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During 1906 the Street Railway Journal printed and circulated 426,950 copies, an average of 8210 copies per week. Of this issue 8500 copies are printed.

The Elevated Shops and Terminals of the Brooklyn Rapid Transit Company

We take pleasure in presenting in this number the first of several articles dealing with the elevated railway shop and terminal construction and operating practice of the Brooklyn Rapid Transit Company as developed within the last two years. It is a noteworthy and creditable fact that all of the plans were prepared and carried out by the company's regular engineering staff. A perusal of the first article will show that, in line with other progressive companies, the Brooklyn management has given a great deal of attention to fire prevention. This is clear from the extensive use of concrete for the buildings, the fire walls in the car yards, the isolated storage of combustible material, the inside alarm system, the shop fire brigade, etc. Other features are the excellent natural lighting of the East New York plant, the means of pit and shop heating and numerous other minor improvements, many of which are applicable elsewhere under almost any conditions.

Considered from the shop standpoint, the East New York installation, in addition to being thoroughly up to date in the exclusive use of electric drive for machine tools, is one of the most comprehensive manufacturing plants so far undertaken by an electric railway company. It is thus an example of the tendency of the larger companies to follow steam railroad practice in the manufacture of numerous parts which do not require a series of complex processes. While this is a feature more likely to claim the attention of like-sized railways, there are many commendable devices and methods of doing things in both plants that will appeal with equal interest to the management of the smaller railway companies.

Electricity for General Railway Service

The Institute paper of Messrs. Stillwell and Putnam, printed this week, is an interesting addition to the already somewhat large literature of the subject. For at least the last ten years engineers have been persistently discussing the advantages of replacing steam by electricity for motive power for ordinary railways. A large number of estimates have been from time to time published, showing quite uniformly a material saving by the proposed change, a saving irrespective of any gains in traffic which might reasonably be expected on account of change in motive power. So far as we recollect, the only adverse estimates have been some in which the authors practically demanded that the electric locomotive should not only do the work of the steam locomotive, but should also be a steam locomotive in all essential properties. Putting aside such extraordinary requirements on the one hand, and excessive estimates of saving on the other, there still remains a great mass of evidence gathered independently by thoroughly competent engineers, and all points directly to the same conclusion.

The present estimate differs from those which have been previously published chiefly in its minuteness of detail and in the fact that it deals with the whole scope of transportation, while most of the previous estimates have been based chiefly on passenger traffic. Passenger traffic, of course, responds so generously to increased facilities that it is a very promising field for electric traction. Freight traffic, on the other hand, involving as it does the hauling of very large amounts of goods at relatively low speeds, has not, until rather recently, been considered favorable for electric locomotives. Within the last decade, however, there has been a great widening in point of view in respect to freight haulage; and, too, freight traffic on railroads has changed radically in the direction of bigger locomotives, larger cars and longer trains. Forty or 50-ton locomotives have been replaced by those of 100 to 125 tons; cars of 10 and 15 tons capacity have been abandoned for those of three times this capacity, and with relatively much less dead weight than the smaller cars. The saving of labor secured by running one long train instead of several small ones has developed co-ordinately with the general simplification of operating conditions due to the same causes. The electric locomotive, with its enormous possibilities of concentrating great hauling power in a single unit, and of simultaneous control of tractive effort at different points in the train, lends itself with a special readiness to this modern view of economical haulage. It also, through superior simplicity, should have a very material advantage in cost of maintenance. Upon this point the estimate of the authors, 2½ cents per locomotive-mile, seems conservative for electric locomotives used in what might be called normal railway traffic.

In their general analysis of operating expenses of electric and steam operation, to which the greater part of the paper is devoted, the authors have used the Interstate Commerce Commission's classification of accounts, and for their figures the general averages published by the commission. The treatment is, therefore, quite different from that which has been followed by previous authors in selecting some road as an example and from the existing conditions building up a hypothetical table of operating expenses under electrical conditions. Although the roads thus included are characterized by wide differences in density of traffic, the resulting figures have the considerable value which always pertains to averages of this kind. From the comparison thus secured, Messrs. Stillwell and Putnam arrive at the conclusion that the saving in operating expenses through changing over to electric operation would considerably more than compensate for the increased fixed charges. The net gain for the entire country averages several hundred dollars per mile of line per year, on a total mileage of nearly 217,000. Evidently in the districts of dense traffic like the Middle States, Middle West and New England, there is far greater opportunity for saving than in the regions of scarcer traffic, in as much as the fixed charges would be relatively much less. In the case of some districts the saving is dubious, but the conclusion on the whole is more favorable to electric traction than we would suppose probable at first thought. This saving, of course, is entirely apart from the advantage gained from increased output of tracks and stations and gain in traffic from the better service afforded,—factors of far greater importance, as shown by repeated instances, than any direct saving in cost.

These estimates are extremely striking, as showing the possibilities of electrical operation upon a very large scale, and some of the figures with respect to the aggregate plant required are somewhat startling. Messrs. Stillwell and Putnam figure the aggregate power house capacity should be capable of supplying continuously 2,100,000 kw. At present prices, nearly a billion and a half dollars' worth of copper, steel and concrete for the overhead construction would be necessary, even at the high voltage recommended, and the electric locomotives would run up to another three-quarters of a billion, assuming the premise of the authors that one electric locomotive will do the work of two steam locomotives. Add to this sum three hundred million more for power plants, including reserve capacity, and one gets a striking idea of some of the material difficulties involved in a complete change of motive power. But changes such as these do not take place in a day. Rather, they gradually spread the total expense over a period of many years. If, twenty years ago, anyone had predicted the total capital invested in electric railways at the present time, he would have been regarded as a fit subject for the madhouse. Another twenty years may go far toward justifying a most optimistic prediction regarding the general use of electricity on railways. For the present, the main thing is to take advantage of the many good opportunities for changing of motive power that are even now offered, leaving to the future the growth of the art. If the experiments now under way turn out well the future will justify itself.

The discussion upon the paper was confined to the electrical rather than to the economic questions raised by the authors, and for the greater part centered around the radical suggestion contained in the paper in favor of a lower frequency. Upon this point there was a striking unanimity of opinion that, assuming single-phase operation, fifteen cycles should be used instead of twenty-five. The debt of the electrical interests to Mr. Stillwell in reducing the frequencies prevalent in the past were eloquently set forth by Mr. Lamme, and a great step forward will be made in future electric railway development if his recommendations are followed in this particular. A gain of approximately one-third in draw-bar pull is a matter not lightly to be disregarded, and while the lower frequency may increase to some extent the cost of other parts of the installation, any such disadvantages are very much more than offset by the greater simplicity and lower cost secured in the rolling stock equipment by ability to increase the power capacity of the motors.

Wiring in Car Shops

The wiring problem in the car shop involves much the same restrictions in regard to fire risks that are encountered in any modern industrial structure, but after the insurance rules have been complied with there remain several other considerations which must be settled before a satisfactory installation can be made. Where the 600-volt trolley wire is carried into the shop over tracks extending from the car house proper, special care is needed to prevent the falling of the exposed conductor upon the machinery beneath, because the most disastrous short-circuits may easily occur in case the overhead construction fails. The use of pipe conduit in pit wiring is quite as desirable to prevent mechanical abrasion of circuits as to forestall fires. Convenience of wiring also is worth taking many pains to secure, with respect to the regular and special work of the shop.

Shop wiring must be inconspicuous and yet quickly accessible, if it is to be of the greatest service. Assuming that the proper sizes of wire have been figured for the different circuits, the problem is to so dispose of the wires that they will not in any way obstruct the movement of machines, materials and employees. Properly installed circuits need very little attention, but when taps are taken off the old lines for new machines it is exceedingly inconvenient and troublesome if the wires are more or less covered by bar iron, brake-shoes, spare coils of motors, shovels and other articles whose storage rights have not been determined. It ought to be easy to follow the course of every shop power, lighting or heating circuit all through each department where it is carried without climbing up on barrels, tool racks and other impedimenta. Sometimes the concealment of circuits arises from the overcrowding of the shops, but if the wires are run in straight lines with 90-deg. bends as high up on the walls away from the floor as is feasible in each shop, the chance of interference can be vastly reduced. As far as possible it is better to wire direct-connected motors on individually driven machines by iron conduit rising from the floor than by dropping connections from overhead. The value of the air space above machine tools for crane and hoist work in facilitating the movement of the work is still far from realized in many shops.

Most street railway repair shops are equipped with quite a number of special circuits controlled by scattered switches. Pit, bench, machine and general lighting, all need to be subdivided to get the best results, and especially to avoid needless burning of lamps and waste of current where no work is being done; electric heaters in sand drying and armature or field coil ovens require separate switches for their control; blower motors, portable motors with flexible cable attachments, and various test circuits are cut in or out at odd places—and in general there is not much co-ordination of the switches. In many instances the shop wiring would be simplified by grouping auxiliary switches on a panel at some central point, and if red pilot lamps of low candle-power were installed at this common center of control, there would be less consumption of current from forgetfulness in shutting it off at isolated points. Auxiliary circuits in power houses are more and more coming to be controlled from the main or a special switchboard, and the practice might well be followed in many a shop which at present is hampered by its illogically arranged power and lighting circuits.

Reducing Power Losses in Repair Shops

The amount of power needed to operate the machine tools of a large street railway repair shop is often less than the combined horse-power rating of the motors of a single quadruple car equipment, so that at first sight it does not seem worth while to go to much trouble to reduce waste in this item. The larger problems of cutting down line losses, improving the economy of power plants and sub-stations, and of decreasing the power consumption of the rolling stock under different schedule conditions are rightfully given the places of importance in the work of the motive power superintendent and his assistants, but after all, a vast amount of good can be accomplished by looking into some of the numerous loose ends of the shop routine in the way of rainy-day jobs.

In work of this kind it is not always a question of decreased net waste of power or material which is most profitable in the long run. A broader advantage in "jacking up the low spots" of shop practice occurs through the improved morale of the whole establishment which results from the betterment of small things. It is well for the executive officer to remember that, while minor details look insignificant from his commanding point of view, which takes in the whole field, these same minute particulars loom large in the eye of the individual machinist or helper. Far better work will be done in a repair shop where the men feel that the company stands ready to provide them with all reasonable equipment and material than in one where out-of-date appliances and scantily-filled supply bins attest the parsimony of the management in the conduct of maintenance.

Few of the smaller street railway shops are equipped with motive power in anything but the most haphazard fashion. As was pointed out above, the power needed is ordinarily small—sometimes a 10-hp or 15-hp motor will drive all the tools used in repairing the cars of a road 40 or 50 miles long. The natural custom is to gather in either a second-hand railway motor which has seen its best days or to acquire some cast-off shunt motor of prehistoric design, couple it up to the shop system by a general scheme of group driving, tie in the circuit breaker and let things go.

A course of this kind may be the best solution of the problem of driving the repair shop in case the motor can be purchased at bargain prices and provided there is considerable chance that in the near future the shop facilities will be largely extended. It is better to have a reserve capacity of 5 hp or 10 hp in the shop motor if a single machine is to drive future shop equipment as well as the present installation, but it is a question if something better than such an extreme case of group driving is not available for large shops, considering the advances lately made in the design of motors of direct driving. By separating the shop tools into even two or three groups there is no doubt but that a more efficient system can be secured. A 20-hp motor running the present shop constantly at one-quarter to one-half its rating will waste more power than a couple of 10-hp machines, or better, four 5-hp units arranged to drive certain tools in simple, compact groups only when they are needed.

These power losses in the shop are greatly aggravated by errors in the arrangement of belts, pulleys, shafts and hangers. Friction losses in the shafting system seriously reduce the capacity of a given motor to handle increased machinery. Unless the hangers are installed as near as possible to the pulleys the resulting bending of the shaft will shorten the life of the equipment and greatly increase the idle losses. It is for this reason better practice to install the motor in the center of the group of tools which it drives, as regards shafting. Tight belts are also a source of much trouble and wasted power. Unless the pulleys are of reasonably large diameter for the work in hand the belt wear and friction losses are bound to be excessive. Lack of attention to the oil supply, bearings out of line and other mechanical defects need to be especially looked after in the driving of street railway shops. In some cases the wiring is too small for the amount of power consumed by the motors, or inferior makeshifts in the way of switches and terminals are used. All these little points need to be watched, for quite aside from the question of power loss is the danger of breakdowns in the shop on account of improper loading of the equipment. The tendency now is to keep cars in the shop as little of the time as is possible, and interruptions in the work of repairs are too costly to be justified by the preventable failures of shop motive power.

THE ELEVATED SHOPS AND TERMINALS OF THE BROOKLYN RAPID TRANSIT COMPANY—ORGANIZATION AND GENERAL LAYOUT AT EAST NEW YORK

Within the past year the Brooklyn Rapid Transit Company has placed in service two model plants for the elevated railway work of its mechanical department. The larger of these installations is at East New York and includes manufacturing for other divisions, while the smaller one at Thirty-Sixth Street, South Brooklyn, is simply an inspection and maintenance shop. An interesting feature common to both installations is the fact that they are located on grounds which served for older plants. At East New

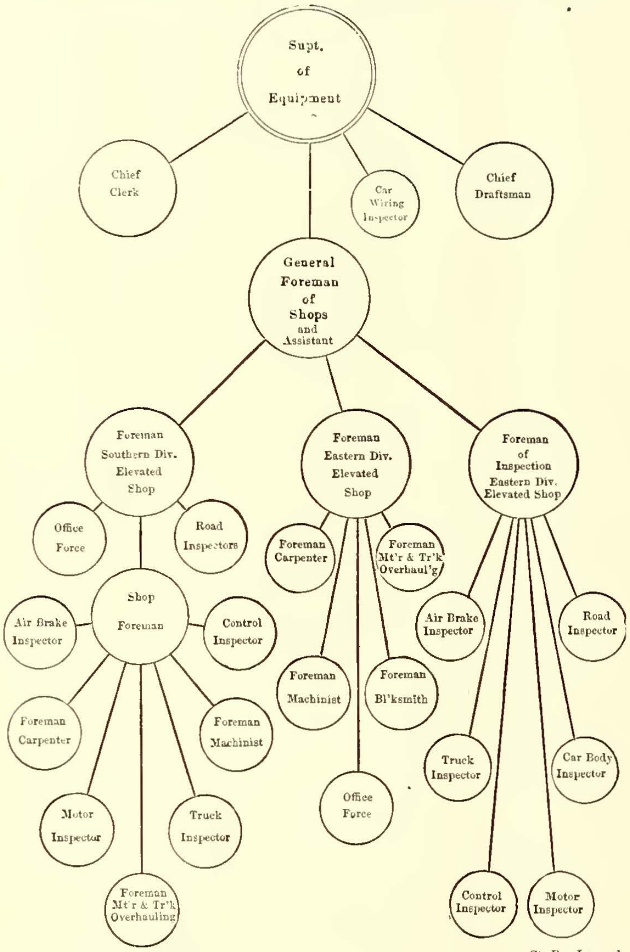


FIG. 1.—CHART SHOWING THE ORGANIZATION OF THE ELEVATED RAILWAY DIVISION, UNDER THE SUPERINTENDENT OF EQUIPMENT, BROOKLYN RAPID TRANSIT COMPANY

York an entirely new set of buildings had to be erected, but at Thirty-Sixth Street it was found possible to remodel as a part of the new plant the terminal station of the old Prospect Park & Coney Island Railroad, which is now a portion of the Brooklyn Rapid Transit system. As the inspection and maintenance methods of the two plants do not differ materially, it will not be necessary to describe the Thirty-Sixth Street shop in detail, emphasizing only such features as involve departures from the slightly earlier installation at East New York.

The reorganization and development of the shop system of the Brooklyn Rapid Transit Company has been under the direction of William G. Gove, superintendent of equipment in charge of the mechanical department. Mr. Gove was formerly connected with the Cincinnati Street Railway Company and with the Boston Elevated Railway Company in charge of the construction and equipment of their first elevated cars. He is a member of the American Society of Civil Engineers. While assistant mechanical engineer of the Brooklyn Rapid Transit Company he advanced ideas governing the construction of these shop plants, laid out the building arrangement and planned the machinery equipment throughout. The design of the buildings and the yard layouts was carried out in the office of the chief engineer. The chart presented in Fig. 1 will give a clear idea of the organization required for the operation of the two elevated plants described in this article.

THE EAST NEW YORK PLANT

A study of the splendid elevated railway shops and terminal yard at East New York reveals that they deserve a high place among electric railway engineering exploits, irrespective of their great size. Like other railways operating in cities where desirable locations are dear, the Brooklyn Company has been obliged to use a piece of ground far from ideal in its configuration. This drawback, however, proved an excellent incentive for the development of novel track and building ar-

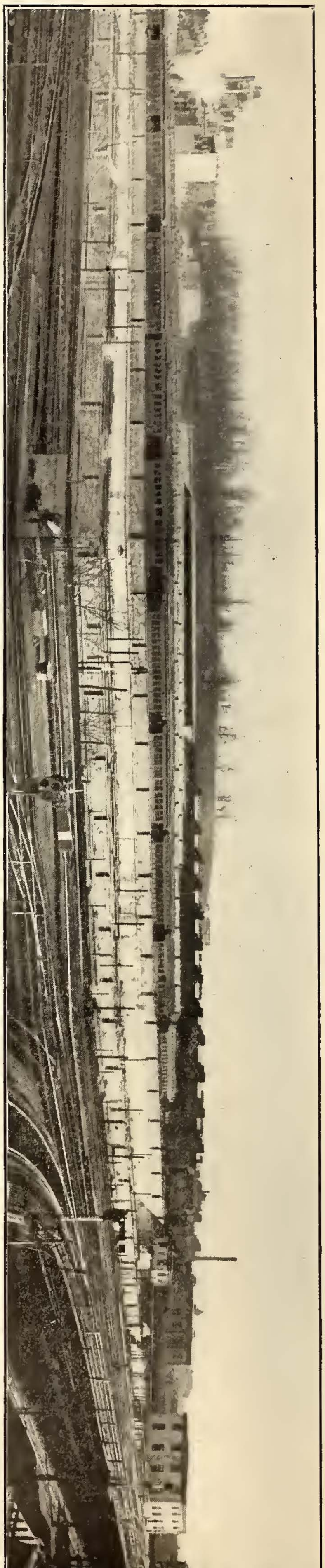


FIG. 2.—THE EAST NEW YORK PLANT AS SEEN FROM THE DOUBLE-Y ELEVATED TRACK ENTRANCE

rangements best suited to the conditions, while the necessity of incorporating with the new machinery many tools used in former shops gave further opportunities for the solution of shop problems. In fact, so many interesting points have been worked out successfully in the construction, equipment and operation of this plant that both large and small traction companies will find here more than one feature worthy of their acceptance.

The equipment of this plant is very extensive, embracing all the necessary provisions for the repair and overhauling of the elevated rolling stock and equipment, and for manufacturing the greater part of the car supplies for both elevated and surface departments.

THE LOCATION

In the June 3, 1905, issue of the STREET RAILWAY JOURNAL an article was published giving the preliminary plans in connection with this plant. Since the work as actually carried out differs in several details from the original specifications, Fig. 3 should be referred to as it shows the general layout exactly as it exists to-day. From this illustration it will be seen that the shop and storage grounds are bounded by Broadway, Fulton Street, Gillen Place and Bushwick Avenue, at the junction of the Broadway and Fulton Street surface and elevated lines. The plot between Gillen Place and Fanchon Place is occupied by a surface car house and a new rubbish incinerator plant,

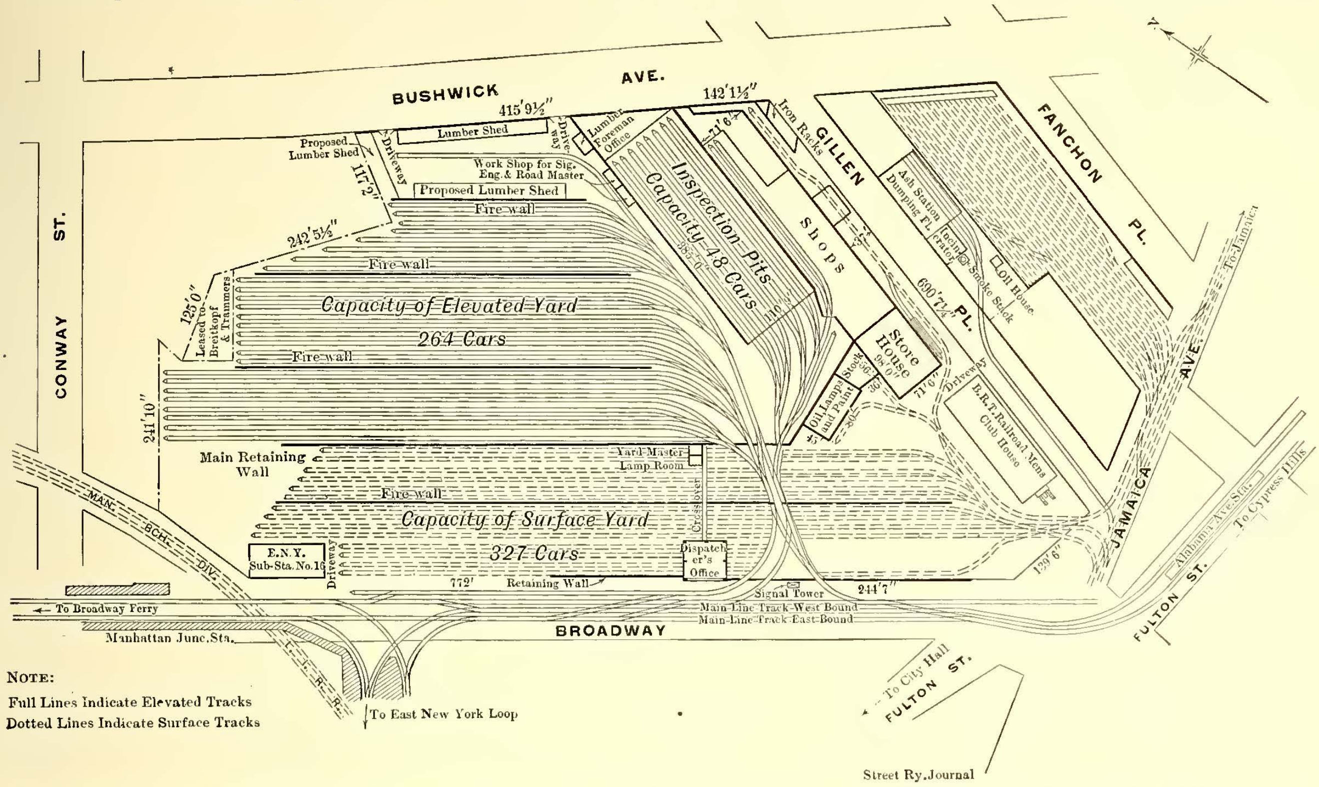


FIG. 3.—GENERAL LAY-OUT OF THE TRACKS AND BUILDINGS OF THE EAST NEW YORK INSTALLATION

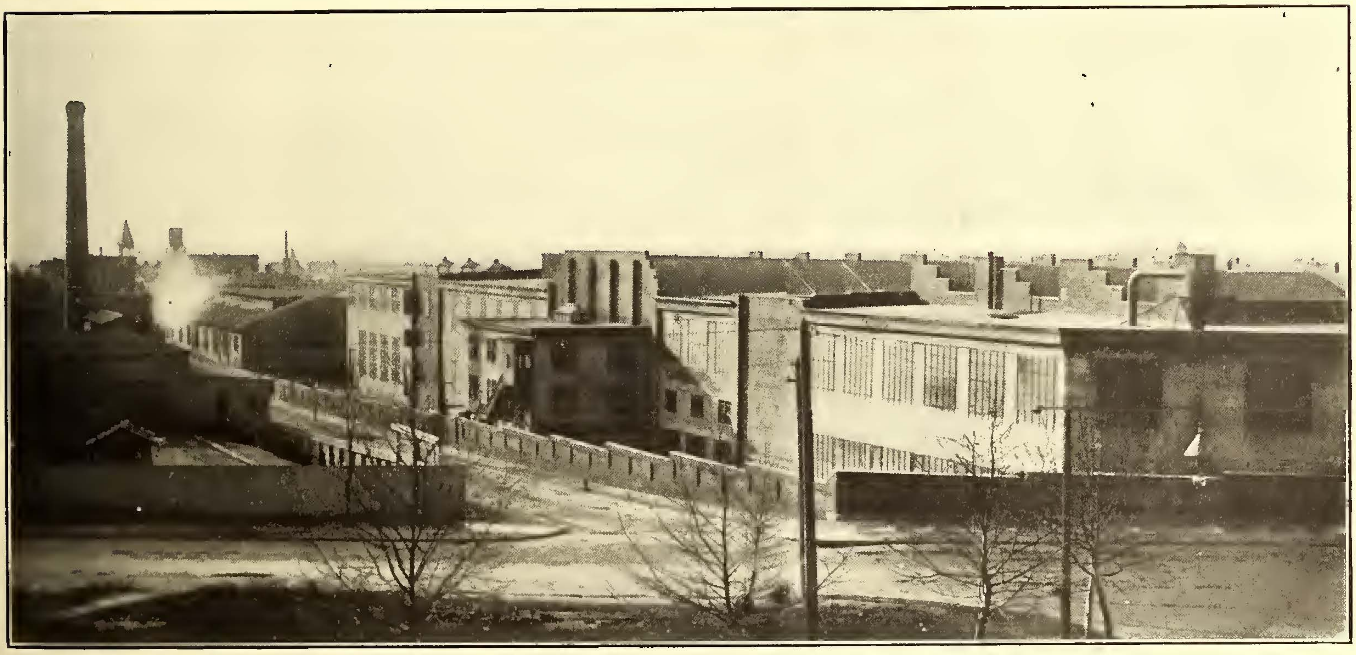
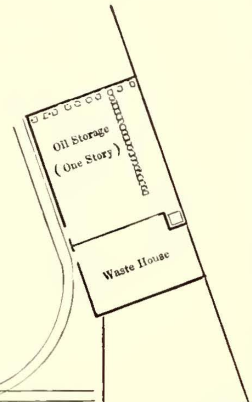


FIG. 4.—GENERAL VIEW FROM BUSHWICK AVENUE, OF THE INCINERATOR PLANT (AT THE LEFT), SHOP BUILDINGS AND CLUBHOUSE AT EAST NEW YORK

which is operated by the company in connection with its refuse removal contracts with the Borough of Brooklyn.

Owing to the fact that there is a difference in level of 27.5 ft. between the Fulton Street corner and the rear of the property on Bushwick Avenue, it was found possible to convert the greater part of the plot into a two-story car storage yard, using the rest of the land along Gillen Place and Bushwick Avenue for the shop buildings. To accomplish this purpose a concrete retaining wall was built along the location indicated, and enough filling-in was done at the rear to bring that portion up to the same higher or elevated railway



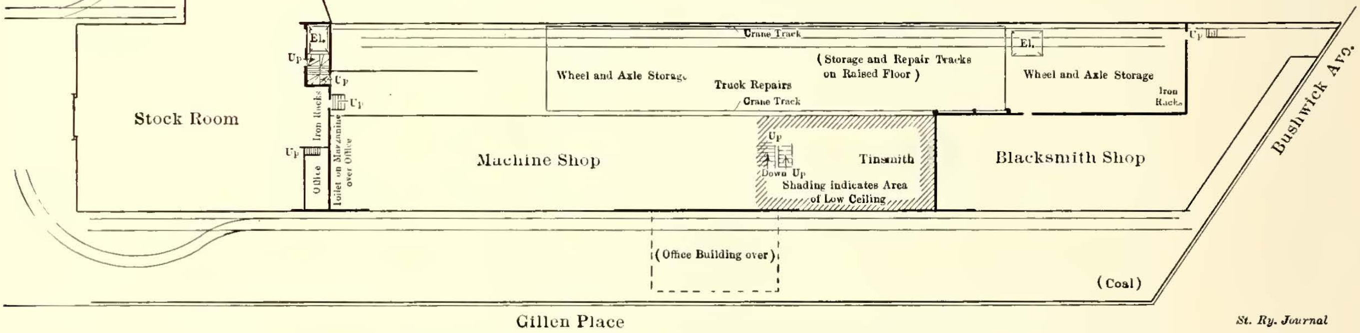


FIG. 5.—LAYOUT OF FIRST FLOOR OF MAIN SHOP BUILDING AND STORAGE HOUSES, SHOWING THE LOCATION OF THE DEPARTMENTS, SURFACE SUPPLY TRACK, ETC.

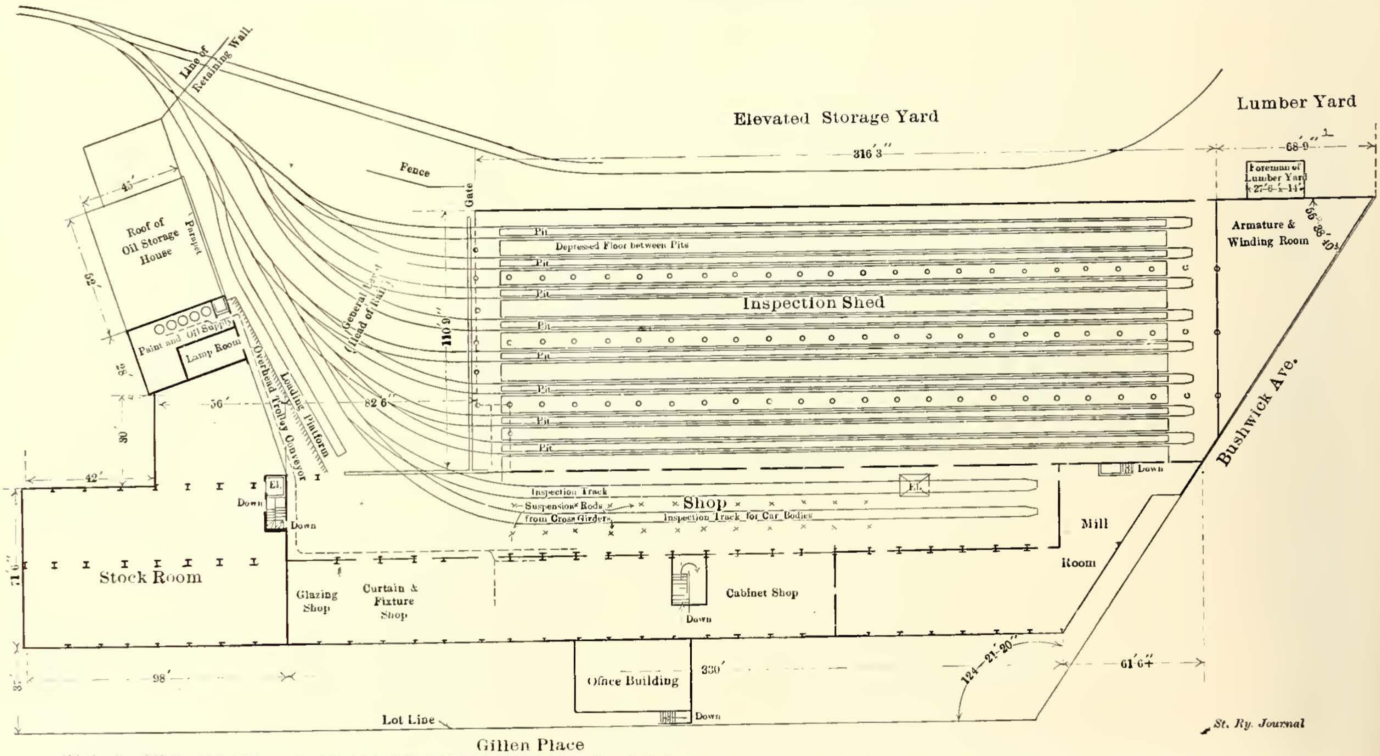


FIG. 6.—SECOND-FLOOR PLAN OF THE EAST NEW YORK SHOP AND STORAGE BUILDINGS, AND OF THE ELEVATED RAILWAY TRACKS

level throughout, while leaving the remainder for the surface-car storage flush with Broadway. This wall runs for 771 ft., extending almost the entire length of the yard, and then turns northeast for about 165 ft. and northwest for 389 ft. to form one of the walls of the inspection shop. The yard portion of this wall has its coping about 18 ft. above the footing. It is 9 ft. wide at the base and about 2 ft. 3 ins. at the top. There is a second retaining wall along Broadway, which is 475 ft. long, about 4 ft. high and 2 ft. 6 ins. thick at the base and 1 ft. 6 ins. at the top.

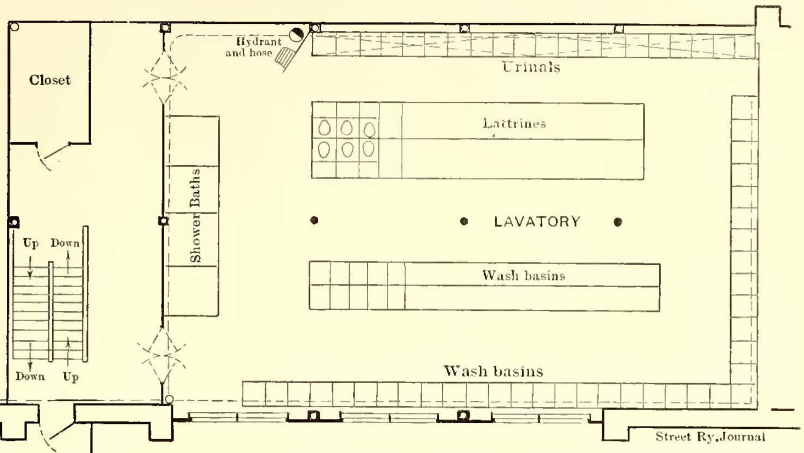
TRACK ARRANGEMENT

Fig. 3 also shows the complete track layout, the surface lines in the yard being indicated by dotted lines and the elevated railway tracks by full lines. The surface connection to the street is made at the corner of Fulton Street and Broadway, with the spur tracks leading to the Broadway surface line. In all, there are fourteen surface-car storage tracks, with a total capacity of 327 40-ft. cars. There is also one surface track running along Gillen Place with short branches to the stock rooms. This track is used for shop purposes only.

The entrance and exit of all elevated trains from the Broadway and Fulton Street lines is effected by a double Y track connection, which passes over the main retaining wall. From the right of this Y a branch leads to the eight tracks in the inspection shed. The regular elevated storage tracks, which are on the left, number twenty-six, with a total capacity of 264 standard elevated cars. There are eight inspection tracks with a capacity of 48 cars and one delivery track running alongside the inspection shed to the lumber storage yard on Bushwick Avenue. An interesting feature is presented in the arrangement of the elevated storage tracks, as on them inspected outgoing trains can wait until required by the operating department. As the inspection shop can accommodate eight six-car trains at a time, its large capacity makes it quite an exception to keep uninspected cars on the storage tracks.

ARRANGEMENT OF BUILDINGS

The shop building, proper, is a two-story structure 37 ft. from Gillen Place and parallel thereto. It is built in two bays, each about 35 ft. wide and 330 ft. long. In the east bay of the upper floor, on the same level with the elevated railway tracks, are located all of the departments doing work on car bodies, such as the carpenter, paint, glazing and mill shops;



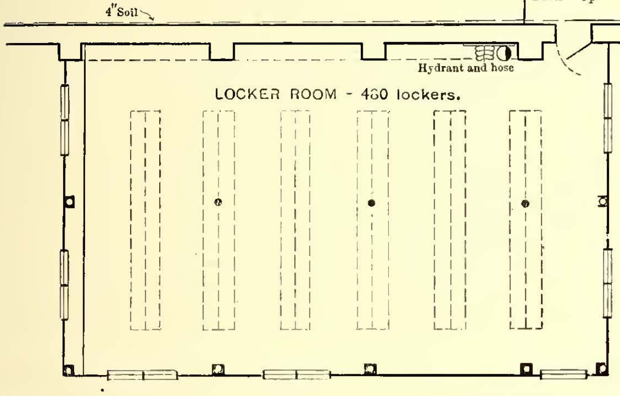


FIG. 7.—PLAN OF THE MEZZANINE FLOOR OF THE SHOP, USED AS A LAVATORY AND TOILET ROOM, AND OF THE LOCKER ROOM, ON THE SAME LEVEL, CONSTITUTING THE LOWER FLOOR OF THE OFFICE BUILDING

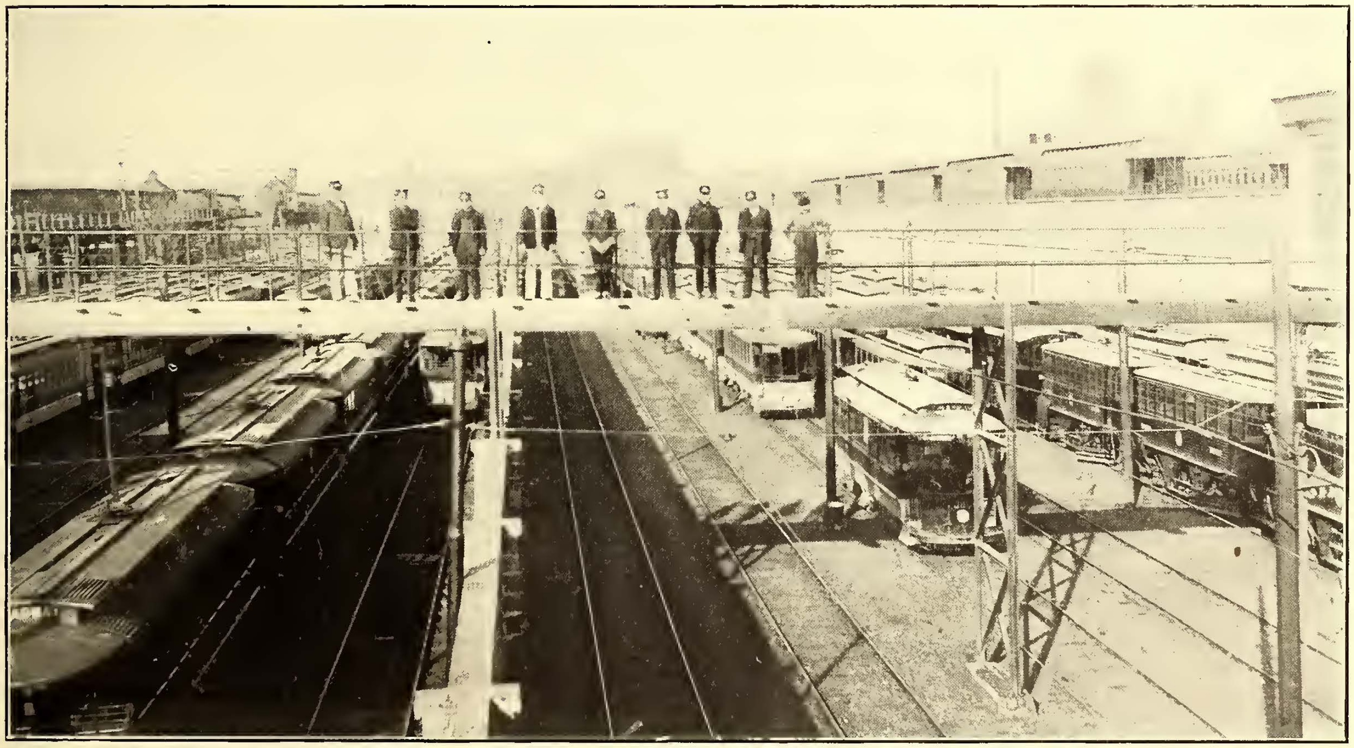


FIG. 8.—BRIDGE FROM THE ELEVATED TRAIN DISPATCHER'S BUILDING, CROSSING THE SURFACE-CAR STORAGE YARD TO THE ELEVATED CAR STORAGE YARD AND TRACKS TO INSPECTION BUILDING

the west bay is occupied by two tracks, one of which leads to the elevator to the floor below. The truck-overhauling shop is on the west side, and the machine and blacksmith sections on the east side of the lower floor. The blacksmith shop is directly under the mill room, and both of these departments are separated from the rest of the building by a brick fire-wall. Between the floors is a mezzanine gallery 15 ft. above the machine-shop level for the main lavatories and toilet. This gallery projects 32 ft. 6 ins. from the shop building proper, and form a room under the offices for the employees' lockers. As this projecting wing rests on steel columns it does not interfere with the supply surface track running alongside the shop building. Access to the offices from the street or Gillen Place is obtained by an outside stairway. The interior iron stairway of this building is of the two-way type.

The inspection shop lies between the elevated storage yard and the second floor of the main shop building. The triangular portion between the rear of this shop and the Bushwick Avenue side serves as a room for coil baking and winding. Adjoining this room is the lumber storage shed and yard, which is bounded by the last fire-wall of the elevated car-storage yard.

In line with the main shop building is a two-story stock

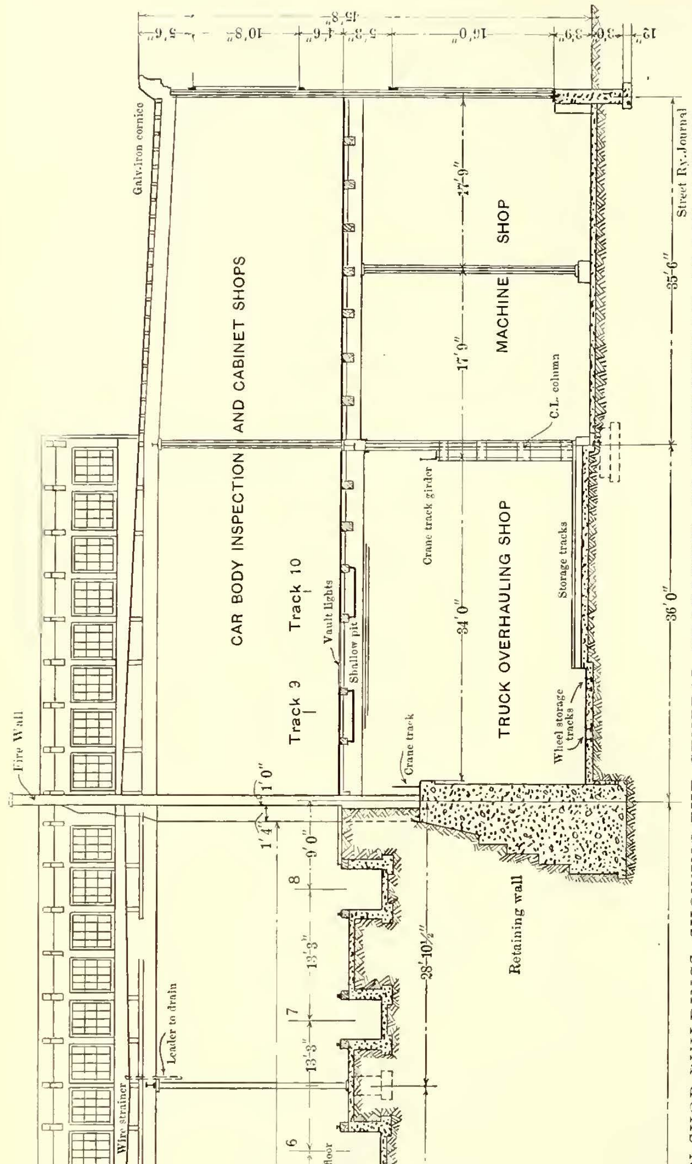


FIG. 9.—TRANSVERSE SECTION THROUGH THE INSPECTION AND MAIN SHOP BUILDINGS, SHOWING THE GENERAL CHARACTER OF CONSTRUCTION, FLOOR LEVELS, TRACK LAYOUTS, ETC. THE MEZZANINE FLOOR OF THE SHOP BUILDING IS NOT SHOWN ON THIS SECTION

room 98 ft. long, in addition to the other store rooms alongside of the tracks, leading to the inspection shed and the coal and iron store rooms on the Gillen Place side near the blacksmith shop. The office of the foreman of the inspection shop is directly before the oil room and in front of the inspection shed. This location makes it easy for him to view everything going on in the yard, besides enabling his clerks to check cars in and out of the shops with the least labor.

The remaining buildings on this plot, aside from the club house of the Brooklyn Rapid Transit Employees' Benefit Association, embrace a despatcher's office and a signal tower at the double Y elevated connection in addition to a new sub-station in the rear of the first four storage tracks.

CONSTRUCTION OF BUILDINGS

A notable feature of this installation is the fact that not a single building of the shop group is of wooden construction, the club house over 37 ft. distant from the main shop building constituting the only adjacent fire risk. All of the main foundation walls and building piers are of concrete. The walls of the main shop, except the retaining wall separating it from the inspection shop, are constructed of steel columns built up of angle-iron frames in cement to form a 2-in. curtain wall. The windows are on the Gillen Place and Bushwick Avenue sides. They have metal frames and sash made by the A. E. Rendle Company, of New York. Each set of windows is opened by turning a hand wheel connected to a rod having a worm at its middle and top portions to mesh with half gears controlling the degree of opening.

The shop, the inspection shed and the armature room have a roof of the saw-tooth type with wood and steel framing. This roof is covered on the steep portions with Johns-Manville asbestos roofiing, and on the flat portions with tar and slag. The main storehouse in line with the shop has the same structural features as the latter, with pivoted side lights. The oil, lamp and paint-storage room has brick walls, concrete floors and a reinforced concrete roof. Between the inspection and storage tracks is placed the yardmaster's office, which is built on steel columns with steel and cement walls.

The trainmaster's building is two stories high, having its lower floor level with the elevated track. It rests on steel columns and has walls of the same construction as the main shop. This building contains offices for the superintendent of the division, signal engineer, the roadmaster of the elevated lines, trainmen's quarters and locker rooms. It is connected by a steel foot bridge with the elevated yard. The signal tower for this elevated yard is a steel concrete structure, from which all trains are controlled through an all-electric interlocking plant, installed by the Union Switch & Signal Company.

FIRE WALLS AND OTHER FIRE PROTECTION

It is apparent from what has been said about the general type of building construction prevalent at the East New York plant, that the fire risk has been greatly minimized. In fact, careful study was given to this question by the company with such success that the insurance premiums in force here are probably the lowest in this country for an electric railway shop installation.

Fire protection in the storage yard was given equal attention as is shown by the construction of fire walls in both the elevated and surface-car yards to isolate the cars in smaller groups and thus prevent a fire in one section doing damage to the cars in the others. The tracks in the surface yard are divided by a hollow-tile fire wall 8 ins. thick, constructed with 12-in. square buttressed piers every 20 ft. to a height of 15 ft. The elevated-car yard is divided into three divisions. One of the fire walls is 6 ft. high and is built on top of the main retaining wall, thus effectually preventing a fire in one yard being carried over to the other. The fire wall in the rear of the "L" car-storage yard separates this yard from the lumber storage shed and yard along Bushwick Avenue. These fire walls are similar to the one in the surface yard. The entire westerly wall of the inspection shed also serves as a fire barrier between the main elevated and storage yard and the inspection shop.

The fire protection of the buildings is by no means confined to the larger methods of construction. All wall openings are protected by double, automatic fire doors. There are also fire dampers in the pipes of the heating system, which close automatically in case of fire and so prevent fire drafts being carried through the different pipes. Danger from the oil tanks is obviated by keeping them 3 ft. under the ground on the Gillen Place side, outside of the building. The brick oil building, next to the main store room, has cement floors and ceilings and is an absolutely fireproof structure with no interior lighting.

Every precaution has been taken also to make an immediately effective fight against the spread of a fire. The human element for this purpose is embodied in the company's own fire brigade, organized for this shop. This brigade consists of a chief, an assistant and about twenty-five men, who are ready for service any time during the day. These men are drilled semi-monthly in the use of ax, hose, pails, fire extinguishers, etc. The fire apparatus installed throughout the plant consists of standpipes, extinguishers and pails. In addition there are a number of "Manhattan" fire-alarm boxes in different parts of the buildings, all connected to the city fire-alarm box outside the office building.

THE HEATING SYSTEM

Without question, the utilization of an incinerator plant for shop heating purposes is a unique development among American electric railways for which the Brooklyn Rapid Transit Company's engineers deserve great credit. The rubbish incinerator plant, thus exploited, is operated by the American Railways Traffic Company, which is a subsidiary corporation having a contract with the city to remove ashes, rubbish and other material. As much of this matter is burnable the company hit upon the sensible scheme of erecting an incinerator plant to furnish at a very low cost all the steam required for heating the shops. A 400-hp plant was therefore installed on the opposite side of Gillen Place on the plot shown in Fig. 3, on page 171.

Steam from this plant is conducted through seven insulated wrought-iron pipes in a concrete-supported trench extending under the street where they divide as follows: One 3-in. pipe 570 ft. long to the club-room heaters; one 3/4-in. extra heavy pipe 245 ft. long to the club-room baths; one 5-in. pipe 185 ft. long to the office-building heaters with a 3-in. branch to the blacksmith shop and the inspection-shed heaters located in the armature room; one 2-in. pipe 230 ft. long from the heater discharge tank on the office floor; one 3-in. extra heavy pipe 315 ft. long for conveying live steam to the hammers in the blacksmith shop, and from which a 1-in. branch is led to a copper heating coil placed in the 300-gallon tank supplying hot water to the shower baths and wash basins. The pipes are laid with a slope of 1/8 in. in 12 ins. toward the incinerator. All pipes 2 ins. or more in diameter have flanged fittings, except the return pipes from the heaters, which have fittings. Every pipe is insu-

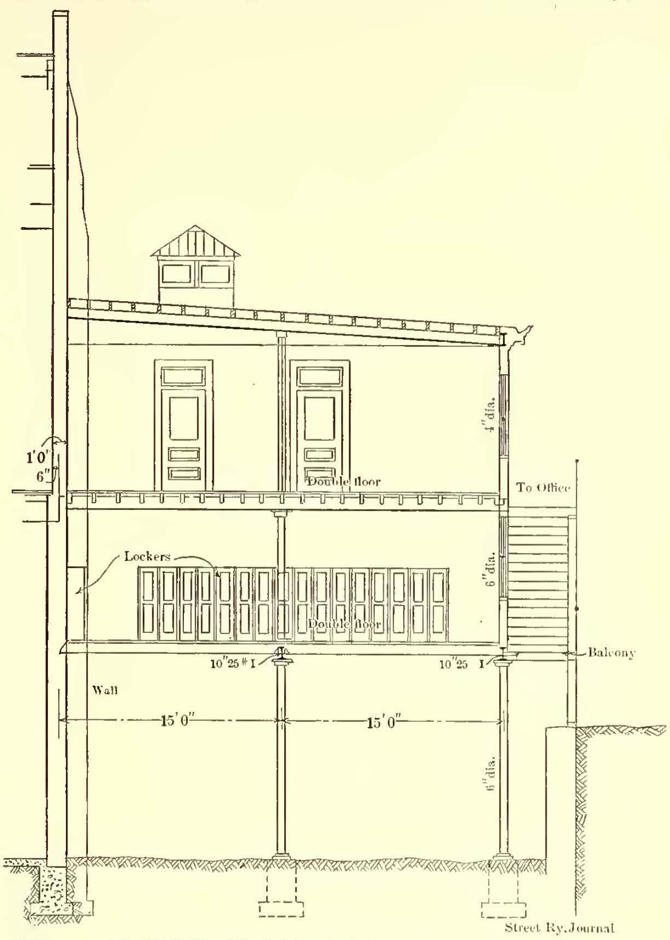


FIG. 10.—TRANSVERSE SECTION OF THE OFFICE BUILDING PROJECTING FROM THE MAIN-SHOP STRUCTURE

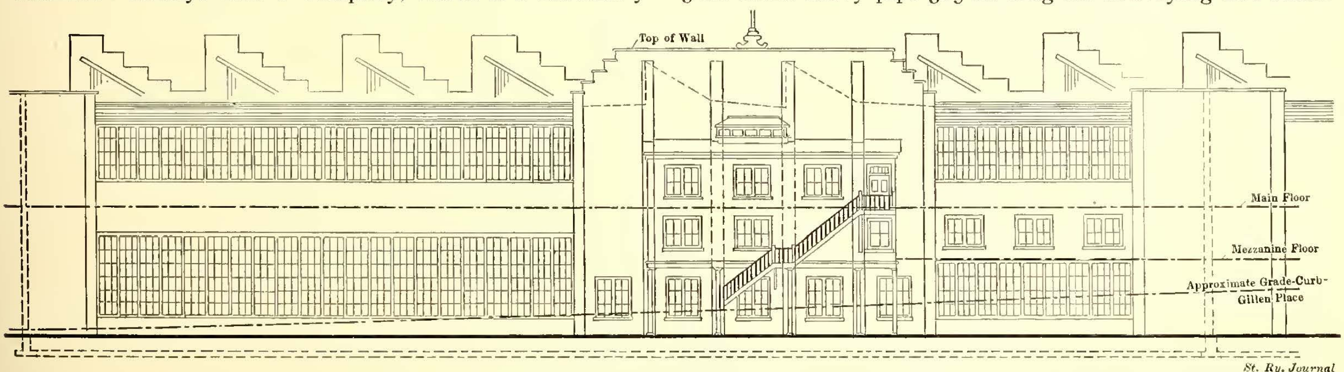
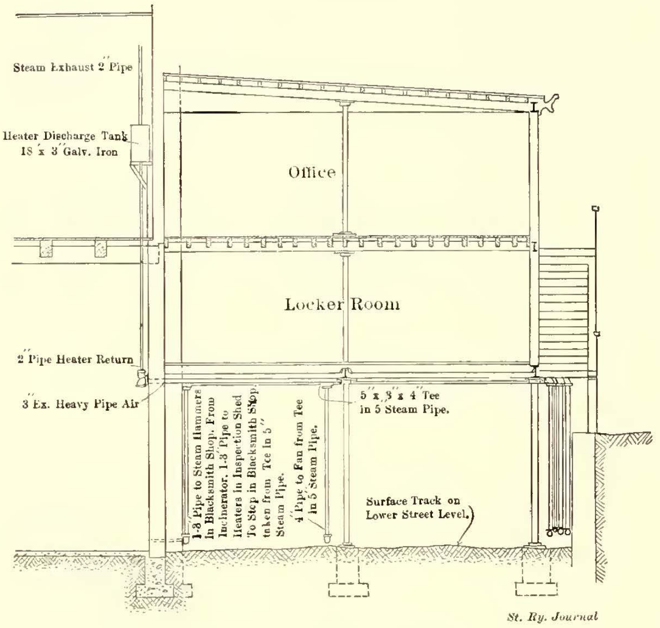


FIG. 11.—PARTIAL ELEVATION ON THE GILLEN PLACE OR EASTERLY SIDE OF THE MAIN EAST NEW YORK SHOP BUILDING, SHOWING THE LARGE WINDOW AREA, AND ALSO THE POSITION OF THE OFFICE BUILDING

lated and has a covering of No. 20 galvanized sheet iron. A partial layout of the piping is shown in Figs. 12 and 13. but further details will be given when describing the heating arrangements of the inspection building.

The heater system proper, as installed by the New York Blower Company, of Bucyrus, Wis., is a hot-air blast taken from the group of steam coils outside of the building under



Section A-A Through Office Building

FIG. 12.—SECTION THROUGH OFFICE BUILDING, SHOWING THE HEATING PIPES UNDER THE LOCKER ROOM

the locker room. The blast is produced by an 8-ft. exhaust fan, driven by a 30-hp variable-speed Northern Electric motor and is carried through galvanized-iron pipes to different parts of the buildings directly under the upper floor, thus keeping entirely out of the way of machines, etc., with outlets located at convenient intervals to diffuse hot air in different parts of the shop and offices. This method is also very convenient for the diffusion of cold air in summer, thus ensuring good working conditions all through the year.

Despite the length of distributing lines, the steam supply from the incinerator has proved more than sufficient to supply all of the needs of the shops and club house. The company, however, was fortunate enough to find a profitable market for its surplus produce by selling steam to a neighbor—Trommer's Brewery. This outside pipe is 5 ins. in diameter and about 1800 ft. long.

LIGHTING SYSTEM

Although the shops and inspection shed enjoy far more daylight than is found in most plants of this character, equal care was given to provide them with plenty of artificial light, not only for auxiliary use on dark days, but for good night work, too. Current is received through a 600-volt direct-current feeder leading to the main switchboard in the machine shop, and is carried from thence through cables to smaller switchboards located in different departments. Both arc and incandescent lamps are used, the latter being usually arranged in a series circuit making up clusters of five 16-cp lamps.

The machine shop is lighted with arc lamps. Directly over the work benches, on the Gillen Place side of the shop, five-light clusters of incandescent lamps are suspended from iron brackets in addition to similar clusters attached to either side of the posts throughout the shop.

In the truck-overhauling shop the arc lamps are suspended from the ceiling above the run of the principal crane. In addition to these arc lamps there are incandescent lamp clusters located over the truck-overhauling stub tracks. Sockets are also placed in different positions throughout the shop for attaching drop-lights, which can be carried to different machines as the operator desires. In the blacksmith shop there are arc lamps suspended from the ceilings and five-light clusters of incandescent lamps at the different machines. On the upper floor of the main shop building, arc lamps are also installed, together with five-light incandescent clusters over each bench.

The storeroom is furnished with drop-lights suspended

Location Plan.

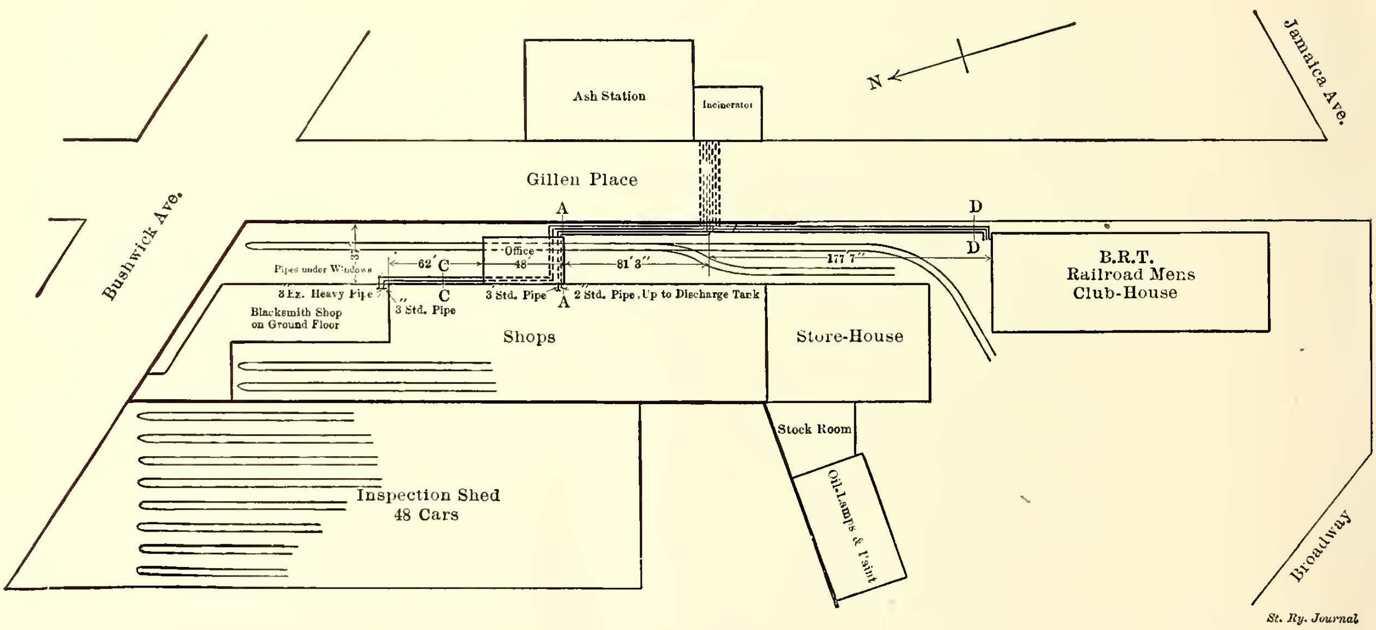


FIG. 13.—PLAN OF THE EAST NEW YORK SHOP AND YARD PLANT, SHOWING PARTIAL LAYOUT OF THE HEATING SYSTEM FROM THE INCINERATOR PLANT

from the ceilings and in sufficient number to illuminate any portion. For fire protection there are no lights at all in the mechanical department's paint and oil ·oom, but an arc lamp placed just outside the door gives enough light to those working inside the room.

On both sides of the elevator shaft between the upper floor and the truck overhauling shop there are two 16-cp lamps with reflectors, which throw the light directly on the truck to be taken down. This makes it easier at this point to couple or uncouple the motor leads.

The inspection shed has five-light incandescent lamp clusters suspended above the floor between the tracks, in addition to the pit lighting described elsewhere. The office is illuminated by four-light ceiling clusters, the fifth socket serving for a connection to a desk light.

WINTER SPORTS AT A NEWBURGH SUMMER RESORT

The success which the Orange County Traction Company, of Newburgh, N. Y., is meeting with in the development of winter pleasure traffic is worth the attention of other railway companies with aquatic park resorts who have not endeavored to exploit them during the cold months of the year. As noted in the Dec. 22, 1906, issue of this paper, the company is encouraging the visits of ice skaters to Orange Lake by heating the summer lunch pavilion after enclosing it with glass, and also illuminating the lake electrically to attract the large number of people unable to come during the day. The company also arranges skating carnivals, fireworks, horse racing and other attractions from time to time announced in the local papers by newsy advertisements. The accompanying illustration is a fac-simile of a column advertisement except that the lower half has been placed on the right for convenience in reproduction. The plans for the company's winter attractions are being carried out by general manager E. C. Boynton, who has also instituted a fare reduction of 25 cents to 15 cents for the round trip to Orange Lake on gala days.

WATCH THIS SPACE

for new attractions at

ORANGE LAKE

WINTER SPORTS

Saturday, December 29, 1906
Amateur Skating Race

Open to all boys under age of 18 years. Race at 2:30 p. m. Valuable prizes will be given.

Moonlight Skating on January 1, 1907.

Fireworks in the Evening

Magnificent display from the Lake will be made at 8 o'clock on New Year's night.

HORSE RACING

On Saturday, January 5th, 1907, at 2:30 p. m.

Cheap Fares at all these attractions.

15 CTS. 15

for the round trip from Newburgh on each of these dates.

NEWSPAPER ADVERTISING OF WINTER PARK SPORTS BY THE ORANGE COUNTY TRACTION COMPANY

REPORT ON THE STRENGTH OF ELM, OAK AND LOCUST INSULATOR PINS FROM TESTS MADE BY THE FOREST SERVICE OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

At the request of certain consumers, the Forest Service of the United States Department of Agriculture recently made tests on fifty-three insulator pins of rock elm, live oak, and black locust. The tests were made at the timber-testing station of the Forest Service at Perdue University, Lafayette, Ind. The results indicate the relative strength of the pins tested. They depend upon too small a number of tests, however, to show in an authoritative way the relative value of these woods.

The pins were of standard size, 1¼ in. by 8 ins. The oak pins were from ⅛ in. to ¼ in. shorter than the others, and of slightly smaller diameter at the shoulder. Their lever arm was also about ½ in. shorter than in the cases of the other two species.

In testing the pins an iron block was clamped to the fixed upper head of a small screw-testing machine. The pins were inserted to a tight fit in a hole in this iron block, and projected horizontally over the pulling head of the machine. The glass insulator was unable to bear the strain of the wire, so an iron model of the ordinary glass insulator was screwed on the pin and connected by means of a heavy wire to the pulling head of the machine. When a strain was put on this wire, the pin acted as a beam fixed at one end and loaded at the other, which is practically the condition met with in practice. The breaking moment (maximum load times lever arm) is taken as a measure of the strength of the pins. The iron block mentioned was used in preference to a wooden cross-arm for supporting the pins, for the reason that this iron block forced the pins to break under the test. Furthermore, it furnished uniform conditions for all pins. Thus, the results of the tests do not show the strength of a combination of pins and cross-arm, but they show the bending strength of the pin itself.

The following table gives the results of the tests:

SPECIES.	No. of Tests.	Weight of Pin.	Rings per Radial Inch.	Breaking Moment (Maximum Load by Lever Arm).
		Grams.		Inch Lbs.
Black locust from Boston, Mass...	23	Avg. 106.3	12	3,970
		Max. 119.3	25	5,380
		Min. 86.6	3	2,520
Black locust from Nashville, Tenn.	7	Avg. 125.9	8	4,087
		Max. 147.1	11	4,930
		Min. 111.8	4	3,010
Rock elm from Nashville, Tenn...	8	Avg. 93.8	42	2,512
		Max. 108.7	48	3,150
		Min. 77.5	33	1,450
Live oak from Houston, Texas....	12	Avg. 127.1	Not distinguishable.	3,025
		Max. 141.0		4,590
		Min. 110.4		1,990

From the table it appears that the breaking strength of the two shipments of black locust pins was practically the same, and may be taken as 4000 lbs. Live oak pins came next in order for strength, with a breaking moment of about 3000 lbs. Rock elm pins were the weakest, having a breaking strength of 2500 lbs. The oak pins were the heaviest the locust next, and the elm the lightest.

The locust and elm pins failed mostly by a splitting from the threads to the shoulder, or by tension at the shoulder. Occasionally the portion of the pin inserted in the block failed by shearing horizontally. The oak pins nearly all failed by tension at the shoulder.

NEW CAR HOUSES IN BALTIMORE

The extensive property loss in Baltimore during the recent conflagration in that city has directed the attention of the engineers and architects in Baltimore to the subject of fireproof construction for buildings to a greater extent than perhaps in any other city. It is not surprising, therefore, that in arranging its plans for a series of new car houses the United Railways & Electric Company, of that city, should decide to pay especial attention to methods of fire protection.

The erection of these car houses was made necessary by the track extensions and cars which have been added to the Baltimore system during the last few years. For some time the use of open terminals was considered, but the resulting depreciation of rolling stock and equipment and the additional power required to start cars cold on winter mornings settled the question in favor of closed storage. The territory of the company was then divided into eight divisions, each operating about 104 cars, and for each of these divisions a modern fireproof terminal or car house was decided upon. All of the car houses follow a typical plan, although the details of their arrangement is varied somewhat according to the shape, grade and other conditions of the site, and also according to the building material used.

The following is a list of the eight car houses which will serve the eight divisions into which the Baltimore system is divided. Of these, one, that at Light Street, is remodeled, three are under way and the others are still in the hands of the engineers and architects.

1. The Edmondson Avenue and Calverton Road car house. This building has the first three sections nearly completed. It is constructed of reinforced concrete throughout, with a slag roof.

2. Electric Park car house. Owing to its location opposite the entrance to Electric Park an ornate facade of brick with terra cotta trimmings has been adopted for this car house. The exterior division walls are of brick. The slag roof is carried on reinforced concrete girders which are supported on concrete posts enclosed within the division walls.

3. Waverly car house, located on York Road near Arlington Avenue. The division and exterior walls of this car house are of concrete block. The columns and roof girders are of reinforced concrete supporting a slag roof.

4. Car house at North Avenue and Gay Street. This building, like the Edmondson Avenue car house, will be of reinforced concrete throughout.

5. Light Street car house. This is an old car house remodeled, as will be described later. It has brick walls with concrete posts and girders supporting a slag roof.

6. Highland town car house, located at the corner of Lombard and Seventh Street. The type of construction has not been decided.

7. Hartford Avenue car house; construction and actual location undecided.

8. Park terminal car house, located at Fulton and Druid Hill Avenues; construction undecided.

This article will describe Nos. 1, 2 and 5 in the list given above, but it will be understood that in their main features the other car houses will follow the general lines adopted for Nos. 1 and 2.

EDMONDSON AVENUE CAR HOUSE, WALLS, FLOORING AND ROOF

An exterior view of the Edmondson Avenue car house, produced from the architects' drawing, is presented in Fig. 1; the plan is shown in Fig. 2 and longitudinal and cross-sections in Figs. 3 to 5. Owing to the grades of the lot on which this car house is being built the interior is on six levels with four tracks on each level.

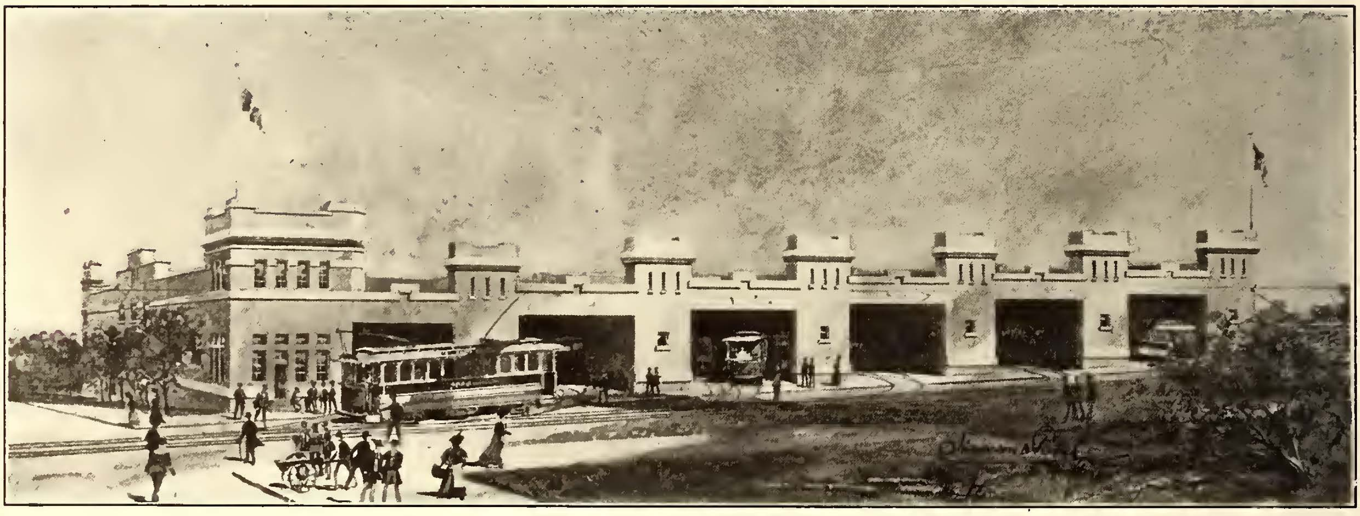


FIG. 1.—EDMONDSON AVENUE CAR HOUSE

The concrete foundations for the interior columns is carried down 3 ft. below the present ground elevation, and those for the exterior walls and roof columns' foundations to 3 ft. below the newly-established grade elevation. The reinforced concrete system used is the Armoured Concrete Construction Company's construction. consisting of round rod reinforcement. The concrete girders and beams are calculated on a basis of 400 lbs. per square inch, and the columns for 350 lbs. per square inch of compression. The reinforcing steel used is calculated at 16,000 lbs. per square inch as a safe working stress. All sash are in metal frames and are glazed with wire glass. A slag roofing is employed.

The floors of the pit and the entire ground floor of the building are of concrete 4 ins. thick, resting on a 4-in. layer of broken stone or cinders. After being laid, this floor is surfaced with a granolithic finish of Portland cement, 1 in. thick. Slag blocks are laid next to all rails in the concrete floor to prevent cracking.

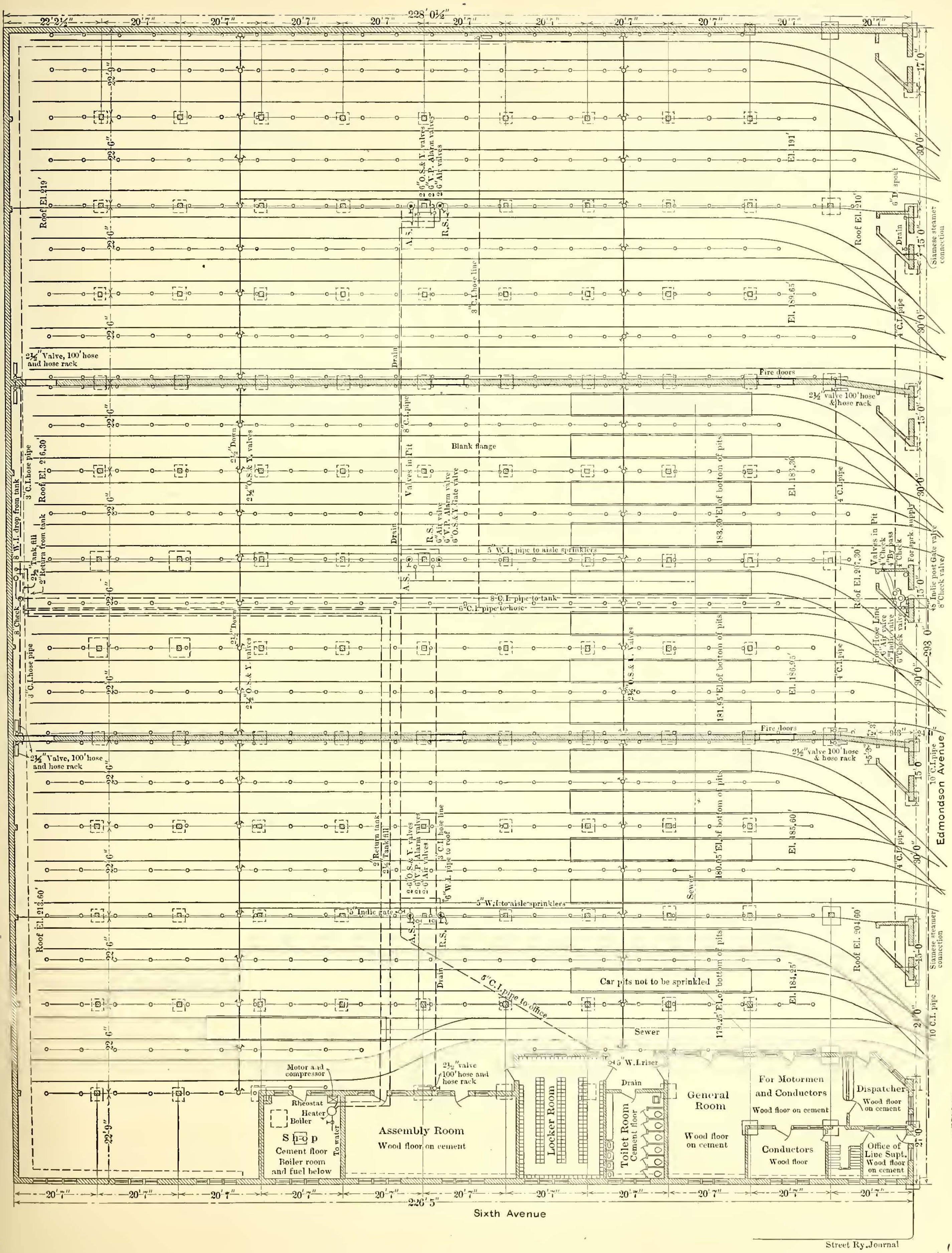


FIG. 2.—GENERAL PLAN OF EDMONDSON AVENUE CAR HOUSE, SHOWING AISLE SPRINKLERS

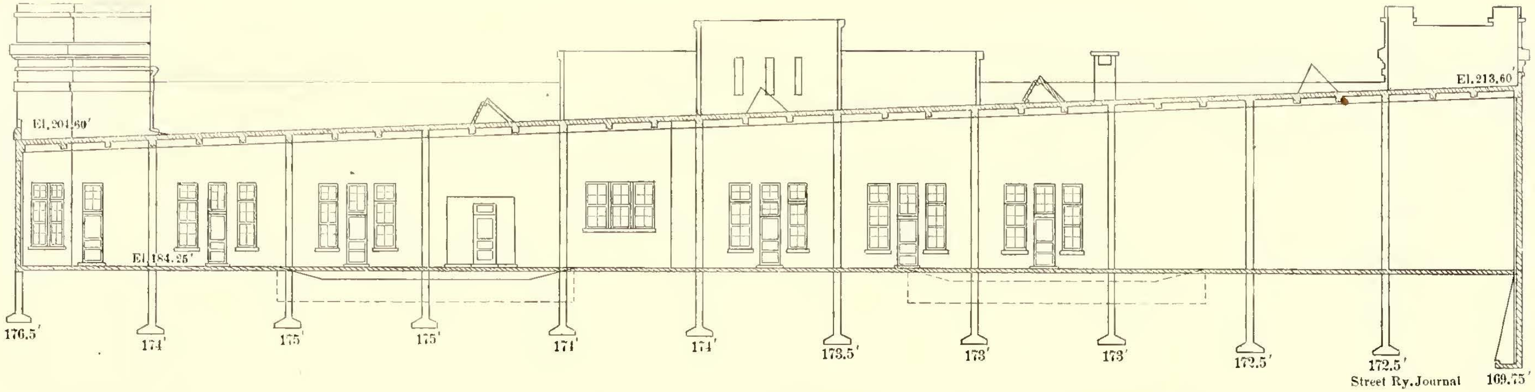


FIG. 3.—LONGITUDINAL SECTION LOOKING EAST; EDMONDSON AVENUE CAR HOUSE

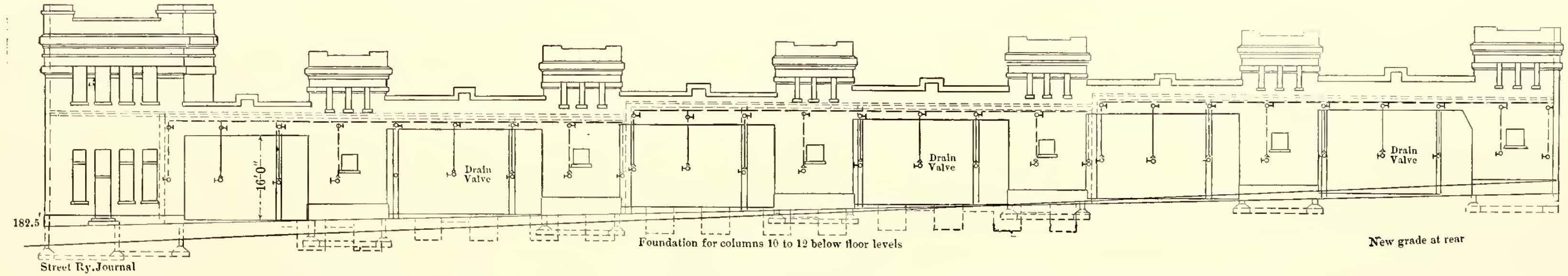


FIG. 4.—FRONT ELEVATION OF EDMONDSON AVENUE CAR HOUSE, SHOWING AISLE SPRINKLER

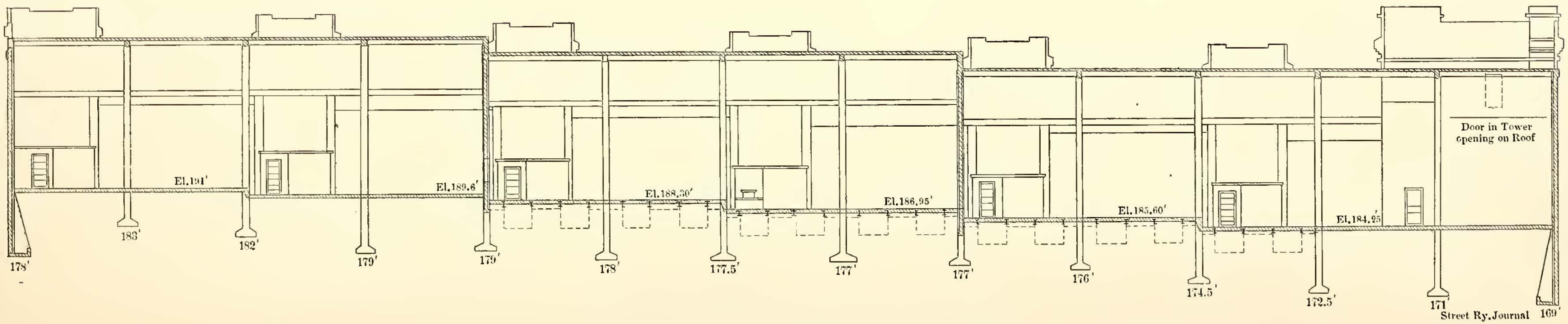


FIG. 5.—TRANSVERSE SECTION, LOOKING NORTH

GENERAL ARRANGEMENT

The storage portion of the car house is divided into two bays separated by a 6-in. fire wall. The communicating openings are provided with double automatic fire doors with the usual fire link. There are fifteen tracks extending the entire length of the building, and as the building is 226 ft. long each track will accommodate five of the standard 42-ft. to 43-ft. semi-convertible cars of the company. Fourteen of these tracks are provided with pits 45 ft. long. The gage of the tracks in Baltimore is 5 ft. 4½ ins. The space between track centers, where there are columns or walls, is 12 ft., and where there are no columns or walls the tracks are on 10-ft. 6-in. centers.

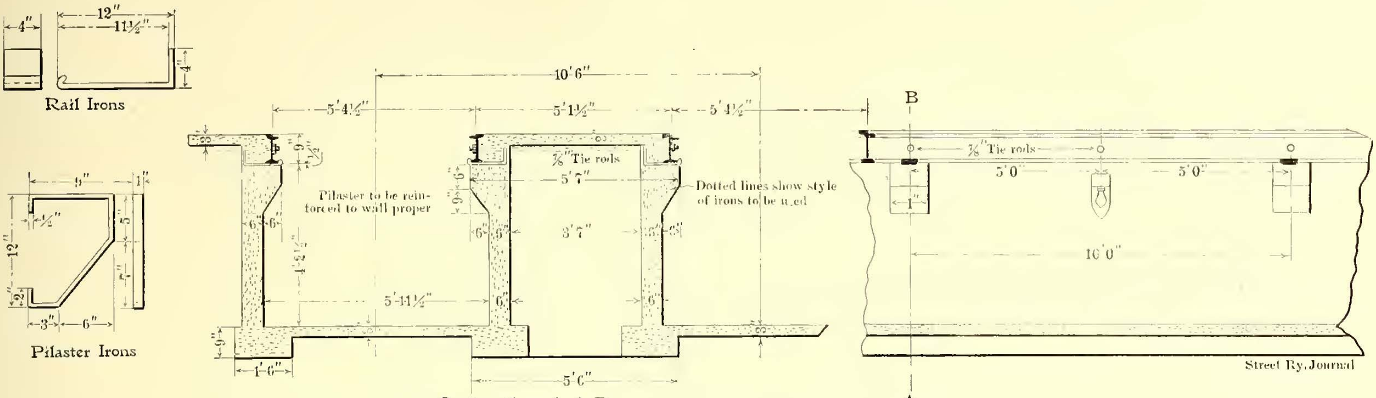


FIG. 7.—SECTION AND DETAILS OF PITS WITH FLUSH AISLES

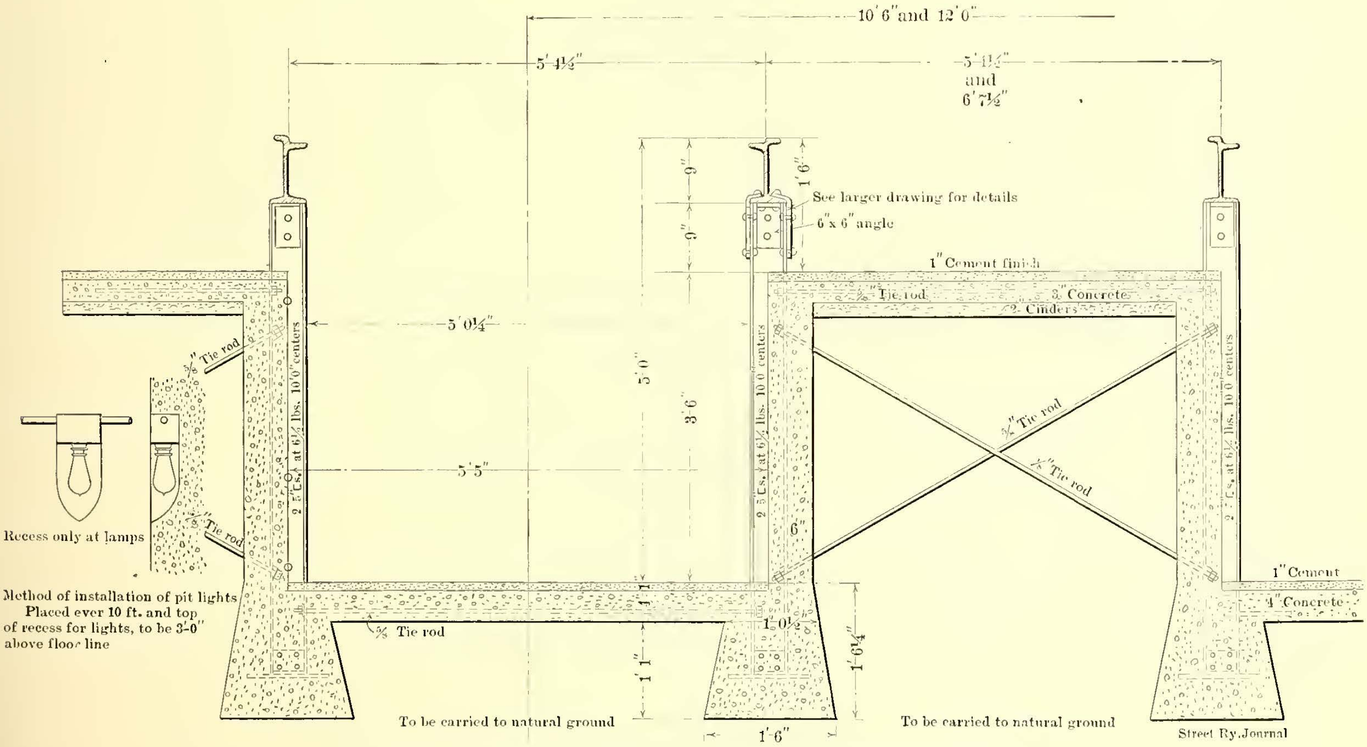


FIG. 6.—SECTION THROUGH PIT WITH DEPRESSED AISLES

Adjoining the four entrances to the car house are four triangular compartments with 6-in. interior walls of reinforced concrete. These compartments are to be used respectively for oil storage in barrels, sand storage, car cleaners' waste, and the storage of oil for daily use. The position of these store rooms so near the entrance has been chosen as being especially convenient. The main entrance to the compartment for the storage of oil in barrels is on the outside of the building. The entrances on the inside of the car house to that compartment and to the other two containing inflammable material are provided with self-closing fire doors. The oil for daily use is not kept in barrels but in a steel tank buried below frost line outside of the building and connected with the oil compartment by two pumps. This tank can be filled from the outside, thereby avoiding any possible chance of fire. The walls of the sand room are carried to a height of only 8 ft. The roof is a concrete slab 4 ins. thick and provided with an opening through which sand can be shoveled directly from a gondola car of the company, which brings sand to the car house. The sand will then fall out through an opening near the floor, from which the car sand boxes can be filled.

PIT CONSTRUCTION

All of the pits except one in each car house have depressed aisles. The latter, of course, are better adapted for work on the journals, compressors or other parts of the equipment below the car, while the flush aisles are much more convenient for the men when putting in armatures. The type of depressed aisle pit used is illustrated in Figs. 6 and 8. The rail throughout is of the 9-in. girder type. As shown

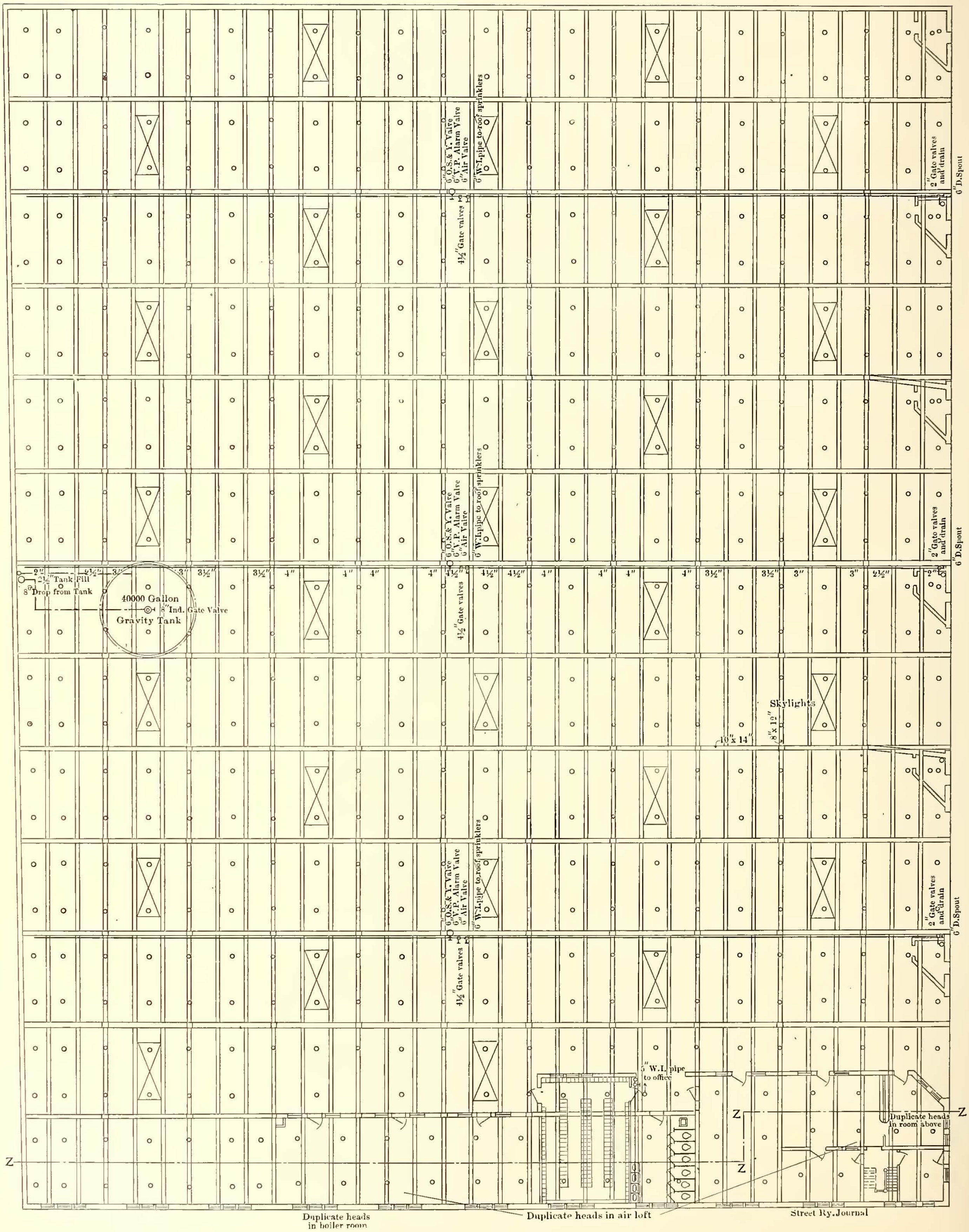


FIG. 9.—PLAN OF EDMONDSON AVENUE CAR HOUSE, SHOWING LOCATION OF ROOF SPRINKLERS

in the engravings, this rail is supported on channel columns spaced 10 ft. centers. The rail is riveted to these channels through forgings at the side and a 6-in. x 6-in. angle between channels under its base. The floor of the depressed aisle is 18 ins. below the head of the rail, or 9 ins. below the base of the rail, allowing a man while at work to sit on the floor of the aisle with his legs hanging over into the pit. The pits are lighted by 16-cp lamps placed in recesses in the concrete, so they cannot be broken. These lamps are spaced 10 ft. apart and are located 3 ft. above the floor line of the pit. The conduits for the lamp wires are embedded in the concrete sides of the pit.

Fig. 7 shows a section through a flush aisle pit. Here the rail is supported on concrete pilasters, which are spaced 10 ft. apart and are reinforced by wrought-iron brackets of the form illustrated. The rails are held in place by 4-in. x 4-in. x 11½-in. angles embedded in the concrete, and the outside rails of the two tracks are held to gage by tie-rods.

The spacing between outside rails, where there are no columns, is 5 ft. 1½ ins. This gives 25 ins. between adjoining cars, or plenty of room for two men to work from the aisles on the cars in adjoining pits and still allow space for passage between. Where there are columns in the aisles this spacing is increased to 6 ft. 7½ ins. In some cases the pit track has a depressed aisle on one side and a flush aisle on the other.

ACCOMMODATION OF EMPLOYEES

It is part of the system of the company to provide good accommodations at each car house for all the crews working from that point. The rooms in all the new car houses are at the side of the building as shown in the plan. The dispatcher's room is in the front of the building and is provided with windows through which he can view practically the entire bay adjoining his office, as well as see all of the entrance tracks and the tracks in front of the car house. The line superintendent occupies the other half of the front of the building and his office adjoins that of the dispatcher. A large waiting room, intended for the motormen and conductors, adjoins the office of the dispatcher, to which it is connected by a passageway. A portion of this room is partitioned off from the main room and will be used by the conductors for the purpose of making up their reports. In the rear of these rooms are the toilet accommodations, together with a spacious well-ventilated and well-lighted locker room, where each employee has his own metal locker.

In the rear of the locker room the company has supplied what it calls its assembly room. Here the men have greater freedom than in the general room for conductors and motormen, and may read, play games, smoke and amuse themselves when off duty. It is proposed to install in each room of this kind pool tables and other games, reading tables and other means of passing the time. In the rear of the assembly room is a small shop for minor repairs to cars, and the boiler room for the accommodation of the heating apparatus is below the shop in a basement. As the company has a very extensive repair shop at Carroll Park, the equipment of this shop will probably be confined to hand tools, with possibly a post drill. The heating plant will provide heat for the offices and rooms mentioned above and for the pits in one bay only.

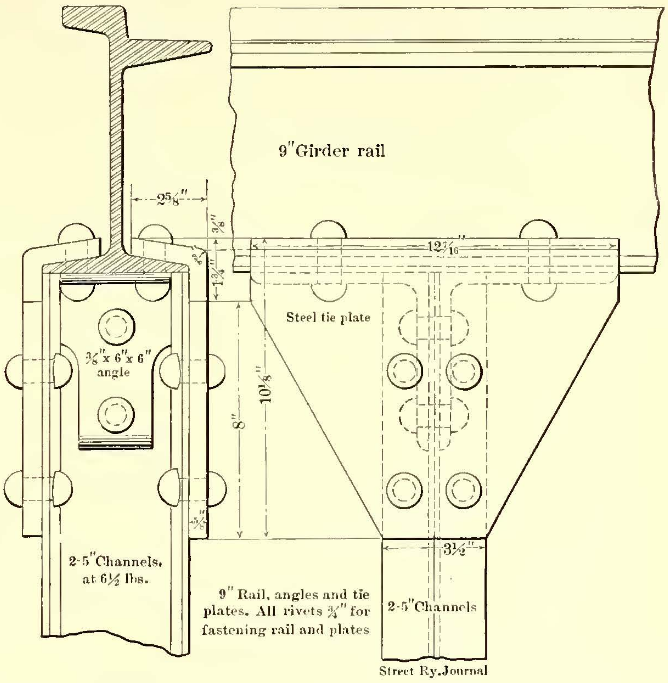
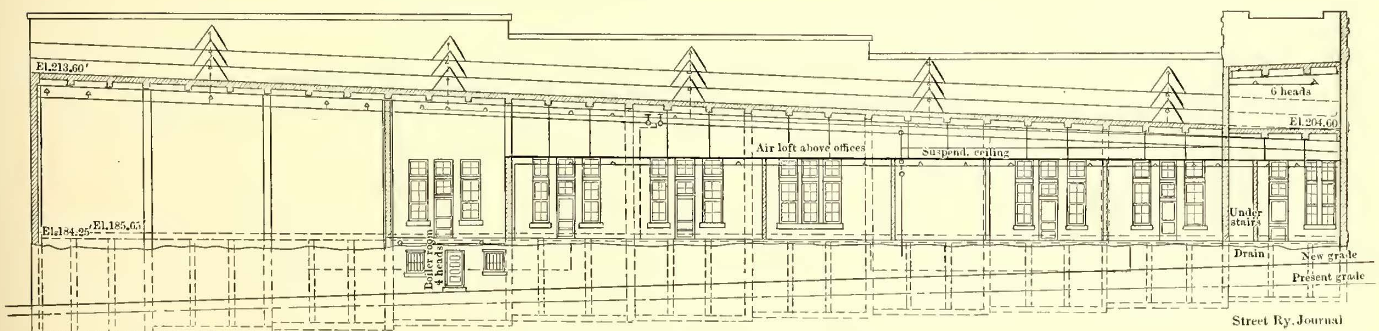


FIG. 8.—DETAIL SHOWING METHOD OF SUPPORTING RAIL ON COLUMNS IN PITS WITH DEPRESSED AISLES

AUTOMATIC SPRINKLER SYSTEM

The automatic sprinkling system at Edmondson Avenue car house is being installed by the General Fire Extinguisher Company, of Providence, R. I., and consists of both aisle and ceiling sprinklers, operated on the standard dry-pipe system of the company. The aisle sprinklers are carried at a height of 8 ft. above the floor, or about 3 ins. below the tops of the car windows, and are spaced 7 ft. centers. The roof sprinklers are carried in a line over the center of each track and each aisle. They are distributed according to the area to be protected, but are usually 10 ft. apart, that is, eleven sprinklers are installed to cover 1000 sq. ft. All sprinklers are supplied with water through 2½-in., 3-in., 4-in. and 4½-in. pipes to 6-in. mains, which are



Section ZZZZ.

FIG. 10.—LONGITUDINAL SECTION OF EDMONDSON AVENUE CAR HOUSE ON LINE ZZZZ (SEE PAGE 182), SHOWING ROOF SPRINKLERS

connected to a 40,000-gal. gravity tank whose base is 20 ft. above the highest point of the roof. This tank is supported on reinforced concrete piers as shown. The general plan of the Edmondson Avenue car house given in Fig. 2 shows the location of the roof sprinklers as well as the other features already mentioned.

Every care has been taken to prevent any interference between trolley poles of the cars and the aisle sprinkler pipes. The latter are discontinued before the special work begins and they are also arranged so that there are openings frequently which if necessary will permit the trolleys to be turned. The aisle sprinkler pipes are supported on hangers which are shaped in the form of Y's and are placed 24 ft. apart. Between these supports the pipes are supported by truss rods from the hangers. These permit additional overhead clearance. A large proportion of the cars are double-truck cars on which there are two trolleys, so that the trolley poles do not ever have to be turned. The single-truck cars on which there is only one trolley can, if necessary, be run back until the cars are clear of the aisle sprinklers, when the trolley may be reversed. In addition the aisle sprinkler pipes are insulated by means of special mica collars which are placed within the joints. These joints prevent danger from grounding throughout the building in case of accidental contact with the trolley wire in any way.

All exterior doors are of the rolling type, either Kinnear or Wilson, and have steel thresholds. All fire-door openings have channel-iron frames around the entire opening.

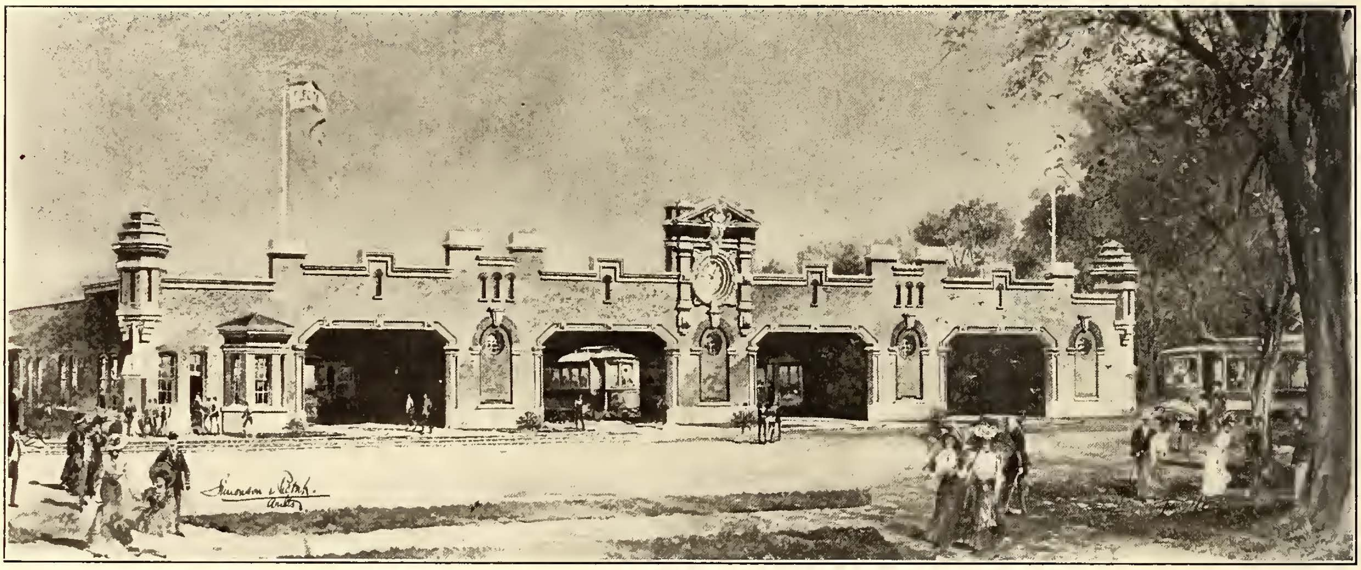


FIG. 11.—ELECTRIC PARK CAR HOUSE

ELECTRIC PARK CAR HOUSE

Plan views and a front elevation of the Electric Park car house, which is the next farthest along, are given in Figs 12 and 13. As already stated, thic car house consists of a reinforced concrete skeleton frame with brick walls on the outside as well as on the inside. The building has a width of 214 ft. and a depth of 314 ft., and is subdivided into five sections. Each section is separated from the next by a brick fire wall with the usual self-closing fire doors. The general arrangement of this building is similar to that of the Edmondson Avenue car house, except that the pits are 90 ft. long and are placed further back in the car house This will allow one car to stand between the pit and the entrance curve. The pit on one track, or that nearest the shop, is located one car length from the rear wall. There is also a slight difference in the arrangement of the oil storage triangular compartment, the entrance to which is from the outside and entirely separated by fire walls from the car house proper. Sand pits and car cleaners' rooms as well as a room set apart for the daily use of oil are provided, as at Edmondson Avenue, and are closed by brick fire walls, having standard underwriters' fire doors.

Aisle and ceiling sprinklers are used in this car house as at Edmondson Avenue, but the equipment is being installed by the Phœnix Fire Extinguisher Company, of Chicago. Owing to local conditions connected with the water supply, it is considered desirable to install in this car house two tanks of 40,000 gals. each instead of one tank.

The pits are drained by an electrically-driven centrifugal pump with a capacity of 75 gals. per minute, with automatic start consisting of a ball float and a Whittingham solenoid automatic motor start.

The Edmondson Avenue and Electric Park car houses were designed by Simonson & Pietsch, of Baltimore, architects, J. Henry Miller being the contractor for the former and the Charles McCaul Company, of Philadelphia, for the latter. Simonson & Pietsch are also the architects for the Gay Street car house, and Baldwin & Pennington for the new York Road and Park Terminal car houses. The Noel Construction Company is the contractor for the York Road car house. Both architects have been working under the supervision of the company's engineers.

OWNERS

Although to be used by the United Railways & Electric Company, the buildings will be owned by the Maryland Electric Railway Company, and their sites by the Maryland Realty Company. These corporations, as mentioned in a recent issue of this paper, have been organized as a part of the financial scheme of the United Railways & Electric Company to assist it in carrying out important and necessary extensions and improvements. These companies operate very much like the car trust companies with the steam roads, and receive as a lease 6 per cent on the money invested by them The expenditure is then retired by amortization. The rela-

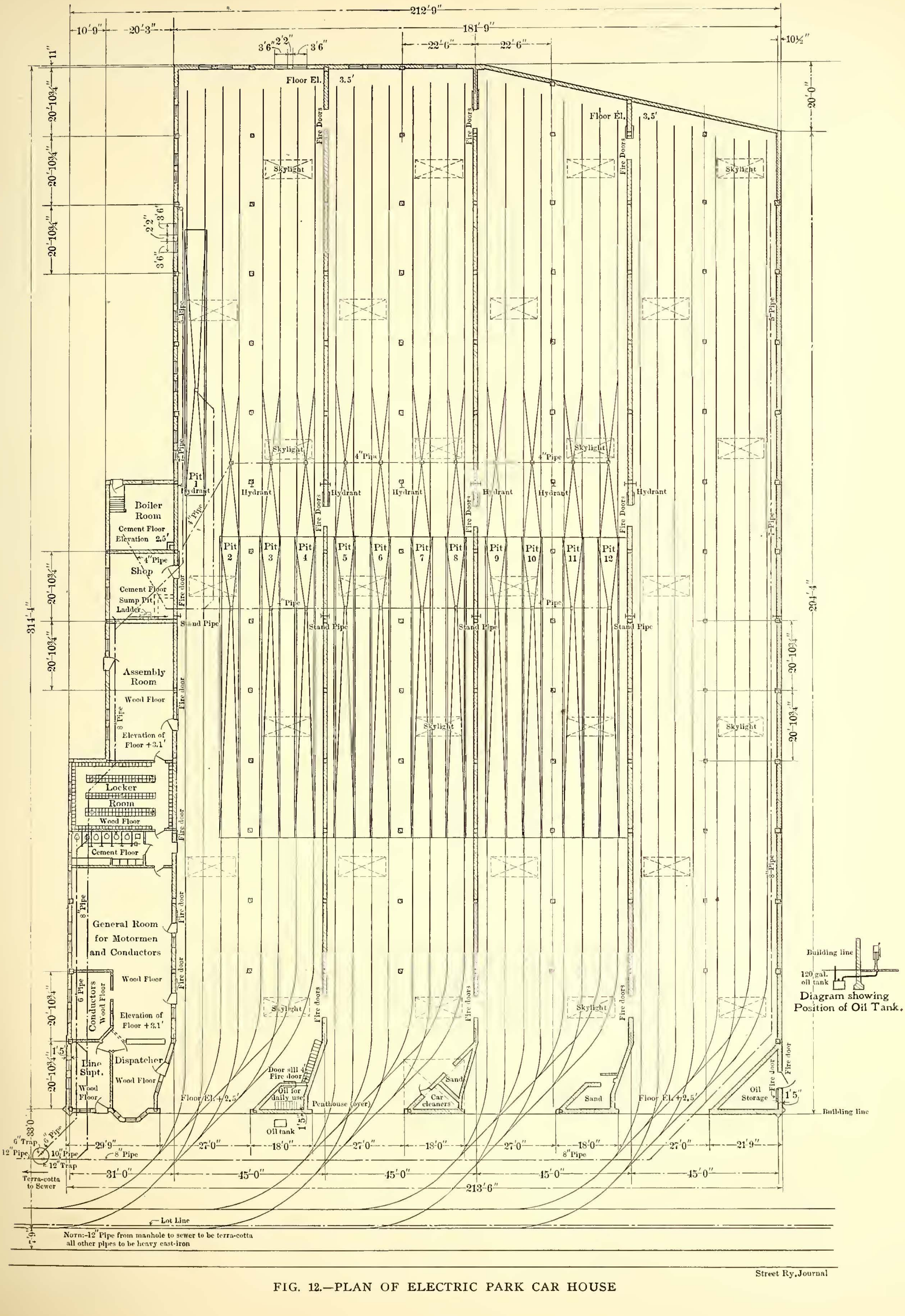


FIG. 12.—PLAN OF ELECTRIC PARK CAR HOUSE

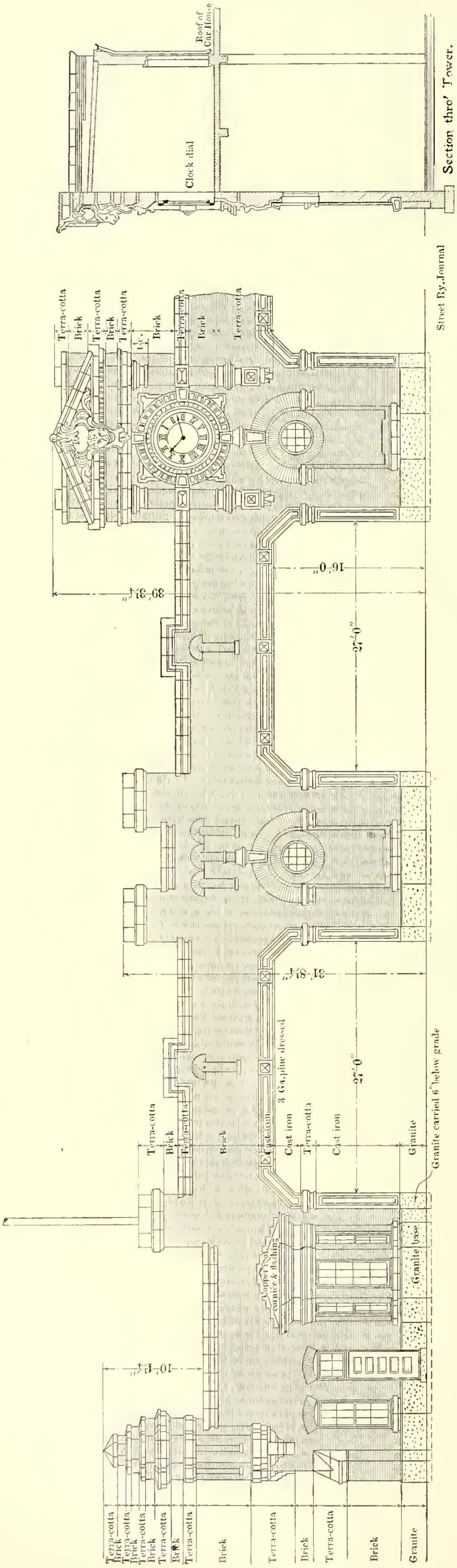


FIG. 13.—FRONT ELEVATION OF ELECTRIC PARK CAR HOUSE

tions of these companies to the United Railways & Electric Company is not confined to car houses, but extends to rolling stock as well, which is purchased on the same basis. The important power station reconstruction now being carried on in Baltimore under the direction of Mr. Stillwell for

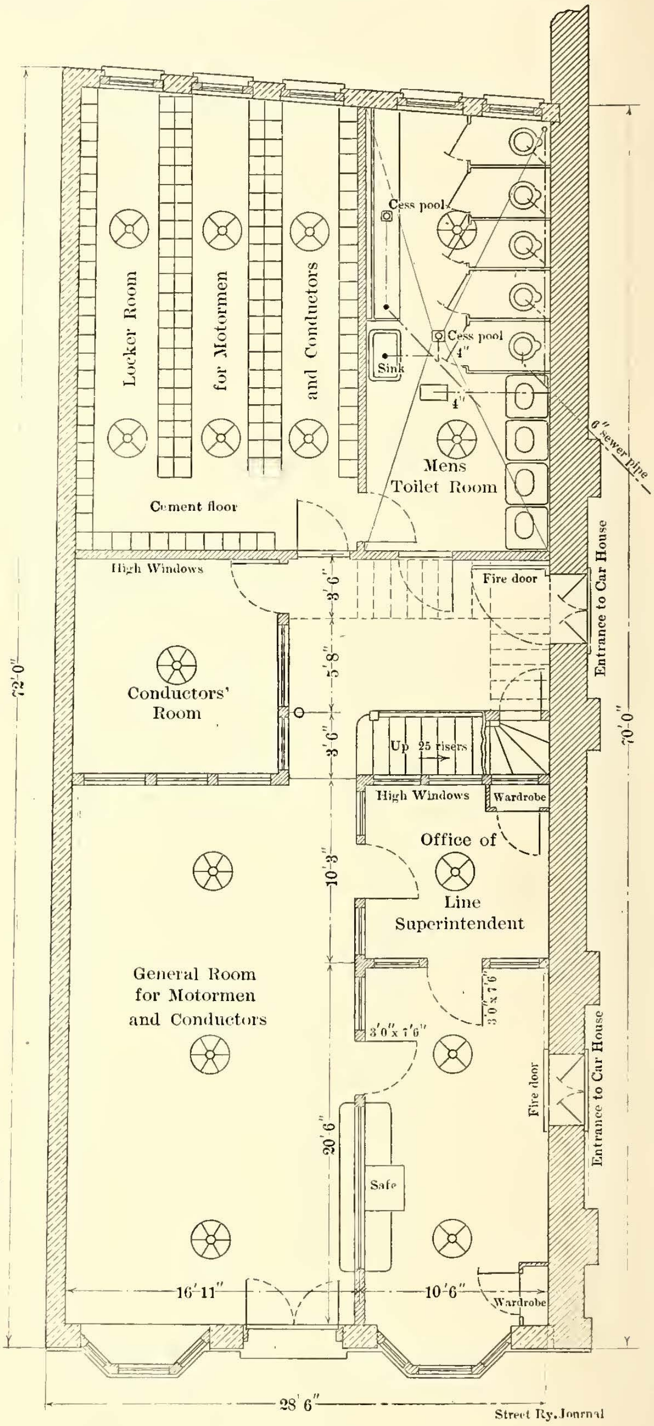


FIG. 14.—PLAN OF GROUND FLOOR OF SERVICE BUILDING AT LIGHT STREET

the United Railways & Electric Company is being financed in the same way.

THE LIGHT STREET CAR HOUSE AND SERVICE BUILDING

In connection with this article on car houses at Baltimore, a short account should be given of the reconstruction carried on at the old Light Street car house of the United Railways & Electric Company and the service building which has been fitted up adjoining thereto. The Light Street car house was the best of the former car houses of the company, but was built with brick walls and had a wooden roof. The old car house was extended to the rear and another building added on the south side directly in the rear of the power house; the entrance to this last addition is made through an opening in the wall of the main car house. This opening is protected by large fire doors. The addition of a slag roof supported on concrete slabs and girders, which has recently been completed, has converted this old portion of the building into a much better fire-resisting structure. The concrete girders are supported on concrete posts erected for the purpose, adjoining the present brick walls. This house has accommodation for about seventy-five cars.

In furtherance of its liberal policy toward its employees already described, the company has purchased the lot adjoining this car house and has erected there a two-story building for its motormen and conductors. A plan of the first floor of this "service" house is presented in Fig. 14. The office of the dispatcher is placed in front, so that he can have a good view up and down the track. Next is the general room, 17 ft. x 30 ft. 9 in., for motormen and conductors, with a smaller room partitioned off as in the other car houses, where the conductors can make up their reports.

The floor above the first floor, shown in Fig. 14, is devoted to an assembly room, which is approximately 71 ft. long by 28½ ft. wide. This room is provided with a pool table and is furnished with arm chairs, desks and reading tables on which the latest copies of the technical and popular magazines are displayed. This building is well lighted and attractively furnished throughout.

DOWNTOWN SERVICE BUILDING

This broad policy of the United Railways & Electric Company to provide attractive accommodations for its employees is strikingly illustrated not only in the rooms which, as has already been mentioned, are being provided in connection with all of the car houses, but also in a service building not connected with any car house located in the business district. The fact that most of the car houses are away from the center of the city suggested the idea that if the men had a meeting or club room near the business district it would often prove convenient as a lounging or waiting room while off duty. Acting upon this suggestion, the company secured a building, about 35 ft. x 100 ft., on the corner of Franklin and Howard Streets, directly in the shopping district. The lower floor is devoted to a waiting room for its suburban passengers where packages can be checked, and to a lost and found department. The second floor contains three rooms, two of which are for the employees, and a smaller room for the division superintendents. The latter room contains a desk which can be used by any superintendent, and sufficient drawers so that each division superintendent can keep his papers locked in a separate drawer. One of the rooms for the men has been supplied with two pool tables, while the other, like the assembly room at the car houses, has reading tables, checkers, and opportunity for other pastimes. The rule that no card playing is allowed is practically the only restriction in the use of the rooms, and no charge is made for the pool tables. The conductors and motormen are given tickets which admit them to the room when not in uniform, so that there is no danger of the privileges of the club being abused by those who have no right to use them.

The New Orleans Railway & Light Company's report for 1906 shows that the car business on Sunday is from 15 to 25 per cent greater than on week days. This increase is attributed to the excellent facilities for pleasure riding.

CONVERTED STEAM RAILWAY IN SWEDEN

BY V. FABER MADSEN

An undertaking of interest more on account of its character than its size has recently been completed in Sweden, in the electrification of the light railway connecting Helsinborg with Raa and Ramlösa. Helsinborg is a thrifty seaport of about 35,000 inhabitants, in the south of Sweden, and is opposite the Danish town of Helsingoer. Raa is a fishing and residential town and Ramlösa is a seaside resort, well patronized during the summer by Swedes and Danes. The railway connecting the three places mentioned was built several years ago on what is known as the Decauville system, and was worked by steam locomotives. The gage was 60 cm (24 ins.). The conversion to electric traction was completed in December, 1906. The distance from Helsingborg to Raa, about 4 miles, will be operated throughout the year, that to Ramlösa only in Summer.

The railway is about 11.8 miles, most of which is double track. The track has been relaid to standard gage with 45-lb. rail. Figure 8 trolley wire is employed on both span and bracket construction.

The plant includes three gas engines, supplied by Nydquist & Holm, of Höganaes, Sweden, direct-coupled to three 60-kw generators. The gas engines are supplied from suction gas generators.

The motor cars are painted the Swedish national colors (blue and yellow), are mounted on double trucks and seat 70 passengers. Christensen air brakes are used. Each car has two 35-hp motors. It is also the intention to haul 200-ton freight trains.

An hourly service, equal to seventeen trains each way per day, is given. When the line was worked by steam locomotives the number of trains each way per day was nine.

The installation was carried out by the Allmaenna Elektriska Aktie Bolaget, Westeraas, Sweden (who also supplied the cars and will supply the locomotives), under the supervision of its engineer, Thure Paulsen, to whom the writer is indebted for much of the information given.

THE CHICAGO, SOUTH BEND & NORTHERN INDIANA COMPANY AND ITS PLANS

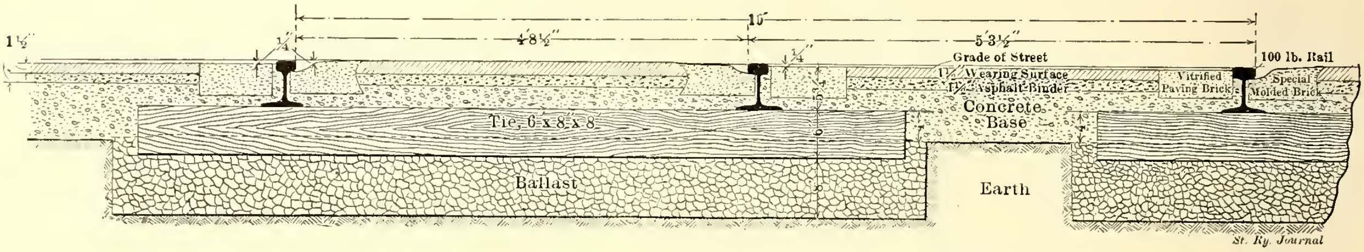
The Chicago, South Bend & Northern Indiana Railway Company has filed articles of incorporation with the Secretary of State of Indiana. The capital stock of the company is $7,500,000 and the incorporators are: C. F. Dieterich and A. E. Dieterich, of New York; James Murdock, Samuel T. Murdock and C. M. Murdock, of Lafayette; Hugh J. McGowan, J. A. McGowan and R. I. Todd, of Indianapolis; ex-Governor Durbin, of Anderson; H. B. Smith, of Hartford City, and A. L. Kitselman, of Muncie. The articles of incorporation disclose the following additional names as stockholders: Randall Morgan and J. W. Vandke, of Philadelphia; Joseph B. Mayor, of New York; Thomas D. Krutz, of Chicago, and Henry Marshall and W. V. Stuart, of Lafayette.

This is regarded as an official announcement of the purchase of the Northern Indiana Railway, involving an expenditure of $4,000,000. The purchasing company will build an electric railway from Michigan City to Chicago immediately and expend $1,000,000 in improving the acquired lines. At Logansport, through which the company will operate, connection will be made with the Lafayette line and the Indiana Traction Company's line to Indianapolis.

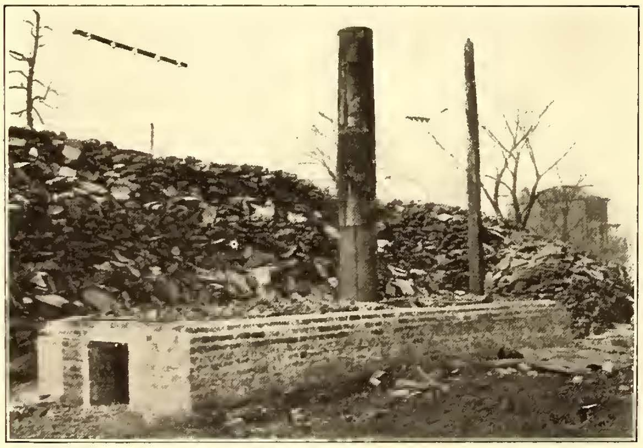
TRACK CONSTRUCTION AND ASPHALT WORK IN KANSAS CITY

For several years past the Metropolitan Street Railway, of Kansas City, has been continually reconstructing and extending its tracks. Several features in connection with this work in paved streets are especially interesting, and through the courtesy of Charles N. Black, general manager of the system, this publication now is enabled to give some of the details in connection with it.

In the downtown districts Trilby rails are employed, but in other portions of the city T-rails of standard A. S. C. E. section and weighing 80 lbs. and 100 lbs. per yard are used. The ties rest on rock ballast instead of the concrete bed often used in other cities. One reason why ballast is considered preferable is that should the tracks ever be taken up the work would be much easier. The concrete base for the asphalt surface extends to within 2 ins. of the bottom of the ties. A specially formed brick with a nose fitting in under the rail is used on the gage side of the rail. The latter is filled on the outside with a grouting of two parts sand to one of cement, and against this an ordinary vitrified paving brick is placed. Attempts to extend the asphalt paving up to the rail in Kansas City have resulted in failure due to the disintegration of the asphalt.



CROSS-SECTION OF STANDARD T-RAIL CONSTRUCTION IN KANSAS CITY

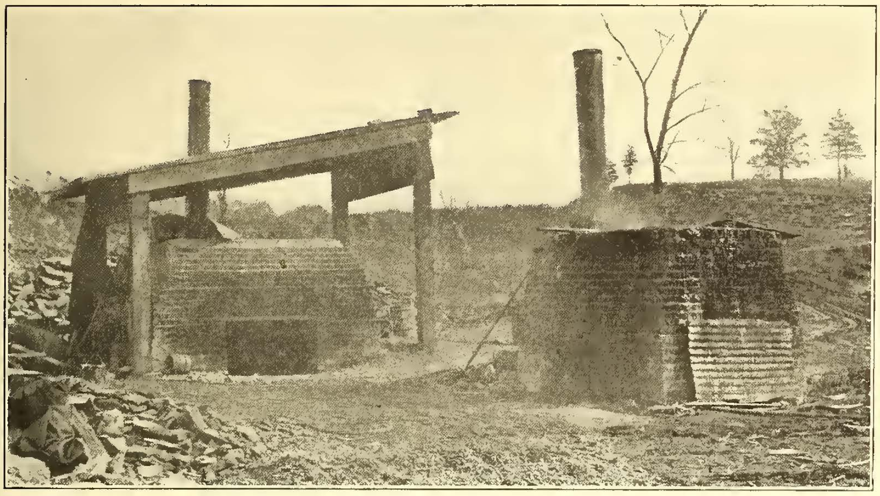


ONE OF THE FURNACES, WITH PANS FILLED READY FOR FIRING. A PILE OF OLD ASPHALT FORMS THE BACKGROUND

The railway company is required to keep up the paving between the tracks and for 18 ins. on either side of the outside rails. For several years the company contracted for the asphalt resurfacing, but for the last two years this work has been done by the company itself at a much reduced cost. The old asphalt is brought from the city, reheated, strengthened with new asphalt and relaid.

The accompanying illustrations show the plant located in the outskirts of the city for working over the asphalt. The equipment for this purpose consists essentially of furnaces and pans for heating the old asphalt and of tanks in which new binding material is melted. The heating pans are of ¼-in. boiler iron, 10 ft. long, 5 ft. wide and 10 ins. deep in the middle. The bottom is a portion of a circle sloping down gradually from the sides. This shape permits the stirring irons to be used to best advantage. At their middle point the pans are strengthened by a cross-brace. After considerable experiment this shape of pan was found to be the best adapted for the work. Deeper pans have been abandoned because of the difficulty of stirring the material. Two of these pans are placed end to end over a brick furnace with their adjacent ends just far enough apart to permit the furnace stack to extend up between them. The old material is broken up in pieces about 5 ins. square and the pans are filled level full. A fire is built in the furnace and the material allowed to heat for about two hours. In the meantime it is continually stirred with bars in such a manner that the material is thrown up from the bottom. This stirring not only prevents the asphalt from burning, but also throws gravel and other impurities to the top where they can be raked off. A few buckets of water are added from time to time during the heating process. After the material has become well heated, from 75 lbs. to 200 lbs. of fresh asphalt, which is kept melted in adjacent tanks, is mixed with it. From the pans the hot asphalt is loaded directly into wagons in which it is hauled to the point to be used. The two pans over each furnace hold just one wagon load, and this amount covers about 25 sq. yds. when spread 2 ins. thick. Usually four double pans are operated and from sixteen to

STIRRING THE ASPHALT DURING THE HEATING PROCESS eighteen wagon loads are heated per day. The labor required at the pans is about one man per wagon load per day. Work is started very early in the morning and is discontinued at about 4 o'clock in the afternoon to permit the last material heated to be laid in the street before dark.



THE TWO FURNACES FOR HEATING THE NEW ASPHALT

The old material is purchased from the city at $0.75 per wagon load, equivalent to 1½ cu. yds. Old ties are used for fuel. The asphalting plant, with a capacity of 400 yds. per day, cost approximately $400. As the contract price for asphalting was never less than $1.12 per yard, and the cost under the present system is about 40 cents, it may readily be seen that the installation and operation of the plant is a very economical venture. It is estimated that the repeated asphalt will last as long as new material. Some that has been in use for two years shows every evidence of substantiating this belief. The track work and asphalt plant is under the direct supervision of E. Butts, civil engineer for the company.

THE PENNSYLVANIA STANDARD ROADBED

The standard track construction of the Pennsylvania Railroad and the modifications made upon the initiation of President Cassatt in the summer of 1905 are mentioned so frequently in track circles that an explicit statement in regard to what is known as "the Pennsylvania standard" and the changes which are being proposed will be of interest. The Pennsylvania standard track construction is shown in the series on the next page. For four tracks, in a cut without sidings, the Pennsylvania Railroad requires a ditch 10 ft. 6 ins. wide from gage of rail and 3 ft. below top of tie at lowest point, the ditch to slope regularly from edge of ballast border, which is 5 ft. out from rail, and 19 ins. below top of tie to the lowest point of ditch. There may be a dry toe wall rising from the back edge of the ditch almost perpendicularly, instead of the turf coming down all the way. The ballast roadbed itself is 53 ft. 8½ ins. wide, 13 ins. deep at the center line and 18 ins. deep at the outside edge of the outside track from top of tie. The bottom surface of the ballast bed has a slope toward the side of ¼ in. to 1 ft. The ties are 8 ft. 6 ins. long, 7 ins. high and are laid sixteen to every 33 ft. of main track. The tracks are 13 ft. apart, center to center.

In cities or towns where there is an industrial siding beside the four main tracks, the distance from the center line of the bed to the bottom point of the ditch is 48 ft. 4¼ ins., the siding having a small bed of its own, separated from and lower than the main four-track bed. While the ballast of the main bed is of stone, the sidetrack bed may be of gravel or cinders. The ditch is made 1 ft. wider on account of the extra track. If necessary, 6-in. cast-iron pipes are run parallel to the ties and through the ballast of the siding.

The changes suggested by President Cassatt, to which reference has been made, were to reduce the expenses of maintenance of way and also to make travel safer and more agreeable. The task of making the plans was given to a committee of engineers, and their object from the first was to design a roadbed with drainage facilities as nearly perfect as possible.

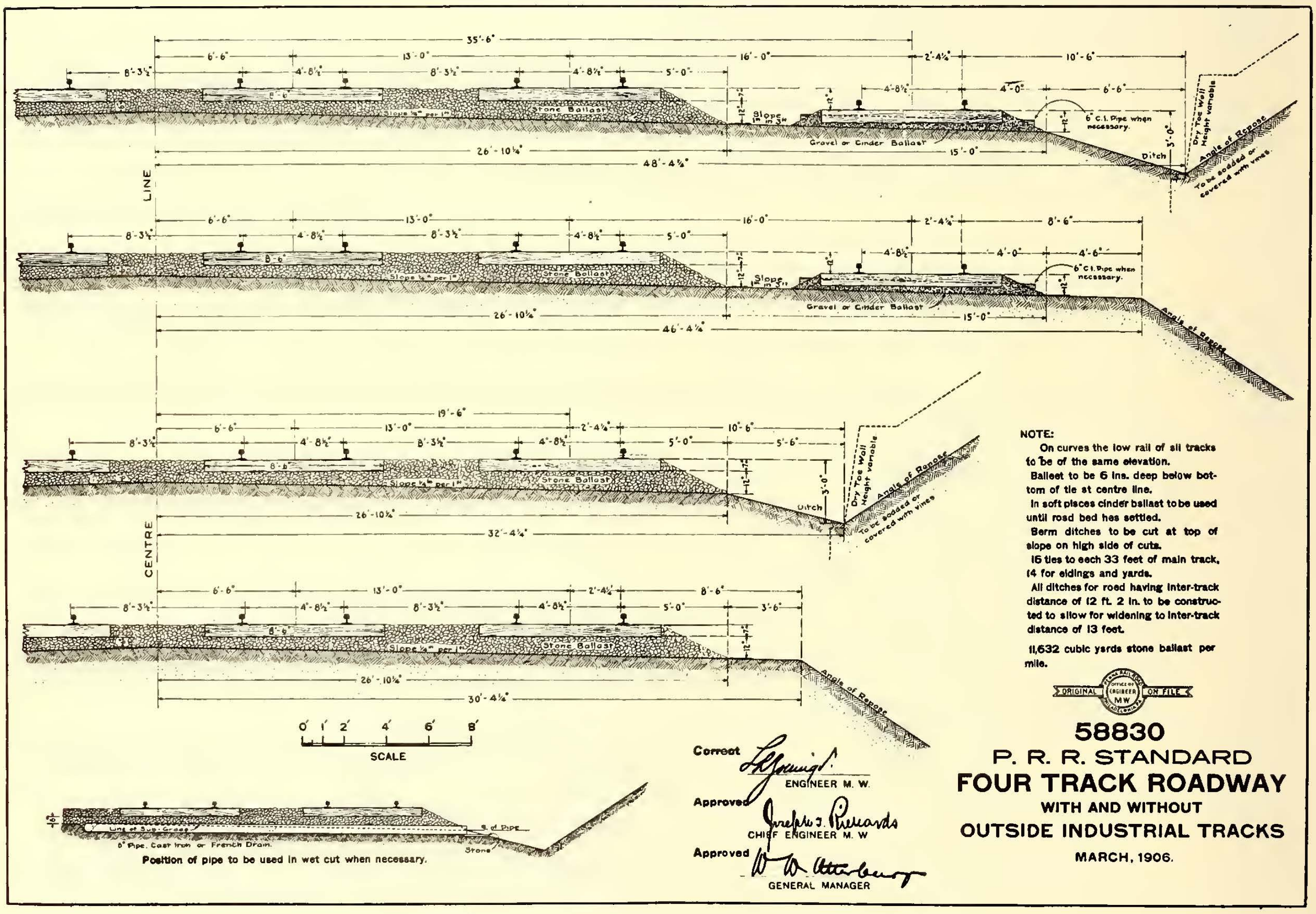
Fifteen miles of new roadbed is the result of the committee's report. Four sections of the main line have been built to conform to the engineers' ideal of a perfect roadbed. One of the two five-mile stretches of standard roadbed is near Lancaster, on the Philadelphia Division, and the other near Newport, on the Middle Division. The two 2½-mile stretches are on the Pittsburg Division, one near Cresson, on the western slope of the Alleghenies, and the other about 50 miles east of Pittsburg, at Hillside.

SECTION OF PENNSYLVANIA RAILROAD TRACK, WITH EXTRA AMOUNT OF BALLAST

The improvements consist partly in the addition of more ballast, that is, 16,965 cu. yds of ballast were used per mile of four-track line instead of 11,632 cu. yds. as in the standard construction. This ballast was not to make the track more steady—the supply already in place was sufficient for that—but for purposes of drainage. The other principal change was in sodding the banks. The grass keeps the banks firm and prevents the washing down of material. The standard ditch on the side is of ordinary soil, but the company has tried the experiment of sprinkling it with oil. This keeps the dust down and weeds from growing. The experiment with the first fifteen miles has proven so successful that the Pennsylvania has already made plans to improve as much more of the main line in the same way.

There are standards for single-track and double-track as well as four-track lines. In the case of two tracks in a cut, the distance from the bottom of the side ditch to the center line of the roadbed is 18 ft. 4½ ins., the stone ballast is 13 ins. deep at the center line and 17 ins. deep on the side. The tracks are 13 ft. apart, center to center, and ditch is 9 ft. 6 ins. wide in case there is no dry toe wall. There are 5127 cu. yds. of stone ballast for every mile of double track. For a single track in a cut the ballast is 15 ins. deep in the middle and 17 ins. deep on the side. The width of the ditch varies according to the weight of traffic on the single track, being narrow for light traffic. Its maximum width is 9 ft. 6 ins. and its minimum width 7 ft. 6 ins. The ballast may be stone or gravel. The allowance of stone ballast to the mile is 2629 cu. yds.

The drainage pipes beneath the ballast are 6 ins. in diameter, of cast iron, and slope from the center line of the road, parallel with the ties, to the ditches on each side. The plans also provide that berm ditches be cut at the top of the slope on the high side of cuts; that for siding and yards the number of ties be fourteen to 33 ft. of track, and that all ditches for a road with present inter-track distance of 12 ft. 2 ins. be constructed so as to allow for widening the inter-track distance to 13 ft. In soft places cinder ballast must be used, instead of stone, until the roadbed has settled. On curves the low rails of all tracks must be of the same elevation.



PENNSYLVANIA RAILROAD STANDARD FOUR-TRACK CONSTRUCTION, SHOWING ALSO SPECIFICATIONS COVERING CURVE, BALLAST, DRAINAGE AND TIE PRACTICE

AUXILIARY SANDING DEVICE

According to the London "Electrical Engineer," twenty cars belonging to the Liverpool City System are to be equipped with emergency sanding boxes. Auxiliary hoppers are used close to the regular hoppers and deliver their sand at practically the same point on the rail, but they are arranged with a valve which promotes a continuous flow of sand when the valve is opened. The platform treadle is arranged with a stop so that under ordinary working conditions the service hopper only is used. In case of emergency, however, the stop can be kicked aside with the foot and both hoppers will discharge on the track, the discharge from the emergency hopper being a continuous stream. By a simple connection the platform treadle is also arranged so that if kicked in the opposite direction it will open both emergency and service sand boxes at the rear of the car. This is to prevent the car sliding backward at stops on grades.

ON THE SUBSTITUTION OF THE ELECTRIC MOTOR FOR THE STEAM LOCOMOTIVE *

BY LEWIS B. STILLWELL AND HENRY ST. CLAIR PUTNAM

Few subjects which are to-day engaging the attention of the engineering world are comparable either in scientific interest or in practical importance to the substitution of the electric motor for the steam locomotive engine. On the Valtellina line and through the Simplon tunnel 70-ton electric locomotives with three-phase motor equipment, capable of developing a draw-bar pull of 28,000 lbs., have displaced the steam locomotive, with results showing both marked improvement in service and substantial economy in operating costs. In the New York subway, eight-car trains weighing 320 tons are in operation, equipped with motors developing during acceleration a tractive effort equivalent to a draw-bar pull of 55,000 lbs. The heaviest passenger locomotive used on the Erie system weighs, exclusive of tender, 206,000 lbs., of which 55.8 per cent, or 115,000 lbs., is effective on drivers. Assuming the adhesion to be 20 per cent, such a locomotive exerts a draw-bar pull of 23,000 lbs. The motors of the eight-car electric train of the New York subway, therefore, exert a tractive effort equivalent to more than twice the draw-bar pull of this locomotive.

PASSENGER-SERVICE FACTORS CONTRIBUTING TO INCREASED EARNING POWER

The more important considerations which affect gross earnings are:

1. Frequency of service.
2. Speed.
3. General comfort of passengers.
4. Safety.
5. Reliability of service.
6. Increased capacity of line.
7. Frequency of stops.
8. Convenient establishment of feeder lines.

1. Frequency of Service. In comparing results attained by the competing systems in such cases, it is impossible, of course, to state in terms of precision how far frequency of service is responsible for the remarkable results observed in the creation of new business, since to these results a number of other causes also contribute. But without attempting to differentiate between these various factors, it is sufficient here to say that of the several causes contributing to the marked success of lines using electricity, the operation of train units or of single cars upon close headway is recognized to be especially attractive. The advantages resulting from frequency of service become relatively less as the length of run is increased.

2. Speed: The possibilities of operating by electricity at speeds exceeding the maximum which can be obtained safely in steam operation, owing to the elimination of unbalanced reciprocating parts of the locomotive, is well known. It is strikingly illustrated in the Berlin-Zossen trials by the attainment of a speed exceeding 130 miles an hour. Even at speeds at which steam locomotives may be operated without great danger of leaving the track, as a result of the effect of unbalanced reciprocating parts, electric engines are far better able to maintain speed while drawing heavy trains. At speeds of 80 or 90 miles per hour, for example, it is extremely difficult to operate with satisfactory results two steam locomotives at the head of the train; while multiple-unit control places any necessary number of locomotive units absolutely and instantly responsive to the will and touch of a single operator. At high speeds, also, the economy of the steam locomotive falls off rapidly while that of its competitor remains practically constant.

3. General Comfort of Passengers: The great advantages of electric traction in respect to comfort of passengers are well known. Cleanliness and improved ventilation made possible by the elimination of smoke and cinders; lighting practically without heat and at low cost by a system which makes it easy to place lamps in any desired location, and heating apparatus effectively and conveniently controlled, are factors of very great importance in building up passenger business under conditions of competition. In operating through tunnels, ventilated with difficulty, the electric motor, in eliminating smoke and the gases of combustion, possesses an advantage which is frequently controlling.

4. Safety: The more important of the considerations of safety are:

a. The fact that in case of a rear-end collision, which is perhaps the most frequent form of accident experienced in the operation of our railway system, the energy which propels the electric train can be shut off generally with great promptness. On the other hand, the steam locomotive carrying in its fire-box from 1500 to 2000 lbs. of coal heated to incandescence, almost invariably sets fire to any broken cars, or other combustible material with which it comes in contact. Where the electric supply to trains is obtained at low potential from a third rail, the risk of short circuit, which may result in fire if the cars be not fireproof, is greater than it is in the case of overhead construction, even when the voltage employed in the latter case is very high. In fact, in the latter case it may be said that risk from the physiological effects of the current or from fire resulting from short circuit is practically eliminated, except perhaps in tunnels of very limited clearance.

b. The elimination of the boiler carrying steam at high pressure also means the removal of an element of risk which in many railroad accidents has destroyed life.

c. The absence of smoke in tunnels, and consequent ability to see signals clearly at all times, constitutes an advantage of the utmost importance for electric operation.

d. The substitution of the electric heater for the stove or steam pipes affords opportunity not only for ideal control of temperature of the cars but almost absolutely eliminates risk of fire.

e. The use of electric lighting also implies a material gain in safety.

f. The danger of derailment in the case of the electric locomotive is far less than in case of the steam locomotive, by reason of the elimination of unbalanced reciprocating parts which tend to lift the steam locomotive from the tracks. The hammer-blow also, in the case of the steam locomotive, is responsible not infrequently in cold weather for broken rails, as a direct result of which many serious accidents have occurred.

g. The electrification of railways where high-speed passenger traffic is involved, affords opportunity for improved methods of protecting trains by signal systems, automatic or other.

h. The ability to cut off power at will from a given section and therefore from trains operating upon that section under certain conditions, which arise not infrequently in railway service, may be availed of to prevent accidents.

As against the considerations above referred to, all of which tend to make electric operation safer than operation

* Abstract of paper presented before the American Institute of Electrical Engineers, Jan. 25, 1907.

by steam locomotive, the addition to the permanent way equipment of an electric conductor conveying power to trains imposes in the former case a material risk not involved in the latter. If the power be supplied through a third rail, a guard should be used whenever possible to prevent accidental contact with the rail by employees or by others walking upon or crossing the track. Several effective forms of guard are available, of which at least one has been in service upon a convincing scale for five years.

5. Reliability of Train Service: Interesting evidence in respect to the relative reliability of steam locomotives and of electric motors carried upon cars and controlled by the multiple-unit system of train control is derived from the official records of the transportation department of the Manhattan Division of the Interborough Rapid Transit system, of New York. The steam locomotives were operated under exceptionally favorable conditions, were not overloaded, were of simple construction, and admirably maintained. The electric equipment that succeeded them is operating trains which average 5.3 cars, as against 3.8 cars in the days of steam operation. The average speed is materially higher. The tractive effort during acceleration of a six-car train is 30,000 lbs., as against a maximum drawbar pull of approximately 7000 lbs. exerted by the steam locomotive. The results for the months November, 1900, to March, 1901, when steam was used, show an aggregate car-mileage of 18,527,773 miles, and aggregate delay of 8258 train minutes. The car-mileage per train-minute delay was 2243. For the corresponding period of electric operation, five years later, the car-mileage was 25,482,081, the aggregate train-minutes' delay 5970, and the car-mileage per train-minute delay was 4268. It will be noted that the months involved in the above comparison are those in which the difficulties of operation, owing to weather conditions and number of passengers transported, are at a maximum. Snow and sleet are among the greatest difficulties to be overcome in the operation of a third-rail system, when, as in the case of the Manhattan, the third rail cannot be effectively protected by reason of limitation in space available on the structure. In view of these difficulties and of the increase in density of traffic, the results obtained are remarkable.

6. Increased Capacity of Line: The better acceleration possible with electric traction permits a shorter headway and train interval than is feasible where steam motive power equipment is employed. In the operation of freight trains, if it should ever become practicable to distribute electric locomotives throughout the length of the train and operate them by multiple-unit control, trains of length far beyond present limits could be operated.

7. Frequency of Stops: The interurban electric line competing with the steam railroad for traffic between two cities possesses great advantage in the collection and distribution of passengers, from the ability of its cars to stop at any street intersection or other convenient point, instead of receiving and discharging passengers at a single railway station in each town. As speed between terminals is increased, the tendency to reduce the number of stops made to take on or let off passengers is noticeable in the development of many interurban lines.

8. Convenient Establishment of Feeder Lines: Frequency of stops for convenient collection and distribution of passengers, and high speed between terminals, being considerations which are essentially opposed, the advantages of a four-track system permitting operation of local or collecting train units on two tracks, and express trains on the other two tracks, are obvious. The great expense of such a system, however, can be borne only where traffic is very heavy. A natural development which during the last five years has been very rapid, is found in the use of comparatively short electric trolley lines in connection with steam express service for long-distance runs. This method of utilizing the advantages of local electric lines by the companies operating trunk line systems is eminently wise, and in general should be highly advantageous to the properties concerned while increasing materially the facilities offered to the public. It may be pointed out, however, that were the trunk line systems to utilize electricity for through traffic, the extension and systematic improvement of local feeders would be facilitated for a number of reasons.

The substitution of electric for steam equipment involves a large investment in power plant, and in electric conductors and apparatus for conveying power from the power plant to the moving trains. The distributing system for alternating-current equipment, which is the only class of equipment deserving serious consideration in connection with the general problem which we are discussing, comprises an addition to permanent way equipment in the form of overhead construction and electrical conductors conveying power from the power house to the trolley or conductor which is carried above the track. At the present time, the limit of potential generally adopted in this country in constructing alternating-current dynamos is 11,000 volts. Where this voltage is generated, and the distance from the power house to the section of railroad to be electrified does not exceed 25 or 30 miles, step-up and step-down transformers are necessary For greater distances, higher potentials are used upon the feeder circuits between power house and trolley, transformers for increasing the generated potential being installed in the power house, and transformers for lowering the potential to that selected for the trolley; e. g., 11,000 volts, being located in suitable transformer houses at intervals of from 30 to 50 miles, depending chiefly upon density of traffic.

The cost of the power plant and distributing system are properly chargeable to capital account.

Our estimates are based upon the assumption that single-phase alternating-current equipment is used; that the trolley potential is 11,000 volts; that each power house supplies railway line to a distance of 150 miles in each direction, the feeder potential employed being 60,000 volts; that the overhead construction is first class in every respect, and steel bridges and field poles set in concrete being exclusively used for the support of both trolley conductors and feeders.*

As regards equipment of the rolling stock, it is the general practice of our railways to charge against operating expenses all new equipment purchased to replace that which has been worn out in service. In the adoption of electricity, it would seem that this method might be followed in general by our more important railway systems, the substitution of electric equipment beginning naturally upon those parts of the system where the resulting advantages are maximum. In other words, worn-out locomotives, etc., on such a system might be replaced by electric equipment and the cost of the equipment charged against operation, just as the cost of new steam locomotives otherwise required would be charged against operation. In cases where the

* In assuming the use of the single-phase system we are not condemning other systems. The three-phase system has not received from American engineers in general that degree of consideration which its possibilities and demonstrated advantages justify. Its use, at least on mountain-grade divisions, can be supported by very strong arguments.

initial substitution of electricity is on a large scale, as compared with the total rolling stock equipment of the railroad making the change, it is probable that a part if not all of the cost of electric rolling stock equipment will generally be charged to capital account.

We proceed to compare the cost of electric operation with the cost of operation by steam locomotives, using as our standard of comparison the grand average results in steam operation in the United States for the years 1901-1905, inclusive. These average results are set forth in the following tables compiled from the reports of the Interstate Commerce Commission. Many of the items included in this tabulation vary between wide limits in the practice of different railroads.

MAINTENANCE OF WAY AND STRUCTURES

Under the general heading, "Maintenance of Way and Structures," item No. 1, "Repairs of Roadway," if changed at all should show some reduction under conditions of electric operation, but obviously no material change is to be expected. We assume, therefore, that this item, amounting to 10.818 per cent of total operating expenses, will remain unchanged.

The items, "Renewals of rails," "Renewals of ties," and "Repairs and renewals of bridges and culverts," may be conveniently grouped. In the aggregate, these on the average steam-operated railroad amount to 6.33 per cent of the total cost of operation. If the electric locomotive be substituted for the steam locomotive, it is safe to predict that this group of items of expense will be reduced; but it is practically impossible to state with accuracy what the reduction will amount to. In general, it is obvious that the substitution of electric locomotives developing equal draw-bar pull, with axle-loads reduced at least 25 per cent as compared with steam locomotives, and with wheel-bases not exceeding those of steam locomotives, should favorably affect these items. From the best study which we have been able to make of the detailed factors comprised under these three items of the classification, it would seem that under electric operation they should be reduced about one-fourth; in other words, they should approximate 5 per cent of the total operating expenses. It is not to be imagined, of course, that railroads adopting electric traction would limit themselves to equal draw-bar pull and not increase loads. They would, naturally, take advantage of the possibility of increasing draw-bar pull so far as strength of draft-gear may permit, thereby effecting gains far outweighing the decrease in operating expenses represented by saving in maintenance of roadway, rails, and ties, which would result from a decrease in the weight of locomotives. This argument is valid, not

TABLE I.

Item.	Amount 1905.	Per Cent 1905.	Per Cent 1903.	Per Cent 1901.	Per Cent Average Five Years.	Estimated Cost of Operation by Electricity.
MAINTENANCE OF WAY AND STRUCTURES	$274,415,279	19.784	21.185	22.272	21.003	22.354
1. Repairs of roadway	144,161,701	10.393	11.093	10.294	10.818	10.818
2. Renewals of rails	18,259,022	1.316	1.386	1.676	1.439	
3. Renewals of ties	36,856,864	2.657	2.487	3.140	2.728	
4. Repairs and renewals of bridges and culverts	32,166,990	2.319	2.461	2.730	2.466	5.00
5. Repairs and renewals of fences, road-crossings, signs and cattle-guards	6,179,686	0.446	0.527	0.598	0.527	0.527
6. Repairs and renewals of buildings and fixtures	29,320,204	2.114	2.590	2.417	2.366	1.300
7. Repairs and renewals of docks and wharves	2,883,274	0.208	0.235	0.283	0.231	0.231
8. Repairs and renewals of telegraph	2,374,932	0.171	0.165	0.158	0.169	0.169
9. Stationery and printing	383,158	0.028	0.032	0.029	0.030	0.030
10. Other expenses	1,829,448	0.132	0.209	0.317	0.229	0.229
Repairs and renewals of track bonding	......	.....	.....	.....	.....	0.800
Repairs and renewals of overhead construction	......	.....	.....	.....	.....	3.250
MAINTENANCE OF EQUIPMENT	288,012,604	20.765	19.133	18.629	19.524	12.287
11. Superintendence	7,831,965	0.565	0.559	0.599	0.578	.578
12. Repairs and renewals of locomotives	114,988,428	8.290	7.408	6.695	7.509	2.253
13. Repairs and renewals of passenger cars	27,342,129	1.971	2.044	2.277	2.080	2.080
14. Repairs and renewals of freight cars	113,723,239	8.199	7.442	7.436	7.657	6.000
15. Repairs and renewals of work cars	3,360,390	0.242	0.242	0.233	0.238	0.238
16. Repairs and renewals of marine equipment	2,650,543	0.191	0.177	0.234	0.194	0.194
17. Repairs and renewals of shop machinery and tools	9,186,101	0.663	0.696	0.605	0.662	0.500
18. Stationery and printing	595,571	0.043	0.046	0.043	0.044	0.044
19. Other expenses	8,334,240	0.601	0.519	0.507	0.562	0.400

TABLE I.—Continued

Item.	Amount 1905.	Per Cent 1905.	Per Cent 1903.	Per Cent 1901.	Per Cent Average Five Years.	Estimated Cost of Operation by Electricity.
CONDUCTING TRANSPORTATION	769,613,017	55.486	55.893	54.979	55.540	43.454
20. Superintendence	25,007,322	1.803	1.742	1.726	1.752	1.752
21. Engine- and round-house men	130,437,844	9.404	9.562	9.340	9.451	4.710
22. Fuel for locomotives	156,429,245	11.278	11.675	10.602	11.292	5.553
23. Water supply for locomotives	9,147,590	0.660	0.614	0.612	0.634	0.000
24. Oil, tallow and waste for locomotives	5,442,970	0.392	0.389	0.361	0.381	0.250
25. Other supplies for locomotives	3,295,384	0.238	0.232	0.206	0.228	0.228
26. Train service	90,654,520	6.536	6.677	7.011	6.739	6.739
27. Train supplies and expenses	21,963,086	1.583	1.552	1.471	1.537	1.000
28. Switchmen, flagmen and watchmen	60,141,422	4.336	4.313	3.848	4.173	4.173
29. Telegraph expenses	24,823,266	1.790	1.754	1.785	1.780	2.000
30. Station service	89,304,658	6.438	6.664	6.947	6.697	6.697
31. Station supplies	8,961,573	0.646	0.667	0.672	0.669	0.669
32. Switching charges, balance	4,201,050	0.303	0.244	0.319	0 284	0.284
33. Car per diem and mileage, balance	18,835,325	1.358	1.400	1.618	1.423	1.423
34. Hire of equipment, balance	3,040,641	0.219	0.214	0.161	0.194	0.194
35. Loss and damage	19,782,692	1.426	1 094	0.819	1.112	0.750
36. Injuries to persons	16,034,727	1.156	1.120	0.911	1.086	1.000
37. Clearing wrecks	3,594,658	0.259	0.284	0.189	0.246	0.200
38. Operating marine equipment	9,903,479	0.714	0.745	0.862	0.748	0.748
39. Advertising	5,959,380	0.430	0.428	0.428	0.427	0.427
40. Outside agencies	19,688,261	1.419	1.449	1.615	1.495	1.495
41. Commissions	233,987	0.017	0.044	0.089	0.050	0.050
42. Stock yards and elevators	786,850	0.057	0.057	0.075	0.064	0.064
43. Rents of tracks, yards and terminals	23,947,881	1.727	1.544	1.724	1.615	1.615
44. Rents of building and other property	4,814,407	0.347	0.411	0.440	0.404	0.404
45. Stationery and printing	8,772,789	0.632	0.642	0.638	0.634	0.634
46. Other expenses	4,408,010	0.318	0.376	0.510	0.395	0.395
GENERAL EXPENSES	55,022,127	3.965	3.789	4.120	3.933	3.933
47. Salaries of general officers	11,676,616	0.842	0.823	0.984	0.883	0.883
48. Salaries of clerks and attendants	18,582,142	1.340	1.254	1.262	1.283	1.283
49. General office expenses and supplies	3,459,470	0.249	0.234	0.257	0.244	0.244
50. Insurance	6,885,932	0.496	0.432	0.384	0.439	0.439
51. Law expenses	7,096,275	0.512	0.541	0.549	0.549	0.549
52. Stationery and printing (general expenses)	2,439,781	0.170	0.175	0.161	0.170	0.170
53. Other expenses	4,861,911	0.350	0.333	0.447	0.365	0.365
RECAPITULATION OF EXPENSES	......	.....	.....	.....	.....	.....
54. Maintenance of way and structures	274,415,279	19.784	21.185	22.272	21.003	22.354
55. Maintenance of equipment	288,012,604	20.765	19.133	18.629	19.524	12.287
56. Conducting transportation	769,613,017	55.486	55.893	54.979	55.540	43.454
57. General expenses	55,002,127	3.965	3.789	4.120	3.933	3.933
Grand total	$1,387,043,027	100.	100.	100.	100.	82.028

NOTE.—It is customary with some railroads using electric equipment to include under the general heading "Maintenance of Equipment," the maintenance of the power plant and electric transmission systems. Both of these, however, are more conveniently treated by including them in the cost of electric power delivered to the overhead trolley system or third rail.

only with reference to high-speed passenger traffic, in which the hammer-blow of the engine is emphasized, but also in connection with freight traffic, where in recent years there is a marked tendency to employ trains of great length and locomotives of extreme weight.

The cost of track maintenance is increased by reason of the electric bonding of the rails. This bonding, including the cost of special bonds necessary where an automatic track signal system is used, will cost about $500 per mile under average conditions. Its cost of inspection and maintenance should not exceed $50 per mile of single track per annum.

The annual cost of "Renewal of rails," "Renewal of ties," and "Repairs and renewals of bridges and culverts," averages in the United States $400 per mile of track, which, as above stated, is 6.633 per cent of average operating expenses. under steam operation, and for equal trains, as we have estimated. 5 per cent for electric operation. The effect of the cost of track-bonding, therefore, would increase the items under consideration by about one-eighth, which is equivalent to an increase of 0.8 per cent in operating expenses. To avoid possible confusion, we include the cost of "Repairs and renewals of track bonding" as a separate item in the column "Estimated cost of operation by electricity."

Under the general conditions which will govern where electricity is substituted for steam in railway operation there can be no doubt that the substitution will result in a material reduction in the cost of maintenance of rails, ties, bridges, and culverts. In this substitution electric locomotives will be used for freight traffic, while for passenger traffic locomotives will be eliminated ultimately and multiple-unit car equipments employed. For the immediate future, however, locomotives will be employed not only for freight traffic but also in some cases for passenger traffic for the practical reasons which have impelled the Pennsylvania, the New York Central, and the New York, New Haven & Hartford systems in electrifying their New York terminals to adopt electric locomotives for handling their through trains.

Reverting to Table I., item 5 will not be changed by the adoption of electricity.

Item 6, "Repairs and renewals of buildings and fixtures," includes repairs and renewals of engine houses and shops, also water tanks and coal-handling apparatus. Under electric operation, it is evident that this item would be materially reduced. This subject will be further discussed when we come to consider item 12. It is conservative to say that for the operation of a given train-mileage, under the average conditions of railway service in this country, the number of electric locomotives required should not exceed one-half the number of steam locomotives now used. The reduction in the number of locomotives implies, of course, a reduction in the cost of repairs and renewals of engine house and shops, and taking this into account, in connection with the elimination of water tanks and coal-handling apparatus, distributed along the line, it is our opinion that this item will be reduced from 2.366 per cent to about 1.3 per cent of the total annual operating expenses.

Item 7 obviously will not be affected.

Item 8. It is probable that this item will be somewhat increased in general where electric operation is adopted The effect upon the operating expenses, however, is so slight as to be practically negligible.

Item 9 will not be changed.

Item 10 we may assume will not be affected.

Under the general heading "Maintenance of Way and Structures," the classified statement of operating expenses of a railroad electrically equipped includes the following items in addition to the foregoing:

a. "Repairs and renewals of track bonding." This has been referred to in our discussion of items 2, 3, and 4, and it is included in our tabulated statement as a separate item amounting to 0.8 per cent of operatig expenses.

b. "Repairs and renewals of overhead or third-rail construction." From detailed calculations the cost of high-class overhead construction, where two tracks are to be equipped, the cost of overhead construction is approximately $10,300 per mile. This includes trolley conductors equivalent to No. 0000 wire B. & S. gage, insulated for 11,000 volts alternating, and supported by steel cables, carried by substantial steel bridges set in concrete and spanning the tracks. For single-track work using steel poles and brackets and catenary support, the cost closely approximates $4,800 a mile.,

Of the total line mileage of the United States in 1905, amounting to 216,974 miles, approximately 0.4 are in double track, including yards and sidings for single-track lines, and 0.6 are single-track. The grand average cost of overhead steel construction of the type considered, therefore, closely approximates $5,000 per mile of track. In this case, our estimate of the annual cost of "Repairs and renewals of overhead construction" cannot rest directly upon actual experience, since practically no overhead construction of this character is in use under the conditions of railway service; but taking into account all of the factors which appear to affect the problem, it is our judgment that the amount required should not exceed $150 per mile of track per annum. This is equivalent to $210 per mile of line per annum, the average ratio of track-mileage to line-mileage being 1.4 to 1.

It is, of course, possible to erect a much cheaper form of construction if wood poles be used. Though the first cost of such construction is low, it involves repairs and renewals constituting a much larger percentage of its cost than in the case of the steel bridge and pole construction set in concrete. The annual effect upon operating expenses with this type of construction as an average figure may be expected to approximate 2.5 per cent.

MAINTENANCE OF EQUIPMENT

Item 11 will not be changed.

Item 12. "Repairs and renewals of locomotives amounts to 7.509 per cent of the average operating expenses of our steam railroads. This item, according to the classification of operating expenses of the Interstate Commerce Commission, "does not include the expense of cleaning boiler tubes and packing cylinders, nor ordinary regular inspection, this being charged to the item "Engine and Roundhouse Men." It does include "all expenditures for account and repairs and renewals and rebuilding of locomotives, tenders, snow-plows (when attached to locomotives), furniture and loose and movable tools and supplies used in connection therewith. It also includes the cost of locomotives, tenders and appurtenances thereunto belonging, built or purchased to make good the original number charged to construction or equipment. As regards "Repairs and renewals of electric locomotives," actual experience to date is not sufficient to justify us in fixing a figure for this item which can be regarded as established. There is, however, evidence sufficient to justify an estimate which in the average case should be approximately. correct. This is given below:

For the year ending June 30, 1901, the car-mileage operated by the Manhattan Railway was 43,860,158. The cost of repairs of locomotives was $173,609, or 0.39 cents per car-mile. For the year ending June 30, 1906, the car-mileage operated by the Manhattan Railway was 61,723,112. The cost of repairs of the electric equipment, including lamps, lamp wiring, and heaters, was $171,927, or 0.28 cents per car-mile.

Had electric locomotives been used instead of the multiple-unit system, the number of parts constituting the electric equipment, as stated, would have been about one-third that now in use. These parts would have been larger and more expensive than the corresponding individual parts constituting the multiple-unit equipment, but the cost of repairs of the aggregate electrical equipment (which is largely labor of inspection) probably would not exceed 60 per cent of the present cost. The results are further influenced unfavorably to electric traction as regards this comparison by the fact that the speed and consequently the power consumption per car has been radically increased, and by the fact that the repairs and renewals of lamps, heaters, and wiring are included.

A careful consideration of the detailed factors involved has led us to the conclusion that had electric locomotives been substituted for steam locomotives, and had the weight and speed of trains not been increased, the cost of repairs of electric equipment would have approximated 0.2 cents per locomotive mile. We estimate also that the cost of repairs to these small locomotives exclusive of their electric equipment operating under the existing conditions would not have exceeded 0.2 cents per locomotive mile, and that the total cost would have approximated one-fourth of the cost of the corresponding item under steam traction. This figure, of course, is available only as a ratio in our consideration of the general railway problem.

The very low cost which was actually obtained in the case of steam locomotives on the Manhattan, viz: 1.57 cents per locomotive mile, is explained by the extremely simple construction of the engines, the fact that they were not overloaded, were operated on an elevated structure, and were admirably maintained. It is also to be noted that the amount expended for repairs was minimized in view of the contemplated adoption of electricity.*

In applying to the general railroad problem evidence afforded by Manhattan experience, it must be noted that the elevation of the tracks places the motors beyond the reach of the dust or cinders which the rush of a train at certain seasons raises from the average railway track. On the other hand, the fact that the average run between stations on the elevated system is only about 2000 ft. exposes both motor and control to the action of brake-shoe dust which is liberated in quantities many times as great as would be the case in average railway service, and this brake-shoe dust is far more injurious to both motors and control than is dust from disintegrated ballast or cinders. In designing electric equipment for general railway service, it is advisable and not difficult to protect the motors effectively against the admission of dust of all kinds, particularly in cases where locomotives rather than multiple-unit equipment is adopted. This would be accomplished naturally by thoroughly enclosing the motor, and ventilating it by forced draft so directed as to prevent admission of dust.

* In this connection it is interesting to note that the cost of maintenance of locomotive and average train under steam operation for the year ending June 30, 1901, was 4.2c. per train-mile while the cost in the case of an equivalent electric train, as shown by records for corresponding months for the year ending June 30, 1906, was 2.1c. per train-mile.

2. INTERBOROUGH RAPID TRANSIT COMPANY, SUBWAY DIVISION

For the year ending June 30, 1906, the car-mileage operated by the New York subway was 31,931,073. The cost of repairs and renewals of electric equipment of rolling stock was 0.38 cents per car-mile. Estimating the probable cost of repairs and renewals of electric equipment, were electric locomotives in use instead of the multiple-unit car equipment, the approximate cost in this case works out at 0.7 cents per train-mile. A locomotive doing the same work as the electric equipment of the average train in the subway (about five cars) must be capable of exerting a draw-bar pull of 30,000 lbs., which with 20 per cent adhesion calls for 75 net tons on drivers. This is about double the weight on drivers of the average steam passenger locomotive, and the figure 0.7 cents per train-mile, obtained in actual service under conditions very severe in respect to maintenance of electric equipment, by reason of the presence of great quantities of brake-shoe dust, is to be compared with the cost of maintenance of steam locomotives exclusive of running-gear, frame, cab, and those other parts common to both electric and steam equipment.

3. WILKESBARRE & HAZLETON RAILROAD

Operation for the year 1905:

Equipment comprises motor cars weighing 43 tons without passengers, and equipped with four 125-hp motors and multiple-unit control.

Effective draw-bar pull (20 per cent adhesion) = 17,000 lbs.

Speed of operation in local service = 30 miles per hour.

Total length of run = 27 miles.

Average number of stops = 6.

Car-mileage operated in 1905 = 262,947.

Cost of repairs and renewals of electric motors = $1,021.70 = 0.39 cents per car-mile.

This road operates in a mountainous country, ranging in elevation from about 500 ft. to 1700 ft. above sea-level. About one-third of the length of the road is on a grade of 3 per cent.

4. LACKAWANNA & WYOMING VALLEY RAILROAD

Operation for a period of four months ending Oct. 31 1906:

Equipment: a, 16 passenger cars, 77,500 lbs. each; b, 14 passenger cars, 64,500 lbs. each; c, 4 freight and express motor cars, 61,300 lbs. each; d, 1 electric locomotive, 94,600 lbs.

Car-mileage operated =527,554.

Repairs and renewals of electric equipment = $4,450.43 = 0.84 cents per car-mile.

5. NIAGARA, BUFFALO & LOCKPORT RAILROAD

Operation for a period of six months ending Nov. 30, 1906:

Equipment: passenger cars weighing about 60,000 lbs. driven by four direct-current motors.

Average speed outside of Buffalo city limits, 20 miles an hour. Approximate number of stops one-way trip: 30 on Buffalo & Niagara Falls division, and 6 on Buffalo & Lockport division.

Length of run outside of Buffalo, approximately 20 miles.

Car-mileage operated, 1,309,682.

Repairs and renewals of electric equipment, 0.79 cents per car-mile.

6. RETE ADRIATICA-VALTELLINA LINE

Perhaps the best instance of electric operation directly comparable with cost of steam operation is afforded by the records of actual results realized on the Valtellina line where both freight and passenger traffic are operated over a line 66 miles in length, traversing a very rugged country and in the winter exposed to severe climatic conditions. The equipment for the year ending July 1, 1904, comprised ten motor cars and five 70-ton locomotives. The service performed amounted to 61,934,569 ton-kilometers. The average annual mileage of motor cars and locomotives amounted to 54,351 kilometers, while the steam locomotives superseded by electric equipment never exceeded an average of 29,000 kilometers. The total cost of electrical and mechanical repairs to locomotives and motor cars, for the year ending July, 1904, works out at 1.4 cents per locomotive or motor-car mile. The rolling stock used on this line is excellent in design and construction and is particularly well adapted to operate in railway service at low cost of maintenance, by reason of the fact that three-phase motors and water rheostats are employed instead of commutating motors and switch-control. The equipment has not been operating long enough to have reached the point where renewals, as distinguished from repairs, have become necessary:

Summarizing the foregoing we have the following:

	Tractive Effort 20% Adhesion.	Repairs of Electric Equipment of Equivalent Electric Locomotive, Estimated.	
	Lbs.		
Manhattan Railway	22,000	0.5c.	
Subway train	33,000	0.7c.	
Wilkesbarre & Hazleton R. R.	17,000	0.38c.	(Actual.)
Lackawanna & Wyoming Valley R. R.	14,000	0.84c.	(Actual.)
Niagara, Buffalo & Lockport R. R.	12,000	0.79c.	(Actual.)
Rete Adriatic-Valtellina Line	......	1.6c.	Complete cost of maintenance of locomotives and cars.
Freight locomotives	......		
Passenger cars	......		

It may be conceded freely in respect to the foregoing data that they are neither sufficiently comprehensive in scope nor extended in respect to duration of service to justify definite and final conclusions. It must be noted also on the one hand that the cost of maintenance may be expected to decrease by reason of further improvement in the construction of apparatus of comparatively new types, and on the other hand that the costs given are for inspection and repairs rather than renewals, since the time has not arrived when any of this equipment has been thrown aside and replaced by new equipment charged to this item of operating expenses as is usual with steam railways.

The reports of the Interstate Commerce Commission do not show what proportion of the item, "Repairs and renewals of locomotives" is chargeable to renewals, but from inspection of detailed reports of our most important railway systems it seems fair to assume that in the case of the average railway from 4 per cent to 5 per cent of the total cost of repairs and renewals of locomotives represents the cost of renewals.

Taking into account all of the various considerations which must affect the conclusions in the general case, so far as we have been able to gather them, we are of the opinion that for equal draw-bar pull, the repairs and renewals of electric equipment of locomotives, assuming good design and construction according to present standards of the art, should not exceed 1 cent per locomotive-mile, and will probably approximate 0.9 cent per locomotive-mile.

Taking the higher figure, it is evident that the substitution of electric equipment for all parts of a steam locomotive other than frame, wheels, axles, cab, and other parts which are common both to electric and steam locomotive construction, a very great saving is effected. We have been unable to fix with satisfactory exactness a figure representing the average cost of repairs and renewals of these parts, but it would seem liberal to allow 1.5 cents per locomotive-mile, this being equivalent to an allowance of something over $400 per annum per locomotive. Taking this figure and adding the estimated costs of repairs and renewals of electric equipment, we have 2.5 cents per locomotive-mile as the estimated total cost of repairs and renewals of electric locomotives, performing the average work now done by steam locomotives.

In 1904 the aggregate revenue train-mileage operated was about 1,050,000,000. To cover locomotive mileage in switching, operating work-trains, and pushers we assume 1,300,000 locomotive-miles. In 1904 the aggregate repairs and renewals of locomotives was $105,633,752, the average cost per locomotive-mile, therefore, being 8.1 cents. A reduction of 2.5 cents, therefore, is equivalent to a saving of 70 per cent in the cost of this item, or 5.256 per cent of operating expenses, reducing this item to 2.253 per cent of total operating expenses under electric operation.

In the foregoing consideration of the item repairs and renewals of locomotives, we have assumed equal locomotive mileage per day in steam and electric service. The item of expense under consideration will be proportional approximately to the mileage, and therefore we have made the comparison upon this basis.

The relative number of locomotives required for a given service is, however, a question of much importance and may be here appropriately referred to.

According to the report of the Interstate Commerce Commission for 1904, the effective train-mileage, not including work-trains, pushers, or shifting mileage, was 58 miles per locomotive per day. Including these items the daily run of the average locomotive in the United States would be approximately 80 miles. The average freight and passenger locomotive is actually on the road not more than six hours in each twenty-four-hour period. In the case of electric locomotives there is no reason, so far as the mechanism is concerned, why it cannot be kept in practically continuous service. Ordinary inspection and maintenance require very little time, and if the equipment be well designed and constructed repairs of magnitude will be necessary only at intervals very infrequent as compared with steam practice.

The fact that the average daily run of the average locomotive is approximately 80 miles is due in large measure to causes which would still exist were electric locomotives substituted. The time spent by freight locomotives in yards and terminals making up trains or awaiting opportunity to take their place in the procession of trains which in these days are demonstrating the insufficiency of track equipment for the business of the country, is a large factor. Perhaps this would not be greatly modified were electric locomotives employed. But other considerations which operate to reduce average mileage are the facts that the steam locomotive spends a large part of its life in the repair shop, and a still larger part in firing up and preparing for its work in withdrawing fires, having boiler tubes cleaned, etc., after its daily run. Nothing short of years of actual experience can establish definitely the ratio of electric to steam locomotives required in average service, but it seems reasonable to assume that this ratio will not exceed 2 to 3 and will probably approximate 1 to 2. It will be noted that the foregoing estimate of cost of repairs and renewals is independent af any assumption as to the relative number of locomotives required, since it is reckoned on locomotive mileage.

. Item 13. In cases where electric locomotives are substituted for steam locomotives, there should be some reduction in this item. Painting should be considerably reduced by reason of the elimination of smoke. The life of the upholstery and interior decoration of the car will be increased.

Item. 14. This item will be favorably and very materially affected if it should ever prove practicable to operate heavy freight trains by locomotives located at intervals throughout the trains and controlled by the multiple-unit system. The bare possibility of this at present may seem fanciful, but those who realize the extent to which the wear and tear of freight cars results from the terrific strains to which the draft-gear is subjected under present operating conditions, especially on mountain grades, and who understand also the increase in track capacity and decrease in cost of train crews which would result in the adoption of a system which makes it possible, if necessary, to double the length and weight of the longest and heaviest freight trains now in use, will be ready to give this possibility serious consideration. Altering the present make-up of trains, so far as location of the locomotive is concerned, makes it possible to operate two or more locomotive units at the head of the train, and to utilize their power to the utmost by multiple-unit control.

Assuming that the methods of train operation remain the same, the adoption of electricity will still effect a reduction in the cost of Item 14, and for two reasons, viz:

1. The practical elimination of damage by fire which now frequently is superimposed upon damage caused by collision or derailment.

2. Reducing the wear and tear of wheels and brake equipment in descending long grades, by reason of the opportunity afforded to brake the trains by causing the motors to operate as generators. No statistical data are available upon which to base an estimate of the probable reduction in this item to be expected from this cause. On comparatively level lines it will not be important, but on mountain-grade divisions it should operate to prevent a very large proportion not only of wear and tear directly due to grade but also of the destructive freight wrecks which are now so frequent. In the way of an estimate, nothing more definite than a guess based upon consideration of probabilities can be advanced; but in the opinion of the writers the general substitution of electricity for steam operation in freight service should reduce this item from 7.657 per cent to something like 6 per cent of operating expenses.

Item 15 will not be changed materially.

Item 16 obviously will not be changed.

Item 17 will be reduced under electric operation since the repairs to locomotives will be radically decreased, as shown, and since the tool equipment required for the electrical machinery is materially less expensive and varied. It would seem reasonable to expect that this item would be reduced from 0.662 per cent to about 0.5 per cent of total operating expenses. Of course a large proportion of the shop machinery and tools are for car repairs.

Item 18 will not be changed.

Item 19. "Other expenses." The classification of operating expenses includes under this item "all expenditures for account of electric light, torches and lamps used in machinery department, shops, roundhouses and offices and the oil and material for the same; the proportion of labor and material for the proper operation and repair of electric lights used in connection with other departments; wages of engineers and firemen and the cost of fuel and water in operation of stationary engines or boilers for supplying power and heat to shops, buildings and roundhouses." We estimate that this item will be reduced to about 0.4 cent.

CONDUCTING TRANSPORTATION

Item 20 will not be changed.

Item 21. "Engine and roundhouse men" includes, in addition to the engine crew, round-house men whose work, of course, is chiefly in connection with the cleaning and maintenance of the engines. This item of averages for the railroads of the United States 9.451 per cent of the operating expenses, of which 91 per cent, or 8.6 of the operating exepnses, are for engine men and for firemen. Of this 8.6 per cent approximately 5.5 per cent is for engine men and 3.1 per cent for firemen.

In considering the substitution of the electric locomotive for the steam locomotive it is obvious that the change eliminates the work which the fireman is employed to perform. The point is frequently made, however, that to reduce the engine crew to one man means an increase in the risk incurred in train operation, and this point obviously is of such importance as to require careful consideration.

If we compare conditions which now exist upon such systems as the Manhattan Elevated with the conditions which existed before electricity was adopted, it seems reasonably clear that with a competent motorman operating the controller which instantly cuts off power and applies the brakes in case the hand of the motorman is removed from the handle of the controller, the safety of trains and passengers is assured in higher degree than it was under the old conditions. The usual argument against the elimination of the fireman is, of course, found in the allegation that in case of the sudden death or serious illness of the engineman the fireman can take his place and bring the train to a stop or operate it to the next station. The controller which automatically cuts off power and applies the brakes cannot operate the train to the next station, but it can stop it much more promptly than the fireman possibly can, even when he is so located upon the engine as to be in sight of the engineman.

But a very large proportion of our steam locomotives are now designed in such a way that the engineman is not in sight of the fireman, and the mechanism of the steam locomotive which he controls has no automatic device for shutting off power and applying the brakes in case he suddenly dies at his post. In such an emergency on trunk-line railways there would be some advantage in the presence of the fireman, owing to the fact that if competent he could operate the train to the next station. This point might be met by having the train conductor or brakeman or flagman qualified to operate the electric train to its destination in case of accident to the motorman. The degree of skill required, so far as actual manipulation of the mechanism is concerned, would be far less than in the case of the fireman who might in emergency be entrusted with the responsibility of operating the steam train.

As regards the wages of the engineman, the Manhattan Railway decided to pay its motormen the same wages which it had paid its enginemen. This decision was based largely upon consideration of the fact that familiarity with the road and experience in operating trains under the extremely close headway prevailing upon this system were of such importance that any risk which might be incurred by substituting new men must be avoided. The great majority of electrically-equipped railways operating under conditions similar to the Manhattan, however, pay their motormen wages comparable to the wages of the men who operate street cars rather than to the wages of locomotive enginemen. It seems reasonable to assume that under average conditions the services of thoroughly competent motormen can be obtained at a figure which will represent a reduction of 1 per cent in operating expenses, making this item 4.5 per cent instead of 5.5 per cent.

The expense for round-housemen, which under steam operation is about 8.5 per cent, will be greatly reduced both by reason of the reduction in the number of locomotives required for a given service and also for the reason of the demonstrated less cost of maintenance per locomotive unit. It is entirely liberal to allow for this item one-fourth of its cost in steam operation, the saving here effected being equal to 0.64 per cent of the average operating expenses of steam railroads in the United States. The estimated cost of the item under consideration, therefore, is 4.71 per cent of total operating expenses.

Item 22. "Fuel for locomotives." One of the marked economies resulting from the substitution of the electric motor for the steam locomotive in railway operation is in the reduction of the fuel account. The cost of fuel upon the average steam railway in the United States for the five years 1901 to 1905, inclusive, constituted 11.292 per cent of total operating expenses. The aggregate cost in 1905 was $156,429,245.

The following figures show comparative fuel consumption upon the Manhattan Railway during the year ending June 30, 1901, when steam locomotives were employed and during the year ending June 30, 1904, when electricity was used. During the period first mentioned one pound of coal produced 2.23 ton-miles, if the weight of the locomotive be included, and 1.5 ton-miles, if the weight of the cars only be considered. During the latter period (electric traction) one pound of coal burned at the power house produced 3.85 ton-miles, excluding weight of locomotives; therefore, the ratio of ton-mileage per pound of coal in favor of electric operation was 2.57 to 1. Including weight of locomotive it was 1.72 to 1. The average speed under electric operation was approximately 2 miles an hour greater than that attained by steam, and if correction be made for this difference the ratio of ton-mileage per pound of coal, excluding weight of locomotives, is approximately 3 to 1, and including locomotives 2 to 1 in favor of electric traction. It should be noted also that in this case the coal burned at the power house was of lower grade, and therefore less expensive than that used by the locomotives, and it is reasonable to expect that in general electric traction will mean utilization of cheaper fuel.

We would point out that the argument from Manhattan experience cannot be met by the statement that the Manhattan is not an average railroad. Were the steam and electric apparatus now operating the Manhattan lines applied to the operation of a division of a trunk-line railway, the one part of the system which would be affected in respect to efficiency is the high-potential transmission lines, and the effect of their greater length in general would be to increase the relative fuel consumption of the electric system by not more than 5 per cent. For trains drawn by locomotives the fuel account (coal only) under electric operation would still be approximately one-half of the cost of the fuel for steam operation, and for passenger service using multiple-unit equipment it would be less than 40 per cent of the fuel used in equivalent steam service, even if we assume that the system of alternating transmission and conversion to direct current by synchronous converters be employed.

The advantage in favor of electric operation is of course more marked if we assume that alternating-current equipment is to be used, as in general would be the case in the electrification of trunk lines or long divisions. In a particular case which we have worked out with great care, the trolley and track rail losses average 3.9 per cent, the load factor being 0.33. This is the result obtained in using the single-phase system for the equipment of a division approximately 40 miles in length, the potential being 11,000 volts. The grand average of traffic in the United States does not exceed seven trains per day passing a given point in each direction, and the trolley and track rail energy losses for this traffic would be less than 2 per cent.

Assuming that such a trolley voltage is used in connection with a feeder potential of say 40,000 to 60,000 volts, the allowable loss in these feeders at maximum load certainly will not exceed 10 per cent and the energy efficiency of step-up transformers, transmission feeders, and step-down transformers will be 92 per cent. Combining this figure with the energy efficiency of trolley and track, as above stated, the resultant efficiency from bus-bars of power house to the train will be 90 per cent.

The works-cost of a kilowatt-hour at the bus-bars of the Manhattan plant is less than 0.6 cent when coal costs $3 per ton, this coal having a calorific value of 14,000 B. T. U. per pound. This cost includes fuel, water, labor, maintenance, miscellaneous supplies, and in short everything except capital charges. It is not abnormally low, the cost of both coal and labor being relatively high as compared with the grand average cost of equivalent coal and labor throughout the United States. Where fuel is less expensive, as in the Middle West, large modern plants, using steam turbines, are producing the average kilowatt-hour at a price not exceeding 0.5 cent exclusive of capital charges, and in at least one case at a works-cost approximating 0.4 cent.

As will be shown hereinafter, were all the railroads of the United States to be operated by electricity, the average plant required, assuming power to be transmitted 150 miles, would approximate 4,000 kw, if the plants supplied but a single line 300 miles in length. The great bulk of the total power supplied, however, would be derived from large plants in which the cost of producing the unit of energy, considering average costs of fuel and labor, should be less than 0.6 cent. While the small plants would exceed this figure we believe that as a grand average 0.6 cent is ample to cover the case. In this connection it may be remarked that water powers and other sources of cheap power supply would tend to keep down the average cost of power under the assumed condition of electrification of the entire railroad system of the country.

In the case of the single-phase, 25-cycle motor, assuming the average length of run for freight trains to be 15 miles and for passenger trains 20 miles, we have calculated that of the energy delivered to the locomotive approximately 86 per cent will be effective for traction in the case of the passenger locomotive, which is gearless, and about 84 per cent in the case of freight locomotive, which uses single-reduction gear. Combining the two, it is safe to say that of the energy supplied at the bus-bars in the power house not less than 75 per cent will be effective for traction in the average locomotive equipment with this apparatus.*

The cost of a kilowatt-hour effective for traction therefore is 0.8 cent and the cost of a horse-power hour effective for traction about 0.6 cent of which 0.35 cent is for fuel when coal is 14,000 B. T. U. per pound, costs $3 per ton of

*For the motor curves upon which these figures are based, we are indebted to the courtesy of the Westinghouse Electric & Mfg. Co.

2240 lbs., and 0.25 cent is for other power-house supplies, power-house labor, and maintenance of power-house equipment.

As we have stated, the railroads of the United States in 1905 used coal costing $156,429,245. For the purpose of estimating the cost of equivalent electric power the following data are necessary, of which those marked by an * are furnished by the report of the Interstate Commerce Commission while the others involve certain assumptions:

PASSENGER SERVICE

*Passenger train-miles.
Passenger car-miles.
*Passenger-miles.
Average weight of passenger trains.
 a. Weight of locomotives.
 b. Weight of cars.
 c. Weight per passenger.
Average speed of passenger trains.
Average length of run.
*Mail and express train-mileage.
Average weight of mail and express trains.
Non-revenue ton-mileage.

FREIGHT SERVICE

*Freight train-mileage.
*Freight car-mileage.
*Revenue freight-ton miles.
Average weight of freight trains:
 a. Weight of locomotive.
 b. Weight of cars.
Average speed of freight trains.
Average length of run.
Non-revenue ton-mileage, work-trains, switching, etc.

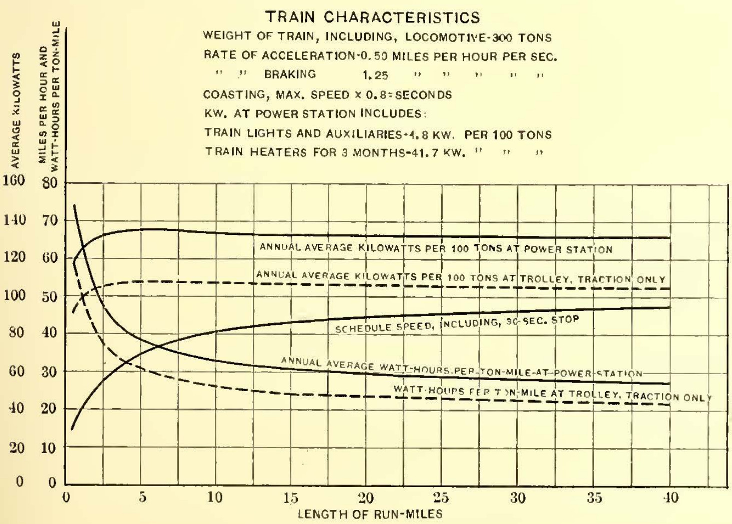


FIG. 1

Referring to the several items in the foregoing lists not directly derived from the report of the Interstate Commerce Commission the assumptions made are as follows:

PASSENGER SERVICE

Passenger Car-Miles: These we have calculated from the stated train mileage and the assumption that the average number of cars per train is 5.5.

Average Weight of Passenger Trains: We assume, a, weight of the average locomotive exclusive of tender equals 60 tons; this is the weight of the average passenger locomotive used by the Erie system; b, average weight of ordinary passenger coaches without live load equals 30 tons. This weight is somewhat in excess of the average weight of cars used by a number of railroads using rolling stock undoubtedly representative of the average in use throughout the country. To this we have added 10 per cent in estimating train weight to cover additional weight of Pullman cars

c. Average number of cars in trains. We assume five and a half cars per train, which is approximately correct for

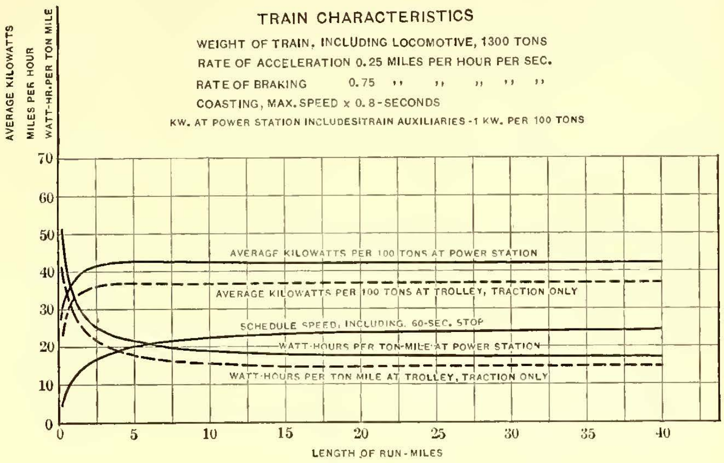


FIG. 2

a number of the more important railroads and is probably slightly above rather than below the grand average.

d. Weight per passenger. We have assumed an average weight of 140 lbs.

Average Speed of Passenger Trains: Referring to Fig. 1, the curve expressing the variation in the amount of energy required for traction as dependent upon average length of run between stations, shows that the increase resulting from a decrease in length of run from 20 miles to 10 miles is but 10 per cent. If the average length of run be further decreased to 5 miles, the increase in energy for traction as compared with that required for a 10-mile run is approximately 18 per cent. Including energy required for heating and lighting the cars, it is not far from accurate to assume 33 watt-hours output at power house per ton-mile in average passenger service.

Average Length of Run: We have assumed, as stated, 33 watt-hours at power house ton-mile including light and heat. This corresponds to an average run of 10 miles.

Average Weight of Mail and Express Trains: We have assumed average weight of mail and express trains to be the same as that of the average passenger train, viz: 180 tons without locomotive or live load.

Non-Revenue Ton-Mileage: This is assumed at 10 per cent to cover "double-headers" and switching. For the entire Erie system the actual figures approximate 7 per cent, and the assumption of 10 per cent is slightly less favorable to electric traction than the facts would probably warrant.

FREIGHT SERVICE

Average Weight of Freight Trains: As regards freight service, in estimating the average weight of trains we have assumed the following: a. Weight of locomotives equals 79 tons. This is the actual average of the freight locomotives of the Erie system exclusive of tender. b. Weight of cars equals 15 tons. This figure closely approximates the average weight of all freight cars of the Erie Railroad.

Average Speed of Freight Trains: The curves (Fig. 2) are based upon a gear ratio which produces on straight and level track a maximum speed of 25 miles an hour. Determination of the error involved by any mistake in our assumption of the average speed in

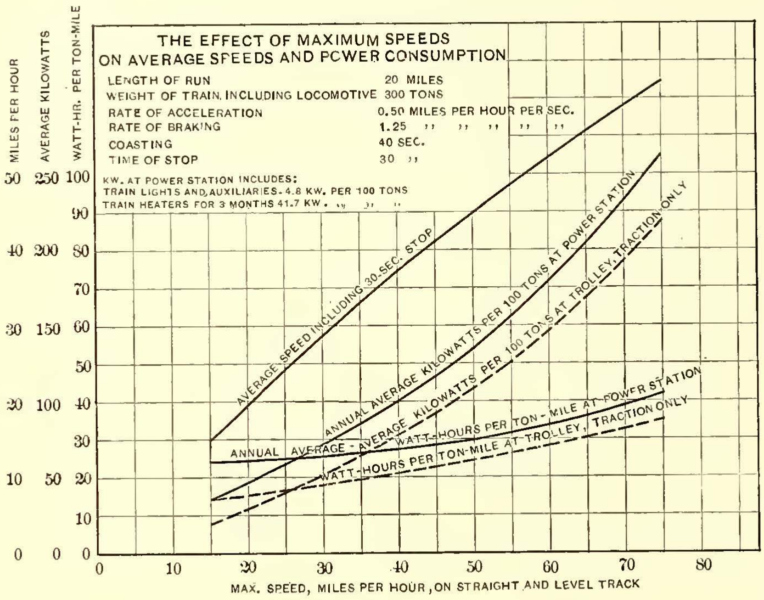


FIG. 3

freight service is facilitated, which shows, for example, the following relations:

Maximum Speed	Average Speed Including 60 Seconds Stop Miles per Hour	Average Watt-hours per Ton-mile at Power Station
20	19	17
25	23	18
30	27	19

Average Length of Run: We have assumed that for all freight service the average length of run is 15 miles. The actual average length of run may vary considerably from the distance assumed without causing material error in our calculation as shown in Fig. 2.

Non-Revenue Ton-Mileage: We have added 15 per cent of the total revenue earning ton-mileage.

Basing our calculations upon the foregoing statistical facts and the assumptions noted, we estimate that for the operation of the entire freight and passenger service of the United States as existing in 1905, the aggregate energy required at bus-bars of power houses would approximate 12,500,000,000 kilowatt-hours per annum. At 0.6 per cent per kilowatt-hour the total cost of energy for traction, for the operation of all auxiliaries, and for the supply of light, and heat to passenger trains would closely approximate $76,000,000 per annum. This figure represents a saving of about $80,000,000 as compared with the coal used by steam locomotives in the year 1905. Referring to the table, the average cost of this item for five years, viz: 11.292 per cent, would be reduced by electric traction to 5.533 per cent.

Item 23 is eliminated if electricity be substituted for steam.

Item 24 should be considerably reduced. We assume that it will be reduced to 0.25 per cent.

Item 25. We make no change in this item.

Item 26 is not changed.

Item 27, among many others, includes the following which will be changed by the substitution of electric power, viz: "Heating, lighting, cleaning and lubricating cars, including the cost of supplying and pumping gas into cars."

In discussing Item 22, we have included in the estimate of electric power required energy sufficient to light all cars three hours out of every twenty-four. We have also included energy sufficient to heat all passenger trains by electricity an average of three months per annum. Both of these are important items. The cost of clearing the cars should also be reduced by the elimination of smoke and cinders from the locomotives. All things considered we believe it is fair to assume that under electric operation this item will approximate 1 per cent of operating expenses.

Item 28 will not be changed.

Item 29. In general it is not to be expected that the large amounts of power required for train operation can be transmitted electrically under conditions which make it necessary to parallel telegraph lines by power circuits without more or less interference with the telegraph and telephone service. Certain technical questions in regard to methods of preventing interference remain to be worked out. The erection of overhead circuits carrying power supply will involve generally more or less shifting of the location of the telegraph lines. This item of expense is taken care of in our estimate by inclusion of the cost of overhead construction, and is treated as a capital account. Telegraph circuits being rearranged with reference to the power circuits, or equipped with one or another of the devices which have been suggested as preventives of difficulties resulting from inductive effects of the power circuits, it might be assumed, perhaps with safety, that Item 29 would not be changed, but we are

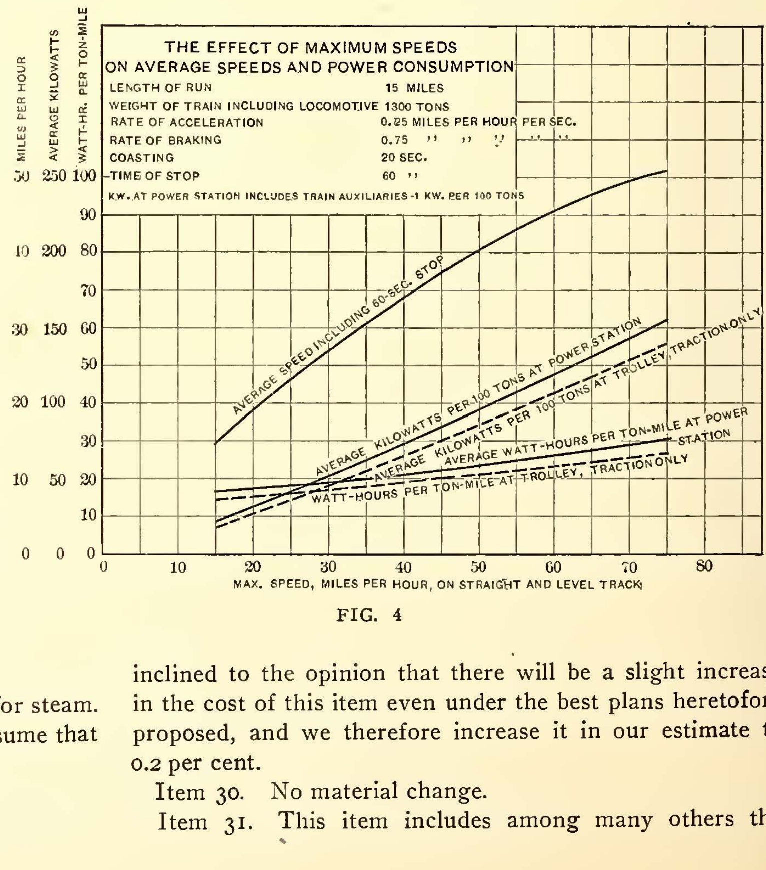


FIG. 4

inclined to the opinion that there will be a slight increase in the cost of this item even under the best plans heretofore proposed, and we therefore increase it in our estimate to 0.2 per cent.

Item 30. No material change.

Item 31. This item includes among many others the following, viz: "All expenditures for account of heating and lighting depots, waiting rooms, freight and passenger offices and other station buildings; fuel and supplies for engines operating freight carriers on docks, wharves and piers to convey freight between boats and cars; supplies used for stations and yards, signal lights, street lights, switch lights, semaphore lamps, etc., also bills of municipalities for lighting highway crossings." For lighting and incidental power service the change to electricity would undoubtedly mean reduction in cost. We will let it stand as it is, however, and would point out the fact that without increasing the cost of this item, a great improvement in facilities for handling freight at docks and wharves and for lighting passenger stations and yards will result from the substitution of electric power.

Items 32, 33 and 34 will not be changed.

Item 35. Under this item the important factors which will be affected by the substitution of electricity for steam are the following, viz: "Charges for loss, damage, delays or destruction of freight, parcels, express matter, baggage and other property entrusted for transportation (including live stock received for shipment) and all expenses directly incident thereto. * * * Charges for damages to or destruction of crops, buildings, lands, fencing, vehicles, or any property other than that entrusted for transportation whether occasioned by fire, collision, overflow, or otherwise; also services and expenses of employees or others while engaged as witnesses in the case of suits." For reasons which have been referred to in our discussion of the subject "Safety," it is clear that there should be a material reduction in the charges for loss due to destruction of freight, etc. Another saving will result from the practical elimination by reason of damage of fire, which now not infrequently is caused by sparks from locomotives. These savings will be offset to some extent by damage due to telegraph, telephone, or other wires coming in contact with the power circuits of the railway, unless reasonable care be exercised in preventing such accidental contact by the adoption of proper precautions when the electric equipment is installed.

In our estimate we have reduced Item 35 to 0.75 per cent.

Item 36. "This account includes all charges on account of employees or other persons killed or injured except lawyers' fees and court expenses." While it is probable that a large part of the expenditures were on account of passengers killed and injured, and while any reduction in fatal and serious accidents to passengers therefore would materially affect this item, we have thought it best in the absence of satisfactory data to leave it practically as it stands, our estimate being 1 per cent.

Item 37. In our opinion this item will be reduced under electric operation for reasons which have been sufficiently indicated in what we have said in regard to item 35. It would seem that 0.2 per cent is a fair estimate of its probable amount.

The items Nos. 38 to 46 will not be changed, nor will there be any material change in "General Expenses."

GENERAL ESTIMATE

According to our estimate, if all the railways of the United States were to-day operated by electricity using the single-phase alternating-current system at the potential adopted for the equipment of the New Haven Railroad, the energy required for operation being developed by power plants such as are to-day in extensive use and transmitted at potentials well within limits established in practical service, and if the rolling stock equipment consisted of locomotives and multiple-unit trains fitted with motors and control apparatus no better than the best which now exist, the aggregate cost of operation which in 1905 amounted in round numbers to $1,400,000,000, would be reduced by about $250,000,000.

To accomplish this result, power plants delivering about 12,500,000,000 kw-h. per annum would be required. Assuming the radius of transmission from power houses to be 150 miles, the load-factor in railway service should be not less than 0.75, and taking this figure it appears that power plants capable of delivering a maximum output of about 2,800,000 kw will be sufficient to operate the entire railway service of the United States as existing in the year 1905. The average output required is about 10 kw per mile of line and 7 kw per mile of track.

In 1905 the average gross earnings of our railroads per mile of line were $9,598, and the average operating expenses $6,409. The foregoing calculations lead to the conclusion that high-class electric equipment now available would reduce this average cost to $5,265. The difference is $1,144 per mile of line, against which apparent saving must be charged the annual interest and depreciation of the power plant, the addition to permanent way equipment, comprising overhead construction and track bonding, the transmission circuits, and the sub-station with their equipment. Assuming 5 per cent interest on cash cost of these items and allowing 5 per cent for a sinking fund to cover depreciation of power house with its equipment and 2½ per cent for a sinking fund to cover depreciation of the overhead construction and distributing system, the aggregate of fixed charges works out at $837 per mile of line. The saving in operating expenses, therefore, is more than sufficient to take care of the increase of fixed charges. In other words, it appears that the entire railroad system of the United States could be operated to-day at less cost by the electric motor than by the steam locomotive. That the railroads in general if so equipped would realize a large increase in earning power will be admitted by all who have given the subject intelligent attention.

In charging against electric operation 5 per cent upon cost of power plant and 2.5 per cent upon overhead construction, transmission circuits, sub-stations, and track bonding, we have departed from methods usually adopted in financing of American railway properties. If no depreciation be charged against the increased capital account represented by the items named, the apparent saving will be materially increased.

While our estimates have led us to the conclusion that under average existing conditions of railway operation in the United States, improved financial results would be attained by the substitution of the electric motor for the steam locomotive, the immediate and general adoption of the new motive power by our railroad companies is neither possible nor desirable. It requires no argument to demonstrate the wisdom of making haste with deliberation in a matter involving interests of such magnitude as those which are tied up with the transportation systems of the United States. Recognizing the magnitude of these interests and having in mind the fact that the art of electric traction as applied upon a large scale to heavy train units is yet young, the point which we desire here to emphasize is the necessity of conservative and carefully considered action upon the part of all members of this Institute who may be called upon to advise in respect to the electrification of railways now operated by steam.

Referring to the tabulated results (Table II.), in which we have applied the estimated reductions in operating expenses under electric traction, amounting to 18 per cent of the present average operating expenses to the ten geographical groups into which the railroad systems of the United States are divided by the Interstate Commerce Commission, the relatively great advantages of applying electric traction to systems operating heavy traffic showing large gross earnings per mile of line are evident at a glance.

THE STANDARDIZATION OF ELECTRIC RAILWAY TRACTION EQUIPMENT

In the concluding part of their paper the authors made a plea for the standardization of 15 cycles for single-phase railway lines, on account of the better adaptability of the lower frequency to motor design, and then said:

For the equipment of the entire railway system of the United States as now existing an aggregate power-house output capable of supplying continuously 2,100,000 kw would be required. Of the electric apparatus installed in the power houses, a change in frequency affects the generators, transformers, and a large proportion of the measuring and indicating instruments. It also affects the cost of the engine or turbine employed to drive the generator. At 25 cycles, the apparatus affected by frequency should cost approximately $30 per kilowatt. At 15 cycles it would cost on the average perhaps $33 per kilowatt. Cost of sub-station transformers would be increased approximately one-third and, in round numbers, the total cost of turbines and electrical power house and sub-station apparatus would be increased from $70,000,000 to $80,000,000.

TABLE II.

Comparison per Mile of Line—by Groups Steam and Electric Operation.
(216,974 Miles Represented.) (Dollars per Mile of Line per Year.)

Group No.	General Location.	Miles of Line Represented.	Gross Earnings.	(Steam) Operating Expenses.	(Electric) Operating Expenses.	Difference Steam and Electric Operation	5% Interest on Electrical Equipment Excluding Rolling Stock.
I	New England	8,094	$14,511	$10,493	$8,604	$1,889	$647
II	New York, Pennsylvania et al.	23,281	20,752	13,671	11,210	2,461	790
III	Ohio, Indiana, Michigan	25,208	12,483	9,198	7,542	1,656	640
IV	Virginias, North and South Carolina	12,542	7,359	4,590	3,764	826	484
V	Kentucky, Florida, Louisiana et al.	24,563	6,867	4,899	4,017	882	475
VI	Illinois, Wis., Dakotas, Iowa et al.	48,672	8,021	5,169	4,239	930	525
VII	Montana, Nebraska and Wyoming	11,546	7,737	4,092	3,355	737	461
VIII	Colorado, Arkansas, Missouri et al.	30,456	6,362	4,308	3,533	775	461
IX	Texas and New Mexico	14,875	5,588	4,108	3,369	739	445
X	Pacific States	17,737	8,439	4,880	4,002	878	464
	United States, total	216,974	$9,598	$6,409	$5,255	$1,154	$516

If it be assumed that one electric locomotive will do the work of two steam locomotives, about 24,000 electric locomotives would be required to take care of the present railway business of the country. Assuming the cost of the average electric locomotive to be $25,000, the aggregate cost of locomotives required would be $600,000,000. Allowing for the increased cost of the 15-cycle transformers, it would seem that the difference in cost of the average locomotive should be not less than $1,000 in favor of the lower frequency, or for 24,000 locomotives $24,000,000. This is more than twice the estimated difference in cost of power-house and sub-station equipment.

It seems entirely safe to say, therefore, that the aggregate first cost of electric equipment and of steam turbine will be decreased by a change from 25 cycles to 15 cycles. The operating cost will obviously be decreased very materially. At least three-fourths of the above estimated cost of electric locomotives, say $450,000,000, represents cost of electric equipment. It will be seen, therefore, that of the apparatus which our electrical manufacturing companies may be called upon to furnish, more than 85 per cent is rolling stock. Obviously, any argument in favor of 25-cycle equipment which may rest upon existence of drawings and patterns and convenience in manufacturing should have comparatively little weight.

The use of 15 cycles instead of 25 cycles also secures considerable advantage in respect to the overhead trolley conductor and track return. With a given limit of voltage-drop, this advantage may be utilized by reducing size and, consequently, the cost of the overhead copper and the copper used to reinforce the track return.

Under the plans which we have assumed as a basis of our calculations, the amount of copper required for feeder circuits, trolleys, and reinforced track-return, estimated at 20 cents per pound, would cost approximately $750,000,000 were the entire railway system of the country as existing in 1905 to be equipped with electric operation.*

DISCUSSION OF THE PAPER

Frank J. Sprague referred to the fact that the statistics quoted by the authors were based almost entirely on d. c. operation, but that the recommendations in their paper were for 11,000-volt a. c. trolley operation at 15 cycles. The speaker plead guilty to fads and fancies in the past, but said that these fads and fancies had been translated into facts. He also believed that ten years from now the railroads of the country would be using 600-volt, 1200-volt or 1500-volt direct current He doubted the advisability of generalizing on all of the railroads in the United States. Many of them are in the hands of receivers and could not raise the money to be electrified if they wanted to. He preferred to deal with the living, immediate question. Three great trunk-line railroads which have terminals in New York City are at present being electrified. He was connected with the development of one and is not ashamed of it. He has criticised some of the development on another. As regards the Pennsylvania Railroad between New York and Philadelphia, he believed that if that line were to be electrified to-day it would be by direct current. He also believed that on a large number of lines which can be properly considered as subject to electrification the higher voltage direct-current system, according to any present development, will give better results in every way than the alternating-current overhead system. He hoped in the early future to present a paper to the Institute on the subject of d. c. and a. c. operation.

Mr. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, referred to the pioneer work accomplished by Mr. Stillwell in reducing the frequency used in a. c. power stations, which in the earliest times was usually 133 cycles per second. Three years ago the speaker read a paper at the Institute recommending a frequency of 16⅔ cycles. There were certain reasons for adopting that

* In all our estimates we have included 0000 copper conductor in the return circuit, this being bonded to the rails at intervals for the purpose of preventing dangerous potential on track in case of a broken bond.

frequency, although 10 per cent higher or lower would not have been of very great importance so far as the operation of the apparatus was concerned. Because of commercial conditions in connection with existing power plants his company has practically been driven to 25 cycles, but the speaker still advocated the lower frequency. From 25 to 40 per cent greater output can be secured from a motor on 15 cycles than on 25. The motor is equally efficient, and the power factor and commutation are equally good. In regard to a lower frequency than 15 cycles, with the latter it is possible practically to saturate the machine so that no great advantage is gained by any reduction below 15 cycles. Mr. Lamme pointed out that a 25-cycle motor will operate perfectly well at 15 cycles and at the same speed, and a 15-cycle motor if well designed will operate on 25 cycles at its nominal capacity fairly well, but at slightly reduced capacity will operate very well. Some tests at East Pittsburg indicate very little difference in the ratio of tractive effort to the weight on the drivers between 15 cycles and 25 cycles. Referring to European practice the speaker mentioned the Valtellina Railway as using 15 cycles. The Oerlikon Company has adopted 15 cycles as standard and the same is true of the Siemens-Shuckert Company. The Allgemeine Company is the principal company which is adhering to 25 cycles. This is largely due to its type of motor, as this company uses the so-called series-repulsion motor, which operates to better advantage if the frequency is not too low.

B. J. Arnold said that so far as he was concerned it made no very great difference which system were used so long as it was a system with which the steam railroads could be equipped and operated for less money than at present. He was one of the first to use the rotary converter system, but never looked upon it as a complete solution of the electric railway problem. He did not entirely agree with Mr. Stillwell that it was advisable to standardize at once, as this would shut out the prospect of developing something which may prove better than anything which now exists. If alternating current is to be used, however, he leaned toward the 15-cycle frequency on account of the increased capacity of motor available between the wheels. He believed in the third rail where it is applicable, but did not believe there were many places where is was applicable. In the Grand Trunk Tunnel he recommended the a. c. overhead system on account of the large yards at each end of the tunnel where a great deal of switching was done and where it was essential that the conductor should be kept from under the feet of the men. The decision to use single phase on this road was made five months before the decision of the New Haven road to adopt a. c. was announced.

W. B. Potter, chief engineer of the railway department of the General Electric Railway Company, thought that standardization was advisable where it did not cost too much, but one could hardly expect any road electrifying to-day to spend a great deal of money simply for the sake of standardization and in anticipation of perhaps some time effecting a junction with some other road. Fifteen cycles has many advantages, and the speaker did not look for the ultimate development of the 25-cycle single-phase motor. That motor weighs about 25 per cent more than the d. c. motor of corresponding capacity. The 15-cycle motor with the same degree of commutation would probably weigh from 10 to 15 per cent more, and its efficiency and the power factor would probably be very largely the same. As regards the tractive effort, tests which he had made indicated that, assuming the tractive effort of the d. c. motor is 100 per cent, that of the 25-cycle motor would be from 80 to 90 per cent, and that of a 15-cycle motor 70 to 80 per cent. When the d. c. motor slips, however, the wheel rotates rapidly and the torque falls off to something like 20 to 30 per cent of the maximum. With the a. c. motor, whether on 25 or 15 cycles, although the wheel slips at a lower point the torque falls off only 10 to 15 per cent, due to the fact that the slip is a series of progressive jerks which allows the wheel to grip the rail so that after the wheel has once slipped it may take hold of the rail and have a higher maximum pull than before it slipped by reason of having cleaned the rail off, which is a condition not secured with d. c. The average draw-bar pull after slipping with a. c. is perhaps 70 per cent greater than it is with d. c. He did not believe that any of the present systems could be considered as suitable to every case. He looked upon the addition of commutating poles to the ordinary d. c motor as comparable in importance with the substitution of the carbon brush for the copper brush. He finally referred to the much maligned third rail and said that up to the present time there had not been much chance to malign some overhead construction.

W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, said that he had recently been compiling some data on repairs of steam locomotives extending over a year and covering the practice with twenty passenger engines. This includes cost of oil waste, flues cleaned, ash pans and grates cleaned, engines wiped, engines turned, engines fired, boilers washed and cost of sand.

The passenger locomotives averaged 5.6 cents per locomotive mile, as compared with 8 cents or 10 cents for freight. This figure can be divided into shop repairs, 3.88 cents, and maintenance, 1.72 cents. He questioned the advisability of using the Interstate Commerce figures as the basis of an estimate to determine the standard frequency. The principal work to be accomplished in the early future is in the Eastern section of the country, where there are a great many 25-cycle plants.

O. S. Lyford, of Westinghouse, Church, Kerr & Company, referred to the opening on Jan. 22 of the Rochester Division of the Erie Railroad by 11,000-volt trolley with 25 cycles. The trucks, which are of unusual size, are entirely filled with 100-hp motors which, had 15 cycles been used, could have been of 150 hp. He pointed out that the cost of items 12, 21 and 22 in Mr. Stillwell's paper could be doubled and still electric operation would not cost more than steam. Another important point was that of getting more service out of the existing tracks, a matter recently emphasized by John J. Hill.

C. L. Muralt, of New York, presented some curves of d. c. single-phase, three-phase and steam locomotives to illustrate their running characteristics. His argument was a plea for the three-phase locomotive, not only because it will carry great overloads without trouble, but also because it can do so without drop in speed.

A. H. Armstrong, of the General Electric Company, pointed out that the New York Central locomotive No 6000 at the end of its trial run of 50,000 miles has a maintenance charge of less than 1½ cents per locomotive-mile for repairs and maintenance, as against 8 or 10 cents with the steam locomotive. He thought that ten years from now engineers would still be disputing over the question of frequency and a. c. and d. c. operation. The steam locomotive has not yet been standardized and master mechanics and engineers have different views of valve gear and other details.

N. W. Storer, chief engineer of the railway department of the Westinghouse Electric & Manufacturing Company, thought that neither the d. c. locomotive nor the three-phase locomotive will meet the requirements of the railways of the country. The single-phase locomotive seems to offer the greatest possibilities. He thought that by using 15 cycles a saving of at least $5,000 could be made in the cost of locomotive over one for 25 cycles, rather than the $1,000 mentioned by Mr. Stillwell. He also thought that very satisfactory lighting could be secured with 15 cycles by using a low-voltage lamp with a heavy filament.

Wm. McClellan, of Westinghouse, Church, Kerr & Company, endorsed the overhead trolley and favored 15 cycles. He did not think it necessary to carry standardization too far. The present steam railroads do very little in the way of exchanging locomotives, but the companies ought to standardize enough to exchange cars. For instance, it is very desirable to standardize the train line so that cars equipped with the same system of multiple-unit control could be operated together. He said that his company had found it very difficult to get entirely satisfactory figures of steam operation. The figure of 1½ cents on the New York Central electric locomotive, it should be remembered, was secured under the surveillance of expert engineers and might not perhaps be a fair comparison.

W. I. Schlichter, of the General Electric Company, favored 15 cycles, but thought that one must consider the question of ultimate cost as some items would be larger. The generator may increase in cost from 15 to 50 per cent, as the speed with 15 cycles will be somewhat of a problem in connection with turbine work. He also pointed out that although the output of the motor is increased 35 per cent this is during acceleration, and that the continuous output of the motor is not correspondingly increased. For long runs, therefore, not so much will be obtained by the lower frequency.

A STANDARD ROADBED FOR COLUMBUS

After testing many roadbed formations, a number of which are still under portions of the system, the Columbus Railway & Light Company, of Columbus, Ohio, has adopted a standard method of construction. Whenever any portion of the system is renewed hereafter, the standard foundation will be put in, until the entire system is laid on this foundation. E. O. Ackerman, engineer of maintenance of way of the company, says the company's present method of construction gives a permanent foundation and has been approved by the city engineer's department.

This foundation is of solid concrete formation, with concrete girders 18 ins. deep under each of the rails. The rails are anchored to steel ties, which are bedded in about 6 ins. of the concrete. Mr. Ackerman admits that this gives a rather rigid track, but this is the feature that is approved by the city engineer, who objects to too much elasticity on account of its destructive effect on street paving. Mr. Ackerman says there is no renewal or extension work on hand at present, but it is expected that when the Central Market system is taken over by the Columbus Railway & Light Company, there will be considerable work done on its lines to bring them up to the standard of the Columbus Railway system. It is also expected that a third rail will be laid on a considerable portion of the Central Market system, so that the Columbus Railway cars, which are broad gage, can be operated over its lines. The Central Market will not be made broad gage, because of existing contracts by which standard gage interurban roads enter the city over its lines. The Central Market also has a contract with interurban roads that have their own lines into the city by which it furnishes the city service required of the interurbans by their franchises.

ELECTRIC TRACTION IN VENEZUELA

A short interurban line between Caracas, the capital, and the neighboring town of El Valle has been changed from steam to electric traction by the Caracas Electric Tramways Company.

The line was originally a narrow-gage road, 68 cm (2 ft. 3 ins.) wide, and as 3 ft. 6 ins. had been decided on as the gage for the city lines, it was necessary to widen the old track to enable the El Valle cars to run into the city. To avoid shutting down the traffic, a third rail was laid to the new gage, and new ties were also placed throughout.

Electric power is purchased from a local transmission company and is received at the railway station at 5000 volts. Here the voltage is reduced by three oil-cooled transformers connected in delta to 460 volts for running a 150-hp, three-phase motor which is belted to a direct-current generator. The overhead line consists of 00 grooved wire with bracket construction on iron poles. The line has a great many curves.

The cars are of the eight-bench open type, with G. E.-58 motors and K-10 controllers. The bodies and trucks were supplied by the J. G. Brill Company. The whole of the electrical material was supplied by the General Electric Company. The entire construction was carried out with native labor under the supervision of E. H. Ludford, the Caracas Tramway Company's manager.

The conversion of the existing horse lines of the city of Caracas to electric traction is at present being actively pushed forward by the London branch of J. G. White & Company, and the Central Railway has also electrified the first section of its steam road with material supplied by the Allgemeine Elektricitäts Gesellschaft, of Berlin.

TRANSFERS IN ST. LOUIS

The new transfer system which went into effect in St. Louis, Jan. 1, as the result of the consolidation of the United Railways and the St. Louis & Suburban systems, necessitated thirty different transfers and introduced radical changes in the general transfer scheme. Transfers are now punched according to directions, and round trips for one fare are made impossible. According to records at the offices of the United Railways Company, more passengers transfer to and from the Olive Street line than any other. On a normal week day about 23,000 transfers will be taken in by conductors on that line. The Jefferson Avenue line is next with 19,000 transfers. Grand Avenue conductors receive about 18,000 transfers, and Broadway line conductors about 15,000. Easton Avenue comes fifth with 13,000. Other lines range from 2000 to 10,000.

The Compania Electrica de Alumbrado y Traccion de Santiago, of Santiago de Cuba, which plans to build about 16 miles of standard-gage electric railway in Santiago and vicinity, has begun the construction of the system and expects to have the lines in operation in October, 1907. Practically all the material was purchased in the United States. The officers of the company are Eudaldo Romagosa, of Havana, president; Jose Marimon, Santiago de Cuba, vice-president; Dionisio Peon, Havana, secretary and treasurer; E. J. Chibas, Santiago de Cuba, general manager; A. W. K. Billings, Havana, consulting engineer in charge of construction.

PROCEEDINGS AND PAPERS OF THE CENTRAL ELECTRIC RAILWAY ASSOCIATION AT THE INDIANAPOLIS CONVENTION

ANNUAL CONVENTION AND BANQUET OF THE CENTRAL ELECTRIC RAILWAY ASSOCIATION

The annual meeting and banquet of the Central Electric Railway Association was held on Thursday, Jan. 24, at the Claypool Hotel, Indianapolis, Ind. Interesting papers were presented on the cost of power, interurban cai design, the handling of accidents and claims and on car lighting. Officers for the ensuing year were elected and in the evening the annual banquet was held. About 175 operating men and trade representatives were in attendance.

MORNING SESSION

The morning session was opened at 11 o'clock by President E. C. Spring, who announced that a stenographic report of the papers and the discussion upon them and the speeches at the banquet in the evening would be made and that these would be incorporated in a souvenir pamphlet with which all members would be supplied. Secretary W. F. Millholland read a list of applicants for membership which included several supply representatives, all of whom were elected. Before the reading of the first paper on the program, President Spring said it was very gratifying to leave the office of the president of the association knowing that every bill contracted for had been paid and that there was a balance in the treasury. This balance, he said, would be depleted somewhat in helping defray the expenses of the evening's banquet, but he considered that the effects of the banquet in stimulating interest in the association justified the expenditure. He also expressed regret at the absence of H. A. Nicholl, general manager of the Indiana Union Traction Company, who was detained by sickness.

G. H. Kelsey, superintendent of power of the Indiana Union Traction Company, then read his paper on "The Cost and Sale of Power by Railways" printed on page 207 of this issue. He emphasized in a very effective manner the fact that maintenance and interest charges on power house, sub-station and line equipment should be included in getting at the cost of power. As noted in his paper, Mr. Kelsey showed a chart, one curve of which showed the cost of fuel, labor and miscellaneous expenses as varying from 0.45 cent on a 5000-kw plant operated by his company to 1.5 cents on a 500-kw plant. This curve was presented to show particularly that with plants larger than 1000-kw capacity the fuel and labor portions of the cost of power decreased very slowly with the increase in size ot the station. The second set of curves on the sheet showed the total cost of producing power in the stations, this cost including interest and depreciation charges. The three curves presented were for the cost with plants run at 40, 50 and 70 per cent capacity. A comparison of the second set of curves with the first curve showed the cost to be very much higher when all charges were taken into account and that the cost with interest and depreciation charges considered was influenced very much by the power factor. During the discussion of Mr. Kelsey's paper John F. Ohmer wanted to know whether or not in arriving at his cost figures Mr. Kelsey had counted in office fixed charges. In manufacturing business he said such charges were considerable, and he thought they ought to be included in power costs.

Mr. Kelsey replied that such items would not be large as compared with the maintenance and depreciation charges, but nevertheless they should be included and he had tried to do so.

T. C. McReynolds, manager of the Kokomo, Marion & Western Traction Company, on being called upon stated that his company had had some experience in renting power. At one town a transformer on a pole was connected to a 10,000-volt line feeding a sub-station and transformed the current to 200 volts for commercial lighting. At another place streets were lighted by arc lights on a 208-volt circuit, and some current was furnished to private consumers. In selling power he thought that item of expense in addition to those dealt with in Mr. Kelsey's paper was that of the care for the lines beyond the transformers. Selling power, however, had not been very profitable with him, largely, he believed, because it had not been pushed.

AFTERNOON SESSION

The first paper read at the afternoon session was that of E. C. Carpenter, claim agent of the Indiana Union Traction Company. His paper, "Handling Accidents and Claims," emphasized the importance of getting accurate reports of accidents from trainmen and of getting into communication with all injured as soon as possible. This paper is printed in full on page 209 of this issue.

In the paper by W. H. Evans, master mechanic of the Indianapolis Traction & Terminal Company, on "The Model Car for Long Travel," the author directed attention to some of the things that have prevented the designing and equipping of such a car as might be called a model car. This paper will be found on page 213.

In the discussion on Mr. Evans' paper, to the question of C. L. Henry as to what he considered a desirable length for an interurban car, Mr. Evans said he thought a 60-ft. car would take care of people on a one-hour schedule. He believed the 67-ft. car an extreme. He was also asked if he did not see a disadvantage in having entrances on one side of the car, since such an arrangement would require platforms on both sides of the track. In this respect he admitted it was a disadvantage, and the operating department of his system had caused him to put a second baggage door on a car that originally had but one.

C. D. Emmons, general manager of the Fort Wayne & Wabash Valley system, wanted to know about the weights of the cars which Mr. Evans had described. Mr. Evans said that the Indianapolis & Northwestern cars weighed about 75,000 lbs. and he presumed that the 67-ft. cars were much heavier. Mr. Evans stated that he preferred the ejector type of ventilator for use in cars. In discussing the ventilation of cars, reference was made to the new Chicago City Railway cars which have a ventilator in the ends of the upper deck. These showed on a recent test an air passage averaging 370 cu. ft. per minute.

R. C. Taylor, superintendent of motive power, thought that with longer cars the proportion of weight of the car to the passenger load was increased. He said the ratio of dead weight to the passenger load varied quite a great deal in different cars, but the dead weight was usually two or three times that of the passenger load, and he suggested that a committee be appointed to bring out plans for the lightening of interurban cars. A motion made to the effect that a committee of four be appointed was passed.

The next paper on the program was that by R. C. Taylor on "Car Lighting," which is published on page 215 of this issue.

After the reading of Mr. Taylor's paper, the committee on nominations was called upon. It reported for president, H. A. Nicholl, general manager, Indiana Union Traction Company; vice-president, F. D. Carpenter, general manager, Western Ohio Railway; second vice-president, R. I. Todd, vice-president and general manager, Indianapolis Traction & Terminal Company; treasurer, W. F. Millholland, secretary and treasurer, Indianapolis Traction & Terminal Company; for the executive board of Ohio, H. P. Clegg, president, Dayton & Troy Electric Railway Company; F. J. J. Sloat, general manager, Cincinnati Northern Traction Company; L. C. Bradley, superintendent, Scioto Valley Traction Company; C. N. Wilcoxon, general manager, Cleveland & Southwestern Traction Company; E. C. Spring, general manager, Dayton, Covington & Piqua Traction Company; executive board of Indiana, Chas. Murdock, vice-president, Fort Wayne & Wabash Valley Traction Company; A. A. Anderson, general manager, Indianapolis, Columbus & Southern Traction Company; F. D. Norveil, general passenger agent of the syndicate lines of Indiana; C. D. Emmons, general manager, Fort Wayne & Wabash Valley Traction Company; C. C. Reynolds, general manager, Indianapolis & Eastern, Indianapolis & Northwestern, Richmond Street & Interurban, Indianapolis & Martinsville, Indianapolis & Western and Indianapolis Coal Traction Companies. The report of the committee was adopted and the secretary was instructed to cast a unanimous ballot for the officers named in it.

Before the meeting adjourned, a rather animated discussion took place as to whether or not interurban lines should make contracts with the old line express companies, and whether or not it would be advisable to organize an express company especially to do business with interurban lines. Mr. Henry said the most important question was whether it was wise and best at this time to make contracts with the express companies that were approaching different interurban companies or to organize a company especially interested in the interurban lines. He said the old line express companies frequently approached interurban companies, and ten years ago they had come to him when he was operating the Union Traction Company of Indiana, but he thought that, especially as the interurban companies had made a big mistake in making contracts to carry mails, they ought to be very careful about making contracts with express companies. Mr. Carpenter said that the old line companies were carrying on business all over the country, while the territory of any company organized by the interurban people would be limited to interurban lines. He said he understood that the Union Pacific had at one time tried to run an independent express company but had made a failure of the venture. He thought that if the interurban lines could get the same contract with the express companies that the steam roads have, such contracts would be to their advantage at the present time. Later on the interurban lines might go in business for themselves. Mr. Wilcoxon thought Legislatures might soon compel old line express companies to interchange with the traction companies. He said his company, the Cleveland & Southwestern Railway, once had a contract with the American Express Company which did not result in much profit to him. He said that there was now an interurban express company operating on all interurban lines out of Cleveland, and the company was making a splendid showing and a good profit. He thought the vital point in the question of entering into contracts at the present time was whether or not the interurban companies would be glad to get rid of them in the future. Mr. Henry explained that his idea was not to organize a company that would be limited in business to the interurban companies, but that they should unite in the support of a company that would have right to transfer its express to other express companies. He did not advocate an express company that would be limited to interurban lines. Mr. Bradley asked what was the duration of the contracts proposed by the express companies, and was told that usually they were to run five years. He added that he agreed with Mr. Henry in that the interurban companies should act with much deliberation and be very careful to make no mistake. The discussion regarding express companies terminated in the passage of a motion, presented by Mr. Anderson, to the effect that a committee of three be appointed to look into the matter of interurban railways handling express by old line companies or by a company to be operated by themselves. The meeting then adjourned.

THE BANQUET

About 175 members and guests were in attendance at the banquet, held in the Claypool Hotel at 6:30 o'clock. President Spring introduced Mayor Bookwalter, of Indianapolis, who, in a speech of welcome, said that when the question of interurban lines entering the city came up a few years ago he had secured a settlement by which all such companies were permitted to enter. He said interurban lines had increased the trading population of Indianapolis 300 per cent. They had also decreased the cost of the accounting rooms of many firms 50 per cent, through the fact that traveling men who formerly made six towns in a week could now make twenty towns in the same time. He referred to a bill that had been introduced in the State Legislature providing for a 1-cent rate on interurban lines, and said that the man who based such a fare on the earning sheets as shown by the company forgot that the time for replacement of apparatus and equipment would come.

President Spring made a few remarks concerning the work of the association for the year, saying he reviewed the work of the past year with a feeling of pleasure and satisfaction. With regard to the permanent secretary's office, he said it had been a complete bureau of information. During the year about 6500 letters had been sent out. He spoke of the resignation of Mr. John Merrill, former secretary, and thanked and complimented Mr. Merrill for the work he had done in instituting the office. He also thanked the Indianapolis Traction & Terminal Company for its co-operation and help. He regretted President-elect Nicholl's enforced absence because of sickness. Upon a motion made by Mr. Norveil, the convention sent a message of sympathy and hopes of an early recovery to Mr. Nicholl.

Mr. Henry, who was referred to by President Spring as the dean of the electric railway fraternity in Indiana, acted as toastmaster, and introduced the speakers of the evening. These were: Jos. A. McGowan, Indianapolis Traction & Terminal Company; John F. Ohmer, Dayton, Ohio; Charles W. Miller, ex-Attorney-General of Indiana; Matthew Slush, of Detroit; Mr. Van Camp, of Indianapolis; D. J. Evans, of The Rail Joint Company; Arthur W. Brady, president, Indiana Union Traction Company; Col. W. T. Durbin, ex-Governor of Indiana; C. W. Wilcoxon, Admiral

George Brown, of Indianapolis; E. W. Olds, superintendent of rolling stock of the Milwaukee Electric Railway & Light Company, and D. M. Parry, of Indianapolis.

INSPECTION TRIP TO RUSHVILLE

Several of the members of the association took advantage of the courtesy of President Henry, of the Indianapolis & Cincinnati Traction Company, and made a trip to Rushville over the lines of this company and inspected the new construction work in connection with the power station at this point.

CAR EXHIBIT

About 600 ft. of double track on Kentucky Avenue was used for the exhibition of cars. The exhibition included private cars, new types of interurban passenger and freight cars, and new type of city passenger and work cars of the Indianapolis Traction & Terminal Company. Among the private cars shown were the "Martha," of the Indiana Union Traction Company; the "Josephine," of the Cleveland & Southwestern, and the "Stillwater," of the Dayton, Covington & Piqua. New interurban cars of the Fort Wayne & Wabash Valley, Indianapolis & Cincinnati and of the Indianapolis, Columbus & Southern traction companies were also exhibited.

The exhibit of freight cars consisted of a large freight motor of the Indiana Union Traction Company, built with an oval roof and of about the same dimensions as furniture cars on steam roads. A trail freight car, built in the shops of this company, was also shown.

Among the cars exhibited by the Indianapolis Traction & Terminal Company was a newly built freight locomotive, for switching purposes about the power house and shops, and a crane or derrick car. The boom of this car is built of I-beams and is rigidly secured to the framework of the house over the machinery. This house is pivoted on a flat car and is mounted on rollers in such a manner that it may be turned through quite an arc on the flat-car body. The crane is operated by a GE-800 motor by means of a K type of controller. Another interesting car exhibited by the company was one containing a motor-driven rotary pump, which is used during floods at points along the line where the drainage facilities are not adequate.

THE COST AND SALE OF POWER BY RAILWAYS

BY G. H. KELSAY

As to what factors should be involved when estimating the cost of power for purpose of sale, there exists a difference of opinion: (1) Cost covering only fuel, labor, repairs, lubricants, wastes and miscellaneous material; (2) cost covering, in addition to the foregoing, interest, taxes, depreciation on equipment, and, we might justly include, legal expenses in connection with damages arising from the generation, transformation and transmission of such power. These costs truly and logically belong to each and every kw-hour of power sold, and each unit of power so disposed of without due regard to such items will surely make it that much harder for a company to make a good plant showing.

INTEREST AND DEPRECIATION

Then the question arises what per cent interest and depreciation shall we add to the fixed charges, such as labor and material, insurance, taxes and all other expenses logically arising from the operation of a power station and transmission line?

The rate of interest is quite easily determined, and on which there is not much room for discussion, whereas, the rate of depreciation will depend on the class of equipment and the portion of the power or transmission system which is being considered in the particular problem involved. Such rate is necessarily a variable quantity, ranging from practically zero to as high as 15 or 20 per cent, in certain parts of electrical railway apparatus, but on this subject railway men will express different opinions.

Some will say that what we take as a depreciation charge should truly be a daily maintenance or repair charge, or that we should keep our equipment up to a standard at all times. Others will say that such depreciation may finally be taken care of by increased earning capacity and increased value of franchise of a property. However, a certain per cent should be allowed when selling power to cover what may be termed depreciation, for there will surely be a day of reckoning when we will require new and better equipment or must replace miles of transmission pole line.

To illustrate by an example where, on account of the depreciation on a transmission line the arms and insulators were obliged to be replaced where such arms had been up only six years, 16 per cent should have been allowed each year to take care of the renewals of the arms and insulators so that it would not be such a heavy burden on the road for one season. The same principle will certainly apply to almost all details of the power equipment of the road, but what this rate of depreciation should be is a very much debated question and on which there has not been enough consideration.

Not all managers would care to operate their road, buying their power and renting transmission lines and distribution circuits from another company—paying for such power a reasonable rate for interest on investment and a fair rate to cover depreciation on the plant and lines, taxes, insurance and all other expenses chargeable, in addition to labor and material charge for such power. This is due to the fact that a fixed rate to cover depreciation has not been regarded as one of the charges in the operation of a power equipment, and to add a conservative rate to the cost of power would very materially increase the per cent operating expenses of a road as against the showing that is now made.

Oftentimes statements are made as to what power is really costing, mentioning such figures as 4½ mills, 5, 6, 7, or 8 mills per kw-hour, as the case may be, which covers only labor and material charges. I quote from one of our recognized authorities on electrical railway engineering, who writes as follows:

"There is a great difference between the cost of power computed from fuel and labor alone, as is often done by those who like to deceive themselves, and the cost with all the items of interest, repairs and depreciation relentlessly footed up. It is not unusual to find the item of depreciation deliberately neglected in computing the cost of power and in other estimates. Street railways have been particularly prone to this sort of financial juggling—it is so convenient to increase the capital account for 'improvements' instead of withholding dividends really unearned or shouldering a genuine deficit."

You will note it is not extremely hard to interpret this gentleman's view as to the propriety of a depreciation charge. We are not justified, therefore, in making a price for the sale of power without giving due regard to a certain per cent to take care of certain expenses, calling them depreciation charges or call them what we may.

SIZE OF PLANT AND POWER COST

In small plants the labor charge is proportionately large and fuel is also large on account of the inefficiency of small units. While in larger plants of 1000-kw output, equipped with approved machinery, the labor and fuel charge decreases very slowly by an increase of the size of the plant, which, however, depends to a large per cent on the character or demand factor of the load which it must handle.

(The author here presented a curve to show the effect of the increased size of plant on the cost of power per kw-hour at the bus-bar, this including only fuel, labor, repairs, lubricants, wastes and miscellaneous material; and another figure showing three curves covering the cost of power in plants ranging in capacity to as high as 2500 kw. These curves were given showing cost per kw-hour for an average output with 40, 50 and 70 per cent of the normal working capacity. They were plotted assuming coal worth $3 per ton delivered at coal bins and interest and depreciation grouped together at 10 per cent per annum. This was somewhat higher than the price ordinarily paid for coal in his locality, but the curves as plotted showed some very important facts, namely, that the cost for power per kw-hour at the switchboard is very much higher when including interest and depreciation and is very materially affected by the load-factor.)

COST OF POWER AT DISTRIBUTING POINTS

An estimate of the cost of power at some particular point on a railway system involves some very nice calculation and deals with somewhat uncertain factors, unless proper recording and indicating instruments are at hand for making some determination. The true labor and material cost of electric power at power plant bus-bars is very easily estimated, but a great amount of actual data from existing stations is often valueless on account of not being carefully and completely worked out, and it can readily be shown that there is a great difference between the cost of power, computing only fuel and labor and material items, as against the cost of power with all the items of interest, taxes, and depreciation carefully footed up.

Possibly the most practical way to determine the cost of power at any point on a railway circuit is to take the cost at the bus-bars of the plant as a basis for calculation. This can readily be determined as a definite sum covering all costs chargeable to the production of each kw-hour of power, by dividing by the efficiency of transmission and transformation to the point of delivery and adding to this all the costs chargeable to the transmission and transformation of such power. The latter would include the labor and material on lines and sub-station equipment, taxes, interest and depreciation on all apparatus from power station bus-bar to point of delivery.

The material and labor cost of direct-current power at any sub-station on a railway system is fairly well determined by dividing the total labor and material charge for generation, transformation and transmission by the total output of all sub-stations for a given time, if the power station and sub-station are equipped with wattmeters for carefully measuring all power. This cost will be different at different sub-stations on account of length and size of high-tension line and character of load on high-tension line and sub-station. If power is sold at a point midway between sub-stations, losses in direct-current feeders will be of some magnitude, depending on the railway load and the size of the feed copper and the distance between the sub-stations.

In figuring the cost of direct current as delivered to a consumer when located at a point on the railway line some distance from the sub-station, there should enter into the calculation on such estimated cost quite a number of elements, as follows:

1. Loss in d. c. feeder and track to sub-station.
2. Rotary and static transformer losses and battery losses where same are installed.
3. High-tension transmission losses.
4. Power house transformer losses.
5. Labor and material costs in maintenance of line.
6. Operation and maintenance of sub-station.
7. Operation and maintenance of power house.
8. Fuel charge for power house.
9. Interests, taxes, insurance, depreciation and any miscellaneous expenses on all power station and sub-station apparatus and transmission line.

The efficiency of a railway system from the power station bus-bar to the car or to a power consumer located at a point some distance from the sub-station is an element which enters into the cost of power to a degree often greater than at first thought, ranging from possibly as high as 85 per cent on a direct-current system with ample feeder capacity and medium loads, to as low as 50 per cent on an alternating-current system with heavily loaded high-tension line, lightly loaded sub-station and heavily loaded direct-current lines.

The following figures, which are of considerable value, were calculated by A. S. Richey and given in a very comprehensive paper on cost of electric railway power production and transmission in the State of Indiana, before the meeting of the Indiana Electric Railway Association in January, 1905. These values are estimated from a total of all railways generating and transmitting at alternating current at that time operating in the State. The figures as made up show per cent of efficiency of the various portions of apparatus from power station bus-bar to the car consuming the power:

	Per Cent
Efficiency of step-up transformers	94
Efficiency of transmission lines	97
Efficiency of step-down transformers	93
Efficiency of rotary converters	80
Efficiency of direct-current distribution	80
Combined efficiency	54

These efficiencies appear at first sight very low, but a little consideration will show them to be very logical, and represent very close actual conditions, when considering an average of all roads operating in the State two years ago.

(The author here exhibited a curve showing the general method and results obtained in determining the cost of power at the bus-bar of a certain sub-station "B," power station equipped with two 500-kw units, with an average load of 63 per cent of one-half of the maximum capacity. In the calculation, depreciation which was taken at 7½ per cent, was figured on 63 per cent of the total cost of the plant, and interest was estimated at 5 per cent on the total cost of the plant. Depreciation was figured on a transmission pole line and sub-station at the rate of 7½ per cent, exclusive of copper, on which there was no depreciation charged. Interest was charged on the transmission line and the sub-station at the rate of 5 per cent.)

In estimating the cost of transmission of power to a sub-station, only that portion of the expenditures on the pole line should be considered as was made necessary on account of such transmission line; that is, that portion necessary to carry the transmission circuit that is not required to support trolley wire, feeder and telephone line. The results as obtained in the calculation show that $.0257 should be realized per kw-hour on direct-current power sold at the d. c. bus-bar at sub-station "B."

Another calculation of the cost of power at the d. c. bus-bars at a certain sub-station located 10 miles from power station showed such costs, including all labor and material charge, 5 per cent interest and 6 per cent depreciation to be very close to $.027 per kw-hour. A similar calculation to determine the cost of power delivered at 15,000 volts 10 miles from a power station, realizing all labor and material charges and a conservative rate for interest and depreciation, figures such costs to be $.016 per kw-hour.

At times a power load may be added to a plant when the prices realized for such power are but little above the net labor and material cost, not even paying a good rate of interest on the investment, on the theory that such amount that is realized over and above the labor and material cost reduces to just that amount the cost of power for the railway load. This results in a better showing for the power plant, and greater earnings of the railway company.

This certainly is not a logical way to make a price for power, and will finally result in a poor investment.

DEVELOPING A DEMAND FOR RENTED POWER. DOES IT PAY

The development of demand for the rental of railway power necessarily depends on the service that the railway company can give and the adaptability of such power for the consumer. The hours of service obtainable from a railway circuit includes on most all railways all hours except from two to four hours in the early morning. These are the ones during which the consumer will prefer to do without service if he has a motor load, but result to a disadvantage if he is a light consumer. However, with a properly developed power and lighting load, the railway companies could very profitably furnish all-night service over their entire line, except at such intervals of time as are required for linemen to make repairs on the high-tension line, or other interruptions in the service beyond the control of the railway.

The kind of power that a railway can make a successful proposal to furnish covers practically every demand for power that can be asked for where such demand will warrant the installation of necessary apparatus. A 500-volt motor service can be handled at all points along the lines of a railway company where voltage on the feeder is sufficiently free from fluctuations to permit such a motor to operate.

A very successful a. c. motor service can be furnished at any point along a railway line where there is a transmission circuit and where the load will warrant the investment of necessary step-down transformer apparatus.

Lighting from railway circuits may be successfully accomplished in the small towns through the medium of step-down transformers and local distribution at any common operating voltage with either the two or three-wire system, furnishing 25-cycle current for such lighting, or by means of motor-generator set in addition to the step-down transformers, approximately 60-cycle current can be furnished and all the advantages obtained as are furnished by our local lighting companies. There may arise a question as to the service obtained by incandescent lighting from 25-cycle current, but such lighting is being done at a great many places without any complaint from customers on account of the low frequency.

Incandescent lighting service can be accomplished through step-down transformers and low tension a. c. distributing circuits, the railway company experiencing but a small per cent of loss from high-tension line to consumer and proportionately small first cost on equipment. Such an installation would not require constant attendance.

Arc lights can be furnished from d. c. feed wires direct, operating five or six lamps in series, thus giving excellent service where the voltage regulation on such circuits will permit such lamps to operate. If the d. c. lamps cannot be used, 60-cycle arc lamps can be furnished and operated through the medium of a motor-generator set at all towns through which high-tension power line pass.

Nernst lamps operating on 25-cycle current will give very satisfactory results, as is reported by the manufacturers and proved by a number of installations using them at various places in the East. Successful operation of Nernst lamps requires good voltage regulation, but the efficiency of a Nernst lamp is very high and deserves consideration when contemplating a lighting plant from a railway circuit.

Railway companies should, when going into the business of supplying power for lighting, provide their power stations with regulators to obtain more even voltage conditions on their transmission lines. However, a careful study of the voltage conditions on a great many power lines now will show better regulation than is furnished by a great many lighting companies.

Smaller towns, where they are not acquainted with the advantages of electric lights, will necessarily be a little slow in taking hold of a proposition that might be offered them, but if railway companies will establish a few such lighting plants, giving the consumer the advantage of a very good rate, which the company can certainly afford, a demand for such service will certainly grow with little effort on the part of the railway company.

The fundamental question is, does it pay to take up power and lighting business along a railway line?

When the railway companies can deliver power to the d. c. bus-bars of any sub-station at a net cost ranging from 2 to 3 cents, paying all costs for the generation and transmission of such power and a fair rate of depreciation and interest, or deliver a. c. power from the high-tension lines directly to the small towns along their lines for a price ranging from 1½ cents to 2 cents or 2½ cents per kw-hour, paying all the costs chargeable to the furnishing of such power, then they should, by adding a reasonable per cent to such cost, handle all the lighting business along their lines at a profit to themselves and at the same time give the consumer the advantages of electric light and power.

THE HANDLING OF ACCIDENTS AND CLAIMS

BY E. C. CARPENTER

There are about as many ways of handling accidents and claims as there are claim adjusters and general managers; very few operating along the same lines; each working along whatever line he has found practical for his company and the conditions under which it is operating. The best way to handle accidents is to prevent them, and it is wise—and dollars are saved—to employ the best and most intelligent men to be had in the various departments of the service thus securing the best results from every standpoint, but, as accidents will happen in the best of families, we will treat the subject somewhat as the auctioneer who still has "one more left."

In a general way, accidents should be handled according to the policy of the company. Should there be no policy in these matters, then the adjuster should work along fairly liberal lines and determine what is best for his company, and gradually establish his reputation in the communities with which he comes in contact.

In the handling of accidents, every claim department should have a system of blank reports concerning the various classes and kinds of accidents, and that will be suited to the peculiar conditions of the individual company. For instance, where a company is operating interurban as well as city lines, the general forms of report should be prepared to cover all such conditions as nearly as possible. Then there is the trouble report blank for trouble occurring on cars, such as ejectments, controversy over fares, or assaults by either passengers or train men; blanks for securing names and addresses of witnesses; an employee's blank for accidents to employees in shops, sub-stations, machine shops track construction, etc.; stock reports for stock killed or injured; telephone report for use of dispatcher in case of serious or fatal accident, in securing short and concise information when accident is first reported; delayed baggage report blanks for agents' use in securing immediate report where baggage is delayed in transit; the usual release blanks covering the various kinds of claims on part of employees, passengers, other persons, or property, that may be made under the laws of the State in which you are operating; indexes for keeping accurate record of accidents, both daily and alphabetically, etc., etc. Thus equipped, the claim department is ready for active work.

The prompt reporting of all accidents, bad, slight, trivial and those of seemingly no importance, and the securing of accurate information regarding same, is of the utmost importance in the proper handling of those matters; and right here is where the transportation department, as well as the others, should exercise the utmost care and adopt vigorous measures to see that employees shall make immediate report of all accidents; that such reports are promptly forwarded to the claim department, and proper discipline should be administered for failure to obey; and further, that information concerning accidents must not be given to any one except the proper officials of the company.

The growing tendency upon the part of injured parties to rush off to attorneys and sue the company for real or imaginary injury, makes it of great importance to have all accidents reported in detail most promptly. This will give the claim department the opportunity for prompt action in such cases, as may be necessary. Usually it is the blind or unreported cases, or the cases which, in the opinion of the conductor, do not amount to anything and are too trivial to report or go to the trouble of taking witnesses, that give the most trouble. Fakirs are usually smooth enough to mislead the conductor and have this kind of a story, then afterward appear with more witnesses than the company, with the result that the case is either compromised or, if tried, a liberal verdict found for the plaintiff, where, had the matter been treated as serious and promptly reported, Mr. Fakir would go a-begging.

Another class of claims which deserves attention, and which seems to be growing and may be a source of considerable loss, is that of claims for delayed or lost baggage. There will be more or less of this class of claims so long as the present imperfect system of checking is in use. There should be a better system adopted to enable each company over whose lines baggage is routed to trace accurately each piece delivered to it. The only thing that can be done under existing conditions by the claim department is to keep the amounts paid on these matters as low as possible, and this can best be done by using a delayed baggage report (form 418), a copy of which is hereto attached. This form is placed with the agents, and as soon as a person presents a baggage check, and it is ascertained that the baggage is lost or delayed, the blank is filled out, giving the name and address of person holding the check, the firm and address represented, check number, where checked, destination, via what route, and value, including contents; this constituting the first part of the report. Suppose the baggage is delayed for two or three days—finally reaches destination—party holding check calls for baggage, the agent, who still

.... Station

Name .... Address ....
(No. Street and City.)

Representing .... Address ....

Kind of baggage .... How many pieces ....

Shipped from .... to .... via ....

On .... 190 ... Check No. ....

Value, including contents $ .... Date .... 190....

Received of INDIANA UNION TRACTION COMPANY all of the above described baggage and contents in same condition as when delivered to said Company, except as hereinafter stated: ....

Dated .... 190.... .... A. M. / P. M.

Signed ....

AGENT'S REPORT.

Cause of delay ....

If damaged, describe condition ....

Forwarded to Claim Department .... 190.... .... A. M. / P. M.

.... Agent

Received by Claim Department .... 190.... .... A. M. / P. M.

By ....

INDIANA UNION TRACTION COMPANY'S DELAYED BAGGAGE REPORT

has the report, fills out a receipt, which is the second part of the report, showing condition in which baggage is delivered, date and hour of delivery, and secures the signature of owner. This determines the condition and time of delay accurately, and reduces the opportunity for making a claim to the shortest possible length of time, as well as showing, under the signature of owner, the exact condition of the baggage. After this is done, the agent fills out the third part of the report which gives his report as to the cause of the delay, and any remarks he may make upon condition of baggage, marks the time of forwarding to claim department and signs and sends it in. In this way, all information needed is secured from interested parties under the most favorable circumstances.

Reports of accidents sent to the claim department usually do not give all the information needed, but are merely the starting point or foundation for the investigation which must follow, and this should be done as quickly as circumstances will permit.

We have found, in the investigation of accidents (except in cases of clear liability, such as collision cases where passengers are injured), that a splendid rule to follow is first to secure as full information as possible from the train crew or employees in charge, taking signed statement, and then, if possible, procure the signed statement of injured party, showing his version of the matter; thus getting at both sides of the question, and noting what will be necessary to be covered by disinterested evidence when the signed statements of the disinterested witnesses are procured. In this way you can gather the facts in a tangible manner, so the merits of a claim can be determined with reasonable certainty. A shrewd investigator can inquire regarding the vital matters of an accident and quickly develop all the witness knows, and in reducing the subject-matter to writing, if he will carefully follow the line of the conversation and use the peculiar expressions and language of the witness as far as possible, omitting immaterial matters, it is seldom indeed that a witness will refuse to sign a statement. Afterward, should the witness testify in court to a state of facts materially different from the statement, he can be confronted with the signed statement and his testimony discredited.

In the investigation of accidents it is absolutely essential for the investigator to have a sufficient knowledge of the law to know what constitutes negligence, not only of an injured person, but the company as well. He should also have a general knowledge of every department of the service for the reason that the rules of negligence differ in cases of employees, passengers, or a person who is neither an employee nor passenger. He should be sufficiently competent so to frame his sentences as to state facts clearly and concisely, and avoid the use of statements that are not clear or are misleading. When you have a witness who knows the facts about an accident, put them in such a way that there can be no misunderstanding. Such a statement will be doubly strong in refreshing the recollection of a favorable witness or of contradicting an unfavorable one in court. These points, we believe, demonstrate the advisability of employing men of sufficient capacity to grasp the situation under investigation.

We have thus indicated a general plan pertaining to the investigation of accidents, but there is one class of accidents —those resulting in death—where a different line of investigation should be followed. In this class of cases the company's employees should be required to report at the office of the claim department immediately after such accidents, and before information of any kind is given to any person, where full details should be secured by the claim department, after which short affidavits covering the main facts of the accident—free from objection—should be prepared, so that the employees can be taken by the claim adjuster before the coroner and affidavit sworn to by the employees. As a rule, coroners are satisfied with a general statement of fact, and they should not be misled, but coroners are usually doctors, and they are very likely, if left to their own resources, to ask about minor matters and secure statements from employees that would be embarrassing in court and hard to explain away, as such statements are reduced to writing and sworn to by employees. It is far easier to prevent employees from making embarrassing statements in this way than to have to explain them away after they are made. The claim adjuster can signify to the coroner his willingness to assist in the investigation, thus placing himself upon friendly relations. Investigation should, of course, be conducted independent of the coroner so as to develop the facts rapidly, and, where desirable, the names of reputable witnesses can be placed before the coroner (whose signed statements have already been procured by the claim department) who will corroborate the employees and relieve the company from criticism. While ostensibly, as well as in fact, aiding the coroner, the investigation can be retarded sufficiently to enable the claim department to interview first all witnesses, thus developing the names of the proper persons to place in the coroner's hands. This gives some idea as to the manner accidents should be handled with reference to the investigation.

The question might aptly be asked: Can the claim department be of any service to the company in the investigation of accidents, aside from the mere development of facts upon which to enable the adjuster to make a settlement or reject a claim? We believe it can.

The claim department is, or should be, the one disinterested department in the investigation of accidents, and every facility should be given to enable it to have the fullest information regarding matters about which it is necessary to inquire. An accident occurs—perhaps a derailment. The transportation department, anxious to be relieved from responsibility, claims a faulty track; the track and roadway department says: Bad judgment of train crew in rounding a curve; or, perhaps, trolley came off and pulled down wires,—transportation department claims overhead work in bad condition, not lined up properly, or headlight or trolley base out of order, etc. The electrical and motive power departments say: No, the trouble was due to fast or reckless running or some other cause. The claim department should pursue the matter as carefully as possible. When the real facts are known, make a report of the same to the general manager for his information.

Then, again, in investigating accidents in the various departments of the service, weak places will develop to which attention can be called and considered by the proper officers. For instance, some dangerous machine in the shops is not properly guarded as the law requires; there may be an exit needed from a dangerous place where men are required to work about the boiler room or elsewhere; foremen or heads of departments may not understand fully the necessity of properly instructing employees regarding the hazards of the work for which they are employed, or of giving additional instruction to employees where they are assigned to work more hazardous than that for which they were employed; the incompetency of conductors or motormen, or others, for one reason or another, may come to the attention of the claim department, and in all such matters valuable service can be rendered by promptly reporting them to the proper officials. It will be necessary, however, for the claim department to show by its work its disinterestedness and its willingness to place above every department, its own included, the good of the company whom it serves.

THE HANDLING OF CLAIMS

This part of the subject assumes that there has been some one chosen to handle them, and we will assume it to be the claim adjuster. I have heard of instances (I am pleased to say it has not been my personal experience) where the hands of the adjuster were so tied by foolish requirements that he is not able to get good results. Some managers have so little confidence in the ability of their adjuster that they compel him to first ascertain what a claim could probably be settled for, then report back to the general manager or general attorney, then go back to the claimant and see if he cannot do a little better, then report back to the real adjuster—the general manager or general attorney—and getting instructions to settle at one-half to two-thirds of the amount the adjuster has reported, again make trips to see the claimant, etc., until all parties become so disgusted that the claimant goes to his attorney and brings suit. The result is that in cases of liability or close question the company pays double what the adjuster could have settled the case for in the first instance. If the officials of any road do not have confidence in the ability and judgment of their adjuster, they had better kick him out and get some one in whom they have confidence, and it will prove a benefit to both. By all means, if you expect good results, do not hamper him in his work by any such foolishness. No one but the adjuster can appreciate the delicacy of a situation when it reaches the critical stage, and he knows, or should know, better than any one, when he has gone the limit in the settlement of a claim, or when the claimant has reached the lowest sum at which a settlement can be made. Then is the time to settle, instead of going back for instructions, giving the claimant the opportunity to change his mind.

An adjuster is not necessarily a peculiar individual. but he should possess some qualifications to fit him for his work. At the recent convention at Columbus, Ohio. this question was asked: "What qualifications should a claim agent possess to be successful?" One of the answers given was the following: "Prepossessing appearance; a personality that attracts; level-headed, with a sufficient fund of common sense readily to adjust himself to surroundings; good judgment (especially of human nature), and with morals and character above reproach." While I am sure many of us do not fill all the requirements suggested, the more nearly we approach the ideal the more successful we shall be.

The settlement or adjustment of claims must, necessarily, be governed by the policy of the particular company represented. To my mind, there is but one right policy, and that is, every case should stand upon its merits; if the company is liable for an injury done, pay what is reasonable; if not liable, or unjust demands are made, stand upon the rights afforded by the law.

There are cases, of course, which should be treated somewhat more liberally: For instance, in case of death from an accident where no liability exists, many times a settlement can be made for reasonable funeral expenses. This should be done. A serious accident resulting in permanent injury, possibly the loss or partial loss of an arm or leg, can at times be settled for actual hospital and surgeon's bills; it is wise to do this, especially in cases of minors. It is also good policy to be somewhat more liberal in settlement with employees than with persons having no connection with the company. If employees understand that they will be treated with a reasonable degree of liberality in these matters, law suits from this class of cases will be very few.

In cases where there is a question as to whether or not the company is liable for an injury done, you have about even chances with the claimants before the matter reaches the court, although in court you must expect that the sympathy of the court and jury is likely to be with the plaintiff, for many times the courts treat cases much as the justice of the peace in Kentucky, who said: "Of course the plaintiff had a good case, or he would not have brought it." It is necessary, in view of the prevailing conditions, to make a very clear defense before a corporation can escape a judgment for the plaintiff. In this class of cases, before a suit is instituted, the adjuster can discuss the merits of a claim with the claimant, or his attorney, with a far greater degree of confidence than in liability cases, and usually secure a reasonable settlement.

In cases where the company is clearly liable, about the only ground the adjuster has upon which he can stand is to know his man; touch him in his vulnerable spot; ascertain what the real injuries are; appeal to the claimant's sense of fairness in the most effective way, and make the best settlement he can that is satisfactory to both parties.

In cases of non-liability, where the facts are clear, as a rule, there should be nothing paid. It is this class of cases it pays to contest in court and win. This will give the company a reputation for fair dealing and only contesting cases where unjust demands are made; and with this sentiment prevailing, a corporation will have more nearly even chances in the class of cases where large amounts are demanded for trivial injuries where it becomes necessary to take chances in court. The effect is that other claimants, who hear of these results, will come direct to the company for the adjustment of their claims.

Just here I would offer the suggestion that there is too little attention paid to giving publicity through the medium of the daily press to cases tried in court with favorable results for the company. It should be a part of the work of the legal department, through local counsel, to see that the local papers publish these matters with other news items.

In cases of injury to stock, or property damage, it pays to be reasonably liberal in the adjustment as the amount involved is usually small; and should suit be brought, it would likely be before a justice of the peace, which means a judgment against the company every time, necessitating an appeal to the circuit court, and taking chances on defeating the case there. The expense necessary for defending the matter is often as much, or more, than would have been paid in settlement in the first instance.

There is one class of accidents in which the adjuster should be "Johnny on the spot"; in collision cases where passengers are injured. There are but few matters that will so thoroughly shake a company, from the president down to the train crews doing the damage, as a serious collision between trains where many passengers are injured. Thousands of dollars are involved. It may be a critical time in financial matters with the company, and might mean a receiver. It is in cases of this kind where the attorneys for the company get "cold feet" and say "Settle; settle at any price," and they are usually seconded by the management. Here is where the adjuster must show his nerve. If he is big enough to handle the situation, and the officials have confidence in him, well and good; on the other hand, if the adjuster cannot master the situation, and is forced to call for assistance upon all the officials, many of whom may be unfitted and inexperienced in such work, then the situation is deplorable. A green hand at adjusting can make some mighty dangerous mistakes, and do it unintentionally. There are few of the officials outside of the legal department (and this is not casting any reflection upon their ability in their own department) who understand how fully a claimant's rights extend under the law, and how to prepare a release covering all matters growing out of an injury. Take the case of a minor, even though the person injured be past twenty years, but not twenty-one, the personal signature would not bind the claimant, and he would still have the right to sue the company within two years after he reaches the age of twenty-one. The same rule applies to all minors. Cases of this kind can only be settled in Indiana by a next friend by proper proceedings. Then the parents have a claim for loss of service, expenses, care, nursing, etc., which must be considered. In the case of a married woman, not only the claim of the injured party is to be considered and settled, but the claim of the husband for loss of his wife's services, expenses incident to the injury, etc.

In talking about an injury, the conversation is largely confined to the extent of the injuries, and when the amount is agreed upon it is easy to make a general statement that this is to cover all matters growing out of the injury, and prepare the release accordingly, securing the signature of husband or parents, as well as the claimant. Should the release cover only a part of the claims growing out of an injury, the settling of one part amounts to an admission of liability as to the others, and suit can be instituted for whatever is unsettled. Should this matter be taken up again, looking to the adjustment of some portion of a claim left unsettled, it is always more difficult to secure a reasonable settlement than had it been done in the first instance.

Quick action in the cases of clear liberality is most desirable, and in most cases settlement should be agreed upon at first meeting. In cases of very serious injury, this is not possible, as it is not expected that seriously or permanently injured persons will settle for a trivial sum; and, even if they did, the settlement could be set aside.

The larger companies have a decided advantage over the smaller ones in this class of cases. They usually have more men in the claim department upon whom they can call in cases of emergency, using their investigators in the adjustment of the minor claims. In collision cases, where possibly one hundred or more persons receive more or less injury, it is best to put just as many competent persons as are available at work securing settlement before ambulance-chasing lawyers have time to get at work, thus covering the ground quickly; and where settlements cannot be made, to establish friendly relations with the injured persons.

The manner in which the last serious collision on the lines of our company was handled will illustrate this in a practical way, if you will pardon the personal part of the illustration:

On the 3d of last September two sections of a train collided in a curve near Peru. Three cars, well filled with passengers (over two hundred in all) were in the wreck. A large number were more or less injured; many received serious injury; a few escaped without injury; no deaths have resulted. The names of 166 of the passengers were secured by train crews. Most of the doctors in Peru were called, and some from Kokomo were pressed into service. The writer was in Detroit, Mich., when he first learned of the accident. On reaching home as quickly as possible an alphabetical list of passengers, with a memorandum of injury, was prepared, and a letter of inquiry at once mailed to each, inquiring as to injuries and requesting prompt reply. This developed quickly those who had sustained injury, either serious, slight or trivial, as the next day replies began coming in, and the department was in touch with the individuals who needed attention, and, judging from the wording of the replies, the cases needing most prompt attention were quickly looked after. Lists were prepared, and a force of three men (a dozen would have been better) were put to work, each taking his own list so as not to conflict in the work, with the result that in ten days 67 releases had been secured; by the close of September 119 had been settled with (this number exclusive of 39 other releases in other matters taken during the month), and by Nov. 1, 141 settlements had been made. A tabulated statement at that time was prepared, in which was shown the party injured, nature of injury, amount paid in settlement and the probable amount of verdict had matter been contested in court. At that date we had made a net saving from the one accident of over $15,000, not including any attorneys' fees or costs incident to the matters. Since that time, several of the more serious cases have been settled. Only five suits have been filed on matters growing out of this accident, one of which has since been settled, and, so far as we know up to the present time, settlement has been made with all but six persons, including the four in suit.

We can demonstrate with reasonable certainty that we have saved the company on this one accident alone over $20,000.

What should the attitude of the claim department be toward the lawyers? Our experience has been that lawyers, as a rule, should be treated fairly, and they should be protected in settlements made, except in cases where lawyers are known ambulance-chasers and in bad odor. These deserve no consideration, for their only motive is to secure blood money, and they will resort to almost any means to get it. Most lawyers are inclined to be fair in their dealings, though high in price. They usually have the ability to make injuries appear fully as bad as they really are, and allowance must be made accordingly. In matters of clear liability, it is better to beat them to the case and get it settled before the lawyer is consulted.

What about the doctor? He is "the power behind the thrown." Doctors usually have more influence with their patients and can do more with them than any one else. Fortunately, reputable doctors often look upon the legal profession with an eye of suspicion, and will, if protected in their bills, assist in legitimate ways in securing settlements. Make friends with the doctors.

The claim department has been dubbed "the rat hole of the treasury." In one respect, all money paid out is a clear loss. In what department, however, is there a greater opportunity to save money? Take the cases of serious trouble; if properly handled there can be a larger per cent of saving than in many of the other departments. The competent adjuster will guard the dollars in the treasury as carefully as though they were his own. He should have every encouragement to keep the "rat hole" as small as possible, and, in order that this may be done, no bill chargeable to the claim department, large or small, in court or out, should be paid without the approval of the claim adjuster.

Where a claim department is conducted along the lines indicated, the result should be a small per cent of the gross receipts paid out, and a large saving for the company.

A MODEL CAR FOR LONG TRAVEL

BY W. H. EVANS

In discussing this topic, it might be well to say that I am not prepared to present what is or could be expected as a model car for long travel but rather to present a few points upon this subject, in the hope that the discussion which may be brought out will serve to advise us just the particular points that would be most desirable in a car of this character, and if this paper will result in creating a live discussion of this topic, the object will be largely accomplished. I am decidedly of the opinion that the most benefits to be derived from meetings of this kind are from the live discussions that usually take place, presenting the advantages and disadvantages to be derived from any proposed new apparatus or equipment. It is not my purpose to occupy your time with any lengthy discussion, but rather to present to you a few points which occur to me as being novel and possibly in the way of an improvement to meet the requirements of a constantly increasing demand for a better and longer service on our interurban lines. This topic is, no doubt, an interesting one to all connected with the traction interests, but presumably appeals more to those directly connected with the handling of passenger traffic, and it is largely from this point the subject is to be considered.

It may be well at first to direct attention to a few of the things which have largely prevented the designing and equipping of such as might be called a model car. This applies particularly to the width of cars for interurban service, which has so far been limited to 8 ft. 6 ins. over all. This necessarily compels the use of narrower seats and narrower aisles than are used on the steam road car in similar service where the cars are built from 9 ft. 6 ins. to 10 ft. 6 ins. in width. It usually occurs that at some point over the line, where it is desired to run interurban cars, the distance between track centers is too narrow, and in some instances this is located in cities where the streets have been improved and paved, making it a very expensive operation to have the so-called "devil strip" widened. But it would appear that this is something that should be corrected in the near future and at least should be very carefully guarded against in locating new tracks or in rebuilding old lines.

This same thing applies to curves at right-angle turns and other congested points which interfere with the operation of cars of sufficient length to accommodate the business, and while there would appear to be some logical excuse for this in cities of the larger class, this trouble is frequently found in small towns and villages, where with a comparatively small additional expenditure for right of way the curves could be made of sufficient radius to permit of the easy operating of any class of equipment which it is reasonable to expect the traffic will require.

In this connection, I would also desire to call your attention to the limited overhead clearance under the bridges and viaducts, particularly where the steam roads cross above the interurban lines, and as this is a time when the subject of track elevation is being actively taken up in a large number of cities, it appears extremely important that traction companies should use every effort to get as high an overhead clearance as possible. We should also remember that the conditions are rapidly changing, and that it may be necessary to have more overhead clearance, and it is impossible at this time to tell what the development of a few years will require in the way of overhead trolley arrangement to properly take care of the heavier cars and higher voltage. What formerly served for the ordinary city street car to pass under with safety is insufficient to take care of even the larger and later improved type of city service cars, to say nothing of the interurban type.

It is well to bear in mind the type and section of rail which is placed in the improved streets in cities, and above all to insist that the tracks are laid standard 4-ft. 8½-in gage.

The question of suitable cars for long-distance travel is one which is rapidly requiring our best attention, and it will be but a short time until through lines will be inaugurated where cars will run from five to ten hours, and possibly more, in one direction. At the present time in the vicinity of Indianapolis this service is inaugurated to Ft. Wayne, Dayton, Lafayette, Indiana and Connersville, with the expectation that this line will be extended to Cincinnati and through service inaugurated. Also that the other lines will be considerably extended, with the prospect of through service from Indianapolis to Louisville, Terre Haute, Toledo and Columbus, and at each of these points connected with the traction systems radiating from those centers.

The type and style of cars which appear to have become the most popular with traction companies is similar to the cars at present in service on the Indianapolis & Northwestern Traction Company's line, where they have been running for some time. Those who have been connected with their operation, are enthusiastic over this style of car for both local and limited service.* Throughout the Middle States this style of car is being used, I think, by the majority of the lines. It is usually arranged to run in one direction, but with a control arrangement on the rear platform to facilitate switching and backing up, should occasion require. These cars are seldom shorter than 50 ft. nor longer than 67 ft. Twenty of these have been in service on the road started, and a number of additional cars have been ordered for service on other lines. These cars are 61 ft. 6 ins. over buffers and 8 ft. 6½ ins. over side sheathing. They are composed of three compartments; the forward compartment serving for the motorman's vestibule and to accommodate the baggage and express as well as the location of the hot-water heater, and is 11 ft. 3½ ins. long. Directly in the rear of this is the smoking compartment, 13 ft. 4 ins. long, with seats for sixteen passengers, the passenger or coach department, being at the rear, is 27 ft. 4½ ins. long with seating capacity for thirty-eight passengers with a roomy platform at the rear which can be entirely enclosed, the step and door openings being on either side. These cars are liberally supplied with glass in the partitions, and there is little to obstruct the view looking forward, depending largely, however, on the amount of baggage which is being carried.

It is a question in my mind whether, with the increase of traffic and the carrying of baggage and express on our longer runs and the fact that a larger number of commercial men are making use of the interurbans and require that their baggage and sample cases arrive with them at their destination, it may possibly be (in order to accommodate this business) necessary to have two cars—one to provide liberally for baggage and express and a smoking compartment, and the other to be a strictly coach department. So far, however, the car mentioned has taken care of this question as well as anything that has yet been devised in a single car.

A car very much on the same plan as this is being operated on one of the Ohio systems, I understand, quite successfully, but it is designed to run with the coach department ahead, the baggage compartment being on the rear of the car, as run in ordinary service. This car in question is 67 ft. long over buffers, 8 ft. 5½ ins. over sheathing and 8 ft. 8 ins. over all. This particular car is seated with parlor chairs and accommodates twenty-nine people in the coach department and ten in the smoker, and has two toilets. That for the men is located in the rear

*The floor plan of these cars was published in the STREET RAILWAY JOURNAL of Oct. 13, 1906, on page 633.

vestibule at the rear of the baggage room, thus locating the hopper at the extreme rear end of the car and clearing the trucks, the entrance being through the baggage room. The motorman's cab is at the front end and is so constructed as to obstruct the view of the passengers as little as possible, giving practically all of those seated in the coach department a clear view ahead, the entrance and the exit of the car being at the front end for both motorman and passengers. There is also an entrance at the rear of the car. The doors and steps of this car are placed all on one side, the left-hand or pole side of the car being entirely free from any door openings whatever, thus forming a very substantial and solid construction. Particular care has been taken in this car with the bottom frame, consisting of six steel I-beams running full length of the car, and the floor is triple, the bottom being steel plates fastened to the sill, covered with yellow pine flooring and that covered with a floor of hard maple, the passenger compartment in this particular car being covered with carpet.

I am aware that this is to a certain extent quite a radical departure from the usual operation of cars of this character, and while from an operating standpoint there may be some things which would condemn this practice, there are features which would appear as commendable. Principally among these is the fact that the passengers boarding the car and leaving it are under the direct supervision of the motorman. An arrangement could be devised whereby the motorman opened and closed the door, thus preventing passengers from alighting from the car except at the proper designated stations, and also avoid numerous accidents from people alighting from the car while in motion. This applies particularly to cases where the conductor is required to go forward and flag a railroad crossing, which frequently results in accidents to passengers at that time. The smoking room in the rear is also an advantage, as this is entirely separated from the coach department, and the fumes of smoke are never carried into it. This arrangement, however, makes it necessary for the conductor to look after the baggage, which I presume would be by some considered a disadvantage, but it would appear to me that this would be offset by the safety secured by passengers boarding and alighting from the car, under the eye of the motorman.

There is no question but that being able to view the country from the forward end is a decided attraction for most passengers on interurban lines, and would appear to have considerable advantage over the practice of having the observation on the rear of the train, so long in vogue on the steam road lines. Particularly in the summer time and in pleasant weather this arrangement should appeal to travelers. Being able to look ahead is also quite a relief to passengers who become sick on the cars, which sickness can be largely attributed to looking out at passing objects through the side windows. The motorman is located in a small vestibule enclosed with glass windows, thus saving him entirely from interference by the passengers, and at the same time offering very little obstruction to the forward view.

It is important, however, that the forward or pilot end of this car be made as substantially as possible and thoroughly braced and strengthened to withstand any impact from collisions which might occur. In fact, this is a matter which requires very serious attention from all those who are connected with the designing of traction equipment, particularly so on cars which are to be used on high-speed lines. A considerable improvement has been made in this direction within the last few years with the introduction of steel into the bottom framing, and while this leads to a somewhat heavier car, the tendency is in the right direction, in the way of securing substantial cars, which should be aimed at rather more than cars of elaborate finish or expensive interior arrangement. In fact, it will not be surprising in the next few years to see all-steel cars in common use on interurban roads, judging from the rapid advancement made in this line with subway and elevated railway cars.

It is possible that the car for longer travel will require considerably more conveniences than has been the practice, particularly in the way of toilet and lavatory facilities, and it is pleasing to note that recently considerably more attention has been given to this. Toilet rooms of more liberal dimensions are being designed, and in some cases water flushing hoppers have been installed as well as lavatories. These latter, while they considerably increase the cost and trouble of maintaining the equipment, afford a convenience on the longer travel cars, which we will probably be required to furnish, notwithstanding the fact that on electric lines very little of the dust and dirt and other inconveniences are experienced incidental to a trip on steam lines, with the locomotive burning soft coal.

I would recommend as far as possible the sliding doors be substituted by swing doors, to permit of a considerably more substantial framing and bracing at the partition of our longer cars, as the sliding door takes up a space which would otherwise be used to considerable advantage in securing a stronger car.

In connection with this paper, we have prepared for your entertainment an exhibition of the principal types of interurban cars, which are actually in service on lines centering in Indianapolis. These, I trust, will serve not only as an exhibition, but will aid you in further investigating the subject of "A Model Car for Long Travel."

CAR LIGHTING

BY R. C. TAYLOR

Few subjects in electric railway equipment have received less attention and deserve more than the question of the proper illumination of electric railway coaches. The modern interurban car carrying passengers over long distances should have its lighting arrangements so designed as to provide sufficient light at all times to give the passengers an opportunity of being able to read with comfort.

HEADLIGHT REQUIREMENTS

The car should also be provided with a headlight burning with sufficient brilliancy to enable the motorman to have a clear view of the roadway far enough ahead to be able to run his car at high speed in the darkness without danger or discomfort to the passengers on his train.

The car should also be provided with sufficient light for danger signals on the rear end sufficiently bright to enable the motorman on a car approaching on the same track to stop in time to prevent a rear-end collision.

The headlight should be an arc headlight with large reflector so designed, arranged and constructed as to be a permanent part of the car's equipment, and if set above the line of vision of the motorman will give a clearer view of the track and more satisfactory light both near the car and at the limit of its range.

The mechanism of the headlight should be strong, simple and reliable with carbons arranged to burn at least six days without renewal. In cities where the ordinances require the screening of the light while passing through streets, a screen of the ordinary type should be arranged as a permanent part of the lamps and facilities provided in the motorman's cab for shifting it to either one or the other of its positions at will.

The headlight should be designed to give a clear view of 3000 ft. along the track on a clear night. During fog or rain or driving snow this range of vision is liable to be cut down to 500 ft., which will be just about as short a distance as a high-speed car can be stopped. This range of headlight view will probably call for an expenditure of energy at the lamp terminals of 5 amps. at 80 volts. This design will provide sufficient light for the "unfavorable" conditions of atmosphere and weather, as it is usually during such unfavorable conditions that an accident or collision is most liable to occur. The headlight of a high-speed car is considered one of the most important features of its equipments, and hence the reason for advocating as strongly as possible and with earnest emphasis the arrangement of keeping one headlight for each operating end of a car.

TAIL AND CLASSIFICATION LAMPS

Most interurban cars are being fitted up for single-end operation, and when so arranged should be supplied with electric tail lights. These should also be arranged as a permanent part of the car's equipment. Two 8-cp lamps behind ruby lenses give a very satisfactory set of tail lights. These should be wired up in connection with a clear light when the trolley is removed or the line current interrupted for any reason. Classification lights equipped with colored lenses may also be fitted up on the front end of the car in the same manner as the two tail lights in the rear and be ready for use at any time it may be necessary to run the car as a classified portion of a train.

LIGHTING THE INTERIOR

The arrangement of lights in the interior compartments of the car should be of such a character as to produce a pleasing effect on the minds of the passengers. Most of our high-speed cars have been designed to attract passenger traffic formerly handled by steam railroads. Our managers have made commendable efforts in designing and furnishing their best cars so as to equal or excel the best rolling stock of other railways, and there is perhaps nothing that will enhance the appearance of the car and conduce more to the comfort of the passenger than comes from riding in a well-lighted coach. There are a great many reasons too self-evident for discussion why a car should have plenty of light at every part of the trip.

The fact that out of nine interurban lines running into Indianapolis, the interior lighting arrangements varies from twenty lights to sixty-five lights per car seems to indicate that there is still room for discussion on the best method of electric car lighting. The performance of these lights on the road and the quantity of light given out seem to indicate there may be room to advocate some improvement in their arrangements.

ARRANGEMENT OF CIRCUITS

The usual method of car lighting is to connect five incandescent lights in series and put as many circuits in the car as its architecture will permit, or the fancy of its designer may suggest. The arc headlight is then connected across the line in series, with encugh iron-wire resistance to cut down the line voltage to 70 volts across the arc.

POWER REQUIRED

With this arrangement, assuming a car with seven circuits or 35 lamps, we then have the following energy consumption per car:

Arc headlight and resistance	2,700 watts
Thirty-five 16-cp incandescent lamps	1,965 watts
Total energy consumption for lighting	4,665 watts
Energy consumed in light by the arc	315 watts
Energy wasted in heat in the arc	2,385 watts

In other words, there is energy enough wasted through the resistance of the arc to furnish more than sufficient light for the interior of the car.

RESISTANCE AND REGULATION

Since the arc lamp as at present arranged seems to be the pivot point around which any suggested improvement might be made, let us assume that enough incandescent lamps are inserted in the circuit to take the place of the resistance and furnish the interior lights. We have a net saving of 1965 watts per car while the lights are in service. So long as the line voltage remains constant and the resistance of the lamp filaments remains constant, with this arrangement the interior lighting effect in the car will be quite satisfactory; but unfortunately it is very difficult with the very best possible design of feeder arrangement, without involving enormous expense, to maintain anything like a constant voltage over the entire system or even a fair average, and especially is this true on long interurban lines, and the results are in a great many cases that the interior lighting of the car becomes very unsatisfactory indeed. The obvious remedy for this fluctuating line voltage would be to insert in the light circuit some form of regulator or other apparatus to maintain a constant potential on the light circuit irrespective of the fluctuations on the line. Several suggestions for the accomplishment of this desirable condition have been advocated, but so far as known none of them has met with a very conspicuous success. A design for this purpose has recently been brought to my attention in which a portion of the current from the headlight resistance is used in regulating the lighting circuits and the balance of the resistance current is used for lighting a number of specially designed arc lamps for lighting the interior of the car. This system seems to merit full consideration, and I believe is on exhibition at this convention.

Another regulator for railway lighting circuits has been designed, which short-circuits a number of the lights in the car, maintaining a constant voltage on those left burning. This regulating system was applied to a car several years ago with quite satisfactory results. There is certainly a demand for such a device for interurban service, and it seems quite reasonable to expect that it will soon be on the market.

USE OF THE COMPRESSOR MOTOR

In the event of no satisfactory regulator being produced to meet this service, this matter of constant potential on the lighting circuit is sufficiently important to warrant the adoption of an independent motor-generator set for car lighting. It is a well-known fact that either the life or efficiency of an incandescent lamp will be very greatly affected if run at a very small percentage either above or below normal voltage. In the design of a new car this detail could be very nicely cared for in connection with the compressor motor.

This motor could be designed to maintain a constant speed at a variable voltage and of such capacity as to run the air compressor and lighting circuit. The lighting generator could be mounted on the motor shaft and no additional bearings or frame would be required. On the compressor gear would be mounted an automatic air-operated clutch. The operation of this machine would then be this: When the lights were burning the motor and generator would run continuously, and the automatic air-operated clutch would throw the compressor part of the device out and in to meet the demands for compressed air. When the lights were not required the operation of the compressor would be the same as at present, starting and stopping the motor. This device is so extremely simple, efficient and of such low cost and its results so prolific of beneficial results in giving satisfactory illumination and long life to the lamps, that it should speedily be adopted.

NEW LAMPS

From the earliest days of electric railroading the time-honored incandescent carbon-filament railway lamp has been the medium of interior car lighting, but it seems quite reasonable to expect that further economy and better light for the same or less energy may very soon be looked for by the selection of some form of more efficient lamp. Experiments have been conducted and incandescent lamps have been manufactured and tested during the past year, having their filaments made of the metals osmium, tantalum or tungsten, with the result that the tungsten lamp has raised the standard of efficiency of incandescent lighting three times as high as the present standard and exceeding in efficiency every form of incandescent or arc lamp except the vacuum tube and flaming arc. Combined with its virtue of high efficiency the tungsten lamp possesses the merit of the simplicity of the present railway lamp and it is hoped may even exceed it in durability. Given, therefore, a high-efficiency lamp that may be made in small units, offering unlimited opportunities of correct distribution, and a constant potential on the lighting circuit, the proper illumination of a luxurious interurban car becomes a very easy problem for the engineer. Whether the high-efficiency incandescent lamp or a specially designed arc be employed in the illumination of the modern interurban car, they should be surrounded with a frosted or opalescent globe backed up with reflectors against a white background giving a soft, pleasant diffusion of the light in all parts of the car interior.

With the car lighting arrangement as outlined the potential of the lighting circuit may be made that which is most suitable for the headlight and the interior lights may be designed for that voltage. This will effect the saving of the energy dissipated through the headlight resistance. The interior lamps may be designed for high efficiency and the total aggregate saving of energy will be the difference between the present practice, 4665 watts, and the suggested arrangement, 1850 watts, or a total net saving of 2815 watts per car. The suggested arrangement, therefore, presents the pleasing prospect of affording an abundant supply of constant light for the headlights, tail lights and interior, and at the same time effects a very handsome financial saving per car per year over the accepted practice of the present system of car lighting.

Fire destroyed the car house of the Camden Interstate Traction Company at Huntington, Va., a few days ago, and seventeen out of twenty of the cars were burned. The loss is $120,000, with full insurance.

THE "GET-TOGETHER" MEETING OF THE ELECTRIC RAILWAY SHOP FOREMEN'S ASSOCIATION

As noted in the Street Railway Journal of Jan. 19, a movement recently was started among the electric railway shop foremen in New York and vicinity to organize an association devoted to the study of car depot and shop problems. The first regular meeting was held on the evening of Jan. 29 in the Wood Building, 122 Market Street, Newark, and was attended by some forty or fifty men connected with the shop departments of electric railways in the metropolitan district.

The proceedings were opened by an introductory speech by Alfred Green, whose personal acquaintance with the individual shop foremen has been very valuable in bringing them together. Mr. Green outlined the purposes of the organization and then announced the committees appointed to select officers for the ensuing year and to adopt the constitution and by-laws. The following officers were elected: President, Clark Prather, of the Public Service Corporation; first vice-president, Milton Hutt, of the Brooklyn Rapid Transit Company; second vice-president, A. Gotshall, of the Interborough Rapid Transit Company; third vice-president, R. Morse, of the Public Service Corporation; secretary and treasurer, John R. Case, of the Public Service Corporation.

After a brief discussion it was decided to adopt the title, "Electric Railway Shop Foremen's Association," as the permanent name of the organization The term "electric railway" was chosen purposely to enable the inclusion of shop foremen of any type of electric road, whether street, interurban or former steam lines. Upon motion, the original constitution and by-laws committee of four was increased to seven with instructions to meet on Feb. 14 to decide upon the regulations to be adopted. The association is taking as its model the constitution and by-laws of the American Street and Interurban Railway Association. The place and time of the next meeting were left to the discretion of the third vice-president. The general sentiment, however, appeared to be that the best place for holding the meetings would be somewhere on Manhattan Island.

After this business had been settled there was an impromptu discussion on the care of armatures. As this was simply intended for a "get-together" meeting, the members were unprepared to present shop data. Nevertheless the talk developed some interesting points, one of the speakers asserting that, judging from his experience, 80 per cent of armature troubles were due to neglect of the bearings. The same speaker suggested that the cost of repairs would be greatly decreased if cars were overhauled every thirty days instead of every sixty days. Another point considered was the number of controllers which one man could thoroughly inspect in a day.

I. R. Nelson, of the Public Service Corporation, congratulated those present on having formed such a valuable organization. He said that this movement for the co-operation of the shop foremen was highly appreciated by the management of his company, and he felt that it would not only be willing to assist with advice, but also with money. He was sure that the managements of other street railway companies would exhibit a like spirit in dealing with this subject.

Alfred Green then addressed the meeting on the value of the work that the association could do. Another speaker was E. C. Parham, who promised to give a talk on brush-holders at an early meeting.

MEETING OF EXECUTIVE COMMITTEE, AMERICAN STREET & INTERURBAN RAILWAY ASSOCIATION

A meeting of the Executive Committee of the American Street & Interurban Railway Association was held at the office of the secretary of the association, 60 Wall Street, New York City, on Jan. 28. There were present: President Beggs, Vice-Presidents Shaw and Brady, and the presidents of the three affiliated organizations, Messrs. Tingley, Adams and Rhoades. By invitation H. H. Vreeland, president of the New York City Railway Company; James H. McGraw, president of the American Street & Interurban Railway Manufacturers' Association, and Messrs. Evans, Martin, Wilson and Williams, members of the executive committee of the Manufacturers' Association, were in attendance.

The secretary presented a report of the progress of the association since the Columbus convention. He stated that the company membership had increased from 200 to 237 and the associate membership from 113 to 156. The proposal that the association change its headquarters from 60 Wall Street to the seventh floor of the new United Engineering Building on Thirty-Ninth Street was approved by the executive committee. The secretary announced that the change would certainly be made within sixty days and that possibly the offices could be moved during February. Announcements of the change in address will be sent to the member companies when made.

The secretary gave an estimate showing that the whole revenue of the association this year would probably amount to about $26,000. This will enable the organization to enlarge its facilities for carrying on work. On account of the extent of the discussions at the Columbus convention and the time necessary to revise the report, the annual printed proceedings of the four associations are not yet ready for distribution, but it is expected that they will be sent to the member companies some time during February. The reports of the four associations will occupy approximately 1400 pages octavo this year. It is planned to bind these reports in two cloth-bound volumes, one containing the proceedings of the American and Engineering Associations and the other those of the Accountants' and Claim Agents' Associations. Member companies will receive a number of sets of these reports, depending upon the amount of annual dues paid to the association. Associate members will each receive one copy of the volume containing the American and Engineering Association reports.

The next subject discussed was the place of meeting for the 1907 convention. The management of the Jamestown Exposition sent an urgent invitation to the association to meet upon the Exposition Grounds or in the city of Norfolk this year, and a representative of the exposition was present to urge the claims of this place of meeting. Invitations were also received from the Board of Trade of Norfolk, the Norfolk Business League, and the management of the local railway system in Norfolk, and these interests were also represented to second the claims of the Jamestown Exposition Company. In behalf of this plan it was claimed that the hotel, convention and exhibit facilities in Norfolk and vicinity would be ample. The secretary also read a letter from the Atlantic City Business Men's League urging the selection of that city as the meeting place, and suggested the location of the exhibits on the pier. This league was also represented at the meeting, and the suggestion was made that the exhibits on the pier could be housed by temporary coverings which would protect them from rain and salt water. The secretary also read invitations which the association had received from the boards of trade in Boston and Chicago to hold its 1907 convention in those cities.

The result of an extended discussion on this subject was that it was the general consensus of opinion that the convention should be held preferably in the East and at some place on the Atlantic seaboard. A committee was appointed consisting of Vice-President Shaw, chairman; Mr. Tingley, president of the Accountants' Association; B. V. Swenson, secretary, and President Beggs, ex-officio, with instructions to investigate the facilities at Boston, Atlantic City, Norfolk and other places in the vicinity of the latter city, and to confer for this purpose with a similar committee to be appointed by the Manufacturing Association. The committee was also given power to select the place of meeting and to make all necessary arrangements for holding the convention there.

The best method of increasing the membership was discussed at some length, and in view of the services which the association is now rendering its members it was considered a very opportune time for securing applications for new members. Mr. Vreeland, chairman of the membership committee, stated that he was planning to conduct a vigorous campaign in this direction. While the membership has increased very materially since the reorganization, and while most of the important street and interurban railway companies are now members of the association, there is still a considerable number of companies not at the present affiliated with the organization.

President Beggs announced that he had made appointments on various standing and special committees and that at the present time he was able to announce that the committees on membership, compensation for carrying the mails, and heavy electric traction were complete. They are as follows:

MEMBERSHIP

H. H. Vreeland, chairman, president, New York City Railway Company, New York City.

C. S. Sergeant, vice-president, Boston Elevated Railway Company, Boston, Mass.

E. C. Foster, president, New Orleans Railway & Light Company, New Orleans, La.

H. J. McGowan, president, Indianapolis Traction & Terminal Company, Indianapolis, Ind.

W. Caryl Ely, president, Ohio Valley Finance Company, Buffalo, N. Y.

James H. McGraw, president, Street Railway Journal, New York City.

Hugh M. Wilson, president, "Electric Railway Review," Chicago, Ill.

W. G. Ross, managing director, Montreal Street Railway Company, Montreal, Ont., Can.

W. A. House, vice-president, United Railways & Electric Company, Baltimore, Md.

T. K. Glenn, vice-president, Georgia Railway & Electric Company, Atlanta, Ga.

COMPENSATION FOR CARRYING U. S. MAIL

G. T. Rogers, chairman, president, Binghamton Railway Company, Binghamton, N. Y.

Capt. Robert McCulloch, vice-president, United Railways Company of St. Louis, St. Louis, Mo.

Gen. G. H. Harries, vice-president, Washington Railway & Electric Company, Washington, D. C.

P. F. Sullivan, president, Boston & Northern Street Railway Company, Boston, Mass.

A. H. Stanley, general manager, railway department, Public Service Corporation of New Jersey, Newark, N. J.

HEAVY ELECTRIC TRACTION

Calvert Townley, chairman, vice-president, Consolidated Railway Company, New Haven, Conn.

E. B. Katte, chief engineer of electric traction, New York Central & Hudson River Railroad, New York City.
L. B. Stillwell, consulting engineer, New York City.

The membership of the other committees will be announced in the technical press as soon as acceptances have been received from all those appointed to serve on them.

Mr. Tingley, president of the Accountants' Association, reported that at its executive committee meeting held in Philadelphia on Jan. 21 the committee considered at length the disposition of the discussion on depreciation which occupied the entire day at the 1907 convention. This discussion has been thoroughly revised and the committee recommended that it be printed in the annual proceedings of the Accountants' Association, subject to the approval of the executive committee of the American Association. On motion, this approval was granted and Secretary Swenson was instructed to incorporate the report of the discussion in the printed annual proceedings of the Accountants' Association. The reports of the committees on public relations and on municipal ownership, presented at the Columbus convention of the American Association, were also ordered printed in the proceedings of that body.

The committee then adjourned.

CORRESPONDENCE

SUBSTITUTION OF THE ELECTRIC MOTOR FOR THE STEAM LOCOMOTIVE

New York, Jan. 29, 1907.

Editors Street Railway Journal:

The writer attended the meeting of the American Institute of Electrical Engineers on Jan. 25, with the hope of hearing the views of certain steam engineers on the paper presented by Mr. Stillwell. But although an invitation had been extended among others to the members of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the New York Railroad Club and the New York Transportation Club, and a number of steam railroad engineers were present, none had an opportunity of offering any remarks, as all of the speakers were called from the floor by the presiding officer. The paper stirred up an extended discussion on the relative merits of alternating and direct current, the proper frequency and other fine electrical distinctions, but the view point of the average railway man received little or no consideration. It also seemed as if both authors and speakers unconsciously forced a balance to make a showing for the electrical side, and were by no means just or fair to the steam locomotive.

It is frequently claimed that one electric locomotive, owing to inherent advantages, can displace two or more steam locomotives. This is undoubtedly based on the very low mileage, e. g., 3000 miles per month, made by the average freight locomotive. As this low mileage is not caused by mechanical or physical limitations, but is entirely due to track and traffic conditions, there is no reason for believing the electric locomotive can make any better mileage than the present steam locomotive. Assuming 10 miles per hour for the steam locomotive, there is a potential possibility of 6000 miles per month, as the portion of time that the locomotive is not available for service is only about 18 per cent of the total time.

The general statements in the paper have little or no bearing on the conditions involved in trunk line service, consequently the portion of it that will most interest the steam railroad man is the reference to cost of operation and especially the summary on page 53. The first point to be noted is that no allowance is made for depreciation. Reconstructing the table to provide for depreciation reduces the saving to a point when the average amounts to only 3 per cent above interest (5 per cent) and depreciation (3 per cent). Group II., New York, Pennsylvania et al., the largest saving, amounts to only 7.6 per cent. Group VI., Illinois, Wisconsin, Iowa et al., nine-tenths of 1 per cent; Pacific States, three-tenths of 1 per cent, etc. This has been done below. Columns 1, 8, 9 and 10 have been added by the writer. The percentage of saving would be even less if the cost of rolling stock were included.

It is quite obvious that such small gains, based on preliminary engineering figures, could not receive consideration for a moment, and leads to the conclusion that the problem is infinitely greater than the mere substitution of one kind of power for another. The statement made at the last International Railway Congress by Mr. Aspinall, of England, that the reason his road adopted electricity was "not to save money but to make money" covers the case.

Group No.	General Location.	1. *Electric Cost per Mile.	2. Miles of Line Represented.	3. Gross Earnings.	4. (Steam) Operating Expenses.	5. (Electric) Operating Expenses.	6. Difference Steam and Electric Operation.	7. 5% Interest on Electrical Equipment Excluding RollingStock*	8. 8% Interest.*	9. Net Saving. Amount.	10. Net Saving. Per Cent
I	New England	$12,940	8,094	$14,511	$10,493	$8,604	$1,889	$647	1,035	854	6.6
II	New York, Pennsylvania, et al.	15,800	23,281	20,752	13,671	11,210	2,461	790	1,267	1,194	7.6
III	Ohio, Indiana, Michigan	12,800	25,208	12,483	9,198	7,542	1,656	640	1,020	636	5.
IV	Virginias, North and South Carolina	9,680	12,542	7,359	4,590	3,764	826	484	775	51	.5
V	Kentucky, Fla., Louisiana, et al.	9,500	24,563	6,867	4,899	4,017	882	475	760	122	1.2
VI	Illinois, Wis., Dakotas, Iowa, et al.	10,500	48,672	8,021	5,169	4,239	930	525	840	90	.9
VII	Montana, Nebraska and Wyoming	9,200	11,546	7,737	4,092	3,355	737	461	738	0	....
VIII	Colorado, Arkansas, Missouri, et al.	9,200	30,456	6,362	4,308	3,533	775	461	738	0	....
IX	Texas and New Mexico	8,900	14,875	5,588	4,108	3,369	739	445	710	29	.33
X	Pacific States	9,280	17,737	8,439	4,880	4,002	878	464	742	36	.35
	United States, total	$10,300	216,974	$9,598	$6,409	$5,255	$1,154	$516	$822	$332	3.

*Exclusive of rolling stock.

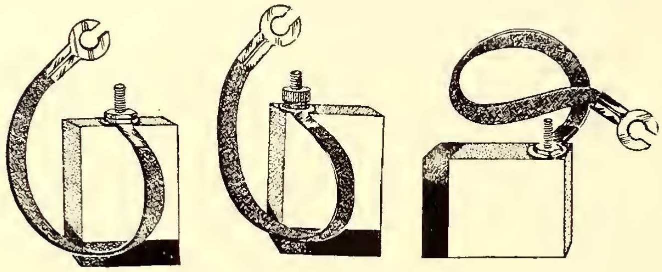
$$\text{Col. 1} = \frac{\text{Col. 7x100}}{5\%}$$

The cost per mile to run the Albany night boats a few years ago was not much higher than the company now pays for electric lighting on the new modern Adirondack and Morse. Yet what justifies the newer and much more expensive boats? Surely not the cost per mile. The only answer, then, is: "Not to save, but to make money."

Steam Engineer.

A CARBON BRUSH DESIGNED ESPECIALLY FOR ELECTRIC RAILWAY SERVICE

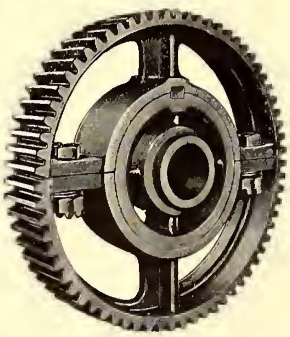
A carbon brush designed especially to meet the requirements of street railway service is the American Special Brush, made by the American Carbon & Battery Company, of East St. Louis, Ill. It is dense, highly tempered and of low resistance, besides being self-lubricating. In addition to street railway service it is adopted for crane service and all machines subject to severe usage. A feature of great value in connection with the brush is a pig-tail connector for small machines. This connector is especially advantageous, as the connection can be detached and saved when the original brush is worn out. Besides the American Special Brush, the American Carbon & Battery Company makes the American Graphite Brush and the American Diamond A Brush, the former designed to meet conditions where a soft, dense brush is required and the latter for use on stationary motors and generators.



DIFFERENT TYPES OF PIG-TAIL CONNECTORS

GEAR WHEEL WITH RENEWABLE RIM TO FIT ANY TYPE OF MOTOR

A novel type of gear wheel has recently been put on the British market by the Electric Tramway Equipment Company, of Birmingham, Eng., and presents so many striking features as to be worthy of description and illustration. As will be seen from the illustration, it is composed of three parts, not counting the keys and bolts used to connect these parts together. They consist of a solid hub, which is a heavy steel casting and is forced on the axle in the usual way by hydraulic or other means. This part is independent of the rim, and the advantage claimed for its use is that as it is subject to no wear it can be left on the axle until the latter is worn out. In this way there is no pressing on of new gears when the teeth are worn. After the axle has to be scrapped the gear hub can be placed on another axle. The rim of the gear wheel is in halves which are bolted together and keyed to the center piece.

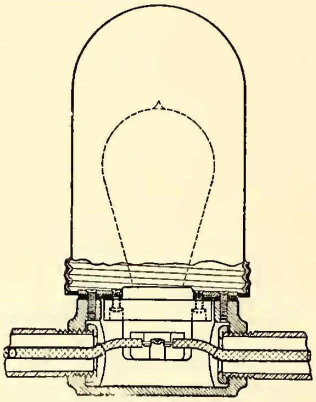


GEAR WHEEL WITH RENEWABLE RIM

The saving in the cost of renewals, owing to the fact that no part of the wheel has to be scrapped, is said to more than repay the slightly increased first cost. The rims of different sizes of gears are interchangeable, so that the gear ratio can be altered at any time if desired, without removing the hub. The wheel is claimed to combine the advantages of both the solid and split gear, and is recommended by the manufacturers in all cases where trouble has been experienced from broken axles.

OUTLET BOX RECEPTACLE

The Benjamin Electric Manufacturing Company, of Chicago, is placing upon the market a new No. 6-B receptacle especially designed for use with outlet boxes, which embodies a number of attractive features. Its contacts do not project beyond the walls of the receptable, and therefore do not readily come in contact with the metal parts of the box or projecting parts of the conduit; wires are easily spread around the base, thus making slack wire unnecessary; binding screws are accessible from the front, obviating the necessity of reversing the receptacle or of tapping wires to make connections; it may be connected while in position in the box, the cover being attached after connections have been made. A steel plate cover is furnished through which the porcelain receptacle slightly projects. Over this a polished brass cover may be used with or without shade holder. Where a shade holder is desired, it is spun upon the brass plate, forming a neat and substantial device.



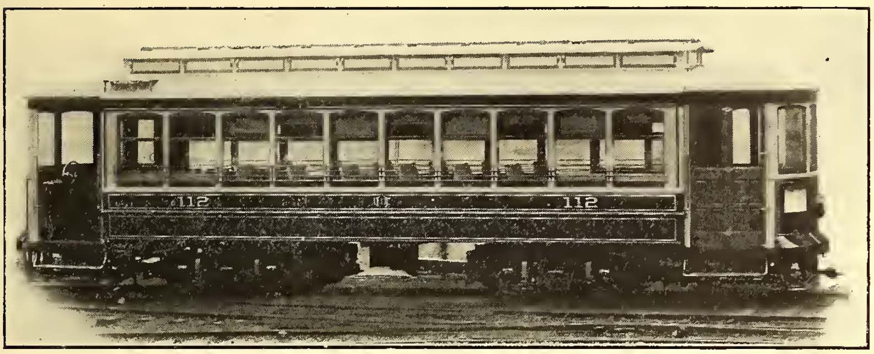
OUTLET BOX RECEPTACLE

Special interest attaches to these receptacles in connection with their contemplated use in the Port Huron tunnel of the Grand Trunk Railroad. The accompanying cut shows a vertical cross-section of the box to be used. It is of cast iron with threaded outlets to receive the conduit, thus securing a water-tight joint. A rubber gasket extending from the outer edge to the center opening through which the socket projects is placed under the steel-plate cover. Both the outer edge and the socket are thus protected against moisture. If found necessary, a vapor-tight globe will be screwed against the rubber gasket. If no globe is used, as will probably be the case with so tight a box, a rubber lamp ring will be substituted. Globe holders of sheet aluminum will be supplied. Where it is deemed desirable to use a guard, provision is made for attaching it directly to the holder.

W. S. Barstow & Company, of New York and Portland, Ore., in order to meet the demands of their rapidly extending business, have recently enlarged their power-plant department. At the head of the department is Perry West, who formerly was general equipment engineer to Joseph Williams & Company, of Louisville, Ky. Subsequently Mr. West joined the forces of Pattison Brothers, New York, and was actively engaged in steam turbine work. Recently he has been with the New York Edison Company. Associated with him is Carl F. Schreiber, who is favorably known for his work in the testing department of the Brooklyn Rapid Transit Company, in the steam department of the New York Central & Hudson River Railroad, and as one of the engineers of the electric traction commission. Another notable addition to the staff is Rulof Klein. Graduating from the Delft Technical University, Holland, Mr. Klein entered on the field of gas engineering. Among other charges in this country, Mr. Klein acted as designing and constructing engineer in the gas-engine department of the Wellman, Seaver, Morgan Company, of Cleveland, Ohio. Mr. Klein has just returned from Europe, after making a tour of inspection of gas-engine power plants in Germany and Belgium.

NEW ROLLING STOCK FOR HAMBURG RAILWAY AND DUNKIRK & FREDONIA RAILWAY

The G. C. Kuhlman Car Company has delivered within a short time twelve double-truck cars of the Brill grooveless-post semi-convertible type to the Hamburg Railway Company, of Buffalo, N. Y., and six of the same type and dimensions to the Dunkirk & Fredonia Railway Company.



EXTERIOR OF CAR FOR HAMBURG RAILWAY

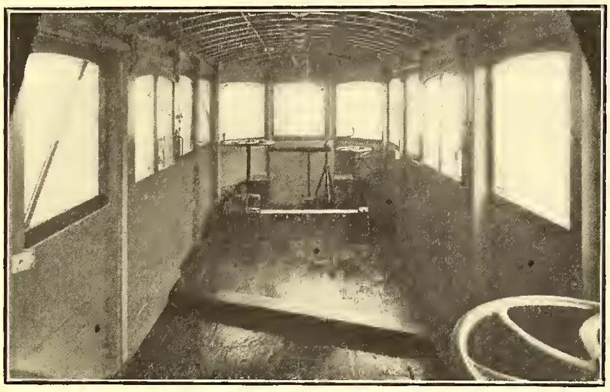
These cars are practically of the same dimensions as a standard 28-ft. car of this type with the exception that they are 3 ins. wider and the platforms are 10 ins. longer. The seats are 36 ins. long, leaving the aisle 25 ins. wide; the longitudinal corner seats accommodate four passengers each. The transverse seats are of the push-over back type with corner grab handles. The seating capacity of each car is 40 persons. A substantial bottom framing is composed of 4-in. x 7¼-in. yellow pine side sills plated on the inside with 13-in. x ⅜-in. plates. The interiors are finished in cherry, stained to a mahogany color, and the ceilings are of three-ply birch veneer; the lights are placed singly along the center of the dome and at each side under the lower ventilator rails. Four-bar bronze window guards extend from corner post to corner post and are an essential adjunct to this type of car in consequence of the unusually low window sills. The trucks are of the No. 27-GE1 type and the cars are equipped with one motor each on the inside end of the trucks of 45-hp capacity. The Chicago type of sliding fender is used and the bumpers are provided with inclined shields. The track scrapers, drawbars, sand boxes, platform steps, gongs and signal bells are of the Brill manufacture.

SOME OF APPLEYARD PROPERTIES OUT OF HANDS OF RECEIVERS

Four of the old Appleyard properties are now out of the hands of the United States Court, Judge Thompson having ordered a final distribution of a balance of $386,966 to claims amounting to $2,000,000. The Columbus, London & Springfield has a balance of $48,628.62 to be paid on claims of $694,709.81, which is 7 per cent to the bondholders. For the Columbus, Grove City & Southwestern the percentage is 10.78, the balance being $10,312.57 for claims of $95,648.21. Claimants of the Central Market Street Railway will receive $8,256 on an aggregate of $269,643, or 3 per cent, while there is a balance of $154,382 for bondholders of the Urbana & Northern, who have claims of $384,645.

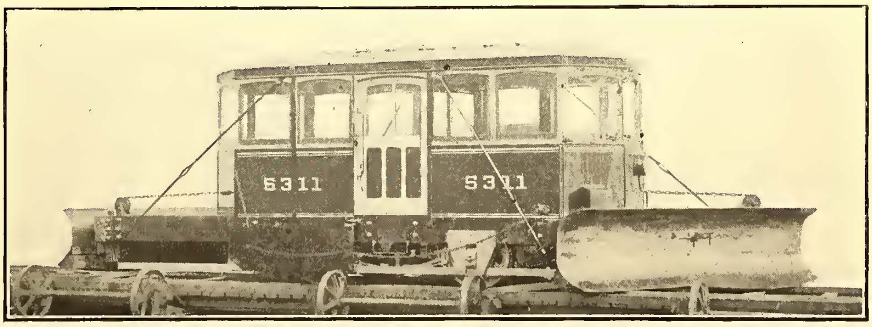
SHEAR PLOWS FOR BALTIMORE

An interesting shipment of snow plows was received by the United Railways & Electric Company from the J. G. Brill Company last month. The plows are of the shear board type, as they are required for double-track service. Although not in a latitude in which much snow is encountered, the managers have found that at times the sweepers must be supplemented by a heavier type of snow-removing apparatus to prevent stalling of the cars at critical times, especially on the lines which extend far into the suburbs and over which the sweepers operate infrequently. The powerful construction includes 6-in. x 12-in. side sills with heavy truss rods anchored at the ends of the sills and brought up to the letter board of the cab, where they are supported by straps three-quarters of an inch thick, which are folded to the posts and reach down to the sill with a toe at the bottom inserted in the sill; iron bars 3 ins. x 3½ ins. extend between the plow posts at each side, forming a powerful brace for the back of the plows behind the lower edge where the greatest strength is needed. The lower edge of the shear boards is horizontal for the full width of the



INTERIOR OF PLOW FOR BALTIMORE

track and sheared on an incline at each end, giving an elevation of 2 ins. to avoid contact with paving stones. The plows are adjustable to a height of 9 ins. above the rails. Folding wings or levelers are provided at the sides, and ice diggers operated by pedals in the floor of the cab are a part of the equipment. The car measures 18 ft. 9 ins.



EXTERIOR OF PLOW FOR BALTIMORE

over the body and 34 ft. 5 ins. over all; width over side sills, 6 ft. 10½ ins.; length of shear plates, 12 ft. 4 ins. The trucks are of the Brill gear type and have a wheel base of 7 ft. The weight of an entire equipment, motors excepted, is 16,000 lbs.

LONDON LETTER

(*From Our Regular Correspondent.*)

With the exception of two routes, the Bristol Road route, which was electrified some years ago by the owning company, and the route between Colemore Row and Hockley, which is at present operated by cable system, all the tramways of the city of Birmingham, with the commencement of this year, passed into the hands of the Birmingham Corporation, and are now being operated by it under the able managership of Mr. Alfred Baker. During the past two years the work of converting the various systems of traction which have been used in this city, has been steadily proceeding, Mr. Baker having been appointed general manager of the Corporation Tramways some little time after the Corporation decided to take over the whole of the tramways and to electrify them. Birmingham is the last of the large cities of Great Britain to have its tramway system electrified, owing to various reasons. The tramways have been operated in this city by different companies, whose leases expired at various periods, and during the past five years it has been probably the worst served city in Great Britain, so far as tramways are concerned. I do not mean that the city actually has been badly served, but in these modern days when one expects to see the light, elegant and well-equipped electric car in all cities of importance, it was something of a shock, even so late as Dec. 31, 1906, to find old, antiquated steam tramways still in possession of many of Birmingham streets, and the cable system in possession of others. This is now entirely changed, and the citizens of Birmingham are now learning what it is to have a first-class electric system. As will be readily understood it was a work of no small magnitude to change over the whole of the system, and when the last steam car arrived at its destination on Monday night, Dec. 31, with crepe attachments amid the funeral groans of those assembled, large gangs of men were set to work all over the city making the necessary final arrangements for the running of the electric cars, which had to be started within the next 4 hours. Many final alterations had to be made in the tracks, and much of this work had to be done at junctions. The whole work was triumphantly accomplished, however. The first day's working of the electric tramway was eminently satisfactory and practicable, and everything worked to everyone's satisfaction. The progress of the 200 cars was necessarily slow, as the drivers were not accustomed to their duties, driving a steam tramcar being a very different operation from driving an electric tramcar. During the first week the average number of passengers carried was 200,000 per day, though when everything is working more smoothly, after a month or two's operation, that figure will undoubtedly be exceeded. There have been no very serious accidents, although there has been a number of trivial ones. Many of them, however, would doubtless have occurred under any other circumstances, and very few were attributable to the drivers of the cars. It is satisfactory that Mr. Baker himself has been entirely pleased, and is quoted as having said that though he had experience with the opening of many new systems he had never known one which had worked so well as the Birmingham system from the commencement and with such freedom from accidents. The Corporation has expended upon the work of the electrification something like a million pounds, but experience has already shown that this will be an excellent investment. The tramway committee will now become one of the best customers of the electrical department of the Corporation, whose new electrical power house was recently described in these columns. The Council has sanctioned the arrangement that for the first 4,000,000 units of energy taken per annum, the tramways are to pay 1½d. per unit, for the second 4,000,000 1¼d. per unit, and for the third 1d. per unit, and it is expected that the whole 12,000,000 units will be required when the full system is in operation. It is also interesting to state that the violent opposition to the extension of the tramways system to the aristocratic suburb of Edgbaston has availed nothing. The Lord Mayor has now announced that the opponents of the scheme have been defeated by the vote which was recently taken, and that the Corporation has been authorized to promote the necessary bill in Parliament for carrying out this extension.

After years of doubt the York City Council has finally decided to adopt the recommendation of the tramways committee to purchase the existing tramways of the City of York Tramways Company Ltd., for the sum of £11,000. As the Corporation has no authority to operate the tramways, it has also necessarily decided to promote a bill in Parliament for that purpose, and will make arrangements for the present system to be continued to be operated by the company until the necessary powers have been obtained. The hands of the Corporation have been somewhat forced by the fact that another bill, called the York and District Tramways Bill, has been duly deposited at Westminster. This is a comprehensive bill for the purpose of providing York and district with a complete system of tramways, including the purchase of the existing system. The Corporation will, therefore, have to be in opposition to this company bill, though doubtless now that the decision has been reached to operate the tramways municipally the company's bill will be thrown out.

The city of Edinburgh seems to be as yet a long way from the solution of its tramway question. It is well known that for years back the city has been well, though incompletely, served by an admirable system of cable tramways, but with the growth of the city, extensions of tramways have become more and more imperative. The limitations of a cable service have become more and more apparent, and for some time it has become quite evident that some modification of the existing system would have to be made. The question having become vitally important, and Edinburgh being opposed to an overhead electric system in the main streets of the city, from an æsthetic point of view, deputations have visited recently many of the English cities where underground conduit or surface contact systems are in use. For the past year or so the tramways committee has been made familiar in Edinburgh with various conduit and surface contact systems by the promoters of these various systems, but this deputation has now had an opportunity of seeing all of the systems at work with the exception of the Kingsland system, which has been strongly pushed in Edinburgh. On the return of the deputation, consultations were had with Sir A. B. W. Kennedy, to guide them in the production of a proper report, and this report has now been presented to the Town Council. The report deals at great length with the various systems seen by the deputation, but the main points are that they find that the electric conduit system is admirable, and having been tested on a large scale in London, has been found to work well in all kinds of weather; that the slot in the existing cable system in Edinburgh could be utilized for an electric conduit system, though the cost of installing a new conduit system, except in streets where the traffic is very heavy, is a serious consideration. They also find that of all the surface contact systems which they saw the "G. B." system, as observed in the city of Lincoln, is the most s[illegible] for the city of Edinburgh, as they claim that it is comparatively noiseless, that it runs smoothly and that the studs, which are small, are flush with the surface of the streets. They find also that the [illegible] the various contact systems does not materially differ, that the running cost per car mile on the various contact systems also are not greatly dissimilar, and they confirm the statement that with the present cable system of tramways it is impracticable to have any mutual interchange of traffic with outside systems. The report goes on to deal with the particular extensions which Edinburgh has at present in view, and goes more fully into the details of all the cost necessary. The report is an important document, though it contains no information which is not already well known to tramway engineers. It is to be hoped that it will have a convincing effect upon the tramways committee, and that something will be done before long in Edinburgh to relieve the existing condition, as extensions of tramways in all directions in Edinburgh are becoming absolutely necessary.

As we hinted last month in this column it has been found necessary for the London County Council to modify to a large extent the running of the electric cars on the Embankment. It has become a somewhat complicated problem, and undoubtedly many alterations will be made before a perfect system is devised; in fact, no perfect system will probably be devised until Blackfriars Bridge is opened for car traffic. At certain hours of the day there seems to be a great rush for cars from the Embankment terminus, but, naturally, at other hours of the day there is no traffic along the Embankment at all, so that cars become unnecessary at that time. On the other hand, the passengers who used to join the cars at the south end of Westminster Bridge, and who can now get them at the north end of the bridge, find that when the cars arrive there they are already full at the busy hours. As we stated last month, all of the cars which used to come to the old terminus at Westminster Bridge have been brought across Westminster Bridge to the

Embankment terminus, but arrangements have now been made so that some of them will stop at various points. Some, especially the cars from the eastern districts, will stop at the old terminus at the south end of Westminster Bridge, some will go as far as Charing Cross, and only a portion will traverse the whole distance to the terminus. The natural conformation of the district has evolved necessarily new problems, as though it is more convenient now for certain passengers to take tramcars on the Embankment, it is a much longer way round to certain points on the south side than by the old routes, but it avoids the walk across the bridges. On the other hand, extra fares have been charged for the journey along the Embankment, so that even now it is more expedient for some still to follow the old route. It will take a few months before everything is satisfactorily arranged.

It is interesting to note that a scheme has now been prepared for providing the tramway employees at the various depots with recreation rooms, and the first which is being got ready is the New Cross depot, which is the largest tramway depot on the system. The room which is being prepared for the purpose will be divided into a dining room and a recreation room, in which will be billiard tables, draughts, chess, a piano, etc. As many of the employees live at great distances and cannot reach home at meal times, or at other times when they are off duty, it has been considered expedient to provide quarters of this kind for them. Several new routes of tramways on the London County Council system have been inaugurated during the past month. The most important on the south side is the one from Tooting Broadway by way of Wandsworth, Battersea and Vauxhall to the Hop Exchange, a distance of between 8 and 9 miles. Another new route on the south side which has been opened is the one between Clapham Junction and Westminster, via Battersea Park Road, Nine Elms Lane and Vauxhall. On the north side of the river the new electric route from Aldgate to Bloomsbury has now been opened, this being part of the tramways system recently purchased from the North Metropolitan Tramways Company. At the Bloomsbury end this system is conected with the lines which go through the subway under Aldwych to the Embankment, and is the first of the new tramways on the north side of the river reaching away to the east to be electrically equipped. The London County Council has also intimated to the local authorities of East London that the work of electrification will shortly be commenced on the tramway lines in Bow Road, and at Bow Bridge connection will be made with the West Ham tramways. The management of the latter will probably arrange [illegible] the London County Council for the temporary working [illegible] the new line is connected with the remainder of the London County Council system.

The [illegible] Metropolitan Electricity Company, a subsidiary compa[illegible] the British Electric Traction Company, has now opened its system of electric tramways from Croydon to Sutton. The tramways are divided into two sections—the Mitcham and Tooting line and the Sutton line—both starting, however, from Croydon, and a contemplated extension will probably enable them eventually to make a circular route. These tramways run through interesting and beautiful country, one of the routes lying across the famous Mitcham Common and Green, and tapping a rapidly growing residential neighborhood. The other route passes through Waddon, a suburb of Croydon, and also the rapidly growing town of Wallington, skirts the ancient village of Carshalton and passes through the famous Carshalton Park, well known as frequently visited by Queen Elizabeth. About 16 miles of track have been laid at present, and current is provided from a large generating station at Sutton, owned by the South Metropolitan Company.

At the annual general meeting of the Underground Electric Railways Company, of London, the company which owns the three Yerkes tubes, two of which are now opened and the other rapidly approaching completion, Mr. Edgar Speyer, chairman of the company, stated that within six months the company would be out of the construction period and would have completed the system of tube railways which it had undertaken to make. The cost of financing these railways has been greater than was anticipated, owing to the unfavorable condition of the money market, but there is ample capital to complete the work still in hand. It is also interesting to note that it is now proposed that the three London tube companies owned by this company be brought under one management. These three tubes are the Great Northern, Piccadilly & Brompton, the Baker Street & Waterloo, both of which are completed and in operation; and, thirdly, the Charing Cross, Euston & Hampstead, which will be ready for traffic early in July. The unification of the management of these tubes will probably take place about that time, when all of the tubes will be in operation. It is expected that considerable economy will be effected by consolidating the management, although the companies will continue to have a separate corporate existence, as amalgamation would mean the promotion of a bill in Parliament, which is considered unnecessary, and the present object can be attained without that. The three companies will possess 23 miles of tube, and have a combined capital of £12,000,000.

The Swansea Tramways Company has recently inaugurated, in conjunction with the Swansea Express Delivery Company, a service by which parcels, traveling bags, etc., may be delivered to any address in the city by means of their electric cars. These packages may be handed to the conductor of any car for delivery to any address in the locality, and if these packages are placed in the cars before 4 p. m. they will be delivered the same day.

The Plymouth Corporation, in electrifying the West Hoe section, determined some time ago that to run full-size cars with top seats in this section would be a mistake. Somewhat of an innovation has therefore been made by supplying some half dozen demi-cars, which will run to and from Pennycomequick and the Promenade Pier. These demi-cars are more economical both in first cost and in operation, as no conductors are used, the driver looking after the fares. As the cars are small, only about two-thirds of the power is required compared with that necessary for the ordinary cars. Passengers can board these cars only at the end where the driver is, and an iron bar arrangement prevents people either entering or leaving while the vehicle is in motion, each passenger being requested to pay on entering. The fare is handed to the driver, who places it in a patent collecting box, which registers the coin inside, though probably tickets will be issued later on, being more convenient for this purpose.

To meet the ever-increasing requirements of the traffic on the Glasgow Corporation tramway system, and to provide the necessary equipment for extended routes, the works sub-committee of the tramways committee has unanimously recommended the building of a hundred extra cars. A proportion of these will have covered tops. The work is to be carried out at Coplawhill, and it is expected that the cars will be turned out at the rate of about two a-week without interfering with the regular maintenance work which is carried on in the department.

The earnings of the Glasgow Corporation electric tramways from June 1 last to Dec. 31, are announced as amounting to £513,642 10s 6d, an increase of £44,674 1s 3d as compared with the corresponding period of the preceding financial year, while the number of passengers carried increased from 119,496,689 to 129,150,604. This is the first occasion upon which the receipts have reached half a million sterling in a half year, and there is now every prospect that when the financial year closes in May the unique record of a million sterling will have been reached. Further important suburban extensions of the lines are contemplated during the present year.

C. W. Mallins, the traffic manager of the Liverpool Corporation Tramways, has submitted a statement showing that during last year the undertaking established a record in receipts, mileage and passengers. The car mileage was 12,115,934, an increase of 48,901 miles, as compared with the previous year. The total number of passengers carried was 122,094,528, being very nearly 3,000,000 more than in 1905, and the receipts were £563,793, an increase of £13,672. The average earnings per car mile last year showed an increase, having been 11.17d, as against 10.94d in 1905.

The Haslingden Town Council has resolved to give notice to the Accrington Steam Tramways Company, Ltd., that at the end of six months from Jan. 4, 1907, it will exercise its powers to purchase the portion of the company's undertaking that is in the borough. It is proposed to electrify the system after the purchase.

Estimates of the cost of constructing the proposed electric railway from Euston to Watford by the London & North-Western Railway Company have been deposited for the information of Parliament. The total cost is put at £2,508,000, the principal items being tube station and loop line beneath Euston terminus, £202,090; passenger subway at Euston, £22,080; tube railway (two tunnels), about 2¼ miles long, £760,360; widenings, alterations, etc., on surface to Watford, £1,119,105; new works in Watford district, £90,200; widening Rickmansworth branch railway, £69,715; and new branch to Croxley Green, £72,655. The company in its bill seeks additional capital powers to the extent of £2,700,000 and to borrow £900,000. The underground tubes, as far as Loudoun Road, will be nearly 4000 yds. in length, and will rise to the surface on a gradient of 1 in 63. There will be two intermediate stations underground—at Chalk Farm and Loudoun Road. The diameter of the tunnels between stations will not exceed 13 ft. 6 ins. (or 2 ft. 6 ins. less than that on the Great Northern & City Railway), and at the stations 30 ft. The deepest point of the line will be at Avenue Road, N. W., where the rail level will be 120 ft. below the surface of the ground. Where the new tube runs beneath the existing tunnels of the London & North-Western Railway at Chalk Farm the depth will be nearly 60 ft., while at Finchley Road the tube will be 100 ft. below the Metropolitan Railway. The new station beneath Euston will make the third there, as stations of the City & South London extension and the Charing Cross, Euston & Hampstead Railway are being built. Intercommunication will be provided between each. The directors propose to make an innovation, so far as tube railways are concerned, by accepting passengers' luggage for conveyance.

A. C. S.

CHICAGO TRACTION MATTERS

Since the Council committee on local transportation of the Chicago City Council recommended the adoption of the traction ordinances providing a referendum vote was not desired by 25 per cent of the voters, all interest in the traction situation has been centered in the collection of the proper number of names to petitions asking that a referendum vote be taken. Two forms of petition have been circulated, one drawn up by the City Council and another prepared and circulated by the Referendum League. In addition to the traction question this latter petition contains a clause with regard to the repeal of the Illinois Sunday blue laws of 1845. This last question was put on the petition in order to obtain signers who would not have signed a petition containing the traction clause alone.

Mayor Dunne has been most active in pushing the circulation of the City Council petition, and in order to cover the city most effectually has pressed the police department into service. This has been strongly criticised by many who consider that the police force should not be utilized for this purpose. The petition of the Referendum League has been circulated largely by men hired especially for this work. In many cases these men were paid according to the number of names secured, and as a result some names are said to have been obtained by fraud.

If the required 86,000 names are secured to the petitions the signatures will be investigated by the Election Board before a referendum is declared.

Mayor Dunne has secured opinions on the traction ordinances from Attorneys Clarence N. Goodwin and Benjamin D. Magruder, formerly judge of the Illinois Supreme Court. These gentlemen state that the united operation of the Chicago City Railway and the Union Traction Company would be subjected to the approval of Judge Grosscup, receiver for the Union Traction Company. Several other objections are stated in the written opinion furnished Mayor Dunne.

President Mitten, of the Chicago City Company, in a recent statement, said if the ordinances are passed and become a law early in February, 300 new cars could be secured during the summer months, and track and power improvements could be made in time to take care of the heavy travel during November and December. If settlement is delayed until after a referendum vote in April the actual work of reconstruction will be so delayed that present congested conditions will continue for another year.

CHICAGO & WESTERN INDIANA COMPANY'S PLANS

The Chicago & Western Indiana Traction Company, known as the "Educational Route," which was organized and incorporated by Edward H. Barrows, has been reorganized by the American Engineering Company, of Indianapolis, which will undertake to complete the road. At a meeting, a few days ago, the following officers were elected: Charles N. Wilson, president; Edward W. Barrows, secretary-treasurer. Mr. Barrows retains the office of general manager. The road is chartered to connect Chicago and Louisville through Valparaiso, Lafayette, Crawfordsville, Greencastle and Bloomington; but the first division, that between Lafayette and Greencastle, is all that will be built now. This division will be 57 miles long. This will be the link that will give a through traction express service from Evansville to Princeton, Sullivan, Terre Haute, Greencastle, Crawfordsville, Lafayette, Delphi, Logansport, Peru, Wabash, Huntington, Ft. Wayne, and, later, Toledo, Ohio. Indianapolis will be reached by a through fast express service over the "Educational" and "Ben-Hur" lines by the joint use of tracks, bringing the cars directly into the station in this city. This service will put Romney, Linden, Whitesville, Ladoga, Roachdale, Carpentersville and Bainbridge in close relation to this city, which does not at present exist by traction lines. The new company will get its power from the power plant of the Indianapolis, Crawfordsville & Western Traction Company—the "Ben-Hur" route—which is located at Crawfordsville.

CHICAGO & OAK PARK ELEVATED EARNINGS FOR YEAR ENDED DECEMBER 31, 1906

The report of the Chicago & Oak Park Elevated Railway Company, which holds the securities of the Chicago & Oak Park Railroad Company, for the year ended Dec. 31, 1906, as submitted to the stockholders at their annual meeting in Jersey City, Jan. 10, 1907, compares as follows:

SECURITY HOLDINGS

The amount of stock issued and now outstanding is:

	Dec. 31, 1906	Dec. 31, 1905
Preferred stock, shares	30,448	30,390
Common stock, shares	56,561	56,458
Total	87,009	86,848

The amount of capital stock scrip outstanding is:

	Dec. 31, 1906	Dec. 31, 1905
Preferred	$12,965.70	....
Common	4,257.00	....
Total	$17,222.70	....

The company now holds of the securities of the Chicago & Oak Park Elevated Railroad Company:

Income bonds, par value	$864,100	$858,900
Stock, shares	91,496	91,446

BALANCE SHEET

Assets		Dec. 31, 1905
Securities—		
Stock of Chicago & Oak Park Elevated Railroad Company and income bonds Chicago & Oak Park Elevated Railroad Company, carried at	$7,682,555	$7,670,948
Notes receivable	1,608,500	1,488,600
Cash on hand	1,239	814
Total	$9,292,294	$9,160,362
Liabilities		
Capital stock—		
Preferred	12,966	14,405
Common	5,656,100	5,645,800
Capital stock, scrip—		
Preferred	12,966	14,405
Common	4,257	12,557
Notes and accounts payable	574,171	448,600
Total	$9,292,294	$9,160,362

Following is the report issued by President Redmond D. Stephens:

The company now holds $1,608,500 of the notes (demand obligations) of the Chicago & Oak Park Elevated Railroad Company for moneys advanced and loaned to said company. The railway company has issued, and now has outstanding, $568,500 of its notes (demand obligations), in addition to which there is a debenture note of $350,000 issued by the Chicago & Oak Park Elevated Railroad Company, and by this company indorsed over and guaranteed to the Northwestern Elevated Railroad Company. The annual meeting of the stockholders of the Chicago & Oak Park Elevated Railroad Company will be held in the city of Chicago on Jan. 31, 1907.

THE CLEVELAND SITUATION

The conferences between President Horace E. Andrews, of the Cleveland Electric Railway Company, and President A. B. Dupont, of the Municipal Traction Company, of Cleveland, relative to the holding plan, have been conducted in private. It is understood that Mayor Johnson has objected to the plan of the two gentlemen in not giving out information as to all that takes place at the meeting, but both men think it better to keep their discussions private until the results are ready for announcement. Of course, some information is given out regarding the subjects that are being discussed, but nothing that would have any bearing in one way or the other on the matter.

Atorneys were called in at times during the past week to settle legal points that came up in the negotiations, and each side has had frequent conferences with attorneys representing the two interests. In this way they hope to get all legal obstacles out of the way before any final settlement is reached. Mr. Dupont has also asked for a mass of information from the city, and the various ordinances of the Cleveland Electric have been carefully gone over by attorneys for the Municipal Traction Company. It seems that they hold that the decision on the Central Avenue and Quincy Street expirations will hold good with all the others, and that they expire on the dates originally fixed, without reference to any other streets with which they may be connected by transfer or other arrangements. That point will have to be determined later on, as the various actions of the City Council may not be similar or of the same intent.

The physical value of the property was under discussion for a portion of the time, and it is said that the figures will be completed within a short time. This work is difficult, because of the increased value of all kinds of material that goes into the makeup of railroads. Copper, steel, electrical machinery and ties have all advanced materially since the greater part of the plant was built, as well as labor. The real estate owned by the company is also much more valuable than when it was first purchased. All these things must be taken into consideration in making up the estimates.

In order to get at a fair valuation of the properties of the company, a prominent real estate man and a contractor, just as able and reliable, have been calld into the case. They will go over all the properties owned and report to the two presidents their finding. Of course, no one is bound by this finding, but at the same time, it is believed that it will aid materially in settling the values.

A report was in circulation during the week that Mayor Johnson would be unwilling to accept a franchise for the Municipal Traction Company that would not allow it to increase the rate of fare above 3 cents in case experience proves that the system cannot be operated at that rate. This report has not been confirmed. It is thought that the Cleveland Electric would not lease its lines unless the rate be made ironclad at 3 cents, although certain conditions might be incorporated that would make it possible to accept such a contract. While the Mayor says that Mr. Dupont has a free hand in these negotiations, the finding will be approved by the Council and by himself if they are satisfactory or disapproved if not.

Nothing has been made public as to the arrangements for the maintenance of the properties or as to who will be the judge as to whether they are being kept up properly in case of a lease. It is believed that no railroad company would be willing to turn its property over to a holding company without reasonable security in this respect, and some provision for deciding without recourse to legal proceedings. A new road entails little cost for maintenance the first two years, but after that the charge becomes heavier all the time and provision must be made for it. Whether the proposed holding company has taken this matter up or not is not known.

Still another point must be settled, and that is as to the corps of department heads and engineers connected with the company. Few companies would be willing to throw out a competent force of men and turn their roads over to others of whom they know nothing. Considerable interest is felt on this point, not only among the men themselves but among outsiders who are following the course of the negotiations.

A prospectus has been issued by the Municipal Traction Company, which states that an issue of Forest City Railway stock will be sold in small lots, as low as $10, the purchasers being given certificates. The issue will be 1000 shares and will sell at par, or $100 a share. The idea is to secure the good will and sympathy of small investors, working men and others who have a little money. The proceeds will be used to purchase new cars and make other improvements. Fred C. Albers will act as trustee for the purchasers and will retain the proxies. No one can purchase more than $30 worth of the issue, according to the rule that has been fixed.

The City Council has extended the time of Secretary H. J. Davies, of the Cleveland Electric, and A. B. DuPont, of the Municipal Traction Company, one week to make their report on the amount the Cleveland Electric owes the city for the use of the streets. Both men have been busy with the holding company work, Mr. DuPont, in negotiating, and Mr. Davies, in furnishing data.

A report has been current the past week that if the holding company succeeds in leasing the Cleveland Electric properties, the 3-cent fares will be good only within the city limits, and the old rate will be charged the suburban towns. It is understood that the franchises of the Cleveland Electric in some of the villages, at least, provide that any rate that may be adopted in the city applies also to them. It would seem that this would make it imperative for any leasing company to charge a single fare between points.

PRIVATE CAR JOSEPHINE MAKES A FAST RUN BETWEEN CLEVELAND AND INDIANAPOLIS

The trip of the private car, Josephine, of the Lake Shore Electric, to Indianapolis and return last week, is probably the longest ever made by a trolley car. The distance is, approximately, 300 miles. The average speed for the entire route was about 30 miles per hour, but in places the car was speeded up to 60 miles an hour. The trip, however, was made on the regular limited schedules over the roads that were used. The route was by way of Lima, Fort Wayne and Wabash to Indianapolis, and the return was made over the Indiana Union and Schoepf lines to Dayton, thence to Toledo over the Western Ohio through-route, and to Cleveland over the Lake Shore. On the return trip the car left Indianapolis Friday morning, at 7 o'clock, and would have arrived at Toledo at midnight had it not been for the stops made at different points. The trip from Toledo to Cleveland was made in 4 hours, the regular running time that will be fixed for the limiteds a little later on. The car bore a party of trolley officials from Cleveland, from the various roads that center in that city.

B. R. T. EXTENDING ITS KENT AVENUE POWER PLANT

The Brooklyn Rapid Transit Company has just disclosed its plans for enlarging its Williamsburg power station structure to accommodate the turbo units recently contracted for. Several years ago the company arranged for land adjoining its Kent Avenue plant, and planned for the ground a structure to be built in sections as demands required. Shortly thereafter work was begun on the first section of this plant to cover half the property, and a few months ago the equipment was installed and the plant placed in operation. The new building now proposed and in which the new equipment previously referred to will be installed, will cover the remainder of the plot. The dimensions of the new half will be about 200 ft. by 130 ft., and like its forerunner, the structure will rise to the full height of a ten-story building. Together with the half already completed and now in partial use, the new addition will cover a tract 200 ft. x 260 ft. and cost $5,500,000. The new power house adjoins the south wall of the old Eastern station, built by the old Brooklyn City Railroad. The first half of the Williamsburg station was built on the Kent Avenue side of the property. The second half will be built to the west, and close up upon the company's dockage. The temporary west wall of the present structure will be torn out and the engine room will be doubled in size. Similarly the two boiler rooms, the one imposed above the other, will be increased in dimensions and thirty-six new boilers of the improved water-tube type will be added to the thirty-six similar boilers already in service. There will be four tiers of offices along the Kent Avenue frontage of the engine room. These will be reached by plunger electric elevator.

INAUGURAL BANQUET OF THE EXPOSITION OF SAFETY APPLIANCES

The first international exposition of safety appliances and industrial hygiene, which is being held at the American Museum of Natural History, in New York, was inaugurated by a dinner at the Waldorf-Astoria, Jan. 28. Hon. Chas. E. Hughes, Governor of New York, was the guest of honor, and thoroughly endorsed the plans of the American Institute of Social Service, under whose auspices the exposition is being conducted. Other speakers included the Italian Ambassador, Chas. Stewart Smith, Carroll D. Wright and W. H. Tolman. The latter gave some particulars of other museums of this character, which are conducted with governmental assistance abroad. A letter was also received from President Roosevelt, commending the American Institute of Social Service, under whose auspices the exposition is being conducted, for initiating the work in this country. The exhibition will remain open for two weeks, but it is hoped to form a nucleus for a permanent museum of this character.

THE FLOOD AT CINCINNATI—INGENIOUS SCHEME FOR OPERATING CARS

High water, which prevailed for the greater part of last week in Cincinnati, interfered with many of the traction lines entering the city as well as the street railway lines. In some sections of the city the tracks were abandoned for several days, while cars especially arranged for high water made their way over other streets as frequently as possible. The bodies of these cars were elevated by placing ties on the top of the trucks and bolting all together. They served their purposes well, although they were not able to accommodate the people desiring transportation. At Eighth Street and McLean Avenue a bridge was built across the back water. At Dodsworth Avenue the water was more than 6 ft. over the tracks, and passengers had to be ferried across. In many other places traffic was either suspended or badly crippled. Lines crossing the river to Newport, Covington and Dayton were also crippled badly, and for a portion of the time Dayton could not be reached. On all the local lines transfers on transfers were given during the flood, in order to aid people as much as possible, and then many were compelled to walk from one line to another or to connecting cars, often several squares distant. The Cincinnati, Lawrenceburg & Aurora suffered severely, and traffic was almost suspended over the entire line for a time. When it began operations it was in a section where the water was not over the road. Great care has had to be exercised in watching the tracks, bridges and trestles to see that they are not damaged sufficiently to be dangerous. Some of the trestles were weighted down to hold them in place.

McDONALD SUBWAY PLAN FOR NEW YORK APPROVED

The Board of Estimate, of New York, on Thursday, Jan. 24, approved the so-called McDonald plan for a subway loop between the Brooklyn and the Williamsburg bridges, deciding upon a four-track road instead of a two-track road and agreeing to leave the question of leasing until the construction work has been completed. It is estimated that the road will take two and a half years to build, and that it will cost approximately $5,250,000.

While no action was taken on the leasing, there is a distinct sentiment in favor of not giving exclusive operating privileges to any company, but holding the loop open to the cars or trains of all companies on payment of a certain rental and under specified conditions. If this plan is carried out the loop will remain practically under the control and supervision of the city authorities, and the trains of the Brooklyn Rapid Transit Company will run across the bridges and round the loop back to Brooklyn, while, should an agreement also be made with the Interborough, the trains of that company would also run round the loop, and thus carry passengers from the furthest parts of Manhattan to such sections of Brooklyn as the loop system will reach. It also would be possible for a third independent company to operate loop trains exclusively.

The action of the board was taken after Engineer Nelson P. Lewis had made his report favoring the plan generally, as outlined in a communication from the Rapid Transit Commission. As proposed, the line will run from the Manhattan end of the Williamsburg Bridge through Delancey Street and its contemplated extension to Centre Street, under Centre Street to the Brooklyn Bridge terminal at Park Row, with a spur running through Canal Street to the Manhattan Bridge. The whole plan includes also a spur running down Nassau Street to the financial district, but there is some doubt as to whether this will be built, as it would interfere with the proposed subway under Third Avenue. In Brooklyn the line will run through Broadway to Lafayette Avenue and thence under that street to the extension of the Manhattan Bridge approach.

REPORT BEING PREPARED ON PLAN FOR BETTERING TRAFFIC FACILITIES IN PHILADELPHIA

Following the request of the directors of the Philadelphia Rapid Transit Company that the Trades Leagle prepare suggestions as the basis of a plan for the solution of the passenger transportation question, the street-car service committee of that body has commenced work upon the proposition. The suggestions which they will prepare will include all feasible points of the plans already presented. The members of the committee hope to be ready to report at least by the time the directors of the Trades League meet on Feb. 14. If work of the committee is in shape before that, a special meeting of the directors will be called. With the approval of that body the suggestions will be submitted to the Transit Company.

CAPITAL TRACTION ANNUAL REPORT

The report of the Capital Traction Company, of Washington, D. C., for the year ended Dec. 31, 1906, shows as follows:

GROSS EARNINGS FROM OPERATION		
Receipts from passengers	$1,704,221.82	
Freight	1,338.00	
Mail	2,903.28	
		$1,708,463.10
Less operating expenses (including taxes; 47.019 per cent of passenger receipts)		801,314.09
Net earnings from operation		$907,149.01
INCOME FROM OTHER SOURCES		
Advertising	$9,000.00	
Rent from land and buildings	7,927.26	
Sale of tickets	1,659.18	
Miscellaneous income	4.29	
		18,590.73
Gross income less operating expenses		$925,739.74
DEDUCTIONS FROM INCOME		
Interest	$43,200.00	
Dividends	720,000.00	
		763,200.00
Net income from all sources		$162,539 74
Add:		
Income from securities owned by insurance reserve		4,280.00
Bills payable		405,000.00
Balance, Jan. 1, 1906		32,670.31
		$604,490.05
LESS EXPENDITURES FOR		
Construction and equipment	$66,234.20	
Extension account	497,618.79	
Insurance reserve	4,227.50	
		568,080.49
Balance, Dec. 31, 1906		$36,409.56

The Tecumseh-Norman Traction Company, of Tecumseh, Okla., will begin construction work as soon as the line has been finally laid out. The power station will be located midway between Norman and Tecumseh. The company will operate a park or parks, but has not determined its policy in this respect. The officers of the company are: W. E. Powell, president; E. J. Dickeson, vice-president; George Weed, secretary; M. H. Tennison, treasurer and financial agent; J. H. Surber, superintendent, all of Tecumseh.

LANCASTER PROPERTIES SOLD

What is regarded as the initiatory steps toward the acquirement of existing electric railway systems necessary to a complete line between this city and Philadelphia was the consummation on Jan. 25 at Lancaster of a deal transferring the electric railway and lighting properties of the Lancaster County Railway & Light Company to interests closely identified with the McCall's Ferry Power Company and the Pennsylvania Railroad Company. The name of the new company will be the Susquehanna Railway & Light Company. The firm that financed the deal are Bertron, Starrs & Griscom, bankers of New York, and financial agents for the McCall's Ferry Power Company. At a meeting, Jan. 25, of the stockholders of the Lancaster County Railway & Light Company, which operates practically all of the trolley lines in Lancaster County, lights Lancaster and Columbia, and furnishes all the electric heat and power used in that county, it was unanimously agreed to accept the New York firm's offer of $100 per share for the common stock, 20,000 shares of which are outstanding, the par value being $50, with the alternative offer of preferred stock in a new company that will be organized, with a bonus of common stock.

PERSONAL MENTION

MR. R. L. HARRISON has been appointed superintendent telegraph and chief dispatcher of the Toledo & Western Railroad.

MR. CHAS E. INGERSOLL has been elected a director of the Lehigh Valley Transit Company, to succeed Mr. Arthur E. Newbold, resigned.

MESSRS. G. S. ACKLEY, president, and E. B. Stone, vice-president of the National Brake Company, of Buffalo, N. Y., are making a trip in Mexico.

MR. E. B. KATTE, chief of electric traction of the New York Central & Hudson River Railroad Company, was married Jan. 26, at Irvington, N. Y., to Miss King.

MESSRS. LATEY & SLATER, the formation of whose firm was recently announced in these columns, have been appointed consulting electrical engineers to the Rapid Transit Commission of the city of New York.

MR. JOHN B. CRAWFORD has resigned as superintendent of the Groton & Stonington Street Railway Company, of Mystic, Conn., to become superintendent of transportation for all the lines of the Ft. Wayne & Wabash Valley Traction Company, with headquarters at Ft. Wayne, Ind., to succeed Mr. C. F. Shelton, resigned.

MR. FREDERICK J. WHITEHEAD has been elected secretary and assistant treasurer of the Washington Railway & Electric Company, of Washington, D. C., to succeed as secretary of the company Mr. James B. Lackey. Mr. Whitehead has been with the company ten years, and is conversant with its history and affairs. In addition to his other duties he will act as head of the claim department.

MR. W. R. DICKEY has been appointed auditor of the Toledo & Western Railroad, in charge of accounting department, vice Mr. C. E. French, resigned. Mr. A. L. Bennett has been appointed trainmaster of the company, in charge of operation of trains, train crews, station agents and the distribution of freight and passenger equipment. Mr. T. U. Franklin has been appointed purchasing and freight claim agent and chief clerk to the president and general manager of the company.

MR. R. W. BROWN has been appointed superintendent of the Adrian Street Railway Company and agent for Toledo & Western Railroad, at Adrian Terminal and Wabash Subway. Mr. Brown will have charge of Toledo & Western trains and crews while on the tracks of the Adrian company. The jurisdiction of Mr. Ira P. Schofield, superintendent motive power and equipment, and Mr. J. S. Deiter, roadmaster of the Toledo & Western, have been extended over the lines of Adrian company.

MR. WILLIAM H. FORSE, JR., assistant treasurer of the Indiana Union Traction Company, has been appointed by President Tingley, of the American Street and Interurban Railway Accountants' Association, chairman of the sub-committee on interurban accounts. Associated with Mr. Forse on this committee will be Mr. A. C. Henry, auditor of the Lake Shore Electric Railway Company, and Mr. A. B. Bierck, auditor of the Long Island Railroad Company. The committee will report at the next convention upon a standard classification for interurban railway accounts.

MR. F. R. NICHOLAS, of Reno, Nev., has been appointed by Gov. John Sparks as State engineer, to succeed Mr. Henry Thurtell, who is to resume his chair as professor of mathematics in the University of Nevada. Mr. Nicholas is at present superintendent of the Reno Traction Company and chief engineer for the Nevada Power, Light & Water Company in Reno. He is also president of the Riverside Park Railroad Company, which intends to build an electric line from Reno to Laughton's Springs.

MR. C. W. CHASE, secretary of the Mobile Light & Railway Company, Mobile, Ala., has resigned to accept a position in Leavenworth, Kan. The employees of the different departments on Jan. 16, presented Mr. Chase with a solid service, consisting of five pieces in a handsome case. Mr. Z. P. Watson has been elected to succeed Mr. Chase. Mr. C. T. N. White-Spunner, who has been with the Mobile Railway & Light Company in different capacities for several years, has been elected treasurer.

MR. THOMAS F. DELANEY has been appointed foreman of the East New York elevated shops of the Brooklyn Rapid Transit Company, succeeding Mr. Ferris A. Overfield, whose resignation is announced elsewhere in this column. Mr. Delaney has been with the Brooklyn Rapid Transit Company for some fourteen years. He has been a foreman of surface car house work for the past seven years, but his wide experience with the company's equipment in general should make him well fitted to take up the elevated railway work at East New York.

MR. H. A. NICHOLL, who was elected president of the Central Electric Railway Association at the meeting of the association last week, is general manager of the Indiana Union Traction Company, embracing more than 250 miles of line. Mr. Nicholl has been engaged in electric railway work for a number of years, but formerly was connected with the Chicago & Northwestern, Yazoo & Mississippi Valley, and Illinois Central Railroads. Previous to his connection with the Indiana Union Traction Company, Mr. Nicholl was general manager of the Cleveland & Southwestern Traction Company. His connection with electric railroading includes terms of service as superintendent with the Rochester Railway Company, and as assistant manager and treasurer with the Ithaca Street Railway, Brush-Swan Electric Light Company, and Cayuga Lake Railway, all of Ithaca and under the same control.

H. A. NICHOLL

MR. FERRIS A. OVERFIELD resigned as general foreman of the East New York elevated shops of the Brooklyn Rapid Transit Company on Feb. 1, to open a general machine business. Mr. Overfield has had a very comprehensive mechanical experience both in and out of the railway field. Previous to entering the employ of the Brooklyn Union Elevated Railroad Company in 1892, as a brakeman, Mr. Overfield was track foreman on the Long Island Railroad, leaving that work to become a stationary engineer, and later to carry on a general blacksmith shop. He remained with the Brooklyn Union only a few months to take up carriage building. In May, 1893, he became a carpenter for the old Brooklyn City Railway, and resigned two years later to do similar work for the New York and Brooklyn Bridge division, on which he later became a motorman and then carpenter foreman. In November, 1901, he was appointed foreman of the bridge shops and advanced to the position of general foreman of the East New York Elevated shops on Oct. 14, 1901, which position he held until the present time. During the period that Mr. Overfield spent at East New York the layout was entirely changed, and the new yards and shops constructed as described in the series of articles beginning in this issue. This reconstruction work gave Mr. Overfield many opportunities to exercise his mechanical ingenuity in working out some of the complicated problems that presented themselves during the transformation. Mr. Overfield leaves the company with the best wishes of his associates for success in his new field.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes. † Deficit.

Company.	Period.	Total Gross Earnings.	Operating Expenses.	Net Earnings.	Deductions From Income.	Net Income, Amount Available for Dividends.
AKRON, O.	1 m., Nov., '06	153,388	99,341	54,047	41,014	13,033
Northern Ohio Tr. &	1 " " '05	118,620	74,340	44,280	39,297	4,983
Light Co.	11 " " '06	1,058,674	588,647	470,026	284,932	185,094
	11 " " '05	964,215	537,676	427,538	285,797	141,742
BINGHAMTON, N. Y.	1 m., Nov., '06	21,634	13,804	7,830	7,711	119
Binghamton Railway	1 " " '05	20,489	11,947	8,541	7,282	1,260
Co.	5 " " '06	138,478	71,388	67,090	38,556	28,534
	5 " " '05	131,072	63,926	67,146	36,128	31,018
CHAMPAIGN, ILL.	1 m., Dec., '06	302,165	*168,779	133,385	......	......
Illinois Traction Co.	1 " " '05	247,449	*126,483	120,965	......	......
	12 " " '06	3,013,108	*1,651,155	1,361,952	......	......
	12 " " '05	2,442,389	*1,294,651	1,147,737	......	......
CHARLESTON, S. C.	1 m., Dec., '06	57,644	37,913	19,731	13,349	6,382
Charleston Consolidated Ry., Gas & Elec.	1 " " '05	54,596	33,371	21,225	13,167	8,059
	10 " " '06	546,579	341,638	204,941	130,349	74,592
Co.	10 " " '05	510,657	304,890	205,767	131,217	74,550
CHICAGO, ILL.	1 m., Nov., '06	96,722	56,817	39,904	26,158	13,746
Aurora, Elgin & Chicago Ry. Co.	1 " " '05	89,415	51,579	37,836	24,450	13,386
	5 " " '06	599,542	306,888	292,654	126,967	165,687
	5 " " '05	540,885	273,666	267,220	122,193	145,027
Chicago & Milwaukee	1 m., Dec., '06	80,615	33,112	47,503	......	......
Elec. R.R. Co.	1 " " '05	66,584	24,199	42,384	......	......
	12 " " '06	884,207	366,397	517,810	......	......
	12 " " '05	594,875	244,552	350,323	......	......
CLEVELAND, O.	1 m., Nov., '06	18,057	11,931	6,127	6,658	†531
Cleveland, Painesville	1 " " '05	20,392	10,841	9,551	7,108	2,442
& Eastern R.R. Co.	11 " " '06	225,248	131,126	94,121	74,031	20,090
	11 " " '05	250,945	134,045	116,900	76,747	40,153
Cleveland & Southwestern Traction Co.	1 m., Dec., '06	52,431	28,895	23,536	16,917	6,619
	1 " " '05	47,540	26,548	20,992	13,955	7,038
	12 " " '06	645,850	363,856	281,994	179,252	102,742
	12 " " '05	543,227	314,254	228,973	152,693	76,280
Lake Shore Electric	1 m., Nov., '06	61,592	35,903	25,690	20,450	5,240
	1 " " '05	61,501	33,992	27,509	20,404	7,105
	11 " " '06	796,128	436,806	359,322	224,653	134,669
	11 " " '05	721,711	393,830	327,881	224,446	103,435
DALLAS, TEX.	1 m., Nov., '06	82,081	*66,150	15,931	15,883	48
Dallas Elec. Corp'n.	1 " " '05	104,111	*52,039	52,072	14,618	37,454
	12 " " '06	1,018,432	*676,495	341,937	184,671	157,266
	12 " " '05	920,051	*565,702	354,349	182,357	171,992
DULUTH, MINN.	1 m., Nov., '06	65,393	41,271	24,122	17,851	6,271
Duluth St. Ry. Co.	1 " " '05	55,154	30,597	24,557	18,171	6,385
	11 " " '06	702,285	377,200	325,085	194,345	130,740
	11 " " '05	602,333	311,906	290,427	188,349	102,078
EL PASO, TEX.	1 m., Nov., '06	35,672	*25,995	9,677	4,067	5,610
El Paso Electric Co.	1 " " '05	25,480	*17,510	7,970	3,823	4,147
	12 " " '06	378,185	*264,040	114,145	46,831	67,314
	12 " " '05	286,116	*188,015	98,101	42,874	55,226
FT. WAYNE, IND.	1 m., Nov., '06	93,143	54,156	38,987	......	......
Ft. Wayne & Wabash	1 " " '05	80,474	46,926	33,548	......	......
Valley Tr. Co.	11 " " '06	1,007,813	618,949	388,864	......	......
	11 " " '05	862,171	530,503	331,668	......	......
FT. WORTH, TEX.	1 m., Nov., '06	67,485	*43,763	23,722	9,942	13,780
Northern Texas Tr. Co	1 " " '05	66,271	*36,247	30,023	9,938	20,086
	12 " " '06	832,681	*535,707	296,975	119,296	177,679
	12 " " '05	658,906	*387,077	271,829	117,372	154,457
GALVESTON, TEX.	1 m., Nov., '06	25,801	*15,149	10,652	4,167	6,485
Galveston Elec. Co.	1 " " '05	22,523	*13,757	8,765	4,167	4,599
	12 " " '06	310,480	*187,969	122,510	50,000	72,510
	12 " " '05	265,940	*184,643	81,297	41,667	39,631
GLENS FALLS, N. Y.	3 m., Dec., '06	123,667	98,378	25,289	49,729	†24,440
Hudson Valley Ry. Co.	3 " " '05	114,045	71,368	42,677	64,218	†21,541
	12 " " '06	599,828	371,721	228,107	235,813	†6,706
	12 " " '05	538,997	320,282	218,715	259,483	†40,768
HANCOCK, MICH.	1 m., Nov., '06	18,545	*11,994	6,552	3,907	2,645
Houghton County St.	1 " " '05	15,215	*11,067	4,148	3,749	400
Ry Co.	12 " " '06	226,125	*146,069	80,056	46,807	33,249
	12 " " '05	167,294	*169,996	†2,703	43,205	†45,907
HOUSTON, TEX.	1 m., Nov., '06	57,105	*35,198	21,907	7,792	14,115
Houston Electric Co.	1 " " '05	52,236	*33,572	18,664	9,049	9,616
	12 " " '06	583,647	*376,667	206,980	94,276	112,704
	12 " " '05	509,008	*307,211	201,796	105,025	96,771
KANSAS CITY, MO.	1 m., Nov., '06	466,220	230,388	235,832	145,529	90,302
Kansas City Ry. & Lt.	1 " " '05	431,486	208,514	222,971	137,299	85,672
Co.	6 " " '06	2,872,989	1,414,620	1,458,369	869,724	588,646
	6 " " '05	2,596,240	1,263,397	1,332,843	820,459	512,383
LONG ISLAND C., N.Y.	3 m., Dec., '06	204,752	149,319	55,433	50,817	4,616
New York & Queens	3 " " '05	188,856	125,501	63,355	50,986	12,369
Co. Ry. Co.	12 " " '06	900,063	601,560	298,503	203,725	94,778
	12 " " '05	795,330	515,445	279,885	204,066	75,819
MANILA, P. I.						
Manila Elec. R.R. &	1 m., Dec., '06	46,500	23,250	23,250	......	......
Ltg. Corp., Ry. Dept.	12 " " '06	513,801	267,674	246,127	......	......
	1 " " '06	85,300	42,233	43,067	......	......
All Depts.	12 " " '06	909,080	464,623	444,457	......	......
MILWAUKEE, WIS.	1 m., Dec., '06	435,006	157,942	277,064	96,874	180,191
Milwaukee Elec. Ry.	1 " " '05	400,905	138,565	262,341	83,087	179,254
& Lt. Co.	12 " " '06	3,679,229	1,734,587	1,944,642	1,073,515	871,127
	12 " " '05	3,348,696	1,551,463	1,797,233	931,016	866,217
Milwaukee Lt., Ht. &	1 m., Dec., '06	86,447	25,035	61,412	28,417	32,995
Tr. Co.	1 " " '05	78,464	19,561	58,903	22,807	36,096
	12 " " '06	733,049	277,416	455,632	324,715	130,917
	12 " " '05	639,128	252,557	386,572	255,314	131,258
MINNEAPOLIS, MINN.	1 m., Nov., '06	458,637	224,969	233,668	117,258	116,410
Twin City R. T. Co.	1 " " '05	417,218	190,360	226,859	113,208	113,650
	11 " " '06	5,149,896	2,402,455	2,747,441	1,236,169	1511272
	11 " " '05	4,320,887	1,961,448	2,359,440	1,113,425	1246015
MONTREAL, CAN.	1 m., Nov., '06	263,260	174,933	88,327	39,276	49,051
Montreal St. Ry. Co.	1 " " '05	232,635	153,628	79,008	22,074	56,933
	2 " " '06	545,083	331,174	213,909	79,886	134,023
	2 " " '05	482,424	295,309	187,115	43,137	143,978
NORFOLK, VA.	1 m., Nov., '06	127,256	74,260	52,996	......	......
Norfolk & Portsmouth	1 " " '05	115,494	65,796	49,697	......	......
Tr. Co.	11 " " '06	1,356,348	837,571	518,777	......	......
	11 " " '05	1,236,644	744,063	492,581	......	......
PHILADELPHIA, PA.	1 m., Dec., '06	234,983	......	......	......	......
American Rys. Co.	1 " " '05	215,308	......	......	......	......
	6 " " '06	1,490,940	......	......	......	......
	6 " " '05	1,358,963	......	......	......	......
PLYMOUTH, MASS.	1 m., Nov., '06	7,215	*5,474	1,740	1,814	†74
Brockton & Plymouth	1 " " '05	6,595	*5,268	1,327	1,828	†501
St. Ry. Co.	12 " " '06	111,109	*70,450	40,660	21,844	18,816
	12 " " '05	101,422	*71,563	29,859	21,346	8,514
ROCHESTER, N. Y.	3 m., Dec., '06	589,695	410,032	179,663	101,770	77,893
Rochester Ry. Co.	3 " " '05	499,539	300,389	199,150	92,237	106,913
	12 " " '06	2,280,452	1,418,613	861,839	402,665	459,174
	12 " " '05	1,930,880	1,079,009	851,879	369,316	482,563
ST. LOUIS, MO.	1 m., Dec., '06	782,515	*463,591	318,924	198,026	120,898
United Railways Co.	1 " " '05	730,462	*428,522	301,940	198,609	103,331
of St. Louis	12 " " '06	9,146,348	*5,567,412	3,578,936	2,377,476	1201460
	12 " " '05	8,460,016	*5,318,369	3,141,647	2,387,915	753,732
SAVANNAH, GA.	1 m., Nov., '06	45,049	*32,594	12,455	11,300	1,155
Savannah Electric Co.	1 " " '05	50,420	*28,413	22,007	11,155	10,852
	12 " " '06	616,706	*383,736	232,970	134,065	98,905
	12 " " '05	580,544	*343,357	237,187	127,342	109,845
SYRACUSE, N. Y.	1 m., Dec., '06	104,816	63,807	41,009	24,358	16,651
Syracuse R. T. Co.	1 " " '05	90,953	50,982	39,971	20,723	19,248
	12 " " '06	1,099,762	853,016	246,746	279,915	187,372
	12 " " '05	964,233	736,704	227,529	245,358	170,157
TAMPA, FLA.	1 m., Nov., '06	48,791	*28,355	20,436	452	19,984
Tampa Elec. Co.	1 " " '05	45,108	*24,210	20,899	1,894	19,004
	12 " " '06	465,414	*271,821	193,593	1,695	191,898
	12 " " '05	408,063	*237,085	170,979	22,714	148,264
TERRE HAUTE, IND.	1 m., Nov., '06	75,437	*43,899	31,538	13,596	17,942
Terre Haute Tr. & Lt.	1 " " '05	55,459	*33,883	21,576	10,429	11,147
Co.	12 " " '06	800,954	*464,696	336,258	157,158	179,100
	12 " " '05	620,768	*407,350	213,418	120,652	92,766
TOLEDO, O.	1 m., Nov., '06	172,728	*94,521	78,207	42,845	35,362
Toledo Rys. & Lt. Co.	1 " " '05	164,418	*86,389	78,029	42,825	35,204
	11 " " '06	1,860,762	*977,209	883,553	466,807	416,746
	11 " " '05	1,737,711	*888,296	849,415	467,846	381,569
WASHINGTON, D. C.	1 m., Dec., '06	18,460	11,197	7,262	......	......
Wash. Alexandria &	1 " " '05	20,529	11,880	8,649	......	......
Mt. Vernon Ry. Co.	12 " " '06	273,267	147,849	125,418	......	......
	12 " " '05	251,643	135,022	116,623	......	......