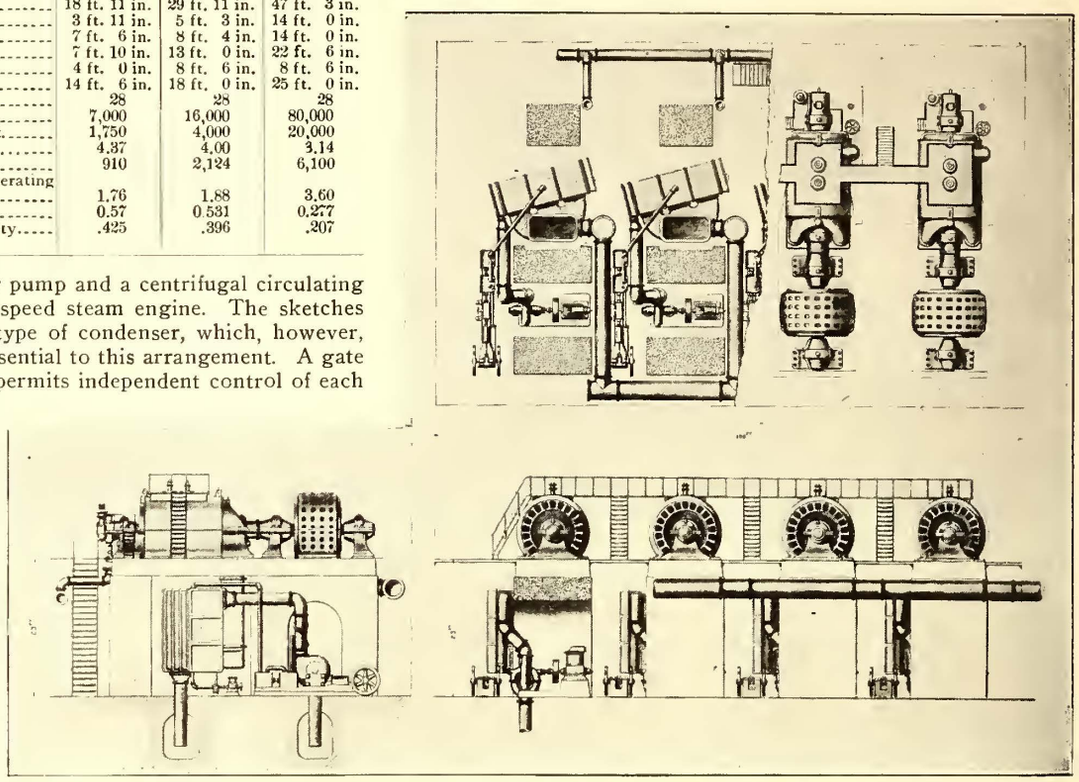


FIG. 14.—TYPICAL TURBINE PLANT ARRANGEMENT. FOUR 400-KW UNITS

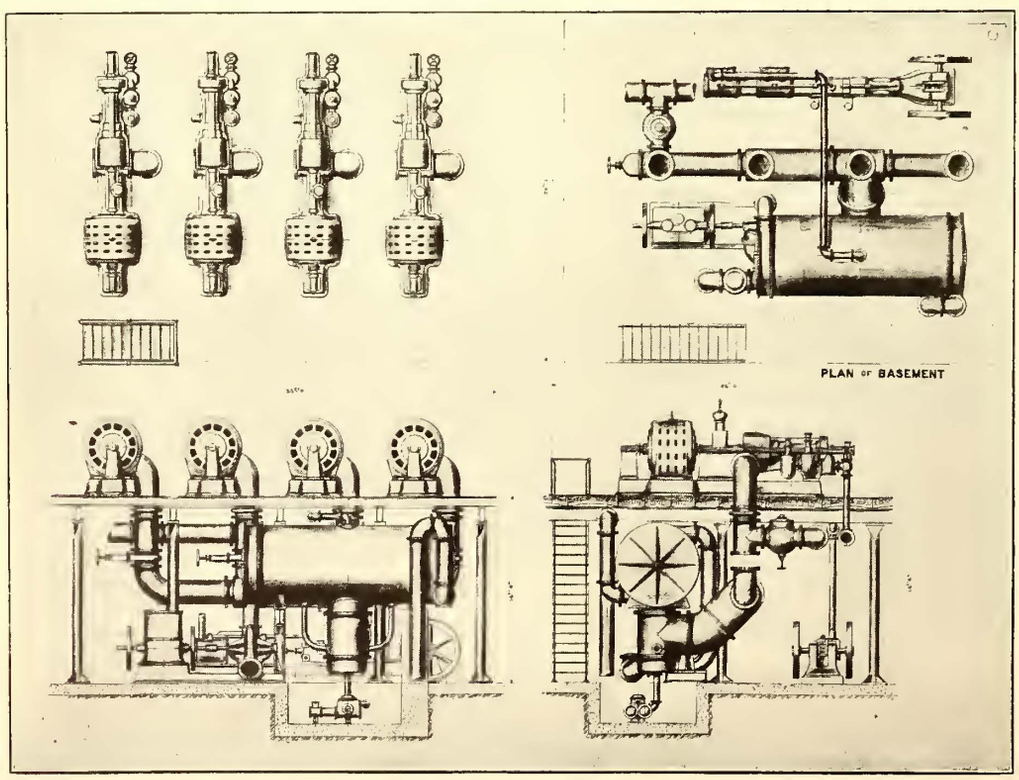


FIG. 15.—TYPICAL TURBINE PLANT ARRANGEMENT. FOUR 1000-KW UNITS

In all of these condenser arrangements, an independent atmospheric exhaust outlet with relief valve is provided for each unit; thus, in the case of loss of vacuum from any sources, the turbines are capable of continuing operation non-condensing. It is also desirable to employ a fluted copper expansion joint in the exhaust riser. The turbine casing is thus relieved of any strain due to expansion and contraction of the riser, which is, of course, firmly supported from beneath by the condenser. This, however, becomes unnecessary in the 5000-kw equipments on account of the shorter connection between turbine and condenser.

The foregoing table (VI.) gives the general data upon these arrangements:

When plotted in graphical form the fact is apparent that, although the greatest relative compactness is found in the large station, the greatest benefit from the arrangement occurs in the smaller stations.

In point of compactness, the New York Edison station, although employing 6500-hp vertical three-cylinder compound engines with direct-connected overhung genera-

tors and with condensing equipments located between engine foundations, requires over twice the room necessary for the turbine station employing units of commensurate size.

It is of interest to note comparative figures on the five great New York power stations:

	Area—Sq. Ft. per Kw Capacity	
	Power House	Operating Floor
New York Edison Company.....	0.96	0.573
Metropolitan Railway	1.27	0.635
Kingsbridge Station	1.40	0.748
Manhattan Railway	2.06	0.884
Rapid Transit	2.32	1.38

RESULTS OF PRACTICAL OPERATION

The soundness of engineering judgment in taking a step so radical as the adoption of steam turbines, is invariably reflected in the entries in the station log and the monthly cost sheet. If opinions were unanimous concerning the several factors comprising the true cost of power, and such figures were generally available, it would not be difficult to formulate legitimate conclusions as to the precise commercial standing of the steam turbine. But data relating to investment and other fixed costs are not easily obtainable, and in fact not infrequently neglected altogether in determining the cost of power. Even the various factors constituting the operative costs, such as fuel, wages, supplies and repairs, are not always available in segregated form. In many industrial plants, one boiler equipment furnishes steam for electric power generators in conjunction with steam engines and special processes. These facts render an accurate analysis of power costs an extremely difficult if not impossible matter.

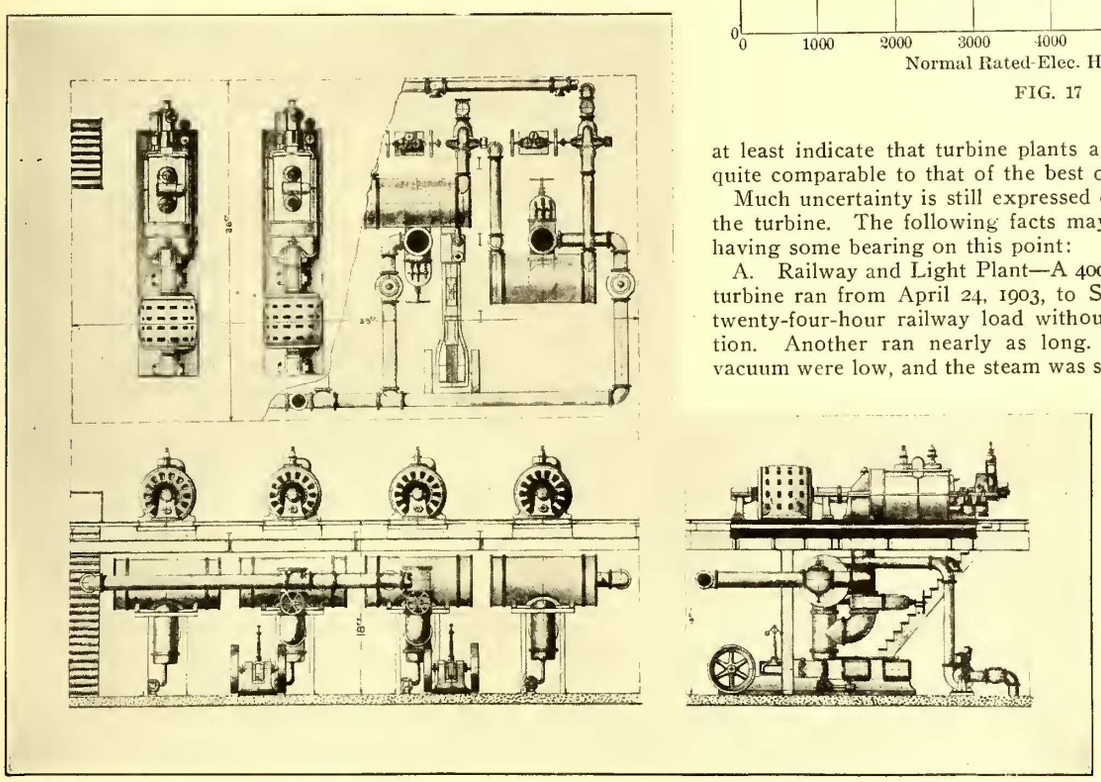


FIG 16.—TYPICAL TURBINE PLANT ARRANGEMENT. FOUR 5500-KW UNITS

In Great Britain, the practice of making public accurate cost records is much more prevalent than in this country. Results from a few central stations employing steam turbines have been collected in Table IX., taken from the "Electrical Times." The stations are all above 1000 kw in capacity; one is non-condensing, and one part condensing, and the largest—the Newcastle-on-Tyne—contains both engine and turbine capacity in the proportion of 3 to 4. It is reported* that within one year after installing turbines, the cost of coal was reduced from .96 cent to .36 cent per kw-hour, and works costs from 1.96 cents to .76 cent per kw-hour. The average of the eight plants is as follows:

		Cost—Cents per Kw-Hour	
Capacity	Load Factor	Coal	Works Costs
2546 kw	13.4	1.18 cents	2.36 cents

* London Electrician, 1904—J. H. Barker.

Omitting, however, the non-condensing plant and the two with excessively low load factor, the average becomes:

Capacity	Load Factor	Coal	Works Costs
2946 kw	14.42	.936 cent	1.94 cents

In the above report the cost of coal is not stated, and the exact measure of fuel economy cannot, therefore, be determined. Other sources, however, show the local price of British steam coal to average fully as high if not higher than the American. The figures at least indicate that turbine plants are being operated at a cost quite comparable to that of the best of modern steam plants.

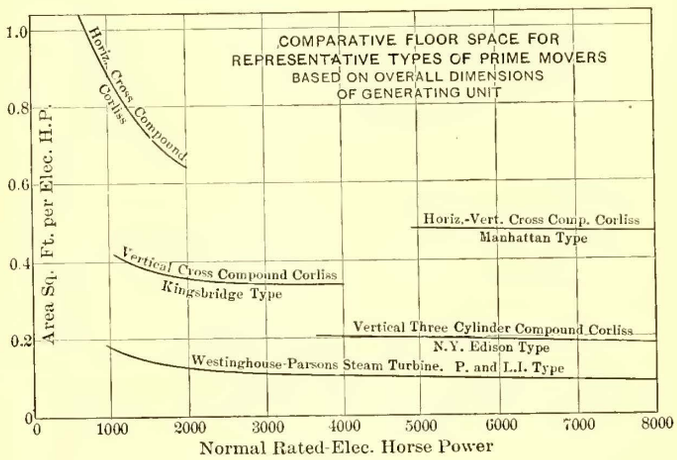


FIG. 17

Much uncertainty is still expressed concerning the reliability of the turbine. The following facts may be of interest as possibly having some bearing on this point:

A. Railway and Light Plant—A 400-kw Westinghouse-Parsons turbine ran from April 24, 1903, to Sept. 11, 1904—505 days—on twenty-four-hour railway load without being opened for inspection. Another ran nearly as long. Both steam pressure and vacuum were low, and the steam was so wet that at one time seven barrels of water collected in the exhaust main during a ten-hour run—unable to be carried over to the condenser—yet, on a recent inspection, no deterioration is noticeable. It has frequently been slowed down by quantities of water in the steam. This turbine has carried 15 per cent overload for fifteen consecutive hours, it has operated the entire railway and lighting system for nine hours without vacuum and has operated successfully in parallel with another turbine and with compensated field alternators belted to high-speed automatic engines. During erection it slipped from a temporary staging, fell 6 ft. and landed bottom side up; no injury has ever resulted.

B. Railway and Lighting Plant—Another 400-kw turbine system ran 375 days, twenty-four hours each, with but 3 per cent shutdown, less than 1 per cent of which was chargeable to the turbine; the remainder to vacuum pump, steam piping, etc. In this plant the steam has been extremely wet and contained much foreign matter carried over from the boilers.

C. Industrial Plant, Stamford, Conn.—After eleven months' continuous operation of a 400-kw unit, the original shop oil-stone marks on the bearings were plainly visible. This turbine ran five consecutive hours at 50 per cent overload. During the winter it runs non-condensing part of the day, supplying 32,500 sq. ft. of heating surface.

D. Industrial Plant, Akron, Ohio—One 400-kw and one 750-kw turbine operate in parallel, with the greatest ease, with two 500-kw and one 150-kw direct-connected Corliss engine units upon a widely fluctuating factory load, due to electric motors, many of which are of 100-hp to 300-hp capacity. The turbines exert an important corrective influence over the regulation of the entire plant.

E. Electric Light and Power Plant, Hartford, Conn.—A 1500-kw unit has been started cold and load applied in seven minutes.

It has carried a load of 2200 kw for thirty consecutive hours. It operates regularly in parallel over a high-tension transmission line with a water-power station eleven miles distant.

F. Railway Plant, Elyria, Ohio—A 1000-kw unit has carried a load of 1675 kw, and operates twenty-hours daily on a railway load frequently fluctuating from 100 amps. to 3000 amps. in two or three minutes. It operates in parallel with another unit of the same size, supplies some power for lighting, and has more than halved the cost of coal per kw-hour of the engine station.

G. Electric Light and Power Station, Newcastle-on-Tyne, England—No. 10 turbine installed in the Neptune Bank station made the following record, as shown by the station log: Out of 7512 hours run—from December, 1901, to December, 1903—the turbine was out of commission fifty-two hours, or 0.7 per cent of the running time. Repairs comprised the relining of the governor throttle valve chest and the renewal of an oil disc.

H. Light and Power Station, Newcastle-on-Tyne, England—3000 kw; capacity, 75-kw to 500-kw units. After eleven years of service for the greater part of the turbine equipment, the cost of repairs at the Forth station averaged, up to 1903, .225 cent per kw-hour output.

These facts would seem to command respect for the turbine as a machine of wide application, rugged and permanent in construction, responsive to excessive and sudden demands, peculiarly suited for parallel operation under the most difficult circumstances, and capable of yielding commercial results under extremely unsuitable conditions. It is not, however, in the makeshift plants that the turbine can do its best work.

Formerly, the turbine has, in many cases, been designed to accommodate existing conditions in the plant. To-day the reverse is true. The plant is now being designed for the turbine, and the more universal this practice becomes, the more marked will be the influence of the turbine on present and future power station economics.

TABLE IX.—COST OF POWER IN BRITISH CENTRAL STATIONS EMPLOYING PARSONS STEAM TURBINES. "The Electrical Times Tables"

No. Stations	Year Ended	Year of Working	Capacity at End Year	Current	Condensing or Non-Condensing	No. of Units Sold	Load Factor	Cost per Unit Sold D. per Kw Hour					D.
								Coal	Oil and Stores	Wages Workmen	Repairs	Works Costs	Average Price Obtain'd
1. Newcastle-on-Tyne	Dec., 1902	13th	7,250	D. C. & A. C.	Conductor	5,509,340	13.98	.20	.03	.11	.14	.48	1 82
2. Newcastle and district	Dec., 1902	13th	3,200	A. C.	Part cond.	2,058 804	14.69	.52	.12	.24	.06	.94	2.90
3. Blackpool	Mar., '02-'03	9th	3,050	A. C.	Non-cond.	2,169,463	14.32	.91	.10	.21	.30	1.52	3.13
4. Cheltenham	Mar., '02-'03	7th	1,980	D. C. & A. C.	Conductor	1,287,421	14.31	.55	.10	.32	.27	1.24	2.83
5. Cambridge	Dec., 1903	11th	1,500	A. C.	Conductor	471,510	9.38	.61	.11	.46	.29	1.47	5.93
6. Harrogate	Mar., '02-'03	6th	1,150	A. C.	Conductor	761,136	13.16	.66	.08	.31	.31	1.36	3.75
7. West Bromwich	Mar., '03-'04	2d	1,150	D. C.	Conductor	1,105,006	15.96	.41	.08	.17	.17	.83	2.02
8. Scarborough	Dec., 1902	9th	1,085	A. C.	Conductor	431,777	9.34	.85	.08	.44	.24	1.61	5.36
Average, No. 1 to 8, inclusive	----	----	2,546	----	----	----	13.4	.59	.087	.28	.22	1.18	3.49
Average, Nos. 1, 2, 4, 6, 7	----	----	2,946	----	----	----	14.42	.468	.082	.23	.19	.97	2.66

THE AMERICAN DIESEL ENGINE

BY E. D. MEIER

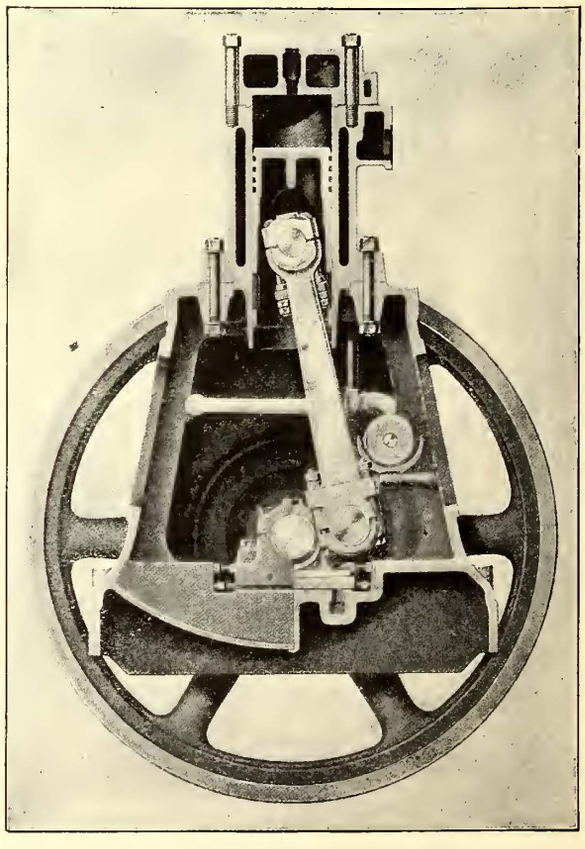
Many of your members will remember certain papers published some years ago in regard to the merits of a new invention in prime movers, called the Diesel motor. The claims set forth as to the economy of this device were so large and far-reaching that most practical men received them with a shrug of the shoulders. They were nevertheless, not only true, but somewhat understated. From the small Diesel motor of 20 hp, which gave these remarkable results, has grown by a natural process of evolution the American Diesel engine of to-day, at present built in sizes from 75 hp to 450 hp.

A short explanation of the working of this engine may be permissible, as many, no doubt, have forgotten the former explanation, while to others the matter may be entirely new.

The Diesel engine is essentially an oil engine, and not a gas engine. Gas engines and previous oil engines which acted on the gas engine principle have all in common the explosion of a charge. This charge is a mixture of a given quantity of gas, or of a given quantity of oil vaporized so as to act as a gas during the process, combined with a quantity of air varying from seven to eleven times the volume of the gas or vapor. It was well known that some previous compression would add to the economic results of the explosive action. But in all cases the power was obtained by an explosion which, from the moment of ignition, was beyond control of the operator or of the governing mechanism of the engine. This fact limited the efficiency of all governing devices which could be applied, and troubles with the ignitor caused other irregularities, so that even where local conditions made the gas engine (or vaporized oil engine) the worthy competitor of the steam engine, uncertainties of its operaton threw doubt on the wisdom of the substitution. Furthermore, a cheap gas, necessitating the installation of a large and cumbersome producer plant, was the only escape from such costly fuels as gasoline or kerosene.

The Diesel engine made the use of the cheapest liquid fuel, such as crude oil, fuel oil, and distillates possible. To these recent experimental developments promise to add the waste product from gas works, known as light water gas tar.

The Diesel engine works on an entirely new principle. First of all, it dispenses with the so-called charge or mixture, which in all explosive engines must vary only between the limits of one gas to seven air and one gas to eleven air. Its cycle is the same as the gas engine, the well-known Otto cycle. There its similarity with the gas engine ends absolutely; in everything else it follows the precedent of the steam engine.



SECTIONAL VIEW OF THE DIESEL ENGINE, SHOWING MAIN WORKING PARTS

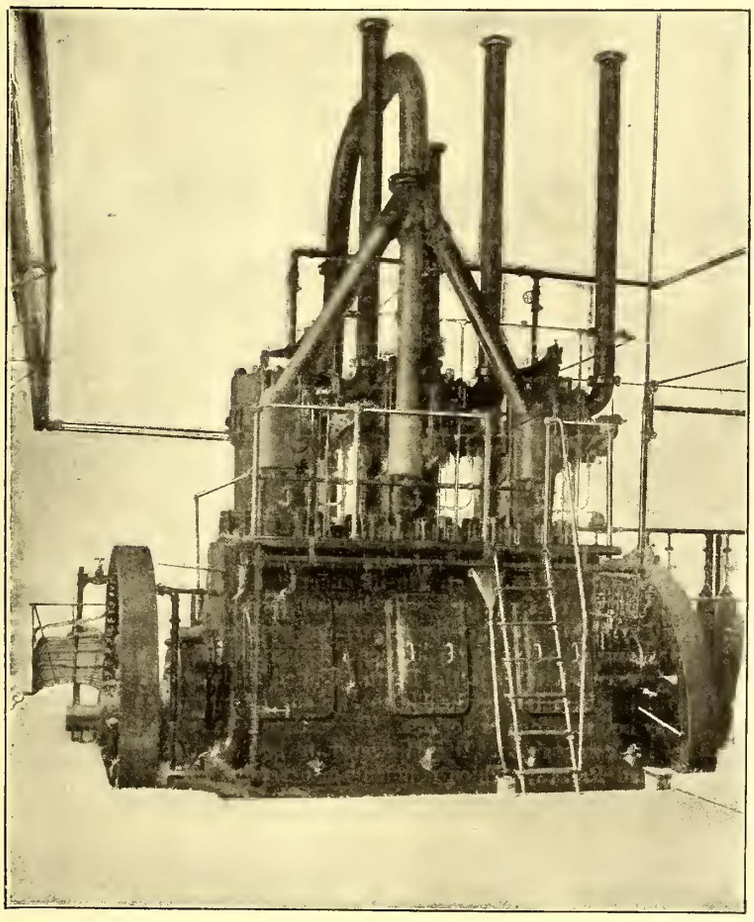
Its first stroke is a suction stroke, drawing in a cylinder full of pure clean air; on the second stroke it compresses this to a tension and consequent temperature sufficient to ignite any fuel which may be injected into it; at the beginning of the third stroke a small quantity of fuel oil is injected into this red-hot air as a spray by a jet of highly compressed air, and thus in a completely pulverized state the fuel meets and mixes with the hot compressed air in the

cylinder, burning completely and during a period of time exactly regulated by the governing mechanism of the engine, generally through one-tenth part of the stroke, subsequent to which the stroke is finished by the expansion of the burnt products; the fourth stroke discharges these products of combustion and leaves the cylinder empty and ready for another suction stroke.

It is evident that the work expended in compressing the cylinder volume of pure air is given off again to the shaft of the engine during the combustion or motor stroke, so that the loss is simply the frictional loss during the compression stroke.

This simple process, absolutely new and original with Diesel, has enabled him to accomplish with one-half pint of common crude or fuel oil as much as the explosive engine does with a full pint of the much more expensive gasoline.

A recent comparison of results extending over a period of regular daily service of six weeks has shown the consequent economy



225-HP TRIPLE CYLINDER DIESEL ENGINES AS INSTALLED IN THE LIGHT & POWER PLANT OF THE GERMAN TYROLEAN ALPS AT THE ST. LOUIS WORLD'S FAIR

of the Diesel engine over a first-class gasoline engine, which it displaced, of 600 per cent.

The modest statement set forth some years ago by the promoters of the Diesel engine, and covered by absolute and binding guarantees, are that 100-hp hours measured in the crank-shaft of the engine will require not exceeding 8½ gals. of crude oil or fuel oil when the engine is running at or near its greatest capacity, nor more than 9½ gals. when it is running at or near half-load. The Diesel engines which are furnishing all the electric light and nearly all the power for the German Tyrolean Alps at the World's Fair, St. Louis, furnish 100-hp hours on the switchboard while running at loads varying during the day from one-quarter to full load, with a consumption of only 7½ gals. of common fuel oil from Whiting, Ind. At 3 cents per gallon this means 100 hp per hour at 2¼ cents, or 100 kw at 3.15 cents. While in some localities such fuel oil or crude oil, delivered in carload lots, may cost as high as 4 cents per gallon, it is readily furnished in many localities contiguous to oil fields at 3 cents and even 2 cents per gallon.

The regulation in the Diesel engine is not dependent on hit or miss, but can be followed up or down the scale as closely as in a steam engine. In the latter it is a question of cutting off more or less from a pretty large volume of steam at each stroke; in the Diesel engine it is the finer one of cutting off a more or less minute quantity of oil from the small volume delivered by the fuel pump at each stroke. It is accomplished by direct action of the governor on the suction valve of the fuel pump, which is held open during a greater or less portion of the pressure stroke, and thus the pump delivers the exact quantity of oil required during each motor stroke of the engine. While the mechanism is necessarily smaller, and more delicate than in the steam engine, it also requires less power and its effect is more immediate.

In a compound steam engine the volume of steam left in the high-pressure cylinder at the point of cut-off must be used in the next stroke of the low pressure cylinder whether at the time more or less would be the proper quantity for that stroke. In the Diesel engine the regulation acts on each cylinder just at the time and in the exact quantity then required.

There remains only the drawback, common to all four cycle engines, that there is but one motor stroke for every two revolutions. For electric light work triple cylinder engines and heavier fly-wheels successfully overcome this, while for electric railway work resort is had to still larger fly-wheels and six cylinders by coupling two triple cylinder engines at the two ends of the same dynamo shaft.

As for the accessibility, reliability and durability of the engine, three years of experimental work have placed these fully on a par with the best steam engine practice, and since then two years and in some cases nearly three years of continuous service by a number of Diesel engines of the new American type give sufficient examples of the success in this work.

Three engines of 225 hp direct-coupled to Bullock d. c. generators can be seen in daily service in the engine room of the German Tyrolean Alps at the World's Fair, where many practical questions beyond the scope of this article will find ready and complete answers.

THE MONO-RAIL*

BY F. B. BEHR

For years, engineers have attempted the design of single-rail railways, but only within the last quarter century has any practical construction of such roads been carried out. Two operating systems now exist, the one developed by Mr. Behr and the other by Mr. Langen. In the former the car is carried upon and above the supporting rail, while in the latter the car is hung entirely below the supporting rail.

The Behr mono-rail is applicable to light railways in sparsely populated districts over rugged country; to elevated railways in towns; and as a supplement to main lines for passenger and all classes of very high speed traffic. The first primitive mono-rail road was built in Algeria and Tunis in 1883, to carry agricultural products, and used animal power only. The next road was built on a tea plantation, and it was used in the collection of tea leaves from the gardens. In 1886 Mr. Behr built in London the first mono-rail road upon which were operated steam locomotive and carriages. On this a gradient of one in ten existed, and the boilers of the locomotive was of the vertical type. In 1888 a mono-rail system between Listowel and Ballybunion, in Ireland, was opened and has worked ever since without a single claim for compensation for any accident. With the development of the automobile there is little call for a system in the first-mentioned field.

For elevated roads in towns, the mono-rail system would cost less, and not obstruct the traffic or light of the street nearly as much as any two-rail system. Substantial elevated construction can be had for from $200,000 to $500,000 per mile, the latter being for double track.

The most important field for the mono-rail system is in high-speed passenger express traffic. The traffic of the present has grown to enormous proportions, and is still increasing at so rapid a rate that when certain increased accommodations are finished, they are generally already outgrown. In England especially it is necessary to develop a high-speed system that can be adapted to the present rights of way, and as this system has in actual operation been run at a speed of eighty-five miles an hour around a curve of 1500 ft. radius, it is evident that this mono-rail road may be built on the same right of way of any of the existing steam roads.

The greatest difficulties now seem to arise on the ordinary roads in their attempts to run several classes of service of widely differ-

* Abstract of paper read at the International Congress of Electrical Engineers, Sept. 15, 1904, at St. Louis, Mo.

ing speeds on the same lines, and on these great lines it is found that the costs of working increase faster than would be explained by the increase in traffic. This additional increase in cost of working is due to the great amount of switching necessitated by mixing the high and the slow speed services. On many roads the passenger service does not pay expenses, and its only service to the company is its advertising value. Of course, the classes of service may be separated by building several ordinary tracks, but in many places the additional right of way is unobtainable, and even with such extra track the speed would be quite limited. With a mono-rail system elevated above the present tracks a speed of over a hundred miles an hour could be economically and safely maintained. Further, the adoption of these systems is cheaper in both first cost and operation. With such safe high-speed passenger express service a new impetus would be given to travel, and doubtless this service would become highly profitable, and at the same time lessen the costs of the freight traffic on the present tracks by in no way interfering with its movements. In the year 1901 the Midland Railway Company's switching reached the fabulous amount of fourteen million miles, and probably cost not less than thirty-five to forty cents per train mile. Usually, this service is very largely non-productive, yet some one must pay it, and the burden falls upon the freight shipper.

The cost for a system to run at 110 m. p. h. is slightly less than the cost of an ordinary two-rail track for a speed of 60 m. p. h.

In 1897 an elliptical track of about three and one-half miles circumference, with ends of 1500-ft. radius, was built for experimental purposes, and a 72-ton carriage operated at speeds varying from 110 to 84 m. p. h. The experiments were carried on for several months without accident.

A high-speed mono-rail between Manchester and Liverpool, a distance of thirty-four and one-half miles, is now under way. The speed is not to exceed 110 m. p. h. on a curve of 1800-ft. radius. Each train will consist of one car and will carry from forty to eighty passengers. Service will be given every ten minutes. The cost of running at 110 m. p. h. will not exceed 15 cents per train mile. Five per cent will be paid above expenses on the capital of fourteen and one-half million dollars provided an average of one-half full carrying capacity is maintained, with a charge of the same fare now existng, while an average of eighteen passengers per train will cover the whole expense of the undertaking. The train will, of course, be electrically operated. With the safety to passengers, together with very high speeds and economy of construction and operation, much is expected from the system.

ST. LOUIS TRANSIT EARNINGS

The monthly statement of the St. Louis Transit Company issued Oct. 5 shows the gross earnings for September to be $1,051,452. The gross earnings for September, 1903, were $635,109, showing a gain for the corresponding month this year of $416,342. The company's earnings have shown a steady increase since March, September being nearly half a million more than the third month of the year. March was notably ahead of September of last year, and officials of the company expect that October earnings will be larger than any month preceding it in 1904.

The earnings of the company for 1904, to date, are as follows:

January	$565,098
February	563,257
March	645,481
April	710,338
May	837,872
June	925,387
July	984,641
August	1,014,776
September	1,051,452
Total for year to date	$7,298,302
Increase nine months 1904, over entire year 1903	$38,845

Small stockholders of St. Louis Transit bonds say they will try to defeat the proposition for absorbing the St. Louis Transit Company by the United Railways. The small stockholders say that when voting begins Oct. 12, they will develop enough strength to defeat the absorption plan mentioned in this issue. One of their chief complaints is that if they want to hold approximately the same influence in the United Railways Company that they hold in the Transit Company, they will have to assess themselves. Many stockholders believe that the best plan is to refuse to acceed to the association proposal, and if necessary allow the Transit Company to go into bankruptcy. In that event the courts would care for their interests. Then the question of the tangible value of the stock would be settled.

COAL HANDLING AND WATTMETERS IN DENVER

John A. Beeler, general manager of the Denver City Tramway Company, was on a short business trip in New York recently. He stated that the Denver Consolidated Tramway Company is proposing to haul coal from the mines of the Leyden Coal Company, some 15 miles from Denver, into the city. To obtain the necessary authority a referendum vote must be taken and this will take place soon after the national election. The charter requires, for a referendum vote of this kind that 25 per cent of the number of voters at the last mayoralty election should request the Mayor to call for such a public expression of opinion. The requisite 25 per cent was secured in a week, as practically all the business men in Denver are in favor of this proposal. The electric haulage of coal will be a great boon to Denver, as it will reduce the cost of fuel in that city. The price per ton last winter was $5. The charter asked for by the company provides that it shall be prohibited from hauling coal which will cost more at retail at the point of delivery than $3.50 per ton of lignite. If granted the authority requested, the company will install a number of coal elevators and will provide motor cars to haul from 1000 to 2000 tons per day.

Another interesting experiment now being conducted in Denver is in the use of wattmeters on the cars. Sometime ago the company equipped fifteen of its long four-motor cars with wattmeters and conducted a series of tests as to the economy of current which could be secured with different men. The individual current records of the different men varied enormously, but show that with care a reduction of 50 per cent in the average power used could undoubtedly be secured. All the cars on one line have now been equipped with General Electric wattmeters, and the test will be continued.

THE DETROIT UNITED RAILWAY AS A PATRON OF MUSIC

Having succeeded on a former occasion in developing much of Detroit's latent poetical talent by giving prizes for the best verses on the merits of trolley riding, the Detroit United Railway has taken an even bolder step in its encouragement of the fine arts by offering $200 as a prize for the best words and music of a song that will symbolize fittingly the remarkable progress of the electric railway and its value to civilization. This composition need have no reference whatever to the Detroit United Railway. It may be general in character, applicable to any city or interurban system. It may be humorous or serious. The author is to retain the copyright of his composition. It is, however, to be dedicated to the Detroit United Railway, which company also retains the privilege of reproducing words and music in any publication and of using same in any advertising literature. The Detroit United Railway will sell no copies. Words and music may be the joint effort of two authors, but words must fit music. No unattached verses or music will be considered. Every contribution must be complete in this respect.

The task of judging the merit of the compositions and awarding the prize will be left to a committee of three of the most prominent musical authorities and artists in the State. They are Prof. Francis L. York, director of the Detroit Conservatory of Music; Harold Jarvis, Detroit's famous tenor, and Prof. E. R. Schremser, director of Schremser's Military Band and Orchestra. These gentlemen have agreed to serve as the tribunal of last resort. The competition is open to all, residents of any State or natives of any country. In view of the enormous number of contributions that will be received, several conditions must be observed. No names or addresses must appear upon any manuscript. A separate letter must accompany each contribution, which in the competition will be designated by a number. The music must not be too pretentious or the verses too voluminous. The competition will be open for several months, the precise time limit to be stated subsequently. All contributions must be mailed or delivered to John H. Fry, Detroit United Railway, 12 Woodward Avenue, Detroit, Mich.

A STREET RAILWAY COMPANY COLLECTS DAMAGES

At Elgin, Ill., recently the Elgin, Aurora & Southern Traction Company brought suit against a teamster who drove against one of the company's cars, and the company was able to recover $200 damages. This is one of the few instances on record in the United States where a transportation company has been able to collect damages in a case of this kind.

FINANCIAL INTELLIGENCE

Wall Street, October 12, 1904.

The Money Market

Although the banks have lost very heavily during the past week and the surplus reserve has fallen to $12,600,000 from $57,000,000 —the high point of the summer—money rates have so far hardened very little. Call loans are still easily obtainable at 2 per cent, the highest figure quoted for them having been 2½. Time money quotations have been advanced to 4 per cent from 3⅝ to 3¾ a week ago. The increasing activity is due partly to the rapid shrinkage of money supplies, and partly to the strong demand from Stock Exchange houses which wish to be as independent as possible of the fluctuating call money market expected during the next two and a half months. This inquiry has naturally directed itself chiefly toward maturities carrying over the first of the year. There has been very little business in sixty-day contracts. Commercial paper is quoted still at 4½ per cent for prime material, and is only moderately active. The most important incident of the week, apart from the heavy drain of cash, was the advance yesterday in the Bank of Germany's discount rate from 4½ to 5 per cent. This step, coming somewhat unexpectedly, found quick response in the markets both abroad and at home. Discounts went up at the continental centers and at London, and there was a simultaneous rise in all the sterling exchanges, our rates moving up 20 points from the low point From the German bank's action it must be inferred that the pressure for idle funds abroad is greater than the majority of financial observers have been reckoning upon. The importance of this disclosure to our home situation lies in its bearing upon the question of gold imports should they be needed to strengthen the local money position later on. Evidently our ability to draw at will from Europe hitherto unquestioned, is now open to serious doubt. This source of help being eliminated our market has to face the prospect of a further heavy outgo of currency to the harvest districts, with the only offset existing in the trust company deposits, which will be rendered available as soon as money rates advance. In this manner Clearing House bank loans will be reduced, and so will the reserve required to be kept against deposits. But that this agency alone will be enough of a counterbalance to the excessive withdrawals of interior cash, is extremely uncertain.

The Stock Market

The rise in prices has continued with no perceptible signs of slackening during the past week. There has been little change in the characteristics of the trading; nine-tenths of the daily transactions are initiated by the professional operators and by manipulation. Two facts lie at the bottom of all explanations for the persistent upward tendency. One is that the floating supply of stocks has been greatly reduced by the permanent removal of large blocks in furtherance of the great railway financial plans. The other is that nothing has occurred or seems to seriously threaten which might start a general selling movement. Yesterday's final report on the corn crop, following the high estimates given out for cotton on the first of the month, disposes of all uncertainty regarding the season's harvests. Taken all in all, there will be at least an average production which will be marketed at high prices, insuring another year of great prosperity for the farming sections. This in itself is extremely reassuring for the prospects of general business. In addition, however, are the specific accounts from the iron and other industries, that demand is picking up rapidly, and that the overproduction which existed up to a short while ago, is being steadily overcome. At a lower level of prices, these favorable features of the situation might fairly be regarded as sufficient reason for the market's upward tendency. Considering, however, both the unusual extent and duration of the present rise, amounting to from ten to twenty points since the beginning of the summer, it is fair to suggest that these evidences of recovery in outside trade have been fully discounted on the Stock Exchange. This impression is not diminished by the wholly artificial character of most of the present operations in the market. If there were not these two powerful circumstances to counsel caution, the enormously extended bank loan account, and the rapidly sinking bank reserves would be plain enough warning to the same end. It is hardly conceivable that the conditions set forth in the money market can keep on as they are now tending, without some sharp check to the demands of speculative borrowers.

Interest in the group of traction stocks has converged upon the rise in Brooklyn Rapid Transit, carrying the stock to new high prices for the year. This in common with most of the other operations of the day may be set down as a purely speculative movement. It has, nevertheless, a more substantial basis than the greater part of the current manipulation in the steadily improving earnings of the company. After the recent spectacular performances in the Metropolitan issues, the indications are that the pool is having the market entirely to itself. Even among the speculative element the whole position of these stocks is regarded as entirely too uncertain to warrant any ventures in them. The disposition is to leave them severely alone.

Philadelphia

Prices have been well maintained in the Philadelphia dealings of the week, and in some cases have gone higher. Consolidated Traction reached 75¼—the highest figure that the stock has ever sold. One thousand shares of it changed hands between 74¾ and 75, and another thousand at 75 and above. There was no explanation for the advance other than the satisfactory state of the company's earnings. Philadelphia Electric was another issue that made the highest quotation touched in some time past. It sold up from 6¾ to 7⅛, reaching later 7. American Railways did no more than hold steady at 47⅞ to 48. Union Traction was inactive at 56. About 1500 shares of Philadelphia Rapid Transit were dealt in, but the stock did not go above 15¼, nor below 15. Some strength was shown by Philadelphia Traction, which rose from 97⅝ to 98. There were also some scattered investment purchases of Thirteenth and Fifteenth Streets Passenger at 306, and Union Passenger Railway at 239½. On the other hand Philadelphia Company common, after advancing from 42½ to 43⅝, developed decided heaviness and fell back to 42¾. The preferred gained a point from 45 to 46, but reacted later to 45¾. Twenty-five shares of Reading Traction sold at 33½.

Chicago

The Chicago market has been dull during the week, and there is little to record about the movements of individual stocks. No sales have occurred in Union Traction, although 600 shares of the common sold yesterday in New York at 7½ to 7¾. City Railway dropped from 178 to 177 on sales of 75 shares. An odd lot of West Chicago was taken at 52. Among the elevated stocks, Metropolitan preferred was strong, odd lots selling as high as 63½. One trade, in the common, was made at 23½. South Side moved up a point on about 200 shares. Northwestern common sold at 23 and the preferred at 57¾. While it is regarded as a little too early to figure the average increase in traffic resulting out of the opening of the new terminal station in Fifth Avenue, officials of the Metropolitan Elevated say there has been a noticeable gain in the number of passengers carried, and what is more encouraging, the rush hour congestions seem to be greatly modified. One of the principal features of the new station will be the saving of one-half a cent on each passenger formerly paid to the loop. Under this plan the new business will represent an additional gain of 10 per cent in revenue.

Other Traction Securities

In Boston the feature of the week was the continued weakness in Massachusetts Electric preferred, reflecting the same anxiety that has been witnessed for some time over the financial position of the company. The stock fell from 57½ to 55 without encountering any resistance. The common kept distinctly steadier between 13½ and 13¾. Boston Elevated was dull and featureless between 153 and 153½, and the West End issues the same, the common between 91½ and 91¾, and the preferred between 111 and 110½. On the Baltimore Exchange the United Railways securities were inclined to be rather heavy again, particularly the income bonds, which eased off from 46⅛ to 45⅜. The general 4s declined from 90¾ to 90, but recovered to 90½. Four hundred shares of the stock sold between 7½ and 8. There was quite a little activity in the Norfolk Railway & Light 5s, which rose from 86 to 88½. Fifty shares of the stock sold at 10. Atlanta Street Railway 5s sold at 106¾, Augusta 5s at 101¾, City Suburban 5s (Baltimore) at 114¼, Anacostia & Potomac 5s at 102 to 102¾, and Newport News & Old Point 5s at 97½ to 98. There has been very little business in the tractions dealt in on the New York curb. Four thousand shares of Interborough

Rapid transit were traded in at a decline from 149 to 146¾. Fourteen hundred New Orleans common sold between 10 and 9½, 1100 St. Louis Transit between 8⅝ and 8, and 450 United Railways of St. Louis certificates at 22⅝ to 23¼. Washington Electric bonds went at 83½ and 83⅜, and the preferred stock between 72 and 72¾.

Detroit United featured at Cincinnati last week. About 2900 shares sold at a range of from 71 to 72⅛. Cincinnati Street Railway sold to the extent of 2400 shares at 145 and 145½, the old figures. Cincinnati, Newport & Covington preferred sold to the extent of 1500 shares at 93½ to 94. The common sold at 31⅝ to 32¼. Cincinnati & Hamilton Traction sold at 46 and 47½ on small sales. Toledo Railways & Light at 23½.

Northern Ohio Traction & Light featured in Cleveland. It has been inactive for many weeks at 13½ to 14. There was talk of a pool for buying. At any rate some 1200 shares sold in small lots, jumping the price to 15½. Northern Texas Traction sold at 39½ to 40 on small sales. Cleveland Electric sold at 73⅛ on small lots. Last week a Cleveland bank disposed of $104,000 of Aurora, Elgin & Chicago 5s to a local syndicate at 75 and accrued interest. They have sold lately at 77 in small lots, and this lot was disposed of to take care of creditors of a local bank which failed lately.

At Toledo last week there was strong upward movement on Toledo & Western Railway stock, which has been inactive for months at around 14. It opened the week at 14 and advanced steadily to 16½ on sales of about 2000 shares, all in small lots. Several lots of Toledo Railways & Light sold at 23½ to 24⅜.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with three weeks ago:

	Closing Bid	
	Sept. 20	Oct. 11
American Railways	47½	47½
Aurora, Elgin & Chicago	a13	—
Boston Elevated	153	153¼
Brooklyn Rapid Transit	54⅞	60¼
Chicago City	185	a177
Chicago Union Traction (common)	7½	7½
Chicago Union Traction (preferred)	36½	33
Cleveland Electric	72¾	73
Consolidated Traction of New Jersey	71½	74½
Consolidated Traction of New Jersey 5s	108½	109¾
Detroit United	66⅛	71
Interborough Rapid Transit	*145	146
Lake Shore Electric (preferred)	a16	—
Lake Street Elevated	3½	3½
Manhattan Railway	*152½	154⅜
Massachusetts Electric Cos. (common)	13	13½
Massachusetts Electric Cos. (preferred)	60	55
Metropolitan Elevated, Chicago (common)	20½	23½
Metropolitan Elevated, Chicago (preferred)	57	63
Metropolitan Street	121⅝	120⅝
Metropolitan Securities	80	82
New Orleans Railways (common)	10¾	9½
New Orleans Railways (preferred)	30	26
New Orleans Railways, 4½s	74½	76
North American	91	94½
Northern Ohio Traction & Light	a14	14⅛
Philadelphia Company (common)	41	42¾
Philadelphia Rapid Transit	15½	15
Philadelphia Traction	*97¾	98
St. Louis (common)	11	8
South Side Elevated (Chicago)	*89½	90
Third Avenue	125	128½
Twin City, Minneapolis (common)	96¾	102¾
Union Traction (Philadelphia)	56	55¾
United Railways, St. Louis (preferred)	55	62
West End (common)	92	91
West End (preferred)	110	110

a Asked.

Iron and Steel

The latest authentic advices from the iron industry leave no doubt that the tide has really turned in this quarter. Consumption of pig iron is increasing more rapidly than production. Orders are coming in more freely for the finished product The disposition among both buyers and sellers is to proceed very cautiously until the outlook is better defined, but there is no gainsaying the fact that sentiment in the trade is decidedly more cheerful, and that the improvement rests on a substantial basis. Quotations are as follows: Bessemer pig iron $12.50, Bessemer steel $19.50, steel rails $28.

Metals.

Quotations for the leading metals are as follows: Copper 13 cents, tin 28 cents, lead 4¼ cents and spelter 5 1-16 cents.

UNITED RAILWAYS COMPANY PLANS TO TAKE OVER ST. LOUIS TRANSIT COMPANY

At a meeting of the directors and large stockholders of the United Railways and St. Louis Transit Company, held in St. Louis Sept. 27, a plan for the reorganization of the finances of the latter company was agreed upon. The plan has been under consideration for a year past and involves the practical elimination of the Transit Company. Under it the United Railways Company will take over the management of the lines now composing the big system. Transit Company stockholders will be allowed to exchange their shares on the basis of five shares of the latter for two shares of United Railways common stock. Most of the latter are still in the company's treasury.

President Murray Carleton, of the United Railways Company, states that the reorganization contemplated no changes whatever in the operation of the lines composing the system. Capt. Robert McCulloch will remain as vice-president and general manager and there will be no curtailment of the service or reduction in force. On the contrary, Mr. Carleton declares the system will be kept fully up to the standard maintained by Capt. McCulloch since he assumed charge, and which has elicited the highest praise from visitors from all parts of the world. "Your street car service is not surpassed by that of any city I ever visited," has been the verdict of the millions who have come to the World's Fair.

As a result of the action taken at the meeting held Sept. 27, Mr. Carlton mailed to every stockholder of the Transit Company two documents, one containing an explicit statement of the financial affairs of the Transit Company and the other containing the terms of an offer made by a syndicate headed by Brown Brothers & Company, which has undertaken to effect the reorganization on the lines proposed. James Brown, of New York, a member of the firm, was in the city and attended the meetings.

The stockholders of the Transit Company are given until Oct. 18 to deposit their shares for exchange on the basis proposed. The National Bank of Commerce of St. Louis, is named as the agent of the syndicate to receive deposits of stock and applications for participation in the syndicate. It is expected that by Nov. 1 the new operating company will have assumed full charge. Last spring, just before the annual meetings of the United Railways and Transit Company, a receivership for the latter company was rumored. The threatened storm was averted at the time, however, and it was generally thought the company would be able to get through the World's Fair period without a reorganization. The earnings have, of course, shown an enormous increase since the Fair opened. For August they were in excess of $1,000,000. or about $300,000 greater than for August of 1903. The expenses have also greatly increased, especially for power and the employment of men and for repairs. About 450 new cars have also had to be purchased.

AN IMPORTANT HEARING IN PENNSYLVANIA

Argument was heard before Deputy Attorney General Flietz on Oct. 4, at Harrisburg, on the petition of the Danville & Sunbury Electric Street Railway Company for a writ of quo warranto directed against the Danville & Riverside Street Railway Company and the Danville & Bloomsburg Street Railway Company, requiring the latter to show cause why they should not be dispossessed of their charter rights on the ground that it is not legally in existence. A decision is not expected for some days. The case is a most important one to the street railway interests of the State in general, and involves about $250,000 already expended by the Danville & Bloomsburg Company, whose line was only opened for travel between those two points a few days ago. All the companies were chartered under the Focht Street Railway Act of 1901. It is alleged that the Danville & Riverside Company, a portion of whose route is now built upon by the Danville & Bloomsburg Company, received a franchise from Bloomsburg Borough, which required that work on the line be commenced within four months, and completed within twelve months. The Danville & Riverside Company agreed to this provision, but never complied with it. The Danville & Sunbury Company contends that this non-compliance terminates the privileges granted the Danville & Riverside Company under the railway act. It is also contended that as the latter's original charter granted the privilege of using 2500 ft. of the route of the Berwick & Bloomsburg Electric Railway Company, which clause in the Focht act the State Supreme Court has declared to be unconstitutional, the charter is therefore null and void. To this argument the Danville & Bloomsburg Company answers that because of the unconstitutionality of this clause, it was justified in getting out a charter for the same route before the two-year limit fixed by law had elapsed. The Danville & Sunbury Company secured its charter for the route after the expiration of the two-year limit.

MEETING OF THE METROPOLITAN STREET RAILWAY ASSOCIATION

The eighth anniversary meeting of the Metropolitan Street Railway Association of New York was held at Carnegie Hall, Oct. 1. This is a benevolent organization of the employees of the New York City Railway Company, and as usual the annual meeting was followed by a theatrical entertainment of more than usual quality, to which the families of the members were invited. The immense hall was crowded with spectators, among them the officers of the company, and a few invited guests of President Vreeland.

This organization is one of the most successful, as well as the largest of its kind in the country, and its treasurer's report for the past year indicates the following condition:

RECEIPTS

Cash on hand Sept. 19, 1903	$16,244.71
Dues collected	28,053.00
Initiation fees collected	1,849.00
Proceeds of ball, etc	6,128.22
Interest on deposits and investments	1,118.00
Receipts of pool room	1,681.16
Miscellaneous receipts, sale of lost property, etc	1,793.51
Total	$56,867.60

EXPENDITURES

Investments	$12,134.50
Sick benefits paid	17,556.00
Death claims paid	11,808.18
Medical fees paid	4,686.75
Sundry and contingent expenses	2,063.58
Expenses of pool room	714.55
Cash in bank Sept. 19, 1904	7,904.04
Total	$56,867.60

During the eight years of operation the association has paid out in sick benefits and death claims $140,644, and it has now an investment fund of $27,577.

In his annual address, President Vreeland said:

"It has been my habit in all the years we have been together to take up annually some topic that related intimately to us as a class, and I have always sought in discussing these topics to avoid the affairs of others who are engaged in activities in which we had no part. It is not my intention now to depart from this practice, the wisdom of which has been endorsed by experience; but I cannot avoid the inclination to say to you some things that have come to me during the year, when considering our affairs as a class, and contrasting them with those of other working men. It has been borne in on me with great frequency, during this past year, perhaps because it has been one of greater disturbance than usual among wage earners, that we have certain causes of congratulation denied to many quite as worthy as we are, and quite as anxious to do the right thing, if circumstances permitted. As I contrast the condition of the street surface railway men with that of men in other crafts, it has seemed to me that in constancy, steadiness, and remuneration, we have had much the better of many of our brothers. Many explanations suggested themselves why we have been thus favored. Many of them, it is true, related to ourselves, but my investigation brought me to the conclusion that the fundamental cause underlying all others was in the constancy of the employment and the unvarying demand made upon our labor by the work in which we are engaged. The duty of carrying the population of a great city like New York to and from its residence to its business, brooks no interruption of weather conditions. Men come and go, in summer heat and in winter frost, and while we know to our sorrow that a first-class snowstorm does interfere with headway, we are, nevertheless, called on to move along our appointed lines through such interruptions as the weather conditions and the truck drivers permit. While others are wasting time and wages in discussions about both, we manage to keep fairly busy, and the result is that on a day like this, marking an anniversary, we have cause to congratulate ourselves on the net financial results to us individually.

"I have lately had occasion elsewhere in discussing the growth of the class to which we belong, to comment on this steadiness of employment from another point of view, and I there took occasion to point out that in the city of New York, and in fact in many other cities, we are numerically as strong as the police force or the fire department, and that while both these great arms of the public service are called into play only to correct and save us from the consequences of irregularities and accidents in human affairs, like crimes and conflagrations, ours is a peaceful work that goes on as steadily as the hours accumulate. The whole business life of this city, as a matter of fact, depends upon our promptness and regularity.

"With the growth of this reliance there has come a great change in the public regard for street railway servants. It is not long ago that, ignorant of the efforts we were all making to improve the traveling facilities of the city, the employees of surface roads were taxed with willfully procuring the very conditions which prevented the successful and efficient operation of transportation lines. But education has gone on apace and now with official, as well as public, recognition of our efforts, we are near the end of many of our difficulties. Under all the criticism that has been ours, patience and persistence have won the day, and the public sentiment I have spoken of has undergone a marked change in our favor. I congratulate you on the growth of this respect, and cannot lose this occasion to say that it has been to me one of the most gratifying results of our labors together."

CHICAGO FRANCHISE MATTERS

A resolution looking toward municipal ownership of local traction properties in Chicago has been defeated by the City Council. This seems to indicate the probable passage of some kind of an extension ordinance. Despite this action, the advocates of municipal ownership are circulating a petition which is virtually an attempt to prevent the passage of any franchise ordinances so that the city can proceed at once to municipal ownership. None of the municipal ownership advocates, however, have proposed any feasible scheme whereby municipal ownership may be obtained sooner than under the proposed ordinance for the Chicago City Railway Company.

Progress toward the passage of a franchise ordinance for the Chicago City Railway Company has been stopped temporarily by the possibility of a consolidation of the Chicago City Company with the Chicago Union Traction Company.

The Chicago Union Traction Company has been notified to cease operation of cars on the lines covered by the old Chicago Passenger Railway franchise on Adams and Harrison Streets. This, of course, is a legal move to prevent the city from giving consent by silence to the occupancy of these streets after the date that the officers of the city claim the franchise expires.

ELECTRIC AND STEAM ROAD CROSSING

Judge Claybough, of the Clinton County Circuit Court, Frankfort, Ind., heard argument recently on the constitutionality of the law passed by the last Legislature in reference to the crossing of steam railroads by electric railways. The law prescribes the safety devices that shall be employed at such crossings and makes their installation subject to the approval of the State Auditor. The law was attacked by the attorneys for the Indianapolis & Northwestern Traction Company in the hearing of the petition of that company for an injunction to prevent the Monon Railway Company from tearing up the crossing at the Fair grounds near Frankfort. The point raised was that the State Auditor, not having judicial powers conferred by the constitution, could not serve in a judicial capacity in the administration of a law. The law in question says safety devices must be put in within six months after the crossing is effected. In the case now being tried the steam road is contending that the electric railway has forfeited its rights by failing to comply with the statute. Judge Claybough's decision will be the first judicial opinion on the constitutionality of the act.

PRESIDENT MELLEN'S REFERENCE TO ELECTRICITY

In his report to the stockholders of the New York, New Haven & Hartford Railroad for the year ended June 30, 1904, President Mellen, of the company, refers to the acquisition by the company of additional electric railway properties and to the trend toward electricity for suburban business that the present cost of this traffic with steam is making inevitable. After referring to the Consolidated Railway Company, the holding company to which all the electric railway properties of the New Haven Company have been transferred, he says that so far as the operation of the electric properties since their acquisition discloses anything, the investment appears to be a wise one. Going then to the question of suburban traffic, he says: "The present cost of doing the suburban business upon our lines is excessive, and it is only by increasing the volume largely we can hope for remuneration. To handle the same as at present is a burden, and to increase the volume and reduce cost through substitution of electricity for steam seems the only solution."

IMPROVEMENTS IN SAN FRANCISCO

In perhaps no other city in this country have more radical changes been made in its street railway service during the last two or three years than in San Francisco, Cal. There are several reasons which account for this condition of affairs. In the first place, San Francisco has always been, until recently, essentially a cable railway city, and while electricity was introduced on a small scale a number of years ago, the steep grades and the popularity of the cable made the operating company loth to make many radical changes in its system. Again, up to two years ago, there were a number of different railway companies in the city; and, although the Market Street Railway Company was the largest and most important, each of the other systems occupied an important position in the transportation system. About two years ago the four principal systems of the city were purchased by a syndicate headed by Brown Brothers & Company, of New York, and steps were taken to reconstruct the system in many ways and improve the service in every direction. George F. Chapman, at that time general superintendent of the North Jersey Street Railway Company, was appointed general manager of the consolidated company, which was given the title of "The United Railroads of San Francisco," and improvements have been carried on ever since that time. Mr. Chapman spent a few days in New York last week on business, and on his return trip to California attended the convention of the American Street Railway Association at St. Louis. In an interview with a representative of this paper, Mr. Chapman said:

G. F. CHAPMAN

"One of the new features which we have introduced on the United Railroads of San Francisco, and which has proved very popular with the public, is the running of all-night cars. Formerly the cars stopped running about 12:30 a. m. and commenced about 5:30 a. m. Now cars are run every half-hour through the night on a number of the lines and on a less headway on others. The service has proved a great success, and is much appreciated by the public. Another new feature which has proved very popular has been the enlargement of our system of transfers. Formerly transfers were given only between certain lines, and this not only caused a good deal of inconvenience, but led to a number of misunderstandings on the part of those who were not well acquainted with the transfer points. This system has been abolished and transfers are now given at all intersecting points. This enables people to travel in any one general direction for 5 cents all over the city. We do nothing with freight, but we operate funeral cars. We have had three funeral cars for several years, and have recently built an additional one. These funeral cars receive bodies at certain designated points where the standing of the car on the track will not interfere with the regular operation of the road. The funeral cars are divided into three parts, the first section is for the body; the second section is for the mourners, and the third section is for the others attending the funeral.

"In other directions also, the company has been making improvements. The changes in track construction have been principally in the direction of installing up-to-date hardened-steel special work in place of the ordinary cast-steel formerly used. In rolling stock we have adopted a standard car 40 ft. in length. These cars are of the well-known California type, with center closed section and end open sections. The former is fitted with longitudinal and the latter with cross-seats. There is a center aisle through the entire car, including both open and closed parts. A gate closes one entrance so that passengers can board the cars and alight on one side only. On our high-speed line between San Francisco and San Mateo we are using 45-ft. closed cars with cross seats. These cars are equipped with four G. E. 57 motors. This line is about 22 miles in length, and for a distance of 10¾ miles runs over its own private right-of-way, where a speed of 45 miles an hour is made. The cars make the trip from San Francisco to San Mateo in a little over one hour."

Mr. Chapman denied that the company was planning to abandon its remaining cable lines. Many of the grades surmounted by the present cable cars are as steep as 19 and 20 per cent, and ordinary electric cars could not be used on them. Electric cars, however, are used in ascending and descending grades as high as 14 per cent. Mr. Chapman attributed the success of the cars on these grades to the use of the track brake which has been developed to a high state of efficiency on the Pacific Coast. A large coefficient of friction is obtained between the track and the brake-shoe, owing to the fact that wooden shoes are used. These shoes are made of pine, and, although they wear out rapidly, they cost only a few cents and serve the purpose for which they were designed.

The company has recently put in a large power station for alternating current distribution, containing two 4000-hp engines connected with four 1250-kw generators of the General Electric type running at 13,200 volts. There are three sub-stations, two in San Francisco and one in Milbury. The company has now 257 miles of track, of which 55 miles are cable, 11 miles are steam, 5 miles are horse, and the balance are electric. The company is planning to change over the steam line to electricity during next summer. It will also erect some new shops next spring. Land for this purpose has been purchased in the outskirts of the city adjoining the Southern Pacific Railroad, and all overhauling, repairing and painting of cars will be done there.

REPORT OF SOUTH SIDE ELEVATED, CHICAGO

The annual report of the South Side Elevated Railroad Company, of Chicago, for the year ending June 30, as made to the Illinois Railroad & Warehouse Commission, shows increased receipts over last year of $145,721, while the operating expenses have increased but $91,971. The amount applicable to stock increased $31,971, although $15,000 more was charged off for depreciation than in the previous year. The total applicable to stock was $579,616, which amounts to 5.6 per cent on the outstanding issue. A good reduction was made in the ratio of operating expenses to gross earnings. The report of operations for the year ended June 30, 1904, with comparisons, is as follows:,

	1904	1903
Whole number passengers	32,916,280	30,074,457
Average daily	89,935	82,396
Earnings:		
Passenger	$1,645,814	$1,503,723
Advertising, etc.	45,028	41,398
Gross earnings	$1,690,842	$1,545,121
Expenses:		
Maintenance way	$66,874	$64,298
Maintenance equipment	134,724	122,867
Conducting transportation	434,952	388,730
Loop rent and expenses	222,525	196,019
General	89,023	84,213
Totals	$948,098	$856,127
Net earnings	742,744	688,944
Other income	10,167	9,922
Total income	$752,911	$698,916
Charges:		
Bond interest	$33,750	$33,750
Taxes	74,545	66,845
Depreciation	65,000	50,000
Miscellaneous	.....	676
Totals	$173,295	$151,271
Balance for stock	579,616	547,645
Dividends	412,952	412,952
Surplus	$166,664	$134,693
Per cent expenses to gross earnings (including loop)	55.7	56.9

The condensed balance sheet of June 30, 1904, shows the beginning of construction work and the capital expansion connected with it. The balance sheet, with comparisons, is as follows:

ASSETS	1904	1903
Cost road and equipment	$12,399,534	$11,999,518
Stocks owned	92,400	92,400
Cash and current account	44,565	28,475
Materials and supplies	42,301	23,357
Other assets	576,845	170,316
	$13,155,645	$12,314,066
LIABILITIES		
Capital stock	$10,323,800	$10,323,800
Funded debt	1,225,000	860,000
Various accounts	89,895	177,709
Bills payable	356,000	.....
Reserve	41,729	.....
Profit and loss	1,119,221	952,557
	$13,155,645	$12,314,066

PRELIMINARY REPORT ON ELECTRIC RAILWAY TESTS AT ST. LOUIS

Prof. H. H. Norris, superintendent of electric railway tests at St. Louis, has reported to the Electric Railway Test Commission the present status of the work of the testing corps, and has made certain suggestions as to the prospects of conducting further tests successfully.

Experimental work has now been completed on the following: Hunt storage battery locomotive; impedance of rails, bars and pipe with alternating current, of different frequencies and current densities; stationary air-compressing plant installed by the Ingersoll-Sergeant Drill Company; car air compressor of the National Electric Company in regular service; storage air brake system of the Westinghouse Traction Brake Company; car tests upon the new cars furnished by the St. Louis Transit Company. All tests were made under different track and weather conditions. There are also in progress upon the test tracks investigations upon the performance of the car exhibited by the Westinghouse Traction Brake Company, fitted with Westinghouse motors and magnetic brakes.

The data collected during these tests are very complete and they are being carefully worked up by the testing corps. The deductions are being put into useful and attractive form and several of the reports are now practically ready for publication. Definite assurances have been received from all the companies regarding the loan of equipment for the proposed air and train resistance measurements outlined in the last report of Prof. Norris. The designs have been completed for the special apparatus and the universal opinion among those consulted in regard to the matter is that the tests will be very valuable, and that they are entirely practicable. The companies promising co-operation are as follows:

J. G. Brill Company, car body; Pressed Steel Car Company, flat car; Baldwin-Westinghouse Companies, electrically equipped truck; Moffett Railway Bearing Company; American Car & Foundry Company, special axles and wheels; Dodge Manufacturing Company, bearings; Indiana Union Traction Company, power, track and assistance.

Prof. Norris also reports that the companies have responded well to requests for information regarding present practice in American car building. A large number of forms have been returned and these will be compiled into a report upon the subject, which should be authoritative and interesting.

MIAMI & ERIE CANAL LITIGATION

The investigation into the affairs of the Miami & Erie Canal Transportation Company has again been held up. The plaintiffs who are endeavoring to secure the names of stockholders, that they may be assessed for stockholder's liability, subpœnaed all the stock brokers in Cleveland and demanded that they testify as to the transactions in the stock of this company. The brokers refused to testify without legal advice, and the court gave them fifteen days in which to submit their objections. Harry Probasco, of Cincinnati, who represents Cincinnati interests, supposed to be adverse to the canal company, and who has been enjoined from taking depositions in the case on his own account, as he attempted to do, has presented a mandamus petition to the Circuit Court to require Judge Dissette of the Common Pleas Court to show by what right he had issued the injunction against Probasco's proceedings. In the meantime the committee representing the bondholders is redoubling its efforts to settle the claims against the canal company. They are also endeavoring to work out the plan of raising $350,000 by an assessment on the stockholders and bondholders to pay off the indebtedness and complete the property into Dayton. The failure to operate the canal-boats since the company became embarrassed has resulted in the formation of sand bars in the canal in a number of places, which adds to the complications.

NEW PUBLICATIONS

Self-Propelled Vehicles. By J. E. Homans. Second edition; 672 pages. Price, $2. Published by Theo. Audel & Company, New York.

In presenting the new edition of this work, the publishers announce that the book has been thoroughly revised and, in large part, rewritten. The general principles of automobile construction and operation, including steering devices, underframes, wheels, tires, bearings and lubricators, are included in the opening chapters. Then follows an exhaustive account of the theory, construction and operation of gas engines, occupying over 100 pages. Several typical engines are taken up and discussed separately, and their properties, as regards balance, speed and power, are discussed in the light of fundamental principles. Probably the most interesting feature of the entire work is the extensive chapter devoted to the description of leading types of gasoline vehicles, including the most important of American build. In this chapter the reader is informed as to the details of the transmission and control apparatus in each case. The chapters on electric vehicles are very complete and certain to prove of practical use to the owner and chauffeur. Electricity meters are described and illustrated in a brief chapter, and the principles underlying storage batteries, their construction and care are outlined. An index at the close of the book puts the entire contents into "ready reference" shape.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

UNITED STATES PATENTS ISSUED SEPT. 27, 1904

770,737. Third-Rail for Electric Railways; Albert F. Chase, Haddonfield, N. J. App. filed March 17, 1904. An inverted rail provided with superposed flanges or wings which shield the contact surface of the rail from the weather.

770,744. Trolley; Samuel Fisher and Albert Sanders, Butler, Pa. App. filed June 27, 1903. A pair of pivoted arms extending above the trolley wheel carry guard wheels adapted to retain the wire in the groove of the wheel; they can be opened by pulling on a cord attached to the arms.

770,886. Controller Apparatus; Patrick S. Barrett, Scranton, Pa. App. filed Feb. 4, 1904. Novel automatic means for periodically arresting the controller-lever in its rotation in order to prevent the too rapid movement of the said lever by the operator, thereby insuring the gradual application of current to the motor.

770,901. Fare Register Rod Operating Handle; Albert H. Hall, Quincy, Mass. Application filed Feb. 1, 1904. A two-part handle encircling the rod, a bolt for clamping said parts together, a tooth formed on the bolt and means for forcing the too into the rod as the parts of the handle are clamped together.

770,911. Third-Rail System; Leslie M. La Barr, Forest City, Pa. App. filed June 22, 1904. Details.

771,027. Signaling System for Electrically Operated Railways; Lewis B. Stillwell, Lakewood, N. J., and Henry Latey, New York, N. Y. App. filed May 18, 1904. Located at various sections along the roadway are signal boxes containing push buttons or similar devices which, when actuated, notify the attendant at sub-stations to cut off the power from a corresponding section of the road.

771,193. Electromagnetic Traction Device and Emergency Brake; Charles A. Wells, Chicago, Ill. App. filed May 11, 1903. A magnet core mounted at one end upon the wheel axle carries a shoe at the other end which may be held slightly above the rail, so that when energized the attraction of the shoe for the rail will add to the pressure of the wheel upon the rail, or the shoe may be allowed to rest upon the rail and furnish an emergency brake.

771,197. Brake-Shoe; Horace L. Winslow, Chicago, Ill. App. filed Feb. 9, 1904. Details of a metal-insert brake-shoe.

771,206. Trolley-Wheel Controller; Benjamin F. Jackson, Boston, Mass. App. filed Aug. 15, 1902. Details.

UNITED STATES PATENTS ISSUED OCT. 4, 1904

771,234. Railway Switch; Edwin F. Davis, Springfield, N. Y. App. filed Feb. 25, 1904. An arm carried by the car and having a cam mounted thereon is so arranged that it may be inclined to cause one edge or the other of the cam to engage with a lever in the roadbed to throw the switch.

771,295. Lighting Electric Trolleys; Walter Burling, Grand Rapids, Mich. App. filed July 11, 1904. When the wheel leaves the trolley wire, a lamp mounted on the trolley pole is lighted.

771,329. Fender or Guard; Frank H. Seavy, Medford, Mass. App. filed March 7, 1903. A fender adapted to move bodily toward the tracks, a device to hold the fender in its elevated position, an auxiliary guard in front of the main guard having rods or bars secured thereto and extended through the main guard to engage said holding device.

771,334. Third-Rail Insulator; Samuel B. Stewart, Jr., Schenectady, N. Y. App. filed May 31, 1902. The insulator is U-shaped and attached to the tie at its bend, its upper ends sustaining the conducting and pick-up rails respectively.

771,423. Trolley Wheel; Joseph N. Drake, Cincinnati, Ohio. App. filed Dec. 15, 1903. A spring mounted in the harp, permitting a swiveling movement of the wheel upon the pole, but tending to keep the wheel in an upright position.

771,472. Trolley Harp; John Hensley, Huntington, Ind. App. filed May 5, 1904. Contact washers carried on the end of contact springs are held by clips so that they will not be lost when the wheel is removed.

771,476. Car Fender; Frederick R. Keith, Randolph, Mass. App.

filed Feb. 3, 1904. The fender is normally elevated and has a nose-bar in advance thereof. Whenever the nose-bar strikes an obstruction, the fender is caused to drop, and in so doing automatically cuts out the motor and applies the air-brake.

771,523. Circuit Controller for Electrically Propelled Vehicles; Bert Aikman, Chicago, Ill. App. filed Aug. 31, 1903. Comprises an electromagnetically controlled detent automatically thrown into position to lock the controller upon the occasion of abnormal ground upon the motive apparatus.

771,529. Semi-Convertible Car; John A. Brill, Philadelphia, Pa. App. filed Jan. 25, 1904. Details of construction .

771,533. Electric Railway; Alexander Churchward, New York, N. Y. App. filed Feb. 20, 1903. A block-system in which the rear section of the sectional conductor is deprived of current when a car or train is on the next section in advance.

771,539. Means for Applying Sand to Tracks; Thomas F. Doyle, and William E. Tice, Chicago, Ill. App. filed Feb. 19, 1904. Means whereby sand is applied to the tracks automatically by the setting of the brakes.

771,545. Car Fender; Jacob Happel, Middletown, Ky. App. filed Dec. 13, 1902. Consists of a frame pivotally suspended from the frame of a car, a friction-roller supported in bearings mounted on said frame and adapted to engage the periphery of the car-wheel, a roller provided with bristles journaled in the forward end of the frame and means for transmitting motion from the friction-roller to said forward roller.

771,563. Trolley Catcher; William M. McArthur, Lockport, N. Y. App. filed May 16, 1904. When the trolley pole rises after leaving the wire, air is applied to a system which moves a rack and winds up a drum over which the trolley cord passes.

771,785. Electric Railway System; William G. Lowrie, New York, N. Y. App. filed June 21, 1901. An armature carrying contact devices runs in the closed conduit in contact with two rails therein and is drawn along by a magnet carried by the car and presented to the roadbed.

PERSONAL MENTION

MR. JOHN CLIFFORD, superintendent of the Wilkesbarre & Wyoming Valley Traction Company, has resigned.

MR. JOHN YOUNG, manager of the Glasgow municipal street railway system, has been appointed manager of the underground system in London controlled by Mr. Yerkes.

MR. JOHN F. STAIR, president of the Trinidad Electric Company, and a resident of Halifax, N. S., is dead. Mr. Stair was one of the richest men in Nova Scotia, and was prominent in banking and railroad circles.

MR. FRANK N. WILCOX, a prominent attorney of Cleveland, died a few days ago. He was identified with a number of traction propositions in a legal way and was attorney for the Mandelbaum syndicate of Cleveland.

MR. GEORGE W. TRACY, for four years superintendent of the Camden, Gloucester & Woodbury Railway Company, of Gloucester, N. J., has resigned from the company to accept a more lucrative position in another part of the State.

MR. J. DESMET MAGUIRE has resigned his position as special representative of the National Electric Company, of Milwaukee, to assume the presidency of the American Electric & Controller Company, with headquarters in New York.

MR. OSCAR G. POUCH has been appointed superintendent of the Orange County Traction Company, of Newburg, N. Y., to succeed Mr. William H. Pouch, who formerly held the positions of superintendent and manager, and who will continue to perform the duties of the latter office.

MR. R. B. KENT, who has been vice-president and secretary of the Atlas Railway Supply Company, of Chicago, has been in the East for the past six weeks recuperating from a severe nervous indisposition. He has been negotiating with large Eastern capitalists for the purpose of forming an organization to manufacture railway supplies and, on consummating his arrangements, expects to be located within the next few weeks. Mr. Kent will be the head and managing officer of the organization.

MR. L. E. FISCHER, manager of the Danville, Urbana & Champaign Electric Railway, has recently been appointed manager of the Illinois Central Traction Company, and of the Springfield & St. Louis Railway Company. These lines connect the cities of Danville, Urbana, Champaign, Decatur, Springfield and Bloomington with St. Louis, and extend from east to west across the State of Illinois. The company also controls the city lines in these towns, and Mr. Fisher wil have charge of their operation as well His headquarters will be in Danville, Ill.

MR. HENRY C. PAYNE, postmaster-general of the United States, and formerly president of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis., and the president of the American Street Railway Association in 1893-94, died Tuesday, Oct. 4, at his apartment in the Arlington Hotel, Washington. Mr. Payne had many important business connections, and had long been prominent in public life, especially in Milwaukee and the State of Wisconsin. He was born in Ashfield, Mass., on Nov. 23, 1843, and graduated at the Shelburne Falls Academy in 1859. At the age of twenty he went West to grow up with the country. He concluded to settle in Milwaukee, and a short time after he arrived there he secured a position with a dry goods company. He kept the place four years, when he married Miss Lydia Van Dyke. He continued in the dry goods business until 1872, when he entered politics. Successively, he became secretary and president of the Young Men's Republican Club, of Milwaukee; secretary and chairman of the Republican county committee of his county; secretary and chairman of the Republican State central committee; member of the Republican national committee from 1880; delegate to the national Republican conventions, 1888 to 1904; postmaster of Milwaukee, 1876 to 1886; vice-chairman of the Republican national committee, 1896 to 1901, and Postmaster-General, succeeding Mr. Charles Emory Smith, from Dec. 17, 1901, until he died. As stated before, Mr. Payne's political activity did not prevent his succeeding equally well in business. In 1886 he organized the Wisconsin Telephone Company. This company was later taken over by the Bell Telephone Company. From 1890 to 1895 he was receiver of the Northern Pacific Railway. He was instrumental in consolidating the street railways and electric lighting plants of Milwaukee into the Milwaukee Electric Railway & Light Company, and was president of the company until quite recently. A portrait of Mr. Payne was published in the last issue of the STREET RAILWAY JOURNAL.

MR. FRANK HEDLEY, who, since Jan. 1, 1903, has been superintendent of the Interborough Rapid Transit Company, of New York, controlling the elevated and the subway lines in that city, has just been appointed general manager of the company. This is an extremely important position, carrying with it grave responsibilities, and the appointment is the highest tribute that could possibly be paid to the genius of the man who has so successfully carried out every detail of his office as superintendent of the company and more especially the peculiar work incident to the building of the underground railroad. The Manhattan Railway, the elevated division of the Interborough Company, is the most congested as regards traffic of any system in the world, with the most limited terminal facilities, also the most exacting conditions as regards the operation of trains. Upon Mr. Hedley will devolve not only the management of this system, but the duty of solving the untried and complex operating problems of the subway. Mr. Hedley is by profession a mechanical engineer, and comes of a family prominently connected with steam railroad and locomotive engineering in England. His grand-uncle, William Hedley, was the designer and builder of the first locomotive traction engine ever built. It was in 1882 that Mr. Hedley came to this country. He engaged with the Erie Railroad as a machinist in its Jersey City shops, and later became connected with the Manhattan Elevated Railway in New York. After serving five and a half years with this company, he accepted the position of master mechanic of the Kings County Elevated Railroad in Brooklyn, where he remained more than three years. Then began the series of achievements in Chicago that finally resulted in his appointment to the position of general superintendent of the Interborough Company, of New York. His first work in Chicago was as superintendent of motive power and transportation of the Lake Street Elevated Railroad. It was under his supervision that the operation of this road was begun. In 1894 and 1895 the construction of the Northwestern Elevated Railroad was begun, and during all the construction Mr. Hedley was on the consulting engineering staff, in addition to his duties as superintendent of the Lake Street Elevated. After the completion of the elevated lines, he acted as general superintendent of the operation of the companies.

FRANK HEDLEY