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Of this issue of the Street Railway Journal 10,000 *copies are printed. Total circulation for* 1907 *to date,* 338,050 *copies, an average of* 8245 *copies per week.*

Our Convention Issue

The STREET RAILWAY JOURNAL this week issues its annual convention number. The practice of publishing a special number just before the fall meeting of the American Street Railway Association, now the Interurban Railway Association as well, has been followed practically since this paper was established, and amounts to the presentation each year to each subscriber of a treatise on some distinctive branch of electric railway engineering. These convention issues are as voluminous as many books on electric railway subjects, but they differ in subject matter from the average engineering text-book, because they are part of a periodical; hence they are compiled from a journalistic standpoint, the basis for which is "news." For this reason each of our convention issues represents matter compiled during the previous few months, and the articles printed discuss current practice. In many respects this makes them more valuable for the active railroad operator or engineer than if the subjects were treated from the standpoint of a text-book and each subject was considered *ab initio.*

Each year the convention number of the STREET RAILWAY JOURNAL is planned along some central idea and it has been the purpose of the editors to select a topic for discussion which is particularly prominent at the time in the electric railway engineering field. Last year, as the convention was held in Columbus, great interest was felt in the development of the interurban railways in that portion of the country; hence the convention number of 1906 was devoted to a review of interurban electric railway practice in Ohio and Indiana. This year the attention of electrical engineers and railroad operators has been attracted in a marked degree to the equipment with electricity of the steam railroads of the country. No other topic has drawn such large audiences to meetings of the American Institute of Electrical Engineers, the Western Society of Engineers, the New York Railroad Club and other technical bodies where papers on this subject have been presented. Discussions on the relative merits of steam and electric power for trunk line service, of direct current and alternating current for electric railway properties, of 600 volts and 1200 volts in direct current working and of 25 cycles and 15 cycles for single-phase roads, have occupied the columns of the technical papers and the attention of scientific and engineering societies. During the past year, also, practically all of the more important installations of this kind, with the exception of the Long Island Railroad, have been put in operation. The New York Central equipment commenced a partial service Nov. 11, 1906, but steam was not entirely abandoned until July 1 last. The West Shore Railroad was officially opened June 15, and the electrified section of the Erie Railroad June 18. The New Haven service commenced July 24. The West Jersey & Seashore was officially opened Sept. 18, 1906, but as the Atlantic City season was practically over by that time the real test came during the summer which has just passed.

It has been thought from these facts that an analysis of the electric railway practice of these different companies would be particularly appropriate at this time, especially as practically nothing has yet been published on the subject.

Articles on the construction of these lines have appeared in this paper, as well as elsewhere, so that engineers are well acquainted with the engineering features of the installations as they were originally. Some changes have been made, however, since the lines were placed in operation, and these, with the method of handling the apparatus by the officials in charge, it is the purpose of this number to describe.

In most cases the electrical equipment of the lines under discussion has been carried out by engineers who received their training in the street railway field, so that the methods followed have differed little, except in degree, from those employed in the lighter railway installations with which our readers are familiar. The operation of the lines, however, has in most cases been in the hands of men trained along steam railroad lines, and they have naturally introduced methods which differ somewhat from those followed on the larger interurban railway properties. The conditions under which the service is conducted also vary from those of interurban electric railway practice, so that the exposition published elsewhere of the details followed by the different roads should prove of value to both steam and electric railway managers.

In our treatment of the subject it has been impossible to cover all branches of the work, or to describe all of the methods employed even in those branches selected for discussion, or to reproduce all of the blanks used even in these branches. Owing, also, to the comparatively recent date at which most of the installations have been put in service, reliable figures on the cost of operation could not be obtained and the managements of the different systems have naturally been unwilling to present figures which, while correct for the period during which the lines have been in service, might give a wrong impression as to future economies. Nevertheless, the articles indicate that the electric system is considered satisfactory by those roads which have adopted it and that the sections put in operation are looked upon by the different managements as precursors only to the wider application of electric power on their systems.

In conclusion an extended article by Philip Dawson describes some of the recent work in Europe and calls attention to the attitude which the railroad authorities in the different countries are now taking toward the introduction of electric power on their steam railroad systems. Outside of Great Britain, the railroads, in the countries considered, are in the hands of the Government, whereby a uniform treatment of the subject is assured. Mr. Dawson is an advocate of the single-phase system for trunk line conditions and his citations of the favor with which this system is regarded by the government authorities in Sweden, Germany, Switzerland and Italy, and his remarks about its adoption by several of the large railroad companies in England, should prove of particular interest.

With our Convention Section, we also issue a Second Section, similar in typographical appearance to our standard issues. This number will also be found replete with interest. The electrical equipment of the Rochester-Mt. Morris branch of the Erie Railroad has not been described in any of the technical papers, so that while a chapter on the subject of its operation is published in our convention section this week, another and much longer article on the constructional features of the line appears as the leading feature of this issue, and comments upon this line appear in the following editorial. In this section, also, Mr. French, engineer of maintenance of way, of the Utica & Mohawk Valley Railway, presents an instructive discussion of steel tie and concrete construction. The practice of the Indianapolis & Cincinnati Traction Company, the pioneer user on a large scale of single-phase motors, has been brought up to date. An account is given of a test of a 7500-kw turbine in New York, and other articles of interest will also be found within the covers of this section.

Single-Phase Traction on the Erie

The "electrification" of the Rochester Division of the Erie Railroad, described elsewhere in our columns by W. N. Smith, has a double interest in that the line in question is not only the first to use single-phase motors in regular railway traffic, but also utilizes for this work power transmitted at 60,000 volts from Niagara. It is the first fruit of the great cataract in the larger work of transportation. By a combination of energy and good fortune, too, the road went into operation some months ahead of the electric system of the N. Y., N. H. & H. R. R., on which work had been long in progress. It is a capital example of the easy applicability of single-phase high voltage traction to existing steam roads, leaving the freight service undisturbed, to be taken up later if desirable. The system involves many novelties and many very ingenious features of construction. To begin with the high-tension transmission line, one finds here an unusual type of construction, forming an ingenious compromise between the ordinary pole line and the tower system which has of late come into extensive use. It employs an A frame for the support of the wires, composed of two heavy cypress poles united at the top. In virtue of the extra support thus given the normal span is lengthened to 220 ft., thus greatly decreasing the number of insulators.

The lightning protection is also out of the ordinary, horn arresters being installed at every fifth pole. It is of course early to speak of the efficiency of this particular feature, but the horn arrester, although somewhat insensitive, has given a good account of itself on some of the important lines on the Pacific Coast and requires little attention, a great virtue in case of its use on pole lines. At the sub-station the lightning protection is more elaborate, consisting of three horn arresters in series, grounded respectively through a concrete column, an electrolytic arrester and a copper fuse wire. The special feature of the sub-station arrangements is the ingenious utilization of the three-phase-two-phase transformation, the two resultant single-phase currents being transmitted over the two nearly equal sections of the road to the north and south of the sub-station respectively. The actual working conductors thus fed are of No. 000 ground copper, carried by a catenary bracket construction. An interesting feature of this is that each steel bracket is permanently grounded to the rails, so that the failure of an insulator means a dead short circuit, the intention being to avoid any danger of poles burning off and obstructing traffic in case of a partial ground. Another safety precaution adopted is the abolition of practically all telegraph and telephone wire overhead crossings, such wires being taken under the track by cables. In a few cases, to which cables could not be conveniently applied, a basket

construction of guard wires has been used to obviate any chance of crosses with the high-tension trolley wire.

On the motor car the equipment consists of four 100-hp motors with Westinghouse electro-pneumatic control. Many ingenious details have been here introduced to provide for safe and certain operation. The service undertaken over the 34-mile line is based on the use of motor cars capable of handling a single trailer when desirable, at an average schedule speed of 24 miles per hour. There are 6 regular stations on the line and 22 flag stations, at some or all of which stops are to be made, so that to maintain schedule a flexible speed control such as this system furnishes is highly important. Experience has already shown that the electric trains can be made to hold the schedule rather better than the steam trains which they have supplanted. The operation of the four classes of trains employed, viz., electric, steam passenger, through freight and local freight, over a single-track road such as the Rochester branch is, involved some complications, but these have been successfully overcome.

Of the technical problems arising for solution in this plant one of the most serious was the interference produced by the current upon telegraph and telephone lines in the vicinity. On an ordinary transmission line such trouble is not formidable, for by proper transposition the inductive effects can be reduced to comparative insignificance. On this single-phase system with track return, kept in electrical instability by the shifting of the load both the electro-dynamic and electro-static effects were very noticeable, especially the latter. No suitable means of eliminating the trouble by working upon the line itself was found, but it did prove practicable to remove the baleful influence by providing the telegraph relays with fairly high resistance discharging shunts. This obviated the necessity of complete metallic circuits for the telegraph service. Such circuits are now in general use for telephone work, and if properly installed give good service, even in proximity to a single-phase line. This result is very satisfactory, since the question of interference from such systems has been a matter of no small concern. Altogether the engineering work on this Rochester division of the Erie seems to have given suitable solutions for a good many of the practical problems of single-phase teaching, and will probably lead to a freer use of the system than has heretofore been judged discreet.

Even Shifts in Power Plants

One of the first questions to be settled when a new power plant approaches completion is whether the operating shifts shall overlap or be evenly divided in respect to the assignment of working hours among employees. In some plants there is a complete change of men at the conclusion of every trick; in others part of the men leave at one time and the rest are retained until the newcomers have been at work for a longer or shorter period. There is certainly something to be said in behalf of each policy.

The plant with the complete or even shift, say of eight hours' watch, has the advantage of a certain solidarity in each of the three tricks which make up the day's run. The men on each trick grow to learn each other's ways, and if good team work is ever possible in a power plant, it ought to result from the even shift. If any of the watches are longer than eight hours in duration some of the others must be shorter, except in the case of two twelve-hour shifts per day. Overlapping tends to do away with rivalry as to records of fuel consumption. With uneven shifts, a man will each day be responsible to two different boiler or engine room foremen, which is in some cases a disadvantage on the purely personal side. It may seem ludicrous to some managers to think of consulting the personal whims of subordinate power-house employees in arranging shifts, but the fact remains that some men in a plant may get along finely with one chief on the watch, and from one cause or another fail utterly to satisfy a second superior, perhaps through temperamental differences. Theoretically all men in the employ of a just and liberal company ought to work together in harmony; practically there are great differences in the esprit-de-corps under different executives, and the even shift plan favors the coalescing of congenial elements into each watch, either through original appointment or transfer.

A clean sweep of employees as a shift changes cannot of course be made with respect to the men whose duties are not duplicated. The chief engineer of a plant is responsible for the station as a whole, in most cases throughout the twenty-four hours, so far as any foreseen routine or emergency work goes. Certain other men, like battery attendants, clerks, and repair men in the larger stations may be on duty during the day only, and these may overlap more or less without trouble. But employees like watch engineers, oilers, pump men, water tenders, firemen, coal passers, and helpers can, as a rule, be shifted together if the station routine is properly planned, with the advantage of concentrated authority and team work, and, in some cases, friendly rivalry to produce good records.

Advocates of the overlapping shift urge that if the entire boiler, engine and pump room force changes as one man, the station is liable to lose its best grip upon the load conditions obtaining at the time of transfer. They also claim that the variation of the load at different times of the day and the responsibility attending the occurrence of the morning and evening peaks demand the retention of the best men in rush hour periods. They emphasize the economy of the overlap contrasted with the employment of uniform shifts containing possibly more men in toto than would be needed if the shifts were not co-terminous.

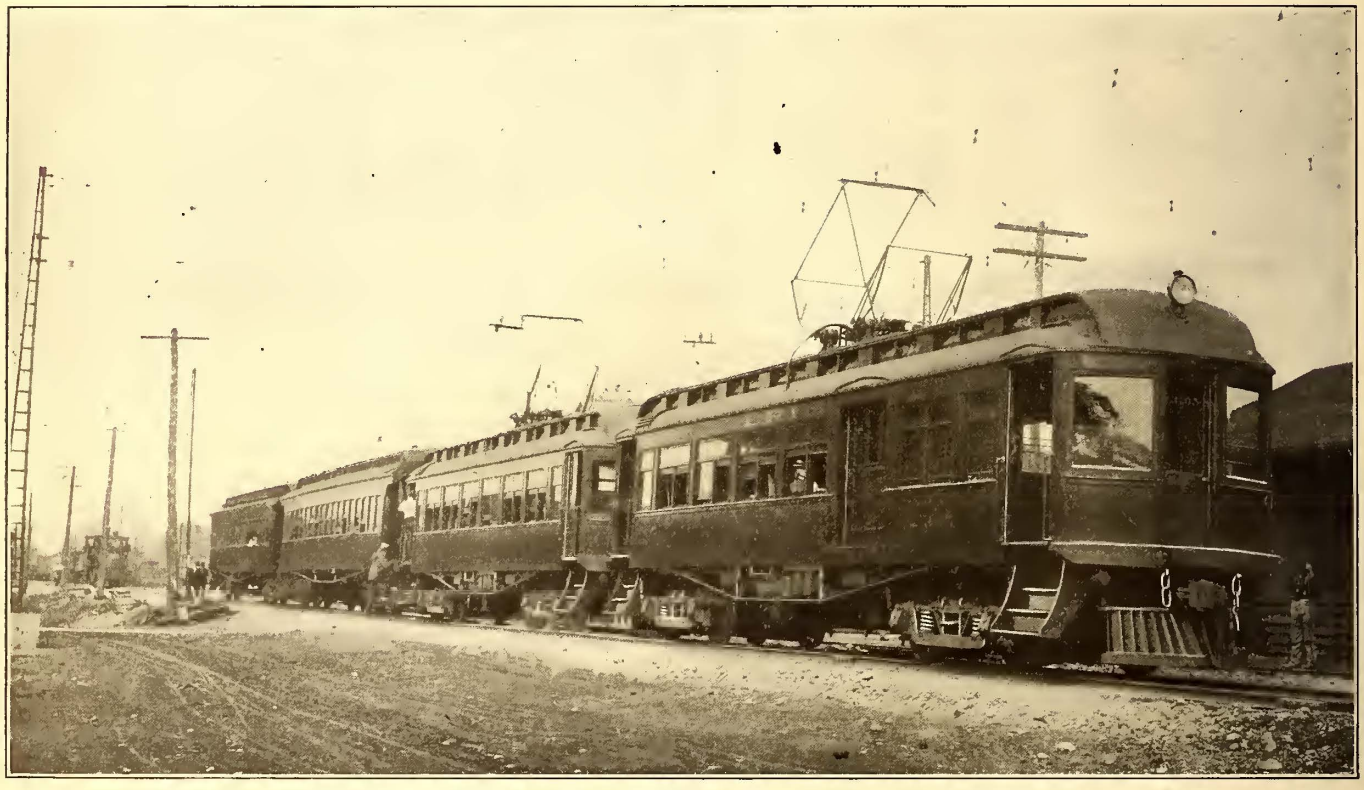
Each plant must be considered by itself in the face of these points, and before any general decision can be reached for varied cases, we must have a more definite knowledge of the exact number of men required in relation to the number of machines in service and the load variations. Where exacting twenty-four-hour service is required, the even shift is likely to prove attractive, as in the case of an electrified steam railroad which handles a very large distributed traffic. If the morning and evening peaks are excessive, requiring many more men in the boiler and engine rooms, the overlap may pay better. Usually, then, it is a question of local conditions as to which plan should be adopted. The main point is to insure that the existing operating conditions are made clear to all successors of retiring employees, and to harmonize the work as much as possible. The matter is well worth considering in relation to the personal equation.

SINGLE-PHASE ELECTRIC MOTIVE POWER ON THE ROCHESTER DIVISION OF THE ERIE RAILROAD

By W. N. Smith.

One of the most important electric railway developments of the present year is the change from steam to electric motive power on a portion of the Rochester Division of the Erie Railroad, which took place on June 18, 1907. This is the first installation of a single-phase alternating system of electrical motive power upon a steam railroad, to go into commercial operation.

The Erie electrification can justly claim the priority of application of several important features which are of interest in connection with the discussion now prevailing upon systems best suited for steam railroad electrification. This line was the first in this country to operate electric cars on the single-phase system over the tracks of an operating steam railroad; the first in this country to use 11,000 volts working pressure commercially on a trolley, and the first instance of a single-phase traction system receiving power from a 60,000-volt transmission line.



FOUR-CAR ELECTRIC TRAIN ON ERIE SINGLE-PHASE RAILWAY

All of the construction described below, except that of the 60,000-volt power transmission line and the car bodies and trucks, was designed, executed and placed in operative condition by Westinghouse, Church, Kerr & Company, engineers, through whose courtesy the drawings and photographs were furnished which illustrate this article.

The section of track equipped is 34 miles long, extending from Rochester, over the main line of the Rochester Division, to Avon, a distance of about 19 miles, thence 15 miles over the Mt. Morris Branch. The railroad is entirely single-track, with sidings at way stations, averaging 3 to 4 miles apart. The grades are light, and the curvature for the most part quite easy, the line being relatively quite straight.

The track was originally laid with 68-lb. rails, but was relaid with 80-lb. rail, taken from another division just prior to the electrification. The road-bed is ballasted with gravel, and the joints are of the Weber type. A single No. 00 protected rail bond is applied to each rail joint under the plate, one of the advantages of the high-tension single-phase system being that the relatively small current combined with the high impedance of the main circuit renders it unnecessary to resort to heavy bonding.

The line crosses a number of bridges, the longest one, that over the Genesee River, about 1½ miles south of Rochester, being 780 ft. long and comprising seven spans. There are also through truss bridges at Rush, and at Caneserauga Creek, near Mt. Morris, and a stone arch bridge over Conesus Creek, a short distance south of Avon.

The electric service is devoted solely to passenger traffic, which is of the local interurban type. The freight service is handled exclusively by steam as heretofore, as are also the through trains operating between Rochester and Corning over the main line of the Rochester Division, a distance of about 94 miles. The steam service between Rochester and Mt. Morris originally comprised three round trips daily. The principal villages served are Avon, Geneseo and Mt. Morris, the other regular way stations being little else than cross-road stops. The population is entirely agricultural, and the Genesee Valley traversed by this line is probably one of the most beautiful and prosperous farming regions of New York State. Instead of three round trips per day, the electric service has introduced six complete round trips between Rochester and Mt. Morris, and three more between Avon and Mt. Morris.

POWER SUPPLY.

The power is generated at Niagara Falls, in the plant of the Ontario Power Company, and is transmitted at 60,000 volts, three-phase, over the lines of the Niagara, Lockport & Ontario Power Company, whose system has been fully described in former technical papers. The Iroquois Construction Company built a branch line from Mortimer, a little over 4 miles south of Rochester, to Avon, locating it

upon the Erie Railroad right of way for nearly the whole distance. The pole construction used upon this branch transmission line is of the A-frame type, using two 40-ft. cypress poles, set abreast of each other, and inclined so that their tops are framed together, the butts being joined by horizontal plank braces underground. The cross-arms consist of two 3½-in. x 6-in. timbers, 8 ft. long. The insulator pins are of cast steel, one being placed at the apex of the A-frame, and the other two bolted near the extremities of the cross-arms, so that there is an equilateral spacing of 7 ft. between each of the three wires. The insulator pins are grounded by copper wire. The neutral of the transmission system is grounded at the power station through a resistance. Lightning protection of the horn arrester type has been installed at every fifth pole. The conductors are of No. 4, hard-drawn, stranded copper cable. The standard length of span between poles is 220 ft., which is shortened at curves where necessary. When crossing over the tracks of the Erie, or other railroads, recourse is had to a special construction of No. 0 copper cables carried on steel towers, so reinforced by guys that it is impossible for a failure of the line to result in dropping the conductors across railroad tracks.

PASSENGER TRAIN SHED, ROCHESTER TERMINAL, SHOWING OVERHEAD CONSTRUCTION

SUB-STATION BUILDING.

The sub-station building is located in the Y formed by the railroad tracks at Avon, and together with the car shed, is adjacent to the roundhouse and division repair shop. The walls of the building are of brick, resting upon solid concrete foundations, the roof and floors being of reinforced concrete. The floors are supported upon steel beams, but the roof beams are of reinforced concrete, like the slabs which they support.

The building is absolutely fireproof, the doors and windows being of kalomein construction, and fitted with wire glass. The building is 39 ft. 8 ins. x 44 ft. on the outside and 29 ft. 10 ins. high from the top of the foundation to the top of the parapet. The door sills and lintels are of concrete blocks, and for architectural effect a belt of concrete blocks runs around the building, at the level of the window sills. The parapet is also topped off with a coping of concrete blocks.

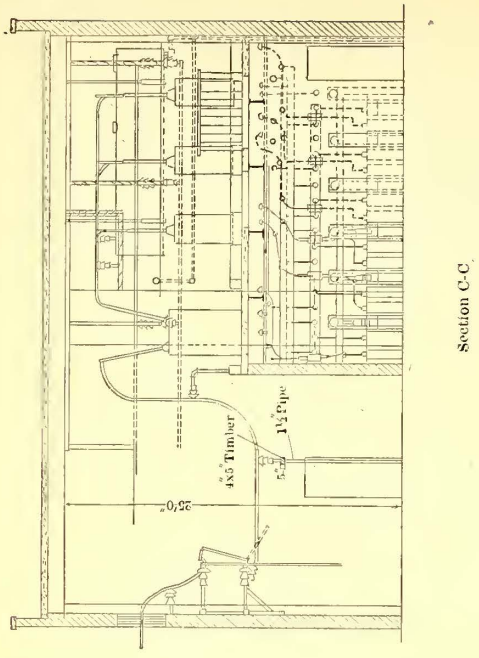
In the basement of the building are located one of the transformer oil tanks and the oil pump. The main floor is divided into three rooms, the main transformer room being 43 ft. x 17 ft., and extending the full height of the structure to allow room for the high-tension bus-bars, which are carried over the transformers. The remaining space on the main floor is divided into a high-tension room (through which the 60,000-volt wires enter, and which is the location of the high-tension circuit breakers, 16 ft. 8 ins. x 19 ft. 8 ins.) and the operating room, which is 19 ft. 8 ins. x 24 ft., where all the 11,000-volt switching apparatus and the measuring instruments are located. Directly over the operating room is a mezzanine floor, reached by an iron staircase, in which are located the 11,000-volt lightning arresters, the 60,000-volt choke coils and the 60,000-volt series coils. The high-tension connections enter through the high-tension room, which runs from floor to roof and pass through the choke coils and series coil, on the mezzanine floor, and then turn through a wide opening in the wall to the 60,000-volt bus-bars, which are located in the upper portion of the transformer room.

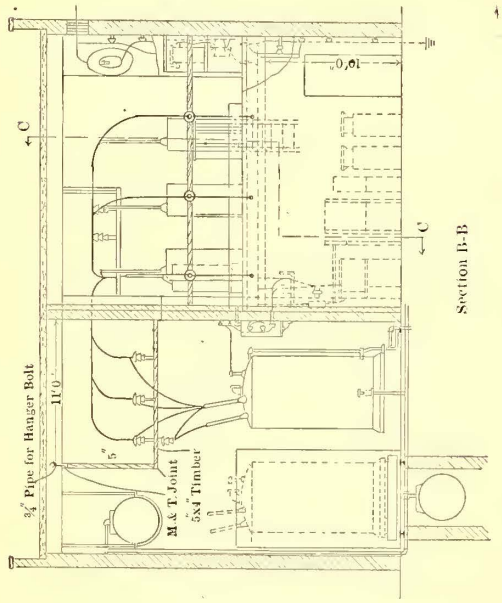
There is space in the transformer room for another transformer of the same size and there is also space in the high-tension room for an oil-insulated circuit breaker should it ever be decided necessary. The interior is painted with cold-water paint of the same light green shade that is commonly used by the Erie Railroad for interior finish.

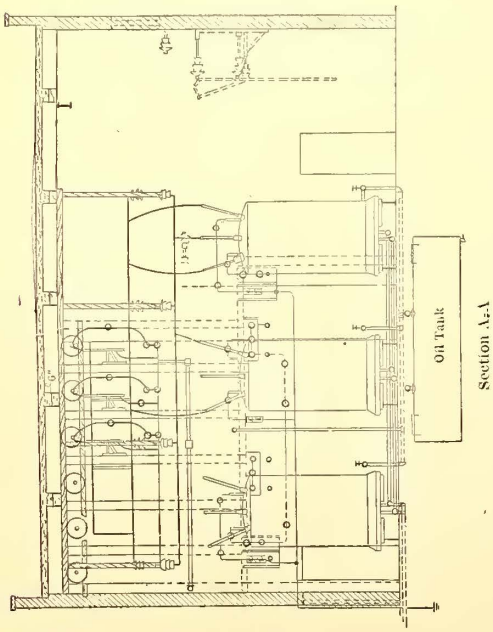
The interior lighting equipment consists of forty-seven 16-cp incandescent lamps. Heat is supplied by a simple system of Colonial wall-type steam radiators, supplied by steam from the locomotive roundhouse.

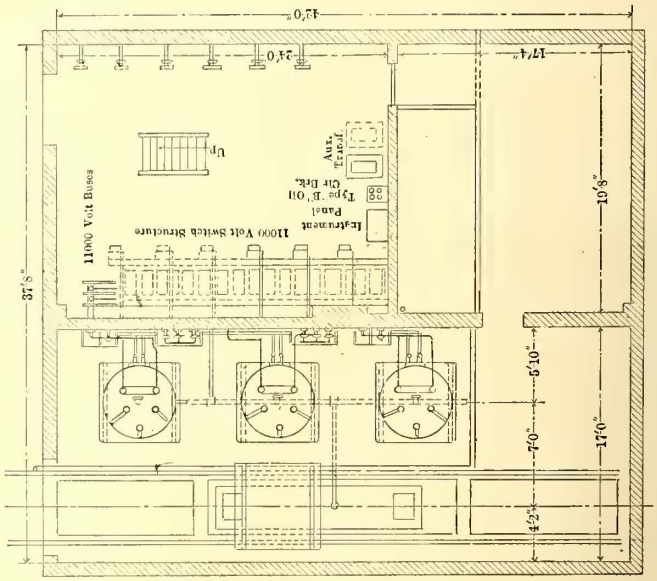
SUB-STATION EQUIPMENT.

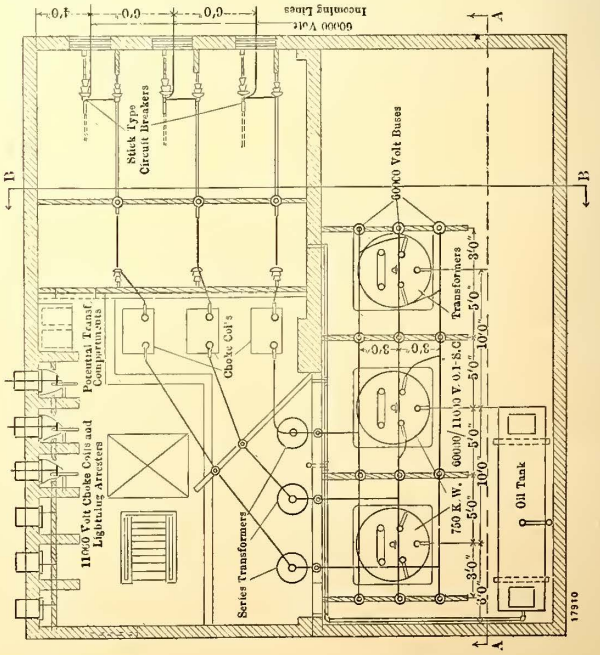
The transmission line terminates at the lightning arrester yard in the rear of the sub-station. The arrangement of the 60,000-volt lightning arresters consists of three horn gaps, arranged one behind the other, on each of the three conductors, the first gap being 4¾-ins. across, the second 5, and the third 6 ins. A concrete column is in series with the first gap, an electrolytic arrester in series with the second and a 5-ft. fuse of No. 18 copper wire in series with the third; that is to say, between one horn and the ground. Both horns of each gap are of ½-in. round iron. Between the line and the first arrester there is a hook-type knife switch, and between the last arrester and the lead into the sub-station, there is a No. 18 copper wire fuse, in each conductor, placed horizontally upon the structure especially devised for it on top of a pole. These fuses are enclosed in wooden tubes about 5 ft. long, wrapped with torpedo twine. The entire arrangement of lightning arrester gaps, fuses











PLANS AND SECTIONS OF THE AVON SUB-STATION

and switches is mounted upon eighteen chestnut poles; and a suitable elevated platform, railed off and fitted with a gate to keep out trespassers, affords means of access to the apparatus when attention is required.

The three high-tension conductors enter the sub-station through glass discs held in 36-in. tile, set in the upper portion of the rear wall of the sub-station.

Within the sub-station, the wires first pass through three 60,000-volt stick-type circuit breakers, mounted directly inside of the rear wall. Thence, over bare copper conductors to the three oil-insulated choke coils, situated on the mezzanine floor, thence to three oil-insulated series transformers, also on the mezzanine floor, from which connections are taken to the power measuring instruments in the operating room. The main connections finally terminate upon a set of copper bus-bars in the transformer room, which are run upon porcelain insulators mounted on wooden cross-arms and placed at a convenient height directly over the line of transformers.

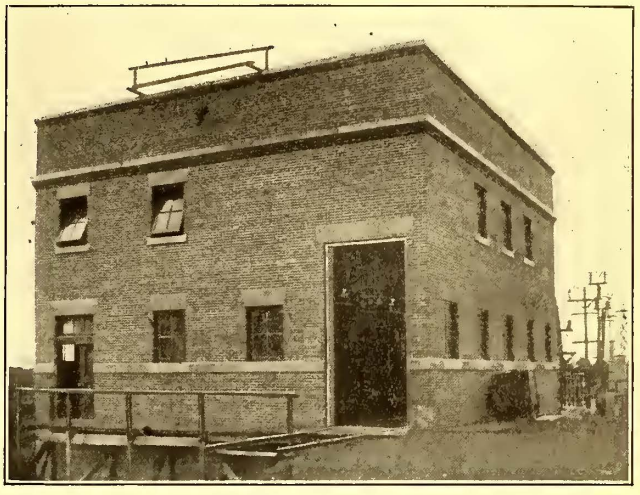
The 60,000-volt three-phase current is rendered available for single-phase distribution by means of three transformers of the Westinghouse oil-insulated water-cooled type, each of 750 kilowatts capacity. For the present installation, two transformers only are used at one time, the third being a spare. The high-tension connections are such that in case of one transformer failing while in service, its connections can quickly be taken off the bus-bars, and put on the spare transformers. The transformer windings are fitted with taps enabling the three-phase to two-phase "Scott connection" to be used. The low-tension windings can be

MAIN TRANSFORMER ROOM IN AVON SUB-STATION

so connected that either 11,000 volts or 22,000 volts can be obtained, so that in case it should ever be desired to transmit railway current for an extension of 40 or 50 miles, to another sub-station it could readily be done without adding transformers to this equipment. The low-tension windings also have six taps, enabling relatively small variations in the secondary voltage, if the same should be necessary to suit operating conditions in the trolley line.

One end of each low-tension winding is directly grounded to the boiler iron case, which in turn is, by means of a No. 0000 stranded copper cable, directly connected to the track return circuit.

The transformer cases are made of boiler iron, and set on



AVON SUB-STATION

a square cast iron base, which is in turn mounted on three pairs of wheels running upon an iron sub-base set in the concrete floor of the room. A track runs lengthwise of the room directly in front of the transformers, a transfer truck running upon it, upon the top of which there is another set of little wheels or rollers, which line up with those upon which the transformer cases are set. When it is desired to remove the windings from the transformer case, it is only necessary to disconnect the electrical, water and oil connections, roll the transformer off its sub-base, and onto the truck, which is then pushed to the rear end of the transformer room where it comes directly under a 10-ton hand hoist, which is able to lift any part of the transformer that repairs may make it necessary to handle.

Two cylindrical boiler-iron oil tanks are provided, each of slightly greater capacity than a single transformer. One is located in the basement directly under the transformer room, so that the oil from the transformer can readily be drained into it. The other is suspended from the concrete roof beams at the top of the transformer room, close to the side wall of the building, this being intended to act as a reservoir for distributing oil back into the transformer. The oil is pumped from the lower to the upper tank by means of a steam pump supplied from the boiler room in the adjacent division roundhouse, where steam is always available. From the upper tank oil is fed by gravity into either transformer. It is thus a simple matter to draw the oil off from any transformer if its insulating qualities are found to have depreciated, and the dehydrating, filtering or purifying apparatus can readily be employed with the aid of the pump, and the supply returned again to storage. The oil piping is of iron throughout.

The water circulation is by gravity, the supply coming from the railroad company's water tank system, at the adjacent round house, being pumped originally from the Genesee River about a mile distant. An artesian well had been opened up on the premises, but the water was so strongly impregnated with sulphur and other impurities that it was thought best not to introduce it into the copper

piping in the transformers, although the cost of such a supply would have been practically nothing.

There are three separate water-cooled coils in each transformer case, each one controlled by its own valve, so that the amount of water may be controlled as found necessary under various conditions of load.

The necessary tranformation from three-phase to two-phase, fits in very well with the natural subdivision of the electrified line into two sections, one of which is about nineteen miles in length, north of Avon, the other about fifteen miles in length, being to the south of Avon. The connections were therefore laid out to operate the sections upon separate phases of the two-phase secondary system. Either the T or V connection can be used, the latter method being employed at present. Each one of the active transformers therefore feeds a separate section.

As mentioned above, one terminal of each single-phase, 11,000-volt transformer is grounded. The middle transformer of the three is ordinarily used as a spare, and the other low-tension lead from this transformer runs to the center of a double-throw switch, whose outside poles connect separately to two low-tension bus-bars. The ungrounded low-tension terminals of the other two transformers connect through single-pole switches, one to each of these bus-bars.

The low-tension bus-bars run along the wall of the operating room, and directly beneath them are three type-E Westinghouse automatic oil circuit breakers, one on each of the two trolley feeders, the third breaker which is situated between the other two, being a spare. One pole of each of the three oil breakers is connected to the center pole of a double-throw hook type switch, by means of which it is thrown upon either bus-bar. The other pole of the oil breaker runs directly to the feeder. The outgoing lead from the middle or spare circuit breaker can instantly be thrown upon either one of the feeders, should the breaker usually controlling that feeder be temporarily disabled. This system of connections is simple, compact and flexible, and has admirably fulfilled the conditions for which it is intended.

The outgoing 11,000-volt feeders run up to the mezzanine floor directly over the operating room, where they emerge from the building through perforated glass discs, set in 18-inch round tiles. Before emerging there are tapped to them two Westinghouse low-equivalent lightning arresters, set in brick compartments, and reinforced by two electrolytic lightning arresters of the 11,000-volt type. A set of call bells is provided so that when the automatic breakers open a bell is rung in the car-inspection shed, adjoining. Also, if the temperature of any transformer runs above normal, a bell circuit connected to a thermometer in the top of the trasformer tank is similarly made to operate. The station itself does not require the continuous presence of an attendant, which is needed in the case of a rotary converter sub-station. The working force is so organized that the car-repair men are always available for manipulating the sub-station circuit breakers, and the cost of attendance is thereby reduced to a minimum.

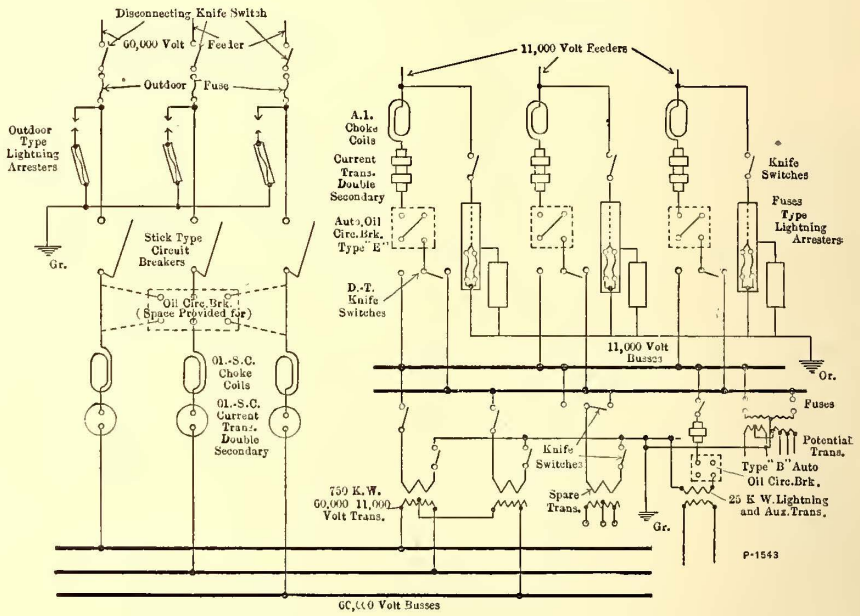


DIAGRAM OF CONNECTIONS, AVON SUB-STATION

CATENARY TROLLEY CONSTRUCTION.

The overhead trolley construction is in many respects unique. It was the first of all catenary installations to operate regularly at 11,000 volts. There were very few precedents to follow; many of the details of the overhead work are entirely original, and nearly all of them were especially designed for this installation by the engineers who executed the work.

The poles are of chestnut, averaging 25 ins. in circumference at the top, and about 42 ins. at the butt. Most of them are about 35 ft. long, but 40-ft. poles were used where the embankments were narrow and steep, and in span construction. Nearly all the construction is of the bracket type, except at the railroad yards at Rochester, Avon and Mt. Morris, and for some distance at Mortimer, where there is a siding on each side of the main track, which prevented the use of bracket construction there.

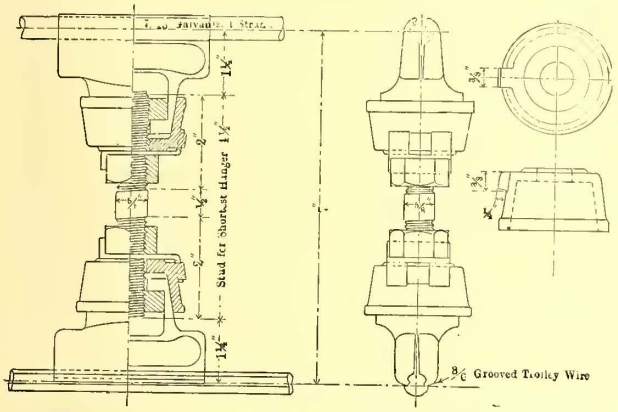
The poles are given about 12 ins. rake. The poles are tamped with cobblestones, of which plenty were available from the coarse gravel with which the road is ballasted. The ground proved very deceptive as regards the nature of the digging, much water-bearing gravel and quicksand being encountered, and oil-barrels had to be resorted to in many instances, to prevent caving in of the holes during pole setting.

The brackets are of on entirely original design, each consisting of a 3 x 2½-in. tee, 10 ft. long, the heel of which is fastened to the pole by a pair of bent straps, the outer end being supported from the pole-top by two ⅝-in. steel truss rods, instead of the single rod commonly used for bracket work. The two rods are attached about 27 ins. back from the outer end, and run one to each side of the pole, and are fastened there to a pole clamp devised for this work, which grips the top of the pole instead of requiring the bolt or truss rod to pass through it. In this way the timber of the pole is kept intact, and does not have a hole bored through it which will admit moisture and induce rot. The two truss rods are threaded at both ends, and at the upper end each one passes through a small iron casting which is in turn carried upon a bolt projecting out from the cast-iron portion of the pole clamp, like a trunion. The whole construction is extremely rigid, and is stronger and more conducive to a

long life for the pole than any bracket hitherto used. Where necessary, at switches, extra long brackets are employed, being lengthened by splicing and an extra truss rod being attached by means of a clamp, to the outer end of such a bracket, and run to the extreme top of the pole.

The insulator pins are of malleable iron, of a type specially devised for this work. The lower portion of the pin was divided and fitted closely over the flanges of the tee bracket, being provided with a single 5/8-in. bolt by means of which the lower split portion of the pin is clamped securely against the bracket. The brackets and pins were furnished to the engineers' designs, by the Electric Service Supplies Company.

The insulator is of the R. Thomas & Sons manufacture, 6⅞ ins. in diameter, and 6 ins. high, made in two parts, but of the three-petticoat type, and known as the No. 3029.

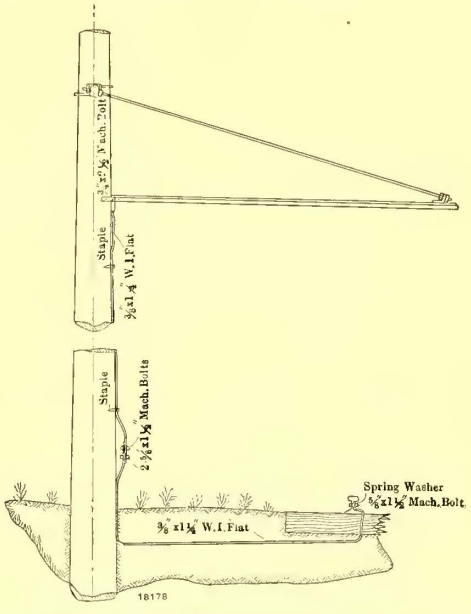


TROLLEY HANGER CATENARY CONSTRUCTION

It was designed by the engineers especially for this installation. As most of the overhead work was done during the winter months, and had to be rushed, a quick-setting cement of litharge and glycerine was used in place of Portland cement, which not only enabled rapid work in construction, but obviated troubles due to the freezing of hydraulic cement while setting.

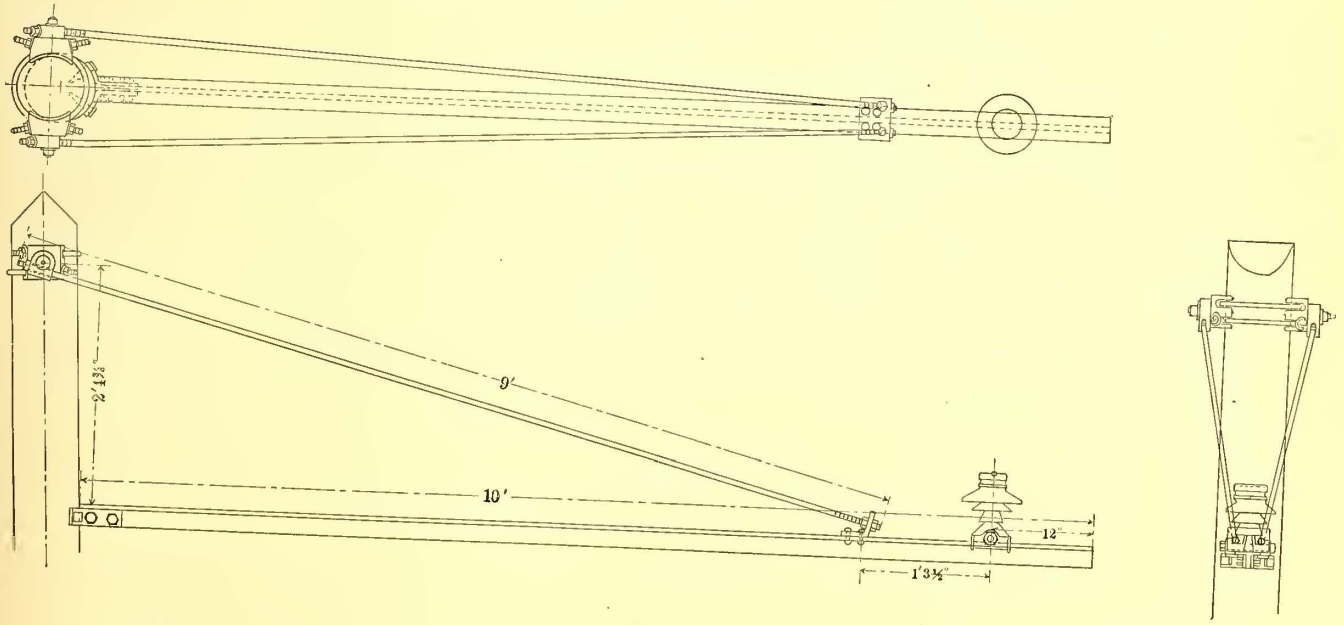
The insulator pins are ordinarily about 12 ins. from the end of the bracket, but there is 27-½ ins. space between the end of the bracket and the point where the truss rods support it, which enables sufficient variation in location of insulator to meet most of the requirements in shifting the alignment of the trolley wire on curves.

The messenger wire is of "extra high strength" steel, furnished by the American Steel & Wire Co. It is of seven strands and is 7/16 in. in diameter. Joints are made by using the so-called "open" and "closed" cable sockets, the sockets being sweated on to the abutting ends of the cables and joined by a pin connection through the eyes of the sockets. The trolley wire is No. 000 B & S grooved copper, the lengths being spliced with the usual type of soldered splicing sleeve.



METHOD OF GROUNDING BRACKET

The spans on the straight line track are 120 ft. in length, and as much shorter than this on curves as required by the radius of the curvature. The maximum deflection from the center line of the track, on curves, is 7 ins. each way. The catenary hangers were of the Electric Railway Equipment Co.'s drop-forged type, being modified by the engineers to suit the requirements. The messenger clip and the trolley

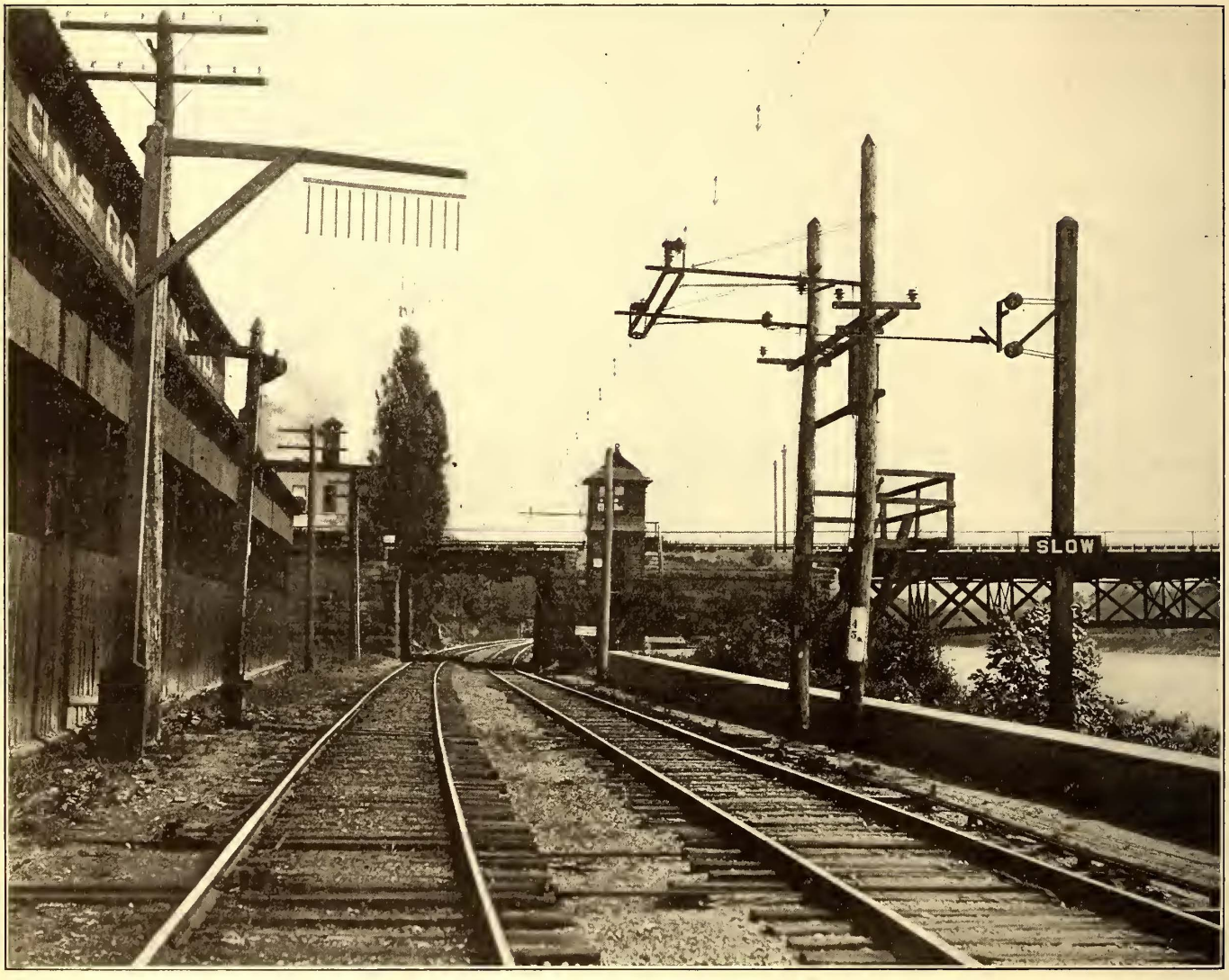


BRACKET FOR CATENARY TROLLEY CONSTRUCTION

clip are of the same type but grooved differently to accommodate their respective wires. They are joined by a 5/8-in. iron hanger-rod, with right-hand threads on each end, the longer rods being flattened in the middle to admit of bending them slightly, so as to conform to the divergence of the messenger and trolley wire near the ends of the spans. Both trolley and messenger ears are secured in position by jam nuts. This type of suspension was developed especially for this installation, and is so constructed that there is no possibility of parts coming loose and falling apart on account of vibration. It is also very quickly and easily adjustable on trolley wires. The hangers are spaced every 10 ft.

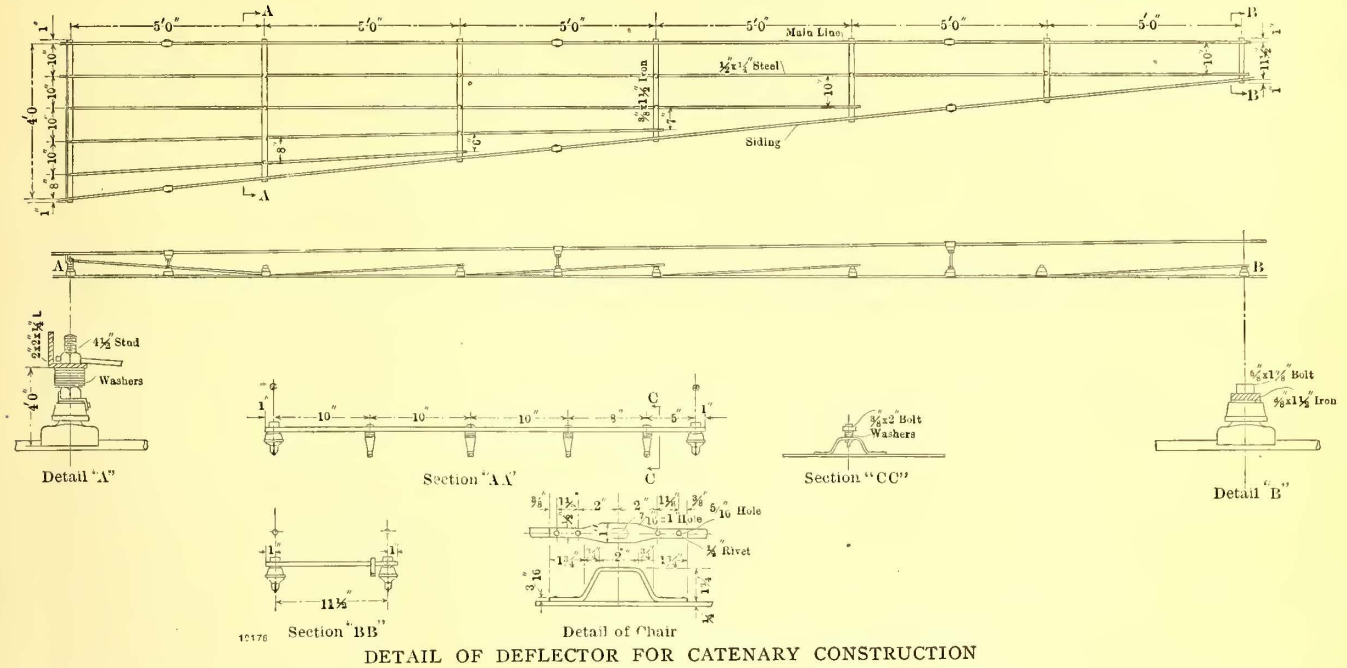
The steady strain rods are of treated wood of the Westinghouse Electric & Mfg. Company's make, and they are mounted at one side of the bracket instead of directly underneath, in order to give sufficient clearance for the pantagraph trolley on curves, where the super-elevation results in the tilting of the shoe from the horizontal. Each steady strain rod is hinged to a spool type Thomas porcelain strain insulator, which is clamped to one side of the bracket in such a manner that the hinged end of the rod is almost at the elevation of the top of the tee bracket. The method of attaching the steady strain insulators to the bracket is such that they can readily be shifted along the bracket to follow up any change in alignment of the trolley wire that may be required by curvature or for any other reason. The clamps holding the steady strain insulators are of 3 in. x 3/8 in. bent iron. The spool type insulators are cemented on to pieces of 3/4-in. pipe, through which passes the 5/8-in. eyebolt by means of which they are attached to the bent irons. Steady strains are used only on curves and turnouts and were not found necessary on tangent track.

The tie wires are of No. 9 Extra BB, galvanized telegraph wire, because it was thought best not to make too rigid an attachment between the messenger wire and the insulator; so that if a bracket became detached from the pole for any reason, its weight and the shock of detachment would tear the wire clear from the messenger and allow the bracket to fall entirely away from the wire and reduce the chance of steam railroad trains colliding with it. An accident to the electrical equipment of a railway operating both steam and electric trains, may shut down the electric service, but will not automatically place any check upon the steam service, so that accidents to steam trains must be guarded against, as a steam train might easily be wrecked by an obstruction which would automatically prevent power from being supplied to an electric train. This was one of the reasons for installing the system of "ground rods" from the brackets to the rails, which is carried out very consistently throughout the installation. Every bracket is grounded to the rail, so that an insulator failure will instantly throw off the power, as it will cause a complete metallic short-circuit. There is thus no danger of setting the wooden poles on fire, which would be possible if this precaution were not taken.



OVERHEAD CONSTRUCTION AT CLARISSA STREET BRIDGE, ROCHESTER, SHOWING TROLLEY SECTION INSULATOR, BRIDGE WARNING AND BLOCK SIGNAL TOWER

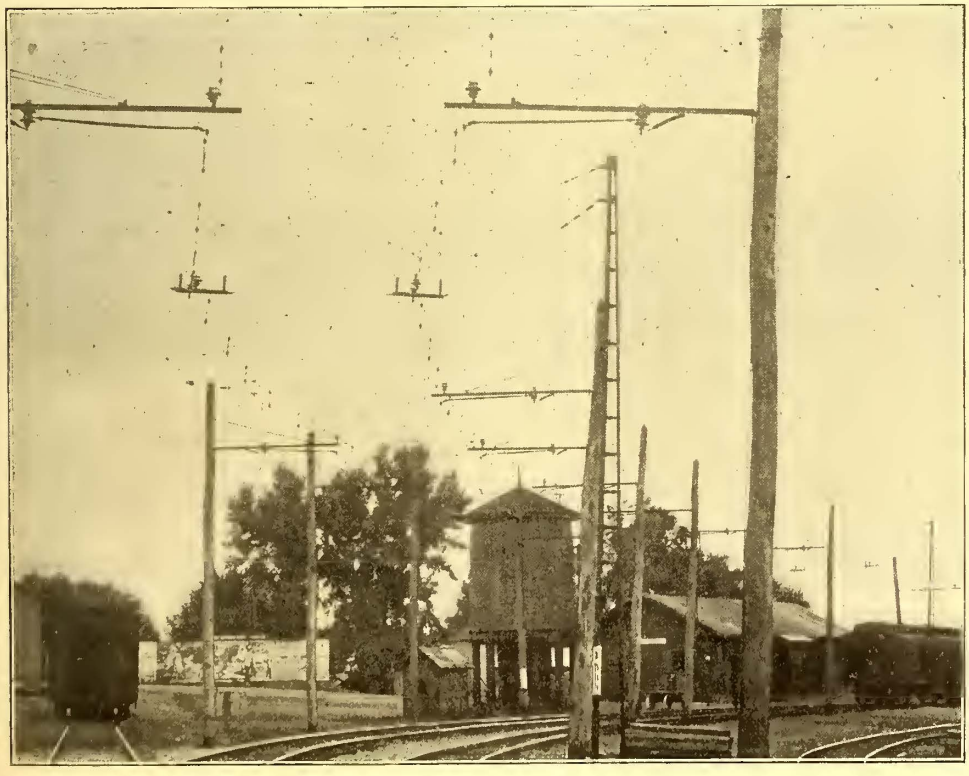
The burning of a wooden pole would not of itself necessarily cripple the electric service, but it would be quite likely to cause an obstruction dangerous to the passage of steam trains which are, of course, independent of any disturbances on the electric motive-power system. Up to the present time, however, there have been no cases where the overhead construction has caused any obstruction to the passage of the steam traffic.



DETAIL OF DEFLECTOR FOR CATENARY CONSTRUCTION

The ground rods consist of ⅜ in. x 1¼ in. flat steel, their upper and lower ends being bolted to track rail and bracket respectively.

The span construction is as nearly as possible similar to the bracket construction, and uses the same type of pin and insulator. A piece of 3 in. x 2½ in. tee about 30 ins. long is suspended from the span wire by hangers of galvanized strand cable, adjustable in length, and fastened to the span wire cable by specially designed clips, the construction forming a sort of stirrup upon which the pin and insulator are carried. The messenger wire rests upon the insulator just as in the case of regular bracket construction. This form is used, not only for spans where there is but one track, but also in the yards at Avon, and Rochester, where three or four parallel tracks are electrified. Span construction, in general, was only used where conditions absolutely required it.



OVERHEAD CONSTRUCTION, MT. MORRIS TERMINAL

The Rochester yard was a difficult piece of construction on account of the distance between supports (which reaches a maximum of 94 ft., where spanning seven tracks, four of which are electrified), and also on account of the uncertain nature of the soil which on the river bank is filled in with gravel and cinders. For these long spans, where it was impossible to use guys of the usual type (the river bank being on one side and the main highway which gives teams access for loading and unloading of freight cars on the other side), it became necessary to use self-supporting span construction, and this was done by using the "Tripartite" type of steel pole, set in concrete. This type of pole being constructed of re-rolled Bessemer steel rails, is less subject to rust, and consequently more durable than any other available type of metal pole, and all of its surfaces are always open and easy of inspection. On account of the great tensile strength of the material, there is considerable saving in weight, and the fact that it was a standardized

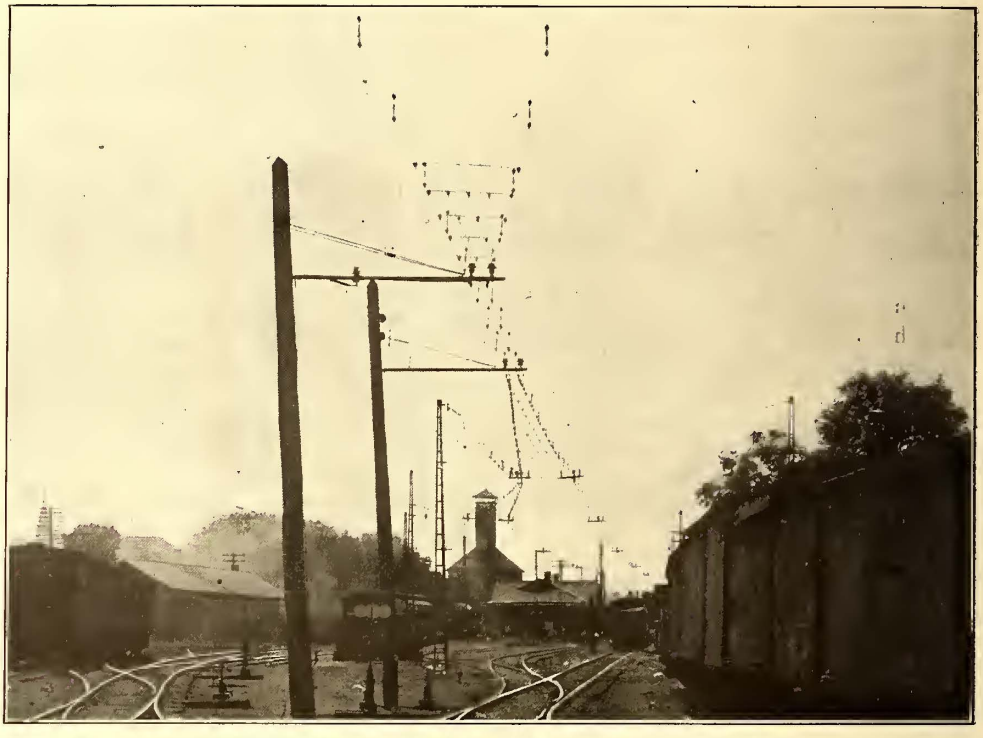
product, enabled quicker delivery to be made than though special riveted poles of structural steel shapes had been especially designed for these locations. The span wires consist of the regular messenger cable fitted with cable sockets sweated on at each end, the same being fastened to turnbuckles and pole collars at the tops of the poles. There are two span cables at each pair of poles, the upper one being used to carry the weight, the lower one acting to steady the arrangement and also to act as a relay in case of an accident to the upper span. Similar construction was also used at Avon, where guying of side poles was not always possible.

A very simple type of pull-off was devised for curves in span construction, and it so happens that both the Rochester and Mt. Morris yards have considerable curvature. The pull-off consists simply of a spool-type insulator, with a piece of pipe cemented through the center, this pipe being slipped over the hanger spacing-rod joining the messenger and trolley clips, thus giving an insulating connection through which an ordinary pull-off cable can be attached to both messenger and trolley wherever required. The division of the horizontal pull between the messenger and trolley wires is easily adjusted to suit the conditions, by shifting the spool-type insulator up and down the spacing rod, by inserting longer or shorter nipples of pipe underneath it. In general, when near a span wire, the messenger cable is supported rigidly on its insulator and the trolley wire needs all the side pull; but in the middle of a span the pull must be equally divided between messenger and trolley wire.

The presence of several through-truss bridges over streams and two low bridges over the Erie right of way necessitated the employment of special construction at these points, particularly at the bridge at Clarissa Street, on the outskirts of Rochester. The original clearances here were so low that the road-bed had to be excavated out and the track lowered about 2 ft., and the minimum clearance between the rails and the trolley wire being finally 18 ft. The messenger is fastened to a horizontal stool-type insulator mounted at the center of a substatial piece of turned oak, which is long enough to carry two more similar insulators, one on either side of the center one.

The steel hangers reaching down from the overhead bridge structure carry the two side insulators, so there are always two insulators in series between the 11,000-volt messenger cable and the steel work of the bridge. These insulated supports are suspended at short intervals from the under side of the steel-work of the bridge, and are further supplemented by the use of steady strains which prevent any side displacement of the trolley wire. The shortest sizes of hanger spacing rods are used in such places. Where the bridge trusses are high enough to permit it an iron stirrup is employed like that used in span work, which carries the standard form of straight line insulator, and the regular type of catenary suspension is employed.

At either side of these overhead obstructions it was necessary to provide warnings for brakemen upon the tops of freight cars, as substitutes for the warnings of hanging pieces of rope previously used. In the accompanying cut on page 657 is given a view of the Clarissa Street bridge, showing both the old arrangement of ropes and the new one, for electrified tracks, which supplanted it. It will be noted at this point only one of the two tracks is electrified and freight trains are here obliged by rule to use the unelectrified track; but to insure that the place shall be absolutely safeguarded, the electrified track is fitted with warning signs of the type shown. They consist of the well-known type of horizontal, suspended swinging wooden rod, mounted with its axis at an angle, so that it swings up as it is pushed to one side. The pantograph trolley is fitted with a set of springs on each side, one of which strikes this warning sign a blow as it passes under and instantly throws it to one side. The blow is struck upon a heavy leather strap held taut by a coil spring of steel wire in tension, the whole contrivance being fastened to the lower half of the pantograph trolley mechanism so that it is at the right height for striking the warning sign. The swinging rod is mounted upon the pole by means of insulators, effectually preventing any leakage to the ground, even though a car might stand still directly under the sign and make contact with it for an indefinite length of time.



AVON YARD, LOOKING SOUTH TOWARD STATION

Nearly all the telephone and telegraph wires which cross over the 11,000-volt trolley wire have been put underground, particularly in the case of the leads composed of only a few wires, but where the line is crossed by heavy telephone trunk lines, they have been protected by the basket type of construction, so designed as to effectually prevent a broken telephone wire from falling across the messenger or trolley wire. This consists primarily of four galvanized steel cables stretched between opposite ends of two cross arms, one placed above and the other below the wires of the intersecting telephone line, and the four cables

are joined by a basket-work of light strap-iron ribs placed at intervals of 3 to 4 feet across the whole span, forming the sides and the bottom of the cradle and effectually preventing a broken telephone wire from dropping any further. This construction was also followed in the case of an electric light line at Avon.

The telegraph department of the railroad company, in connection with the signal department, constructed a private telephone line of two copper wires between Rochester and Avon, with instruments at all signal towers and stations in the dispatcher's office, and at the sub-stations, and car shed, and master mechanic's office. This telephone system is run upon the trolley bracket poles, transposed every third pole, and has worked satisfactorily.

Lightning protection for high tension single-phase railway lines not having as yet been standardized, only a part of the line was equipped with line lightning arresters, which are of a swinging fuse gap type of construction, made by the Westinghouse Electric & Manufacturing Company. This type of lightning arrester consists of a gap one side of which is connected directly to the trolley through a No. 4 copper wire, and the other side being directly connected to the ground rod through a fuse enclosed in a tube which, while the fuse is intact, is maintained in an inclined position like a pendulum held back from its position of rest; but when the fuse is blown, a latch is released which allows the fuse tube to swing to a vertical position which shows conspicuously from the ground, and signifies to the patrolman that the fuse should be replaced. The fuse tube can then be lifted off the suspending lugs by a pair of insulating tongs made for the purpose, and the fuse renewed and replaced in a few moments.

On the other half of the line, lightning arresters were not installed. During the summer, two of the poles were struck by lightning, but the metal-work of the brackets and truss rods being entirely grounded, these poles were not damaged below the topmost point of attachment of the truss rods, which is generally not over 18 ins. from the top of the pole. In a number of instances the lightning-arrester fuses have blown, but it is not known how many of them have blown simultaneously. Although the extent to which this type of arrester is fully protective, is hardly established as yet, it can be stated that at no time since regular operation started, has any injury to the car equipment resulted from lightning, though there were several severe storms during June and July.

The trolley line is divided into seven sections—one comprising the Rochester terminal, one of the Avon yard, three sections in the main line between Rochester and Avon, and two sections south of Avon.

The sections are divided by trolley section insulators, made by the Westinghouse Electric & Manufacturing Company. They are of the overlapping type, made of impregnated wood, and are of sufficient length to insure insulation at 11,000 volts. Each section insulator is carried upon two brackets, mounted on poles spaced 10 ft. apart. As the trolley and messenger must both be completely insulated on opposite sides of the breaker, heavy strain insulators are introduced upon which the messenger is dead ended, the two insulators being connected across the gap by a heavy steel rod. This entire combination is supported upon standard insulators mounted upon the regular brackets.

One of the breakers, that opposite the sub-station at Avon, is different from the above-mentioned type, in that it is not of the overlapping type, it being necessary to absolutely separate the two halves of the trolley line in order to utilize the separate phases of the trolley current in each half.

The only feeders necessary are those connecting the sub-station with the trolley on opposite sides of this section break. The principal object of cutting the trolley into additional sections is to facilitate the locating of line trouble.

The conditions of electric traction upon this line are such that no feeder is necessary besides the trolley wire, and consequently there is no necessity for feeding the sections separately. A jumper is therefore provided at each section insulator in which is placed a hook-type knife switch that can be operated in case it is desired to cut that section out. Normally, however, the switches are closed and the effect of the jumpers is to make the trolley wire continuous.

Another detail peculiar to the catenary type of trolley construction is the "deflector"—a sort of mechanical fender placed in the angle formed by the intersecting trolley wires at switches. The type of deflector here used consists of four or five bars of flat steel, ½ x ¼, suspended by riveted hangers, from crossbars spaced five feet apart which in turn rest on standard trolley clamps fastened to the trolley wire. The particular advantage gained by this construction is that no extra tension is needed to keep the bars from sagging and getting crooked, this type of deflector being of minimum weight and entirely self-contained. They are placed in both angles of each switch. The object of the deflector is to prevent the end of the pantograph shoe, when traveling under either wire from becoming hooked over the other.

CARS.

The cars equipped with electric apparatus are six in number, and together with their trucks were furnished by the St. Louis Car Company. The electrical apparatus was installed upon the cars and trucks by the engineers at the railroad company's car shops in Buffalo, N. Y. The cars are 51 ft. 4 ins. over bumpers, 40 ft. over corner posts, and 29 ft. 4 ins. betwen truck centers. They are 8 ft. 9 ins. wide over sheathing, and 13 ft. 8⅝ ins. in height above the rail. Four of the six have two passenger compartments, the other two having a baggage compartment about 14 ft. long, and a small smoking compartment with six seats, besides the regular passenger compartment.

The bottom construction of the cars comprises side sills of 5 x 8 yellow pine, with 6-in. steel channel and fillers, intermediate sills of 4½ x 6 yellow pine, and center sills of 6-in. I-beams, with fillers. All the cars have upper and lower truss rods and needle beams of 5-in. I-beams. End sills are 8 x 6 in. oak. The flooring is double, and trap doors are fitted over the motors.

All the lower side windows are equipped with sash balances, and the interior of the car is finished in mahogany with light green veneering in the ceiling, of a very pleasing appearance. The seats are of the "Walkover" type, upholstered in dark green plush in the main passenger compartment, and in rattan in the smoking compartment. There is a continuous basket rack on either side over the windows. The end doors are of the double sliding type. The vestibule doors are of the single sliding type, and trap doors are fitted over the steps. Each vestibule is fitted with a double-acting swinging door so arranged as to form the motorman's cab, and when not so used it is folded back to completely enclose the control apparatus and brake gear, and leaves the vestibule unobstructed for passengers.

Each car is fitted with a 50-cp headlight, at each end, on top of the hood, and it is also fitted with a gong, air whistle and with the standard train air signal used by the Erie Railroad. The toilet is in the center of the car, adjacent to the partition between the compartments. The "Standard" steel type of platform buffer is used, and the regular M. C. B. coupling, air hose connections and safety chains are

provided, so that the cars can couple up to any of the standard Erie Railroad rolling equipment.

There being an open space between the abutting vestibules when two motor cars are coupled together, due to the rounded and projecting buffer beams of the platforms, this opening being nearly 18 ins. in width, which is wide enough to allow a person to fall between the cars, there were provided canvas curtains about 5 ft. high with snaps attached which enable them to be quickly stretched across the space, one on each side of the vestibule end door, so as to insure the safety of trainmen and passengers when walking from one car to another, with the train in motion.

The trucks are both alike, wheel base being 6 ft. 8 ins. The axles are 6½ ins. diameter. The trucks are of the standard M. C. B. swing bolster type, with heavy framing. The brake shoes are inside hung.

The heating equipment consists of thirty-two of the Consolidated Car Heating Company's electric heaters of the truss plank type and 450 watts capacity each in the main portion of the car, and two "No. 192 M. S." heaters in each cab.

ELECTRICAL EQUIPMENT.

The electrical equipment of the cars consists of four No. 132-A Westinghouse single-phase railway motors, with a nominal rating of 100 hp each, the gear ratio being 20.63. The suspension is of the nose type, and solid gears are pressed upon the axles.

The control system is of the Westinghouse electro-pneumatic type, and includes three distinct circuits, the high potential, the low potential and the control circuit.

The high potential circuit includes the pantograph trolley, line switch and the transformer. The pantograph trolley mechanism is operated by a pair of springs and by an air cylinder. The trolley is raised and held against the wire by means of springs against its own weight, and it is lowered by the application of air pressure to pistons working in cylinders that form part of its base. When down, it is automatically locked, and the latch of this lock can only be withdrawn by applying air pressure to another small piston which then unlocks the pantograph, allowing the springs to raise it. This trolley mechanism is so connected with the control circuit through the line relay that any interruption in the supply of high-tension current immediately causes the trolley to be lowered by applying the air to the main clinders in the trolley base.

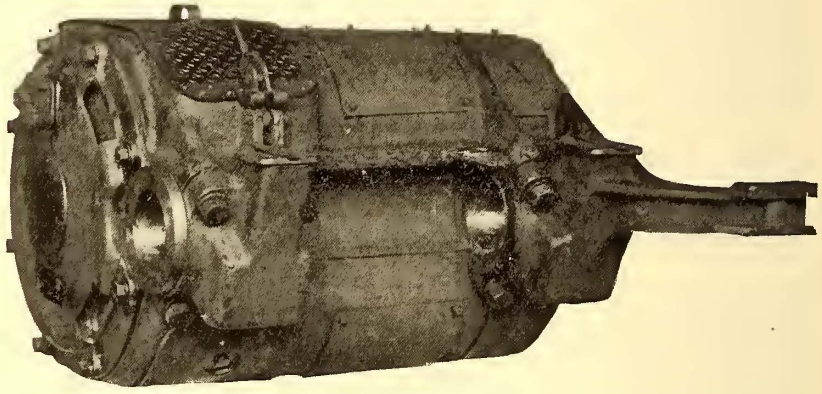
The line switch is equivalent to a main high-tension circuit breaker. It is opened and closed by air pressure, admitted by electrically operated valves. In case the supply of air is exhausted, as when the car has stood for some time unused, the line switch must first be held in mechanically by means of a handle provided for the purpose until the air pump, which can then be thrown into operation, has compressed air to about 50 lbs. pressure, which is enough to properly actuate the control system.

To raise the trolley when there is no air pressure available, there is provided a small automobile tire pump. This pump is placed underneath one of the car seats, and is connected by a three-way cock into the trolley air piping system. It enables the air-operated trolley latch to be withdrawn and power to be obtained to start the air compressor and set going the motor generator set used for charging the storage battery and supplying current to the control circuit.

The transformer is of 200 kw capacity, and is of the oil insulated type. It has three high potential and eight low potential taps, the latter running from 300 down to 110 volts, at which latter pressure current is provided for heating, lighting and auxiliary purposes.

The high-tension wiring of the car is done mainly with varnished cambric cable, drawn through loricated iron conduit. A small amount of high-grade rubber cable is used, but it is thoroughly protected with varnished cambric tape wherever there is danger of a brush discharge to ground breaking down the insulation.

In the main low-potential circuit are the switch group, the preventive coils and the reverser. The switch group is a set of air-operated switches controlled by magnet valves, all mounted in one frame. It is placed athwart the car as near as possible to the low-tension end of the main transformer. The switches of the group are all provided with interlocks, which automatically govern the connections in such a way that each switch of the group acts only when the current in the motors has reached a predetermined value, thus making acceleration automatic. Preventive coils are used across the terminals of some of the switches of the group, to prevent excessive current flowing at the instant of closing the switch. Each switch in the group is fitted with its own blow-out coil. There are two reverser switches actuated by air pressure, one for each pair of motors.



132-A SINGLE-PHASE MOTOR USED ON THE ROCHESTER BRANCH

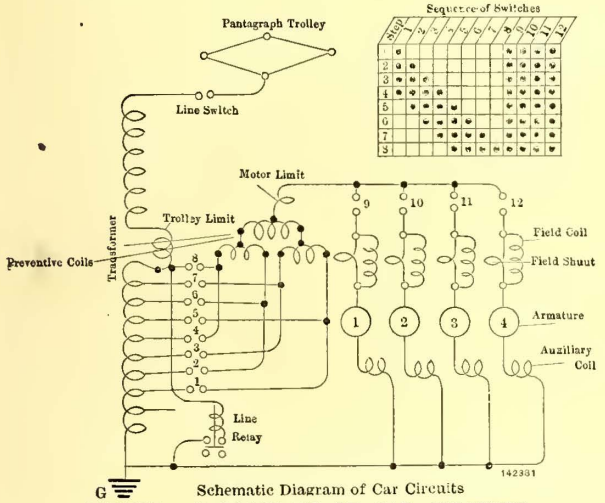
Current from the main motor circuit is led through the motor limit switch, which makes effective the functions of the interlocks on the switch group, and renders it impossible for the successive switches to be thrown in unless the limit switch is closed.

The control circuit includes a master controller in each vestibule, the train line wires and their connections to the valve magnets and interlocks, a storage battery supplying current for these wires, and a motor generator set, which is used either to charge the batteries or to actuate the control system. The master controller makes the proper connections by means of which the 15-volt storage battery actuates the valve magnets which control the action of the air-operating main contactors in the switch group, and the reversers. The controller handle is normally held in a vertical central position by springs, unless it is moved to one of the running points by the motorman. When released from the grasp of the hand it flies to the vertical position, cutting off the power, and enabling the emergency application of the brakes by means of brake relay valve alongside of it. There are two holes in the face of the master con-

troller, directly under the handle, and attached to the handle by means of a chain is a plug which may be inserted into either of these holes. The master controller is not operative unless this plug is pushed all the way into the lower hole, which closes the line switch, connects the generator and battery, and puts the brake relay valve into circuit. This is the ordinary running position of the plug. In case the line switch is opened by an overload, which generally causes the trolley to be lowered, the plug is taken out of the lower hole and placed in the upper, which action immediately closes the line switch, releases the trolley, and allows it to spring up against the wire. As soon as the power is thereby returned to the main circuit, the plug is taken out of the upper hole and replaced in the lower one.

There is a push button upon each side of the bottom of the master controller case. That on the right hand side is used for dropping the trolley and opening the line switch. When the button on the left hand side is pressed the switch group is stepped up to the last or high speed notch and remains in that position until the handle of the controller has been returned to the off position.

There are four distinct notches on each side of the controller, the first corresponding to the coasting position with



SCHEMATIC DIAGRAM OF CAR CIRCUITS

the power off, the others enabling such gradations of speed as may be desired. Reversal is effected by moving the controller handle to the opposite side of the center or dead point. If the controller stops on the dead point, as it will if released by the hand, it will immediately apply the brakes.

The motor generator set is a compact machine of about 1/6 kw, the motor being of the self starting induction type, wound for 110 volts, the generator being normally of about twenty-three volts. It is placed under one of the seats in the car and is covered by a box with removable lid, so that it can easily be reached for such small attention as it requires. It is mounted upon rubber bushings, and runs so quietly that its presence in the car can hardly be detected.

The storage battery consists of seven cells contained in a wooden box with handles, carried in an enclosed box underneath the car. No other auxiliary lines for any purpose are connected to the control circuit in order to prevent it from being disabled by accidental grounds.

In one vestibule there is located in an asbestos lined compartment enclosed with steel doors a slate switchboard panel upon which are carried all the switches and fuses for the control of the battery and motor generator set, the lighting circuits and heaters, and also the main connection from the low tension side of the transformer to the auxiliaries.

The control circuit is fitted with junction boxes, branches running to receptacles at each of the four corners of the car directly under the end sills. The jumpers for connecting the cars and the receptacles are of the 12-point type, there being twelve wires in the main control circuit.

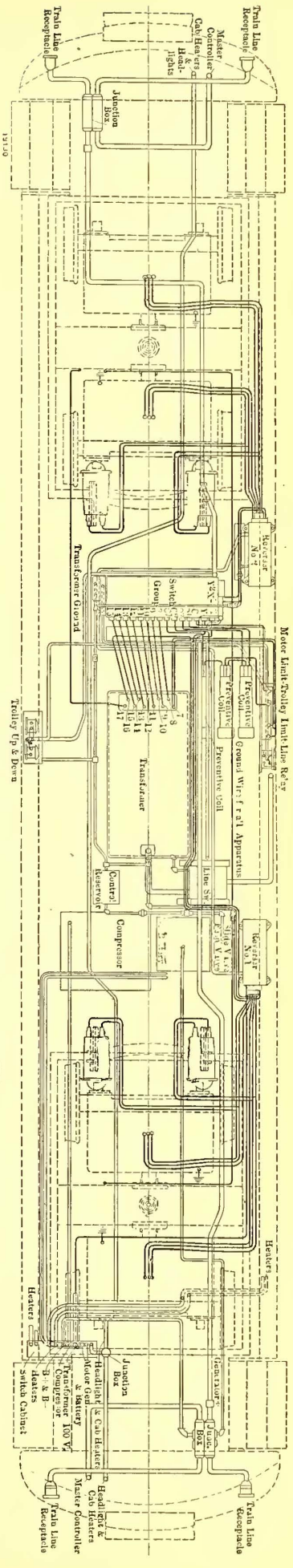
The low tension wiring between the transformer and switch group and motors is all enclosed in a boxing of "Transite," to insure its protection against mechanical injury, as the inductive effect of heavy currents at low potentials renders the use of iron conduits impossible for this part of the wiring.

The air brake and electrical equipment were placed upon the cars by the engineers at the Buffalo car shops of the Erie Railroad.

CAR INSPECTION SHED

Adjacent to the sub-station is a car inspection shed, a brick building that will accommodate four cars. It is 136 ft. 6 ins. long, 30 ft. 5 ins. wide and 20 ft. high in the clear, between the track and the bottom of the roof girders, and 24 ft. high from the top of foundation to the top of the parapet. The general style of construction is similar to that of the sub-station. It is remarkably well lighted, there being a window in each bay 6 ft. 11 ins. wide by 13 ft. 6½ ins. high. Two tracks run clear through the building, the ends of which are enclosed by rolling steel doors of the Wilson type, about 12 ft. wide and 18 ft. 9 ins. high. One of the two tracks is provided with a pit about 110 ft. long and

GENERAL ARRANGEMENT OF WIRING AND ELECTRICAL APPARATUS



4 ft. 4 ins. wide, in the clear, and 3 ft. deep from the top of the rail to the top of the convex brick floor.

The foundations consist of concrete piers, joined by heavy reinforced concrete lintels upon which the brick walls rest between the piers. The building is located on filled-in ground, and the piers reach down to a reasonable distance below the level of the original natural soil. The space around the building and between piers and underneath the floor and pit of the building is filled in with gravel and cinders.

The roof is a 4¼-in. reinforced concrete slab, supported by steel girders, slightly pitched in one direction. There are no partitions or separate rooms in the building.

A trolley hoist is provided at the rear end of the building, traveling across it on the bottom flanges of an I-beam attached to one of the roof girders. A third track, not connected with the outside tracks, runs up and down the middle of the building between the two car tracks. A transfer table is located in a cross pit situated about midway of the building, by means of which a car standing on the floor track may have a truck taken out from under it and shifted over to the center track, on which it can be run under the trolley hoist in case repairs are needed. The sides and bottom of this transfer pit are made of concrete.

The floor of the car barn, other than that taken up by the repair pit and transfer pit, is paved with second-grade paving brick, laid on sand, which was well packed down with water.

The station is supplied with light by means of seventy-seven incandescent lamps in pairs and clusters, connected up by a conduit system and steel plate switch cabinet to the auxiliary light transformer in the sub-station.

The pit is also provided with ten incandescent lamp outlets and extension plugs. No electrical means are provided for moving the cars in the station, there being always steam locomotives available for shifting the cars in and out of the building.

The inspection shed is, like the sub-station, heated by steam. The radiators are of the Colonial wall type, one being set in each bay and fed by a steam pipe passing underground through a concrete pipe trench, which also carries the compressed air piping. The latter is supplied from a steam air compressor outfit in the division repair shop. The main steam supply header runs overhead directly above the windows, and the condensed steam waste is discharged into the open air. A 4-inch water line runs completely through the building, and there is one 2½-in. hydrant at each end just inside of the door and a third in the center of the building.

The above facilities for effecting electrical repairs are supplemented by the regular division repair shops, located alongside the steam locomotive roundhouse at Avon, which are equipped with the usual complement of machine tools.

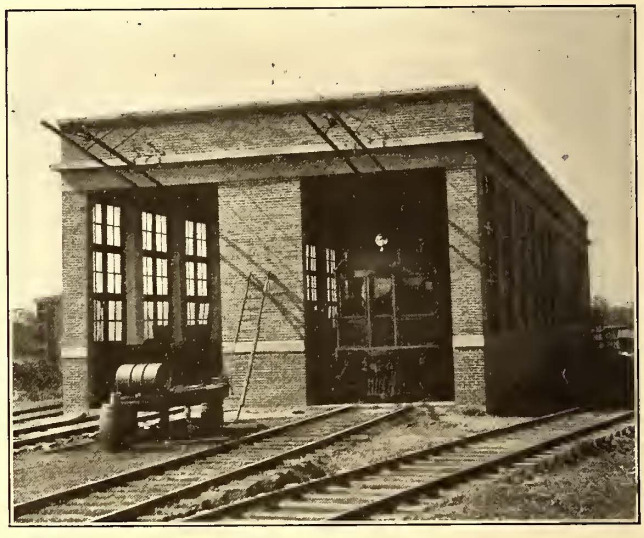
At the Rochester terminal a concrete inspection pit 60 ft. long is provided on one of the side tracks close to the passenger station.

OPERATION

The equipments above described were intended to be sufficient for operating single car trains with one stop per mile over the entire road, at an average schedule speed of twenty-four miles per hour, or to haul one trailer making stops about two and one-half miles apart at the same schedule speed. The company has furnished shelters where the public highways cross the line, there being twenty-two of these flag stations besides the regular intermediate way stations at which steam trains stop, six in all, or a total of twenty-eight stations at which electric cars may be required to stop. Practically the electric cars stop at all the regular way stations, but at only a portion of the flag stations. A single passenger coach is frequently attached to a motor car, and on some trains baggage, milk or postal cars are regularly hauled. When two trailers are hauled two motor cars are required, making a four-car train, as shown in the attached photograph. The service has proved immensely popular throughout the Genesee Valley through which it passes, and it is intended to increase the number of motor cars in order to handle the business a little more comfortably next season. It is found that the electric trains on their thirty-four miles of line can be depended on to keep to their running time rather better than the steam passenger and freight trains operating over the main line.

SIGNAL SYSTEM

The railroad company has installed a positive block system for insuring the safety of trains with the frequent headway at which they are obliged to be run upon the single-track road, which must also handle steam passenger and freight traffic at the same time. The blocks extend between the regular way stations, or if such blocks are too long, switch towers are added, making the blocks average about four miles in length from one end of the line to the other. Without going into detail it may be stated that the function of the positive block system is to absolutely prevent more than one train at a time from occupying a block. The sidings are fitted with interlocking switches controlled by the block operators in the towers or in the way stations, and the movement of trains is thus regulated with the greatest care. The towers are all connected by the private telephone line, while the way stations retain the usual telegraphic communication with the train despatcher's office at Rochester. By means of the telephone communication it is instantly possible for a train crew to get in touch with the chief despatcher and be properly located, but all train orders are transmitted by telegraph and written out on Form 31, as is the uniform steam railroad practice throughout the country.



CAR INSPECTION SHED

TELEGRAPH SYSTEM

As is well known, the single-phase trolley system causes interference with telegraph lines along the right of way, and unless both the electrostatic and electromagnetic induction are properly compensated there is always danger of telegraphic communication being seriously affected. The

static effect is particularly annoying, as it is absolutely continuous as long as the trolley line is charged, whether or not there are any cars moving. Various means were proposed and tried by the Western Union Telegraph Company for the elimination of the "static," which always causes the telegraphic relays to chatter, but the most successful thus far known is that due to the inventive genius of E. W. Applegate, quadruplex expert for the Western Union Telegraph Company, who has developed a very simple means for overcoming static interference. Mr. Applegate worked upon the theory that it was useless to try to compensate for the static, and that the thing to do was to "pacify" the instrument by additional devices. The Applegate "static pickup," for which a patent has been applied, comprises a back contact relay and a high resistance shunt. The current enters the relay 1 and 2 through a 150-ohm coil or magnet, attracting the armature *C*. When the line opens

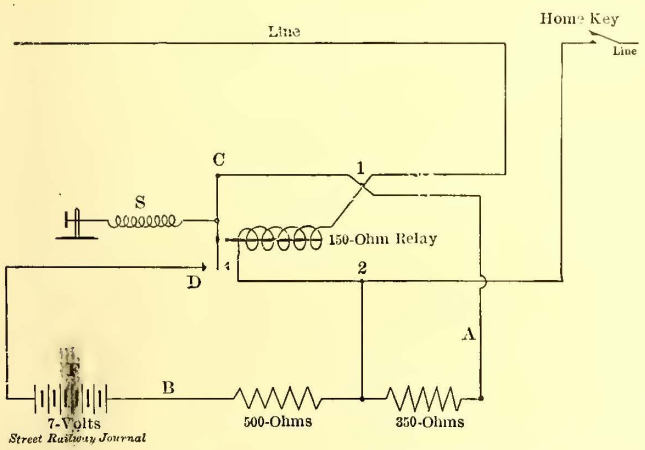


DIAGRAM OF STATIC PICKUP FOR TELEGRAPH RELAY

by any operator opening his key the armature *C* falls back and through the back contact connects points *C* and *D* by the aid of a spring *S*.

The shunt *A* consists of 350 ohms of carbon stick, and provides a better path for the static than do the magnets, pacifying the magnets to a certain extent. When the line opens and the armature connects with the back stop *C* and *D*, both the *A* and *B* shunts are in with the main line and pick up the static which escapes through shunt *A*, relieving the agitation of the armature so that it can respond to the closing of the line.

The shunt *A* robs the relay of main line battery current very materially, so that it responds to the home key sluggishly. Consequently the auxiliary battery *F* is inserted in shunt 2. When the armature *C* falls back this battery acts upon the magnets and assists their prompt response to the home key or to any other operator to such an extent that the shunt *A* does not cause noticeable drag. No matter what the line static may be these shunts "pacify" the instruments and the static is not felt.

The armature spring is adjusted high enough to overcome the wave of static that escapes *A* and *B* shunts. The aid of the 7-volt battery overcomes this adjustment and leaves the relay very prompt and satisfactory.

The resistance of the shunt *A* must be determined by the distance from the ground and battery at each end of the line. The nearer to the ground the less is the resistance of the shunt, as in close proximity to battery and ground the static is more pronounced and the effect of the main battery upon the relay is likely to be correspondingly diminished.

By this arrangement all the telegraph wires are "singled," and metallic circuits, the necessity for which was at one time pending, were discontinued, and the repeater service which they necessitated was also discontinued, and there is now a spare wire between Rochester and Mt. Morris through the entire zone of static interruption.

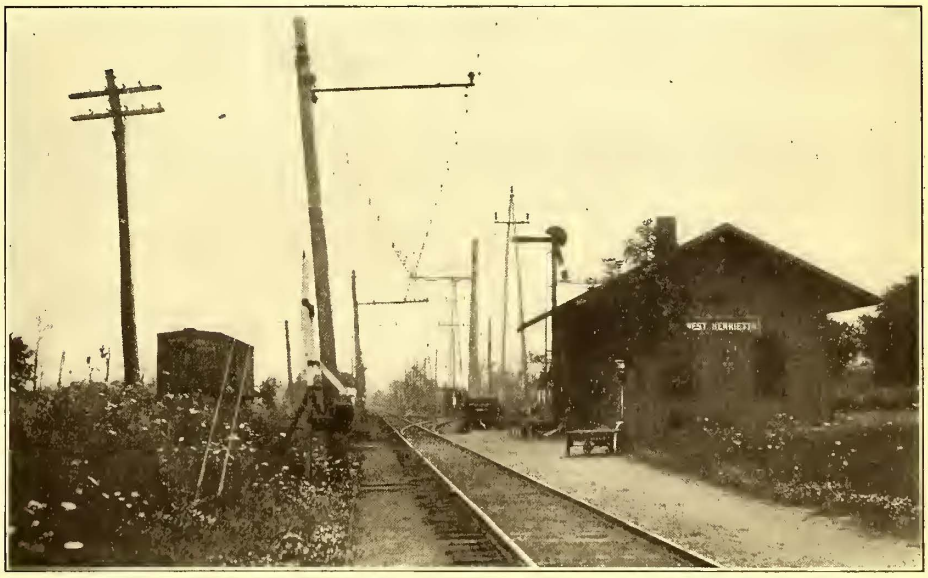
Speech over the telephone line is very clear and distinct, and although the wires and instruments have a heavy static charge, a few simple precautions enable it to be of great use to the operating department. It is intended to carry portable telephones upon the cars.

ORGANIZATION

The single-phase system was recommended for the electrification of this division by the Electric Traction Commission of the Erie Railroad, and after authorization by the company was installed under the general direction of J. M. Graham, vice-president and head of the construction department of the Erie.

The engineering and the construction work were carried out and the system brought into operative condition by Westinghouse, Church, Kerr & Company, who designed and erected the buildings and the catenary trolley construction, bonded the track and installed the electrical apparatus in the substation and on the cars.

The adjustment of the telegraph system was carried out jointly by the Western Union Telegraph Company and the telegraph department of the railroad company.



OVERHEAD BRACKET CONSTRUCTION MAIN LINE AND SIDING AT WEST HENRIETTA STATION

The order was given to the engineers on June 6, 1906, and although the intense activity in construction work all over the country at that time rendered it difficult to secure materials and labor promptly, the work was pushed so rapidly that about seven and one-half months later, on Jan. 22, 1907, the first official trial trip was run between Avon and Rochester. The severe winter weather thereafter prevail-

ing delayed the completion of the work until spring. During April and May the whole equipment of sub-station apparatus, lines and cars was thoroughly tried out in a course of experimental operation, which also enabled the railroad employees to become familiar with the new system. On June 18 commercial operation began and has since continued permanently with marked success.

The Erie is one of the oldest steam railroads in the country, but that it is also one of the most progressive is demonstrated by its policy of giving a thorough trial to a system of electric traction whose characteristics of simplicity in construction and economy in operation make it so eminently fitted to replace steam motive power wherever the economic conditions point to the desirability of its substitution, for the betterment of either passenger or freight service.

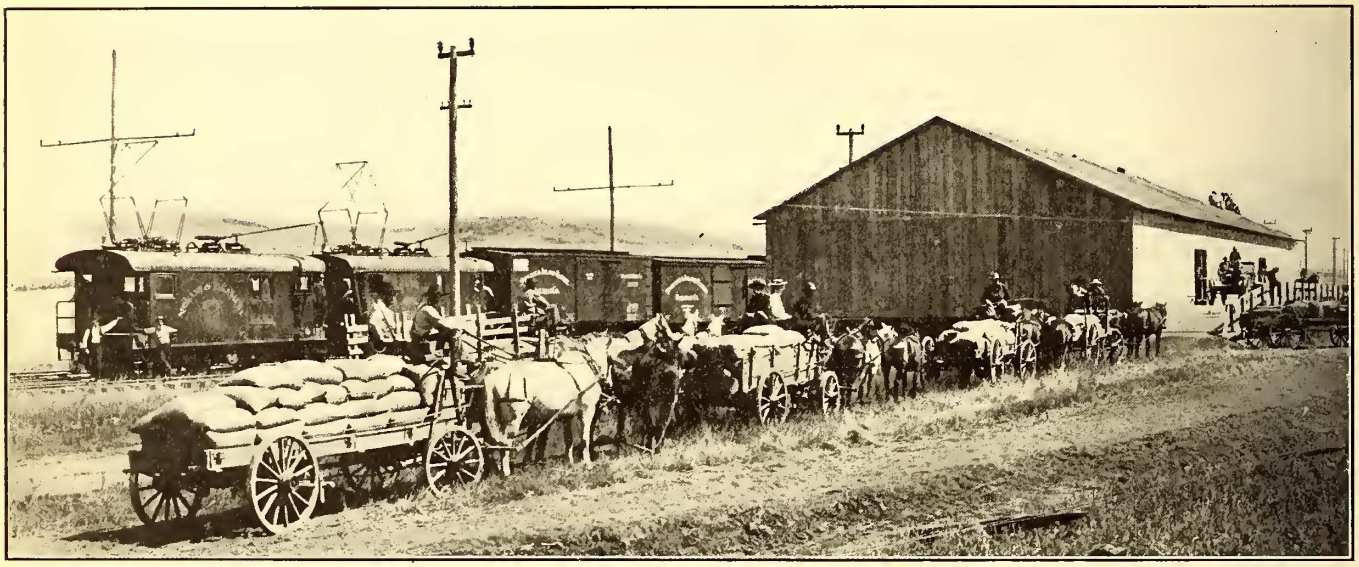
HANDLING FREIGHT ON THE SPOKANE & INLAND SYSTEM

Freight service on the Spokane & Inland Empire Railway was begun when the first section of the system was placed in operation a little more than a year ago, and with the opening of each succeeding extension has been extended, so that now the handling of freight is a very important branch of the company's business and plays a conspicuous part in the operation of the different lines. Properly to understand the character of this service, it is essential that one be acquainted with the territory seved and with the lines that extend from Spokane as the hub of the system.

Originally incorporated as the Spokane Interurban System, the Spokane & Inland built a line south from Spokane through Waverly, Rosalia, Thornton and Colfax, and surveyed for a line from the latter city to Penawawa, Wash., and Lewiston, Ida. A branch was built, however, from the main line approximately midway between Spokane and Colfax to Palouse City, and the Y-connected system between Spokane, Colfax and Palouse City is about 106 miles in length. The products of the territory are for the most part grain and lumber. The Spokane & Inland division intersects the main productive agricultural district of the Pacific Northwest, Whitman County holding the ten-year United States record yield per acre for production of wheat, oats, barley and potatoes. Conservative estimates made of this season's crops show 10,000,000 bushels of wheat, 40,000 tons of oats and barley lying tributary to the Inland Empire System. There is now in operation a chain of thirty grain warehouses along the company's lines, and as these granaries are located every few miles the farmers find it very convenient to ship over the Spokane & Inland Company's lines.

Single-phase compensated locomotives are used for freight handling, the freight-car equipment being made up of standard freight cars such as are used on the steam lines with which the Spokane & Inland interchanges traffic. These lines are the Great Northern, the Canadian Pacific and Soo lines. The agreement of the Spokane & Inland with these companies provides for the publishing of through rates over the roads with which equipment is exchanged. The company also has traffic connections with the Red Collar Steamship Line, which plies between Coeur d'Alene City and Harrison and points on the St. Joe and St. Maries Rivers, a distance of sixty-eight miles. The Red Collar Company has four steamers in operation, besides four tugs and six barges, all for handling freight.

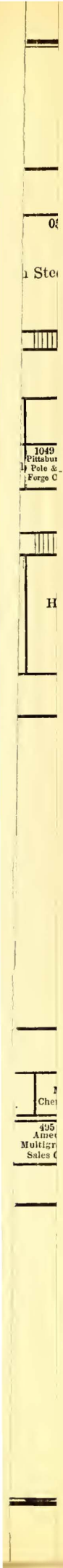
In this connection it is interesting to note that traffic over the Coeur d'Alene division has increased very rapidly, passenger traffic during the past year having gained 40 per cent. Freight traffic has grown even faster, jumping 75 to 80 per cent. On this division d. c. current is used, and for heavy freight hauling the locomotives are coupled in pairs, two of them being capable of hauling a train of fifteen loaded cars up a 2 per cent grade at eight miles per hour.

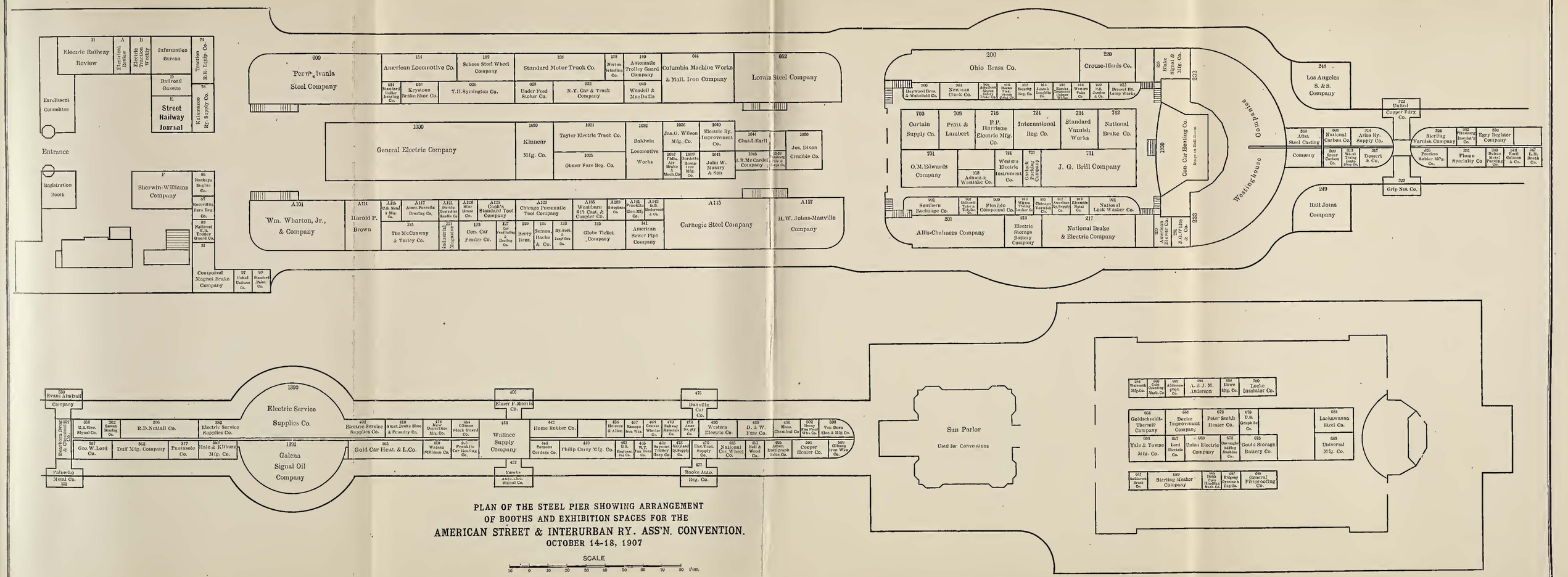


A SUBURBAN FREIGHT STATION, SHOWING TEAMS DELIVERING GRAIN FOR TRANSPORTATION OVER SPOKANE & INLAND

On the Spokane & Inland division, which runs in a southerly direction from Spokane, a distance of seventy-six miles to Colfax and Palouse, Wash., the company is handling freight with 50-ton 600-hp locomotives, of which it has six. These will be augmented in the near future, however, with eight 72-ton 700-hp locomotives.

The company's main freight yards in Spokane are 300 ft. x 2000 ft., and are located centrally with the Great Northern, Spokane International and O. R. & N. yards directly north, and the Northern Pacific yards directly to the south. The Spokane freight terminal, which is 40 ft. x 300 ft., is used by both the Coeur d'Alene and Inland divisions.





PLAN OF THE STEEL PIER SHOWING ARRANGEMENT
OF BOOTHS AND EXHIBITION SPACES FOR THE
AMERICAN STREET & INTERURBAN RY. ASS'N. CONVENTION.
OCTOBER 14-18, 1907

SCALE
10 0 10 20 30 40 50 60 70 80 Feet

STEEL TIE AND CONCRETE CONSTRUCTION ON UTICA & MOHAWK VALLEY RAILWAY SYSTEM, UTICA, N. Y.

BY M. J. FRENCH, Engineer of Maintenance of Way.

With each succeeding year, as the price of wooden cross-ties has advanced and the quality of the timber has decreased, the necessity for a more durable rail support has become more imperative. As the rolling stock of the city system has been changed from the single truck "bob-tail" type to the double truck car of 40 ft. to 50 ft. in length to meet the increased volume of travel, and as the larger and heavier interurbans have become a common sight in the crowded city streets, the track engineer has been compelled to devise a system of construction that will stand up under the severe treatment and exacting requirements now imposed upon it.

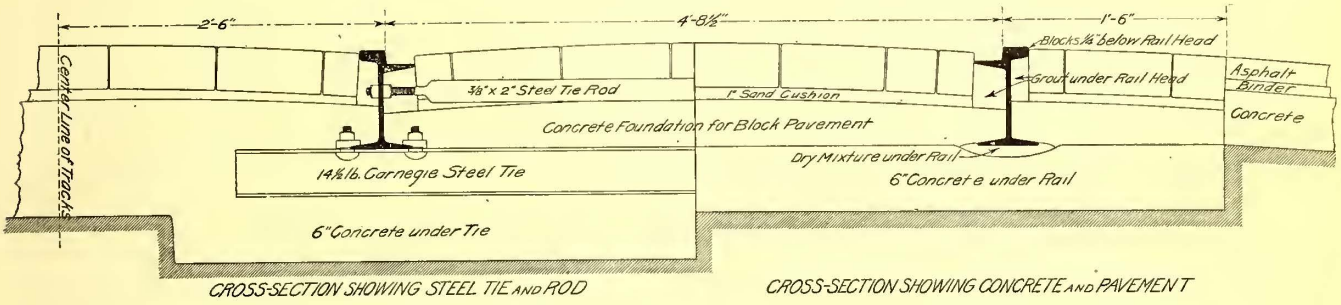
An additional burden is often imposed by the all-wise "City Fathers" in specifying in the franchise that a type of rail shall be used that all practical trackmen must admit is in its design opposed to safety in operation of cars and is more suited to the tires of the teamster's truck than to the wheels of the electric car. Then, too, the problem of laying and maintaining the specified kind of pavement is often one that in its solution calls not alone for ingenuity, but more especially for untiring watchfulness during construction, so that the chance of vibration and consequent disintegration of the pavement may be reduced to a minimum.

The cost of the old style stone-ballasted track has become appalling as wages have advanced and the quality of common labor has depreciated. With the advent of the steel tie and concrete construction some of the old problems have become easier of solution, but new ones have developed that require careful consideration.

On the city system of the Utica & Mohawk Valley Railway Company in 1905 the most approved type of stone ballast and wooden tie construction was employed with 9-in. tram head girder rails and vitrified block pavement laid on concrete. In a trench 23 ins. deep was placed 8 ins. of crushed limestone ballast, 6 ins. x 8 ins. x 8 ft. southern pine ties 2 ft. on centers were used and ⅜ in. x 2 ins. tie rods were placed at 6-ft. centers. The structure was concreted from the bottoms of ties to within 5 ins. of the tops of rails, the spaces between the rail head and base were filled with a grout of one part cement and two parts sand, and upon a 1-in. sand cushion 4-in. paving blocks were laid and grouted with Portland cement. The joints were welded with thermit. This type of construction costs $6.15 per lineal foot of single track, including all office and engineering charges.

The company has this year been using the concrete and steel tie construction with the same kind of rail and pavement at a cost of $5.45 per ft. of single track, girder rail being specified in the franchise. The ties used are the Carnegie type, weighing 14½ lbs. to the foot, 7 ft. long with a depth of 4¼ ins., a base of 6 ins. and an upper flange of 4 ins. Eight inches of excavation or nearly one-third the cost of excavation is saved in using this type of tie as compared with the wooden tie and also the expense of the entire 8 ins. of stone ballast is saved. The saving on cost of wooden ties is worth considering also. As every steel tie, with ties spaced 6 ft. on centers, takes the place of three wooden ties spaced two feet on centers, the relative cost would be $1.57 for the steel tie with four rail clips and four ¾ in. x 2½ ins. oval neck bolts as compared with 3 ties at 65 cts. each and 18 spikes at 1½ cts. each or a total of $2.22, thus making a saving of 10 1/10 cts. per foot of track.

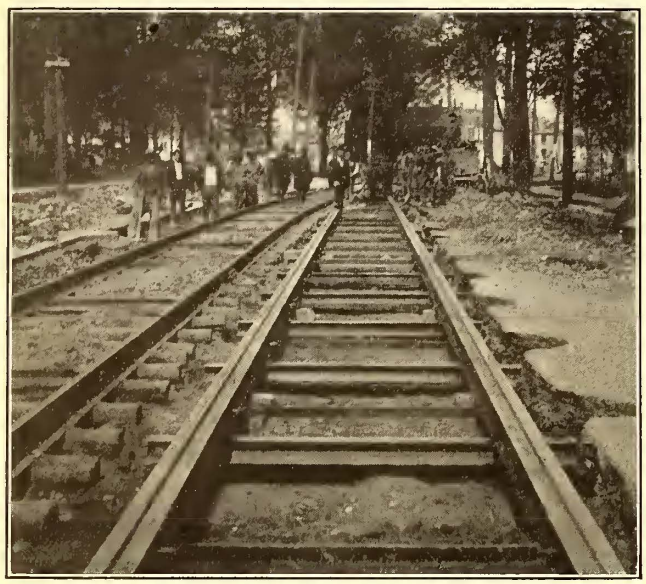
Our work this year consisted in reconstructing with double tracks a single-track section of our Whitesboro street line over which our interurban cars running between Rome and Little Falls are operated in both directions. As we were compelled to maintain traffic on the street we decided to divide the work in sections, the first of which comprised a section 1850 ft. in length from which old 9-in. tram-head rail was to be removed, and the second section was of 7-in., 70-lb. T-rails. On the first section a temporary track of 80- lb. A. S. C. E. T-rails and wooden ties was built on the side of the street before beginning excavation. The materials excavated consisted of sandstone and cobble paving on the railroad strip, and asphalt outside with a 6-in. foundation of old concrete pavement and then earth to a total depth of 15 ins. below the top of pavement. The old paving blocks were broken with stone hammers for use in concrete at a cost of 60 cents per cu. yd. and the old concrete was broken for about 40 cents per cu. yd. The cobbles were saved for use under curb stones. On the first section the paved street was so narrow that it was necessary to finish one track to a condition ready for paving and run the cars on that before the excavation for the second track could be done. On the second section excavation was made for double tracks by lowering the old track to sub-grade and then it was thrown to one side to allow construction on the other side of the trench.



CROSS-SECTIONS OF LATEST TRACK CONSTRUCTION ON THE CITY LINES OF THE UTICA & MOHAWK VALLEY RAILWAY

The steel ties are placed on the sub-grade approximately six feet apart, the 9-in. girder rails (Lorain Sec. 95-297) are placed on these, being fastened together temporarily by standard ribbed 12 hole plates having four bolts per joint. The rails are raised from the ties to allow the ties to be moved under the tie-rod holes, spaced 6 ft. centers. The ties are then held firmly in place by a nipping bar on a block fulcrum while the standard Carnegie clips are tightened down on one rail by button-head bolts, the upper

flange of the steel tie being punched by the manufacturer to receive the button, thus preventing the turning of the bolt. The tie rods are then placed and tightened to bring the rails to gage and the opposite rails are bolted down to the ties. After lining the track approximately surfacing is done by raising the track slightly above grade on wooden blocks about 15 ins. long cut from old ties and shims split from the same material. Then the track is lowered to final grade at the grade stakes by striking the wooden blocks



SECTION OF TRACKS LINED AND SURFACED ON BLOCKS READY FOR CONCRETE

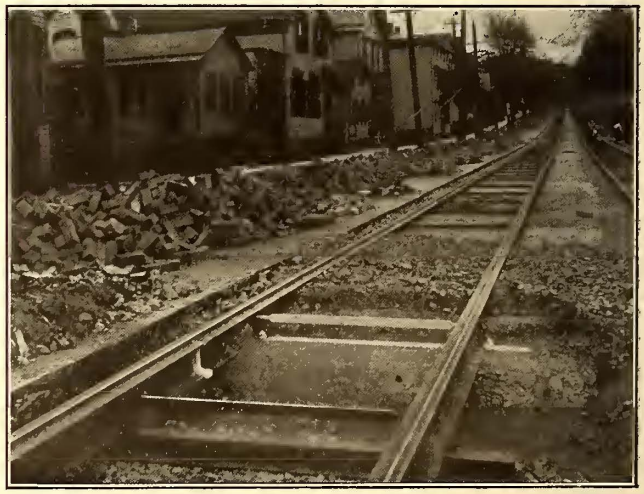
with a heavy maul, thus bedding them solidly in the sub-grade, after which the rails are lowered in the same manner to true surface throughout. Some rails are surface bent and in such cases the surfacing must be accomplished by weighting down the rail with wooden ties or large stones in case the rail is convex, the weight remaining in place until the steel ties are concreted in. If the defect is concave in form, the rail is left unconcreted at the defective portion until the concrete on either side has become set when the low spot is jacket up and blocked, after which the concreting is finished. In surfacing the track a block is placed under the rails alternating with the steel ties, but the ties are not blocked up for surfacing.

The next step in the work consists in checking up the distance between base of rails and sub-grade to insure the required depth for 6 ins. of concrete, but no backfilling is done if the depth is more than 6 ins. Then a trench having a depth of 6 ins. and width of 18 ins. is dug underneath and parallel with each tie to receive the concrete reinforcement. In this trench a dry mixture of one part cement. three parts sand and six parts crushed stone is placed, after which the mixture is thoroughly tamped under the tie with tamping picks, care being taken not to raise the track from its bearing on the wooden blocks. Often the sand or stone is damp, resulting in the mixture tamping to a very compact mass. This mixture absorbs moisture from the ground and the wet concrete placed upon it, becoming in a few days the hardest concrete in the work. The advantage in using the dry mixture is that there is no shrinkage away from the bottom of the tie in setting and the track is supported so that the blocks can be removed as the regular foundation is laid.

The foundation proper consists of a 1:3:6 mixture thoroughly hand mixed. Space on the street is so limited after the concrete materials are delivered that no room is available for a machine mixer. The sand and stone are measured in wheelbarrows, the sand and cement being first mixed to a uniform color by turning with shovels, then wet to the consistency of soft mortar. The stone, thoroughly wet, is then wheeled on to the mixing board and the aggregate thoroughly turned over. The mixture is placed by shovel as directed by the spreader and is carried well up to the tops of the ties. Two laborers thoroughly tamp the mixture against the web and under the top flanges of each steel tie. Another laborer with wooden pounder tamps the concrete to a compact level mass and another man with flat bladed shovel crowds out the concrete from under the base of the rail, leaving a space from ½ in. to ¾ in. in depth under the rail. The surfacing blocks are removed from each section between the steel ties just as the filling of concrete is brought up to them.

At this point the track is carefully looked over for imperfections in line and grade and where the fresh concrete is disturbed it is thoroughly retamped. On the following day a dry or slightly moist mixture of one part cement and four parts sand is thoroughly tamped into the space left under the base of rail on the previous day. The tampers use tamping bars and work in pairs, striking the mixture directly opposite each other at the same time, thus thoroughly filling the space with a solid mass and avoiding the slight air space that always forms from the shrinkage when wet concrete is carried up from sub-grade over the base of rail. The concrete is omitted at the joints, and where it has been found necessary to block up the joints to secure proper surface, as often is the case, the blocks are also left in place, until the concrete sets.

After the dry mixture is thoroughly tamped a second gang of concreters places the top coat forming the founda-



DETAIL OF TRACK CONSTRUCTION, SHOWING CONCRETE CONSTRUCTION WITH STEEL TIE EMBEDDED IN CONCRETE FOR PAVEMENT AND THERMIT JOINT

tion for the pavement. As one track is constructed at a time the center strip is concreted only half way and is left with a ragged edge that is thoroughly scraped and wet to secure a good bond when the second track is concreted. The top surface of the pavement foundation is worked true to templates resting upon the rails to give 1 in. crown between rails and between tracks. Between the rails of each track the concrete is brought up to within 4½ ins. of the top of tram. With a sand cushion of 1 in. and a Mack paving block 4 ins. deep the stretchers form a half groove and ease wagon wheels across the rails. The concrete in

the center strip and outside of the outer rails is kept 5 ins. below the rail heads, and the blocks on this portion are laid ¼ in. below the rail heads to prevent crushing of the blocks by false flanges on wide tired wheels.

Welding of the joints takes place after the concrete has set, the work being done substantially as described in the article published in the Street Railway Journal of Jan. 12, 1907. Every sixth joint is left as an expansion joint until the paving is completed, to insure against breakage from contraction of the rails during cool nights.

As the railway company was given the franchise on this street under the condition that it maintain the entire pavement, 36 ft. in width, for a term of twenty-five years and the new rails will undoubtedly be replaced before the expiration of that period it was deemed advisable to pave outside of the outer rails a strip only 18 ins. in width instead of the regulation 2 ft. as the entire brick strip would be disturbed in renewing the rails, it being found cheaper to take up and relay all of the blocks than to cut out the toothing and patch in again.

The railway strip is paved with one row of paving blocks laid as stretchers on both sides of the rail, the balance of the pavement being laid with blocks at right angles to the stretchers. After the pavement is swept clean and pounded to an even surface by two men with a regulation paving pounder striking upon a hardwood board the blocks are grouted in with a mixture of equal parts of Portland cement and fine quartz sand. These are first thoroughly mixed dry in a mortar box, water is added to make a mixture that flows easily and when the box is dumped the grout is thoroughly brushed into the joints with push brooms. This operation is repeated after the first flushing has settled and become partly set thus filling all joints. One barrel of cement makes sufficient grout to flush about 20 sq. yds. of pavement. When the grout has taken on its initial set the head and tram of the rails are scraped clean.

After the paving is grouted the expansion joints are welded and concrete is placed to within ½ in. of rail base. After 24 hours the dry mixture of cement and sand is tamped under the rail as in the regular construction, the top coat of concrete is placed and the joint is paved in.

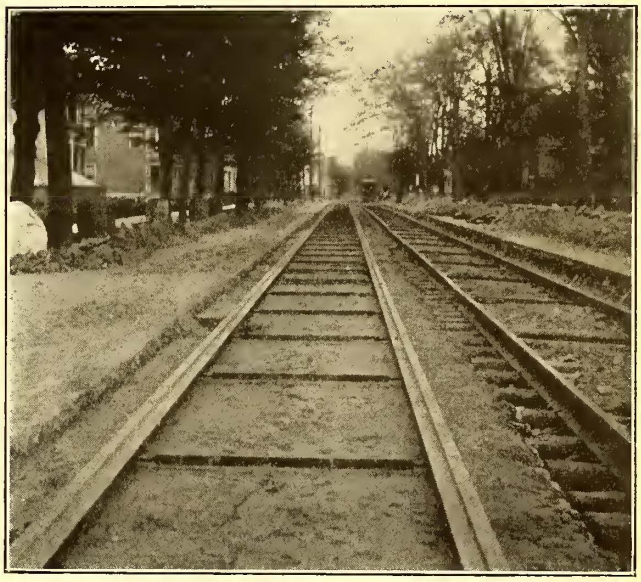
Of 281 joints welded but three were defective; in two of these the thermit did not adhere to the rail and was broken off with a sledge; in the third the rail broke outside of the weld and was rewelded without difficulty.

Standard cast-iron track inlets 10 in. wide by 4 ft. long are placed in pairs at a distance of 500 ft. apart. This inlet has a cover perforated with 46 holes in two rows 1 in. x 2½ ins. in size and the bowl slants towards an 6-in. nozzle at one end that is piped directly into the street sewer. This inlet is set with the top of grate 1 in. below tram of rail and the tram is cut away on the up-grade side for a distance of 18 ins. The paving is lowered to form a basin and thus the water is prevented from flowing past the basin on the tram of the rail. The cut edges of the trams are ground down with an electrically driven emery grinder to prevent cutting of rubber tires.

Following is a summary of cost of labor on the various subdivisions of the work:

Placing and removing temporary track, 31 cts. per ft.; excavation per cu. yd., including hauling, $1.05, or per lineal ft. of single track, 46 cts.; track laying and surfacing per ft. of single track, 19 cts.; thermit welding per joint, including labor on moulds and crucibles, $1.24; concreting per cu. yd., including dry mixture under ties and under rail bases, $1.51, or concreting per ft. of single track, 45 cts.; delivering track materials per ft. of single track, 4 cts.; delivering concrete materials, including loading and hauling of sand 19 miles by work train and breaking of old concrete and stone to use in new concrete, 13 cts. per ft. of single track; placing track basins, two basins being located every 500 ft. of single track, $8.64 per basin or 2 cts. per ft. of single track; delivery of paving materials, including loading of blocks at store yard, 11 cts. per ft. of single track; hauling away old materials, including old rails, wooden ties, scrap, old paving materials and cobbles, 3 cts. per ft. of track; cleaning up street, including removal of unused materials, broken bricks and regrading of lawns between sidewalk and curb, 10½ cts. per ft. of street; flagmen and switchmen per ft. of single track, 8 cts.; timekeeper and watchmen per ft. of single track, 5 cts.; engineering, superintendence and inspection, not including time of foremen, 9 cts. per ft. of single track. The total cost of labor per ft. of single track was $2.19.

The item of excavation seems high but as it consisted partly in breaking up and removing a section of 4600 ft.



ONE TRACK READY FOR PAVING; OLD 7-IN. T-RAIL TO BE REMOVED FOR SECOND TRACK

of "Silicia-Barytic" pavement, and old patented concrete pavement about 6 ins. thick, upon which asphalt was subsequently laid, and about 1000 ft. of Telford pavement with foundation of building stones set on edge, the cost is not excessive.

The wages paid per hour for labor are as follows: Foreman in charge, 30 cts.; track foreman, 27½ cts.; foreman on excavation, 25 cts.; concrete foreman, 25 cts.; teams with patent dump wagons, 45 cts.; with common wagons, 40 cts.; track men, welding helpers and concrete surfacers, 17½ cts.; common laborers, 15 cts.

Later we built 1500 ft. of double track construction, using Lorain Sec. 95-400, a 7-in. T-rail with 3-in. head and 6-in. base, the T-rail that is recommended by the committee on standard rails of the American Street & Interurban Railway Association for use in paved streets. We used the same type of concrete and steel tie construction on this work. The center strip is 6 ft. wide on this work and 5 ft. on the girder-rail construction previously described. Instead of using an Arthur hump block in paving against this rail on the flange side a standard Metropolitan block was used under and parallel with the head, packing the block in place with a slightly moistened mixture of one part cement and

four parts sand, using a block of wood as a tamper. A flangeway was formed by laying blocks at right angles to and with top surface ¾-in. above those under the rail head. The total cost of labor per ft. of single track was $2.207, or about 2 cts. more than the girder track construction. While there was 2 ins. less excavation in depth than with the 9-in. rail the total width of trench was 1 ft. more, due to the wider center strip and there was an average of 1 ft. extra excavation in depth on account of the readjusted grade being lower than the original surface of the street.

MAXIMUM LENGTH OF SERVICE FOR POLES, TIES AND TIMBERS

BY EDWARD J. WEIHE.

The reduction of depreciation and the cost of maintenance by securing a greater length of service for wood poles, ties and timbers, is a subject that is forcing itself rapidly upon the management of public-service properties. In justice to the future dividends of these properties, definite action can no longer be deferred, yet the busy manager and his heads of departments often find little time to sift so seemingly abstruse a problem. The writer believes he can do them no greater service than to present the facts essential to a thorough understanding of this subject.

THE STRUCTURE OF WOOD

On examining the cross-section of a tree, we notice, first, a light colored wood next to the bark, and next to it, a darker colored wood that extends to the center of the tree. The darker or heartwood is mature wood and differs from the lighter wood in that it is no longer active in the production of growth. It is much more dense; its cell-walls are thicker; its cells contain more resin and tannin and less water, albumins, sugars and starches. The lighter or sapwood is the growing wood. Each year it adds a little to the diameter of the tree by what is seen as a ring. As time passes the inner rings of sapwood become transformed into heartwood. The sapwood is, therefore, the soft, nutritious wood, full of water, sugars, starches, albumins, etc.

If a very thin cross-section of wood is held to the light, we see that each ring is made up of minute pores. If we place a very thin longitudinal section of wood under the lense of a microscope which will magnify the object examined several hundred times, we find that these pores are really cross-sections of cells that are many times as long as they are broad and taper to a point at each end. The sides of these spindle-shaped cells cohere firmly by what is called the middle lamella, and "break joints" by over-lapping each other. In this way they form the long tough fibres of wood. Such an aggregation of cells is called wood-tissue or cell-tissue. A conspicuous example of simple cell-tissue may be seen in the pulp of an orange, and gives some idea of the appearance of the microscopic cells of wood-tissue as they appear when highly magnified. In hard woods the walls of these cells are very thick as well as dense, while in soft woods they are much thinner. Differences in the strength of timbers are due to differences in the form and disposition of these cells.

Although the highest magnifying power that can be brought to bear on wood-cells fails to reveal any apertures in their walls, they are readily permeable to certain liquids. The cells must, therefore, be porous, not only in the sense of having an interior cavity, but also in having in their apparently imperforated walls, innumerable channels through which liquids may pass. The energy with which wood-cells absorb water may be gathered from a well-known fact. In granite quarries long blocks of stone are split by driving plugs of dry wood into holes drilled along the desired line of fracture and pouring water over the plugs. The liquid penetrates the wood with immense force, and the toughest rock is easily broken apart.

HOW WOOD DECAYS

Not until the epoch-making researches of Pasteur and his school was it positively understood that decay is due to low forms of plant-life called fungi. The toadstool, mushroom and bracket-fungus are familiar examples of fungi of large size, while ordinary mould and mildew are examples of the smaller kinds.

At the proper season these fungi give off clouds of microscopic, dust-like substances, as seed, called spores, and the wind blows them in all directions. These spores must have water, air, food supply and some heat in order that they may grow, and these conditions are generally fulfilled when they come in contact with unprotected wood. Once in contact, they begin to secrete a substance known as an enzyme. This enzyme has the power to dissolve its way through the cell-walls of the wood, where it converts the sugar, starch and albumin into soluble form. The spores of the fungus absorb this converted matter, and, having taken food, they grow. The single cells which constitute the spores, at first elongate and then divide by cleavage. The newly formed cells again divide, and soon we have numerous thread-like bodies instead of the original spores. This goes on with great rapidity and these threads form a net-work, called a mycelium, which invades the wood-tissue in all directions. Layer by layer the new or sapwood gives up its food elements, each year's growth of wood presenting a slightly greater barrier to fungus, until it reaches the darker or heartwood. This, as explained, contains less food and harder cell-walls and consequently the fungus makes slower, though equally certain progress, until all of the wood is consumed.

There are a great many kinds of fungi. Some confine their action to one set of food elements in the wood; while others attack certain other constituents, but all have the same general method of action.

SEASONING OF TIMBER

As already stated, there are four conditions essential to the growth of the fungi which cause decay. Therefore, if we take away either of these four essential conditions, we prevent decay. For instance, if we place wood entirely below the surface of water or several feet below the surface of the ground, we exclude one of the conditions, air, and the wood will not decay. If we take away the condition of moderate heat the wood will not decay. Below 32 degs. F. and above 150 degs. F. no decay occurs. If timber is cut at that season of the year when it contains the least amount of sap, which forms the food-supply of the fungi, its length of service will be materially increased. Likewise if we thoroughly dry the wood by proper seasoning, we exclude the water condition necessary for the fungi to grow, and the wood resists decay.

Timber seasoning is therefore a most practical method of increasing the life of both untreated and treated timber. At the same time it forms the most important preliminary step to successful chemical treatment, while its cost in interest on investment and labor is insignificant, considering returns. Furthermore, seasoning saves considerable in freight charges when it becomes necessary to ship timber

long distances. Green wood contains upwards of 50 per cent water, but when exposed to the sun and air the water rapidly evaporates, until, in its thoroughly air-dried state, but 15 to 20 per cent remains. The space occupied by the evaporated water is replaced by air, which occupies as high as 60 per cent of the bulk of seasoned wood. Seasoning results in considerable shrinkage in the contents of the cells of wood, making more space for the preservatives to enter, and the starches, sugars, albumins, etc., so dessicated, do not invite attack by the fungi.

PRECAUTIONARY MEASURES

All timbers should be removed from the vicinity of decaying wood as soon as it is cut and the bark removed. The timber should then be piled so as to allow the greatest amount of air circulation between the pieces and, in rainy districts, so that the upper pieces will form a roof. Any piece showing signs of decay should be immediately removed, as one unsound piece will infect the whole pile. Storage yards for ties, poles and timbers should have ground covered with cinders, gravel or "dead sand," and be well drained. All vegetation should be kept down and all decayed wood should be promptly removed and burned.

Seasoning increases the strength of all timber. Steaming weakens all timber. Ties should be air-seasoned from six to twelve months before chemical treatment, depending on the kind of wood used. Poles should be seasoned as long or longer, depending on diameter.

The treatment given to each piece of timber should be varied, according to its dryness. Tie timbers should be halved or quartered, treated and, when layed, turned heart side down. No trimming, framing, boring or cutting should be allowed after timber has been treated unless such parts are again treated to as much preservative as will be readily absorbed.

Dogs, pike-pole points or cant-hooks should not be used on those parts of treated poles or piles which enter the ground or water. The use of tie-plates and the adoption of screw-spikes, as recommended in Bulletin 50 of the Forest Service, will prove a great economy. No strips of iron or plates should be fastened tightly on the bases of poles as is often done to protect them from mechanical injury, as this induces decay by confining moisture in the parts so covered. If plates are necessary they should be attached in such a manner as to leave an air-space between the plate and the surface of the pole.

All of these suggestions are easily carried out, cost practically nothing and will produce a very material increase in the length of service of ties, poles and timbers.

CHEAPER TIMBERS AVAILABLE'

The following is a list of the cheaper timbers available for railway purposes:

Northern & Eastern U. S.	Central U. S.	Western U. S.
*Red Oak Family.	*Red Oak.	*Loblolly Pine.
*Loblolly Pine.	*Swamp Oak.	*True Firs.
*Chestnut	*Loblolly Pine.	*Yellow Pine.
Carolina Pine.	Hemlock.	*Lodgepole Pine.
Hemlock.	Black Gum.	Tamarack.
Maple.	Beech.	Hemlock.
Beech.	Tamarack.	Eucalyptus.
Birch.	Cottonwood.	
Ash.		
Elm.		

N. B.—Those marked with a star should receive most consideration.

By proper treatment these timbers can be made to replace successfully the now prohibitively high-priced woods, such as white oak, longleaf pine and cedar. The red oaks and black oaks have every quality of an ideal tie when properly treated.

Most of these timbers are quite porous and take treatment readily. Loblolly pine, red oak, birch and Norway pine take treatment easily, while hemlock, tamarack, spruce and Douglas fir are among the refractory timbers. The latter, however, yield to treatment by longer heating during treatment. Dense timbers, if difficult to penetrate, are also slow to lose the preservative.

PRESERVATIVE TREATMENT

With the knowledge of what has already been said about the structure of wood and the causes of decay, we can easily see that if we can introduce substances into the wood-tissue that have a poisonous action on fungus life we shall prevent decay as long as those substances exert this influence in the wood. An effective preservative must therefore be powerfully antiseptic and its nature must be such as not to injure the wood fibers. To remain in the wood it must not be volatile or capable of being leached out by water. Furthermore, the preservative should have great penetrating power.

Going carefully over the history of wood-preserving, both here and abroad, beginning with the railway era, we are lead to the conclusion that, of more than 200 substances tried for the preservative treatment of timber, the test of time has eliminated practically all but two: coal-tar creosote and zinc chloride.

Data extending over more than fifty years show that these substances, when properly applied, will double the life or durability of wood. They are now used to the practical exclusion of all others, both here and abroad. Creosote comes nearer to being an ideal preservative than zinc chloride. The solubility of the latter in water proves a detriment for some exposures, but when used in combination with creosote this objection is overcome. The zinc chloride must be free from hydrochloric acid and iron.

The creosote, tar-oil, dead-oil or heavy-oil, as it is variously called, must be the product of coal-tar and free from any form of petroleum. Only the heaviest oils should be used. Those containing a considerable percentage of anthracene, acridine, etc., are best.

Redistillation of creosote oil, by accurately gaged temperatures, to secure that fraction of the oil which contains the greatest amount of active principles, is now gaining headway in this country and renders it possible to get the full value of this oil for application in a concentrated form.

APPLICATION OF PRESERVATIVES

There are various methods of applying wood preservatives; many require elaborate and expensive plants and for this reason are out of the question for general adoption. For well seasoned and dry wood the brush method is commonly used. This consists in applying two or three coats of the hot or cold preservative with a wire-bound brush. Dipping convenient-sized pieces in the hot or cold preservative is also productive of good results on well seasoned wood.

But for wood that is to be placed in contact with or in the ground, and particularly where partially seasoned wood only is available, what is known as the "open-tank method" of application is rapidly replacing other methods. The cost of installation brings it within the reach of every public service property, and by it poles, posts, ties and timbers may be treated economically and effectively.

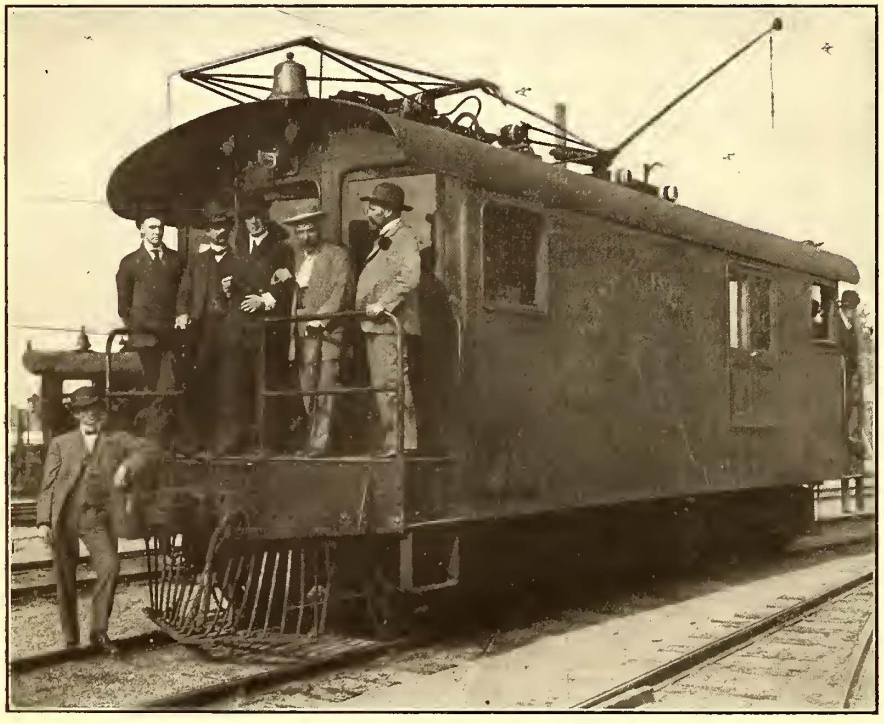
THE OPEN-TANK METHOD

This method requires an open tank, made preferably of

¼-in. steel or iron and arranged so that a fire can be built underneath it, or, better still, so that it may be equipped with steam coils.

Sufficient preservative is run into the tank to cover the portion of the timber which is to be treated, and the temperature of the liquid is raised and maintained between 100 and 110 degs. C. for several hours—three to six hours generally for seasoned wood, depending on its character and condition.

We know that air occupies as high as 60 per cent of the bulk of seasoned wood. According to the familiar law of physics, air expands 1/273 its volume for every degree C. that it is heated. Consequently when we heat the timber in the preservative from about 20 degs. C. to slightly above 100 degs. C., the air in the wood expands about one-third in volume and, in forcing its way out of the wood, expels much of the moisture from the cell walls. This air rises to the surface of the hot preservative in the form of small bubbles and the moisture leaves the oil in the form of vapor.



MEMBERS AND ESCORTS OF THE ROYAL COMMISSION

After the timber has been heated a sufficient length of time the heat is shut off and the preservative is allowed to cool, or, better still, the timber is taken out of the hot preservative and submerged immediately in a tank of cold preservative. The air still in the wood now rapidly contracts and tends to form a vacuum, which draws in the preservative with considerable force, securing deep and thorough penetration. The depth of this penetration can, to a degree, be regulated by the length of time the timber is allowed to remain in the cold preservative. A lateral penetration of half an inch may be obtained in poles by this method.

For timbers too large to be transferred during treatment the plant should consist of a treating tank, a supply tank and a receiving tank. This equipment will make it possible to shorten the treatment by running out the hot liquid into the receiving tank and admitting the cold liquid simultaneously from the supply tank. The preservative can later be pumped back into the supply tank.

Given a high-grade preservative, carefully applied by this simple method to wood that has been allowed some time to season, an increased life many times greater than the cost of treatment is positively assured.

ROYAL COMMISSION OF GERMANY AT SPOKANE

The royal German electric railway commission, whose trip to the United States was noted in these columns several weeks ago, was very much interested in the single-phase system of the Spokane & Inland Railway. The commissioners were entertained in the absence of President Graves by other officers of the company, Vice-President A. L. White, Wm. F. Zimmerman, J. B. Ingersoll and F. H. Shepard, special representative of the Westinghouse Company. The party was taken in the president's special car 40 miles south to Spring Valley Junction, the round trip being made in a little over two hours. Upon the return the Commission inspected the Inland's big electric freight locomotives. A train of fifteen standard freight cars was attached to one of the electric locomotives and taken as far south as Moran Prairie on a 2 per cent grade. Several stops were made and the members of the Commission were amazed at the ability of the locomotive to stand the heavy overload without the least damage to the apparatus.

PERSONNEL OF THE COMMISSION

The Royal Commission visiting Spokane was in charge of Geheimrat Wittfeld. Other members of the Commission were Director Friedrich Jordan, of Felten, Guilleaume, Lahmayer Company; Director Emmerich Frischmuth, of Siemens Schuckert Company; Director Philip Pforr, of the Allgemeine Elektricitats Gesellschaft, and Dr. Ing. Walter Reichel, eminent engineer and professor of electricity in the Berlin Polytechnic School.

Speaking for the members of the Commission, Geheimrat Wittfeld said: "We were very agreeably surprised in Spokane and the surrounding country. It seems almost incredible that all these fine buildings could have been built and the city grown to nearly 100,000 population in twenty-five years. We have read much about the success of the new Spokane & Inland Railroad, which has been commented upon in the German press, and what we have seen here has more than repaid us for coming across the continent. The substantial and permanent construction of the road, especially the overhead work, and the completeness of detail, is also a surprise to us. Taken altogether the Spokane & Inland is undoubtedly the best equipped electric railroad of equal mileage in the world."

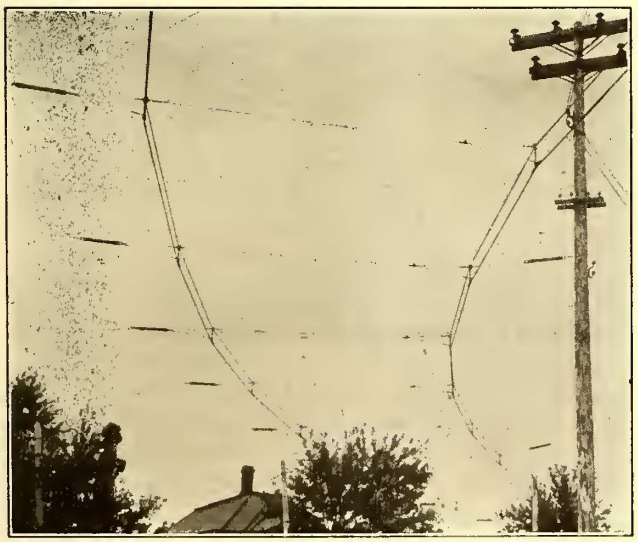
During the trip several of the party were photographed while standing on one of the locomotives. This photograph is reproduced herewith. The gentlemen shown, reading from right to left, are Messrs. Pforr, Wittfeld, Zimmerman, Jordan, Randall and Ingersoll. Geheimrat Wittfeld and party have already investigated the New York, New Haven & Hartford Railroad and the Erie Railroad in the East, and are now returning by San Francisco and the southern route.

IMPROVEMENTS AND EXTENSIONS ON THE INDIANAPOLIS & CINCINNATI TRACTION COMPANY'S LINES

The original Indianapolis-Rushville line of the Indianapolis & Cincinnati Traction Company now represents less than half the mileage of the lines operated by the company. The line of the Indianapolis, Shelbyville & Southeastern Traction Company from Indianapolis to Shelbyville, has been leased and this together with a 17.21-mile extension to the Rushville division and an extension of 21.24 miles to the Shelbyville line is now operated by the company. Excluding 4 miles of city track in Indianapolis, over which the cars are run to the Indianapolis Traction & Terminal building near the center of the city, the system has about 100 miles of track. The lines are operated from executive offices in Indianapolis by Charles L. Henry, general manager, through whose courtesy the following account of the improvements and extensions on the system is presented. The operating offices are at Rushville.

In addition to the construction of the two extensions that on the Rushville division from Rushville to Connersville, and that on the Shelbyville branch from Shelbyville to Greensburg during the past year the old portion of the Shelbyville line has been changed over for alternating current operation, and extensive changes in the roadway have been made to cut out sharp curves. Other improvements on the system consist in additions and changes in the power-house at Rushville, and abandonment of the old Shelbyville power-house, the construction of a cross-country high-tension line from Rushville to Shelbyville and a complete alternating current feeder system for the Shelbyville line.

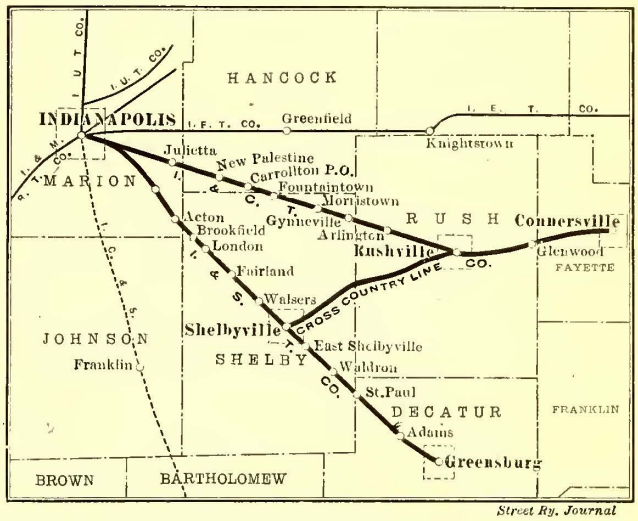
A substantial brick freight station has been built at Rushville, a brick building which serves as a car house and freight depot has been erected at Greensburg and combination passenger and freight stations with living quarters for the agent have been constructed at several of the more important stations along the line.



OVERHEAD CONSTRUCTION AT A CURVE ON THE RUSHVILLE LINE

THE CONNERSVILLE EXTENSION

Of the two extensions that to Connersville is the most interesting from an engineering standpoint, because of the rough country through which it was pushed. The heaviest grading was necessary at Williams Creek, about ten miles west of Connersville, where there was a variation in the level of the unbroken ground of 150 ft. in one-half mile. At this point a concrete arch with a 50-ft. waterway was built over the creek, and a fill 65 ft. high was made. The arch has an 80-ft. parapet wall. The fill, which was made wide enough for a double track, is about 900 ft. long and contains approximately 65,000 cu. yds. of earth. The dirt for the fill was obtained from heavy cuts at each end; the cut at the west end being about 30 ft. deep. At another point on the line a 30-ft. concrete arch was built.



MAP SHOWING ROUTE OF THE INDIANAPOLIS & CINCINNATI TRACTION COMPANY

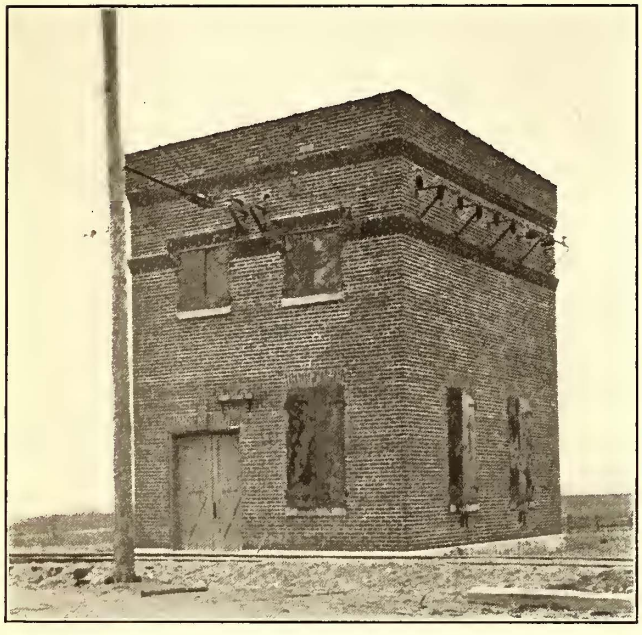
VIEW ON THE CONNERSVILLE EXTENSION, ILLUSTRATING OVERHEAD CONSTRUCTION AT SIDINGS

The Pennsylvania steam railway between Rushville and Connersville makes a detour to the north to avoid the rough country, with the result that the electric route is about three miles the shorter between the two towns.

The Greensburg extension of the Shelbyville line passes through comparatively level country. The only noteworthy

structure on this line is a viaduct over the Flat Rock River near St. Paul. The central portion of the steel structure is carried by two concrete piers built up to a point about 20 ft. below the track.

The Connersville extension is built on a private right of way 66 ft. wide. As in the construction of the portion of the line from Indianapolis to Rushville, the extension has been built with a view of ultimately double tracking it. For practically the entire distances a roadway 28 ft. wide has



GLENWOOD SUB-STATION ON THE CONNERSVILLE EXTENSION

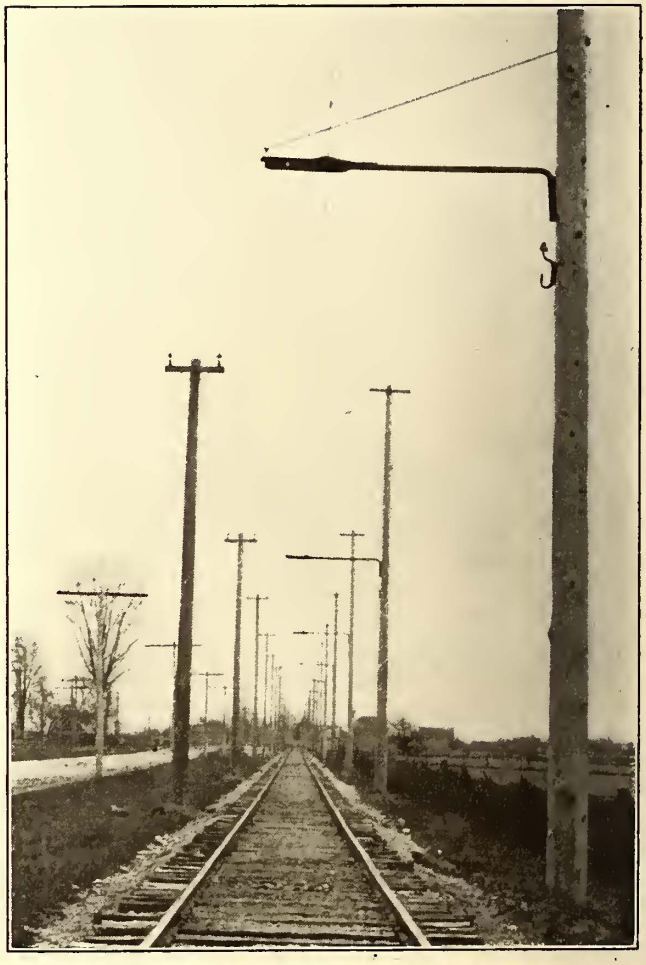
been built. The cuts are 36 ft. wide at the bottom. Provision is made for double tracks with 14-ft. track centers and center-pole trolley construction.

The roadbed on both extensions is ballasted with 8 ins. of gravel under the ties, the ballast being obtained from gravel banks along the line. The ties are of white or burr oak placed two feet apart. The rails are 70 lbs. and are in 60-ft. lengths. They are laid broken.

The maximum grades on the new extensions, and these are on the Connersville line, are 3 per cent. Every advantage was taken of the topography of the country to make these velocity grades. There are no curves on them, with the result that no braking of the cars is necessary, and there is no loss of energy due to them. Vitrified clay pipe served for waterways up to 36 ins. in diameter, and cast-iron pipe was used for openings from 3 to 5 ft. in diameter. The larger waterways are of concrete construction. On the old portion of the Shelbyville line the direct-current trolley and feeder construction were entirely removed and were substituted by a bracket catenary construction practically identical with that on the old Rushville division. As on the old division an independent pole line was erected to carry the high-tension feeders to the transformer stations, and the same catenary and high-tension construction employed on both the new extensions. The trolley poles are 40 ft. high and are placed 120 ft. apart. At the top a cross arm carries four telephone wires which are transposed every fifth pole. The brackets, which are made somewhat heavier than those on the original Rushville line, consist of an angle iron with a right-angled bend for attachment to the pole at one end and a loop over which the porcelain messenger insulator is supported at the outer end. The trolley is placed 18 ft. high and is suspended on tangents from the messenger by hangers placed 10 ft. apart. The hangers vary in lengths from 11 to 6 ins. The trolley is protected by Westinghouse lightning arresters placed one-third of a mile apart and are grounded to a ¾-in. iron pipe driven into the ground. The poles of the high-tension lines are 35 ft. high and are placed 115 ft. apart.

ADDITIONS TO POWER HOUSE

In the original construction of the power station building at Rushville, two 500-kw units consisting of Corliss cross-compound engines and Westinghouse generators were installed and space was left for a third unit. In the meantime, however, the turbine has been developed and in the space left for the 500-kw unit two 1000-kw Curtis turbines will be installed. One has already been put into operation and the erection of the other will soon be completed. To the original installation of the three boilers in the boiler room five more have been added. The new boilers as well as the old ones are of the B. & W. type and are each 350-hp capacity. The first boilers were provided with natural gas burners in the front. Within the last few years, however, natural gas has failed rapidly and cannot now be depended



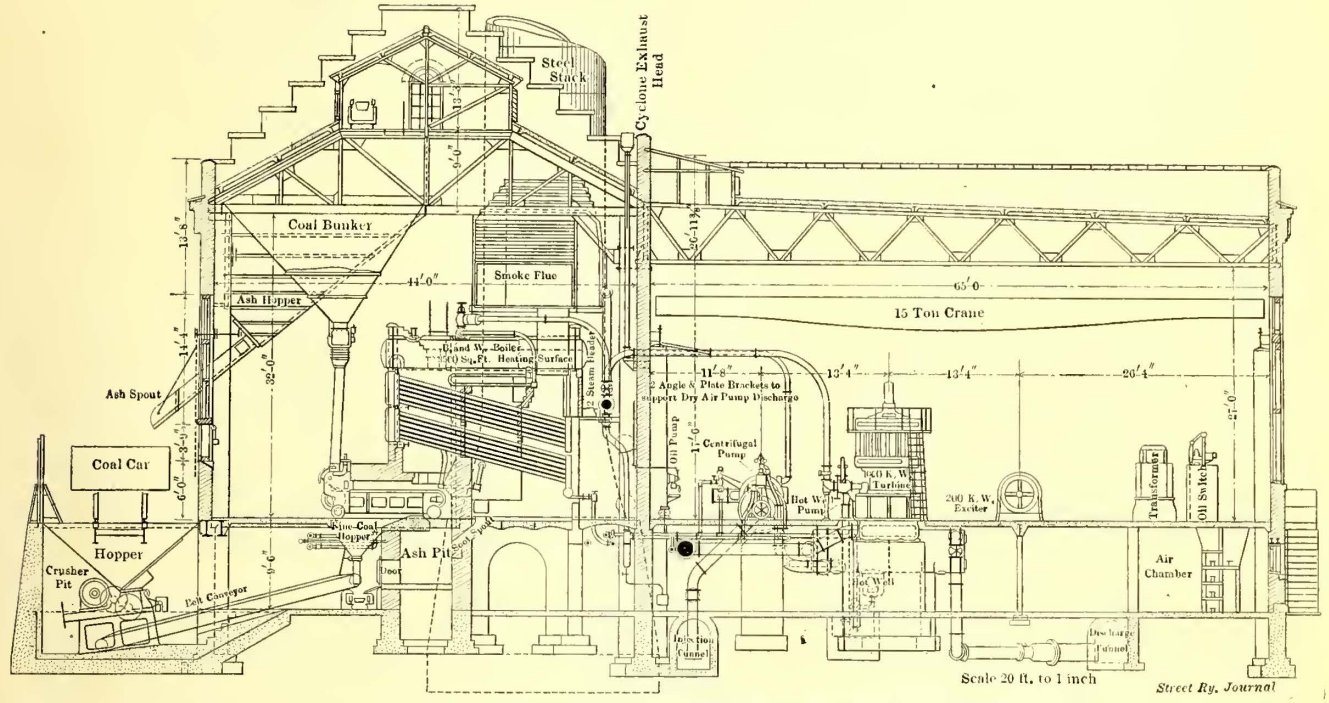
HIGH TENSION AND TROLLEY POLE LINES ON THE CHANGED-OVER SHELBYVILLE LINE

upon with certainty. The gas burners have been changed to the side of the boilers, and the new boilers as well as the old ones have been provided with B. & W. chain grate stokers.

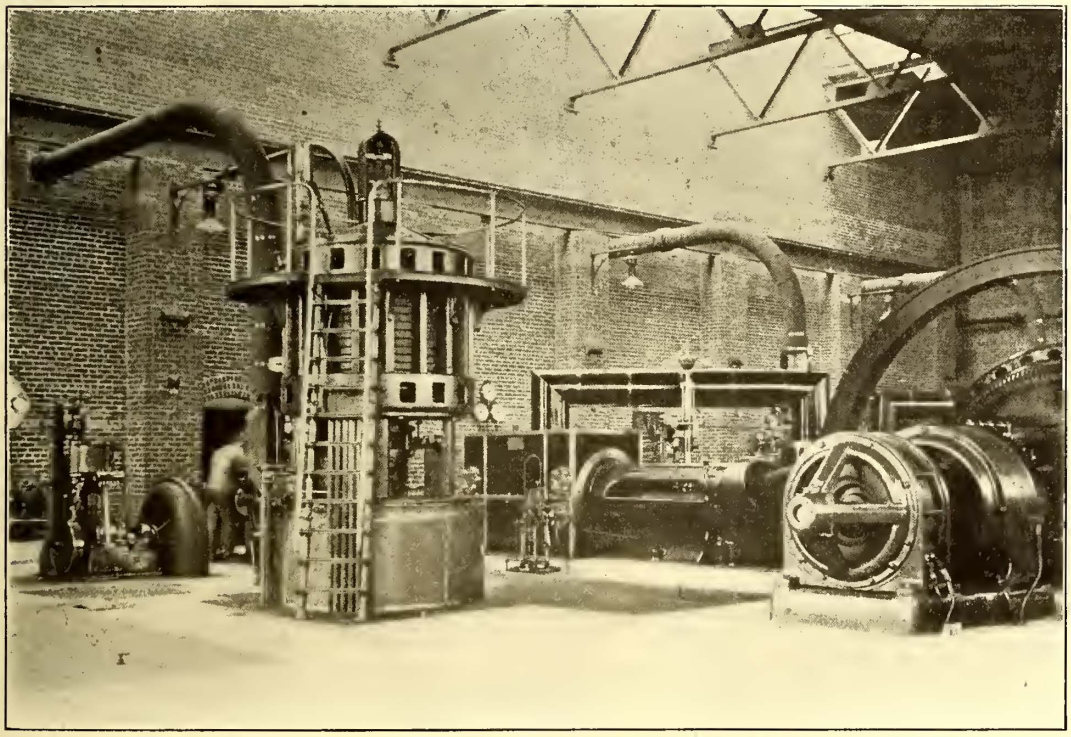
A complete coal-handling plant, including overhead storage bunkers of 450 tons capacity, has been erected by John A. Mead. A coal track runs parallel to the boiler-room wall on the north side. At a point midway of the length of the building a steel hopper is placed under the track. Be-

low this is a motor-driven crusher. A transverse belt conveyor carries the coal from the crusher to a longitudinal bucket conveyor which makes a complete loop, passing along the basement floor under the ash doors, along the end walls of the boiler room and over the coal bunkers. An ash hopper installed between the bunkers has a chute extending over the coal track outside the building and the bucket conveyor is employed to elevate the ashes from the basement and discharge them in this hopper. The coal handling plant, which is all driven by direct-current motors, has a capacity for 40 tons per hour. The turbine installed has its exhaust below the engine-room floor. The auxiliaries are all steam-driven and with the exception of the Wheeler surface condenser, are located above the engine-room floor. A 12-in. centrifugal pump driven by a vertical engine, supplies injection water from a concrete tunnel under the basement floor. The dry vacuum pump is of the horizontal type.

The hot well pump of the vertical type has its steam cylinder just above the engine-room floor. An additional motor-generator exciter set of 100-kw capacity has been provided for the turbines, and for each machine a bank of two 500-kw Scott connected three-phase to two-phase tension feeders leav- been installed.



CROSS-SECTION OF RUSHVILLE EXTENSION TO POWER STATION



1000-KW TURBINE IN THE INDIANAPOLIS & CINCINNATI POWER HOUSE

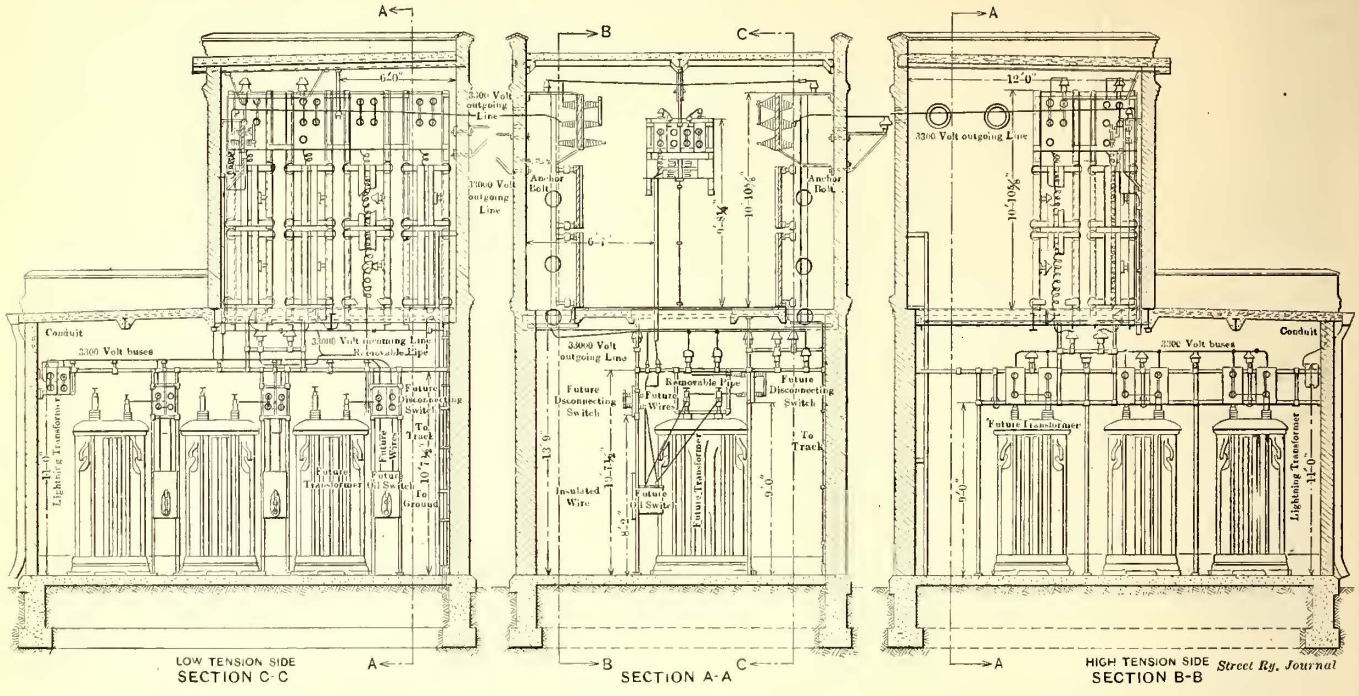
NEW HIGH-TENSION FEEDER SYSTEM

The new high-tension feeders leaving the station consist of a 33,000-volt single-phase line to supply the one new transformer station on the Connersville extensions and the cross-country line to Shelbyville, which feeds the transformer stations on the Shelbyville division. This cross-country division, which consists of a 2-phase, 4-wire line, on 35-ft. poles is about 18 miles long and follows the Pennsylvania Railroad for practically the entire distance to Shelbyville. It terminates in a switching station in the old Shelbyville power house from which practically all of the generating apparatus has been removed.

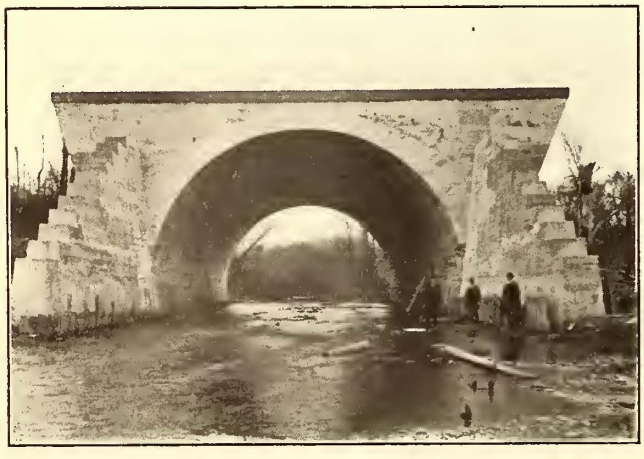
The bus-bars in the switching station are connected to

both the incoming and outgoing feeders by 33,000-volt hand-operated oil switches. The switching station also contains a complete installation of lightning arresters and a 300-kw transformer for supplying current to the Shelbyville repair-shop motors. Two single-phase lines, each of No. 4 copper, go in each direction from the switching station to the transformer stations which are located at New Bethel, Fairland-Prescott and Adams. As the alternating-current portion of the line is 46 miles long, the average distance between stations is approximately 9 miles.

The station buildings are of brick and concrete construction and are provided with steel shutters. They differ from the older stations in that the upper portions containing the lightning arresters do not continue the full depth of the buildings. The upper portions of the two stations nearest Shelbyville, those at Prescott and at Fairland, are built large enough to allow the high-tension lines feeding the more distant sub-stations to pass through them. Disconnecting transformers. Space is left for a third one whenever the service requires its installation. The transformers are connected through hand-operated oil switches to the 3300-volt buses from which the trolley feeder is taken off. This



GENERAL ELECTRICAL ARRANGEMENT OF THE FAIRLAND SUB-STATION



A 50-FT. CONCRETE ARCH OVER BIG WILLIAMS CREEK

NEW BOILERS, STOKERS AND BUNKERS IN THE RUSHVILLE STATION

double-throw knife switches are provided which permit the through lines to be either disconnected or connected to feed the intermediate stations. The transformer equipment of each station consists of two 300-kw oil insulated, air-cooled passes out the front of the building at the height of the trolley and feeds directly into it through a triple car connection.

To provide for the high-tension feeders to the trans-

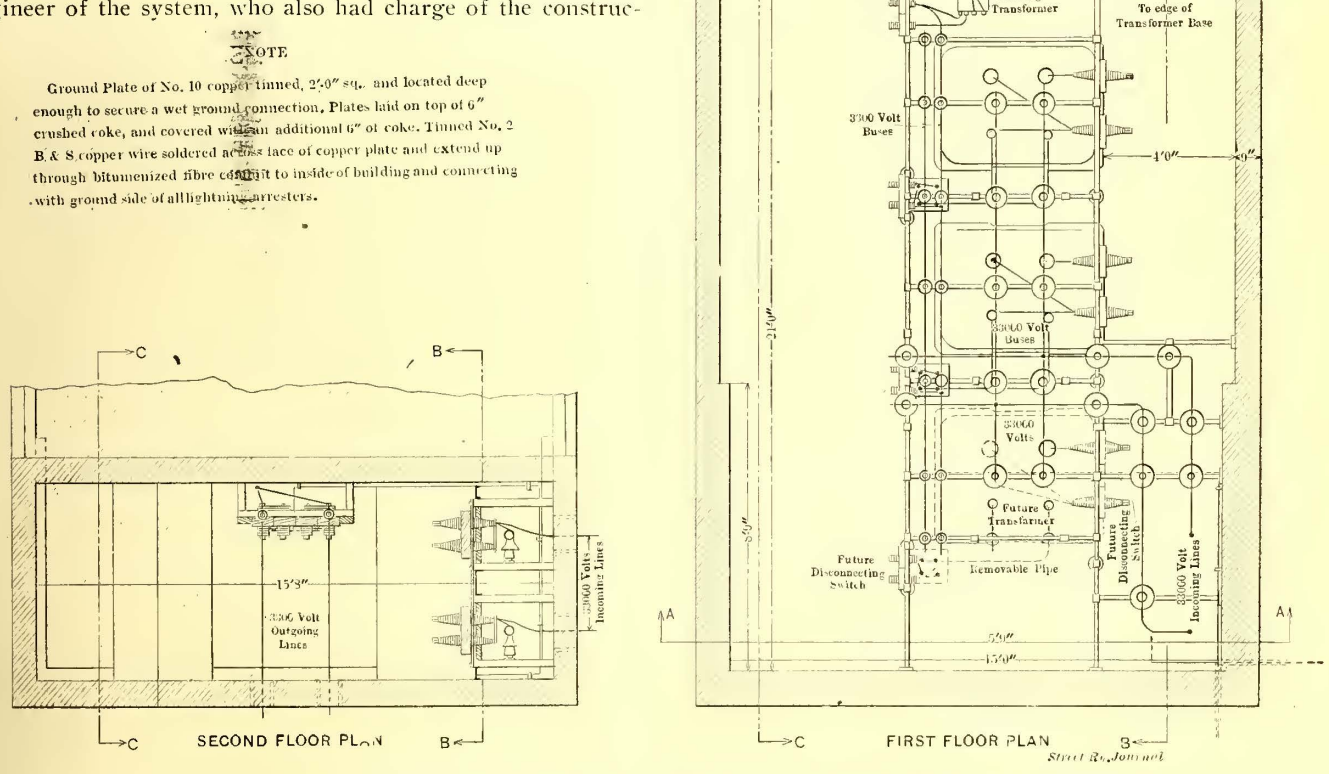
former station on the contemplated extension beyond Connersville to Cincinnati the one new sub-station on the Connersville division is built with the upper portion the same dimensions as the lower part. Provision is made for the entrance and exit of these through two-phase lines. This new station is located at Glenwood, about ten miles west of Connersville and just east of the deep fill at Williams Creek.

For operating the additional lines ten new passenger cars and four additional express cars have been added to the equipment. The new cars are equipped with four 100-hp No. 132 A a. c.-d. c. motors. All of the old motors have been removed from the old equipment and those of the new type substituted. The company now has twenty-four equipments of these new motors.

TESTING AND INSPECTION OF MATERIALS

All materials used in the work of constructing and reconstructing the lines were carefully inspected and tested. The track rails and the steel used in the power house and viaduct construction were inspected at the mills by R. W. Hunt & Company, and representatives of this company inspected the steel bridges during their construction. All the cement was tested by J. W. Moore, chief engineer of the system. Eight samples of cement were taken from each car and these samples were tested for fineness, tensile strength and initial set. In addition, the manufacturers were required to furnish mill tests of each batch.

The power house improvements were made under the supervision of G. D. Nicholl, electrical and mechanical engineer of the system, who also had charge of the construction of the high-tension lines and the transformers stations. Sargent & Lundy were consulting engineers for the company and designed the sub-stations and the power-house extensions.



PLAN OF ARRANGEMENT OF ELECTRICAL APPARATUS IN THE ADAMS SUB-STATION

The headquarters of D. G. Edwards, vice-president in charge of traffic of the Morgan-Dolan-Schoepf electric lines, have been moved from Cincinnati to the new First National Bank Building in Columbus, Ohio.

ECONOMY TESTS ON A 7500-KW WESTINGHOUSE-PARSONS STEAM TURBINE IN THE NEW YORK EDISON COMPANY'S WATERSIDE STATION NO. 2

The following data comprise the principal results obtained on Sept. 1, 1907, during an eight-hour economy test upon turbine No. 253, installed earlier in the year, at Waterside Station No. 2, of the New York Edison Company. This test was conducted entirely by the New York Edison Company, under the direction of J. P. Sparrow, chief engineer. The various arrangements therefor were carried out in accordance with a mutual agreement between builder and operator entered into previous to the test, and the results, as herein given, were obtained by independent computation.

The turbine unit tested is of standard Westinghouse construction throughout. It has a maximum rated capacity of 11,250 kw and was built to operate on 175 lbs. steam pressure, 28 ins. vacuum and 100 degs. superheat. Under these conditions the turbine unit was guaranteed to have a minimum steam consumption of 15.9 lbs. per kw-hour at the generator terminals, with a normal speed of 750 r. p. m. Incidentally, the electrical efficiency of the generator was guaranteed to be 97.8 per cent, exclusive of friction and windage, at a load corresponding to that sustained during the test. The results of the test detailed below show an economy about 7.5 per cent better than the guarantee.

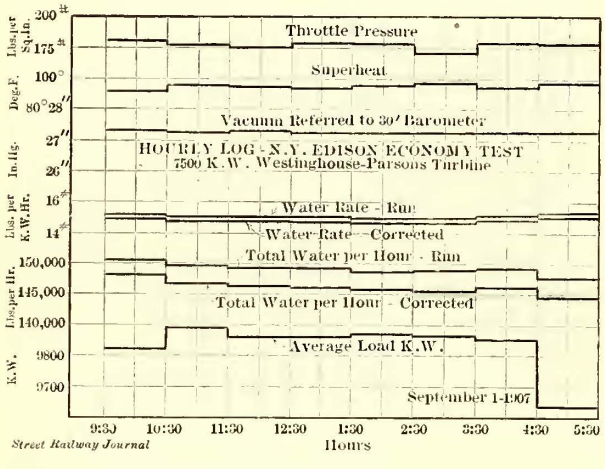
During the test period No. 2 Waterside Station sustained practically all of the 25-cycle load on the system, of which the unit under test carried practically 70 per cent, the remainder by the other turbine units in the station. This load was maintained as constant as possible by remote control of the turbine governor by the switchboard operator. Between the first and the last hours of the test the maximum

variation in load was held within 4 per cent above and below mean. During the last hour, however, the load decreased somewhat. Previous to the test this turbine unit had been running on a load of 7000 kw, which was increased to its test load ten minutse before the start.

Three-phase electrical load was measured by the two-wattmeter method, using two Weston indicating wattmeters of the standard laboratory type. These instruments were calibrated at the New York Electrical Testing Laboratories immediately before and after the test. Power factor was maintained substantially at unity, and all electrical readings were taken at one-minute intervals.

As a surface condenser was used in connection with this turbine unit, the water rate was determined by weighing the condensed steam delivered from the condenser hot well. This condensation was weighed in a tank mounted upon platform scales, with a reservoir above large enough to hold the condensation accumulating between each weighing.

These weighings of 12,000 to 13,000 lbs. each were made at intervals of five minutes. By using a loop method of connecting the gland water supply the necessity for correcting condensation by an amount equivalent to the weight of the gland water used, was avoided. A continuous gland



LOG OF TEST MADE ON TURBINE IN THE NEW YORK EDISON COMPANY'S WATERSIDE STATION NO. 2

water circuit was used entirely outside of the weighing apparatus, and all overflow from the standpipe was returned to the hot well delivery.

As the circulating water is quite salt, any condenser leakage may immediately be detected by the salinity of the condensed steam, which should be pure distilled water. On this account, condenser leakage was determined entirely by chemical analysis, employing the silver-nitrate test with a suitable color indicator. This method proved extremely sensitive, and possessed a decided advantage over the ordinary method of weighing the leakage accumulating during a definite period when the condenser is idle and under full vacuum. As samples of circulating water and condensed steam could be taken at the same time, this method made it possible to discover any change in the rate of condenser leakage taking place during the test, while the method of weighing above described provides only an average result during the period.

In this condensing plant, the delivery of the hot well pump is automatically controlled by a float valve in the interior of the hot well. This maintains the water level therein at a practically constant point, and hence no correction had to be made for difference in level of water in the hot well before and after the test.

Steam pressures and temperatures were determined close to the turbine throttle. As usual, the degree of superheat was obtained by subtracting from the actual steam temperature the temperature of saturated steam at the corresponding pressure carried at the time. All gages and thermometers were calibrated previous to the test. Both pressure and superheat were somewhat below the guarantee.

Vacuum was measured directly at the turbine exhaust by means of a mercury column with a barometer alongside for reducing to standard barometer—30 ins. This also obviates the necessity for temperature correction between the two mercury columns. During the test the vacuum was not maintained quite up to normal.

RESULTS OF TESTS

The following data represent the results of the tests, calculated for the conditions as actually run; *i. e.,* for instrumental errors only:

Duration of test	9:30 a. m. to 5:30 p. m.
Average steam pressure at throttle, lbs. per sq. in. gage	177.5
Average superheat at throttle, degrees F.	95.74
Average vacuum (referred to 30 barom.) in. mercury	27.31
Average load on generator, kw	9830.48
Average steam consumption, as tested, lbs. per kw-hour	15.15

Owing to the departure, during the test, from specific operating conditions upon which guarantees were based, it was necessary to correct the observed results by the following amounts:

Pressure (2.5 lbs. high) correction, 0.25; Vacuum (0.69 in. low) correction, 1.84 per cent; Superheat (4.25 degs. low) correction, 0.29 per cent.

These corrections were mutually agreed upon previous to the test as representative of this type of turbine. When applied to the observed steam consumption given above, the following results, representing contract conditions, are obtained:

Average corrected water rate during 8-hour test, 14.85 lbs. per kw-hour.

Guaranteed water rate, 15.9 lbs. per kw-hour.

Referring now to the accompanying log, it is interesting as a check upon the average figures above presented, to observe the results segregated into hourly periods, as shown. Here it will be noted that the load was considerably lower during the first and last hour than during the main part of the test. Neglecting, therefore, these two hours and considering only the six hours' period from 10:30 a. m. to 4:30 p. m., the results are as follows:

Average corrected water rate, 14.8 lbs. per kw-hour.

Equivalent water rate, 10.65 lbs. bhp-hour.

Equivalent water rate, 9.8 lbs. ihp-hour.

The two latter quantities are determined by applying conversion factors for generator efficiency and for internal losses.

In connection with these tests, a noteworthy agreement exists between the results noted and those previously obtained from tests of machines of similar design installed in the Manhattan Station of the Interborough Rapid Transit Company, New York, and the Long Island City Station of the Pennsylvania Railroad. At the same loads and with equivalent operating conditions the performances of the machines are almost identical. These economic results, while not exceeding in actual steam consumption the best records of European practice, yet are considered extremely good in view of the moderate operating conditions under which the test was conducted.

THE CHEMICAL LABORATORY AND THE ELECTRIC RAILWAY

During the past two or three years progressive managers have begun to realize that an intimate relation exists between the life of electric railway appliances and materials and their physical and chemical characteristics. The varying performances of different materials under the same general conditions, and the dissimilarities in behavior of even the same appliances and substances when subjected to substantially identical service tests have been shown clearly that nothing but a thorough scientific study of their physico-chemical nature in a chemical laboratory affords a certain basis for the preparation of specifications.

A highly developed organization of this character has been gradually built up in Boston during the past twenty years by Arthur D. Little, a consulting chemical engineer of that city; and as public service corporations, particularly electric railways and central stations, have received special attention from this laboratory and its staff, it is thought that a brief outline of the character of work undertaken in the electric traction field by this organization will be of interest at this time.

The offices and laboratory occupy two floors at 93 Broad Street, Boston, and the staff includes about twenty men, each of whom is a specialist in a particular field of research and practice. The organization includes eleven chemists, two chemical engineers, a bacteriologist, two mechanical engineers and two electro-chemists. Its object is to afford manufacturers, public service corporations, and large consumers generally the extensive laboratory facilities and special knowledge required for the initial control of the quality of their supplies and the most effective use of them thereafter. Experimental work, research and routine chemical work are also undertaken, thus constituting the laboratory the chemical department of the client's organization.

Perhaps the most important work thus far handled by the laboratory with respect to street railway practice is in connection with the fuel question. A coal department is a special branch of the organization, the objects of which are:

First, to furnish the client with a definite, trustworthy basis for determining what particular quality of coal is the most economical for him to buy and use.

Second, to insure by systematic inspections and analyses that the selected quality is in fact delivered.

Third, to advise regarding the most economical methods of storage and handling.

Fourth, to secure by expert control of fire-room conditions the most efficient results from the coal consumed.

To secure these results the plants are first inspected to determine conditions as to equipment, practice, and necessary limitations. This inspection includes a study of the coal or oil in use, temperature measurements, flue-gas analysis, and if necessary, complete boiler tests. The report submitted advises definitely as to the relative efficiency and actual money value of the coals used or offered, and the most effective methods of practice for each particular plant. The specifications prepared by the organization define accurately the quality of coal which will give the best results for the conditions. The quality of deliveries is controlled by inspection and analysis and the fire-room practice checked by subsequent vists and blank form records as conditions may require. The performance of grates and settings is also studied.

Under this system of control of deliveries and fire-room practice the client may reasonably expect economies equal to 10 to 30 per cent of the entire fuel account, while in connection with the purchase of coal a thorough knowledge is offered of market conditions, actual cost of production, variations in quality in different regions and mines, and records of companies as to failures in delivery. Both by analysis and by determination of the heating value of fuel samples the cost of the heat unit in the fuel supplied is figured, enabling the determination of the relative efficiency and economy of the different priced fuels. To illustrate this point random analyses of two samples of coal selling at different prices are given as follows:

	Sample No. 42,324	Sample No. 42,449
Moisture	0.94%	1.49%
Volatile	20.46	21.06
Fixed carbon	55.44	71.62
Ash	23.16	5.83
Sulphur	3.09	0.75
B. T. U. per pound of coal	11,815	14,739
Price at mine	$1.25	$1.40
" f. o. b. vessel, discharging port	3.80	4.10
Cost per 100 hp per day at mines	5.67	5.08
" " " " " " " port	17.22	14.88

Particular attention was called in this case to the high percentage of ash and low B. T. U. of the cheaper coal, which, reduced to dollars and cents, showed a difference of $2.34 in cost of generating 100 hp for one day at the point of delivery in favor of the higher-priced and higher-grade coal.

In all cases where analysis or calorimeter tests are made extraordinary care is observed in securing representative samples. An important part of the work of the coal department is, as hinted above, the scientific study of actual fire-room practice with the object of controlling the combustion processes in the best way to secure economy in fuel consumption.

Another important branch of Mr. Little's organization is the lubrication department, which is prepared to take charge of the lubrication account of any company on a yearly contract, and to assist in securing the most economical and efficient lubrication. The method is first to make an inspection of the conditions under which lubricants are stored, distributed and used in power houses and car barns; this is then incorporated in a report covering the operating conditions, together with recommendations as to any needed improvements in the methods of physical control of lubrication supplies. During the course of the inspection samples are taken of the oils and greases being used, these samples being forwarded to the laboratory for analysis and test to determine their quality and value. Should the composition and constants of these oils be not such as the laboratory would recommend, the organization drafts specifications defining the qualities of lubricants, which experience shows to be best adapted to the special requirements of the case. Purchases then made on these specifications ensure supplies of uniform quality at lowest prevailing prices. After the specifications have been submitted to several responsible dealers with requests for bids on a yearly contract, the samples are tested, the most suitable oils advised for purchase, and their use followed in the plants.

An illustration of the work carried out by the lubrication department for a large street railway system is outlined below. An exhaustive study of the lubricating conditions at 26 car houses was made with a view toward improving the

practice in the use of lubricants. The same oils were in use at all the barns, tests giving the following results:

Name	Sample No.	Gravity, Beaume	Flash Test	Viscosity	Cold Test
Journal oil	42,537	25.2	505° F.	277 at 130° F.	46° F.
Compressor	42,539	30.8	396° F.	141 " 100° F.	32° F.
Track	42,538	16.0	378° F.	224 " 130° F.	26° F.

These oils were of good quality, both in flash test and viscosity, but for winter use it would be better if the journal oil and compresser oil were 10 degs. lower in cold test.

At many of the car barns the condition of the various oil houses was not good. There was found a decided lack of care and economy in the use of lubricants. Economical methods were lacking, there were no tanks or drip pans, nor means of heating the oil houses in cold weather. The floors in many cases were covered with sand to absorb the drip oil, and buckets instead of cans were used. Some of the barrels depended upon wooden plugs in place of faucets. Wide variations in the oil consumption per car per month were found at the different car houses, as is shown by the following table:

LUBRICANTS PER CAR PER MONTH

No. Car House	No. of Cars in Daily Operation	Journal Oil, Gallons	Compressor Oil, Gallons	Motor Grease, Pounds	Gear Grease, Pounds
1	15	1.1	.66	6.6	1.66
2	12	1.2	..	4.1	1.2
3	65	3.5	.76	20.7	1.5
4	60	0.71	.9	11.2	.7
5	23	1.3	.43	6.5	3.2
6	87	1.7	.57	1.77	4.
7	17	.8	1.1	4.4	4.4
8	30	1.6	.8	5.8	5.
9	9	1.8	..	6.1	..
10	17	.7	.2	3.	.1
11	36	1.6	1.2	3.5	5.5
12	23	4.3	.8	13.	2.1
13	30	1.5	1.5	4.	4.
14	17	3.	2.	22.9	22.9
15	8	2.	..	9.3	5.
16	35	.57	..	1.4	..
17	6	1.6	.8	20.7	8.2
18	56	1.85	.47	7.6	8.4
19	11	2.3	1.0	7.6	2.2
20	19	5.2	1.3	5.2	28.5
21	21	9.5	4.75	38.1	..
22	5	1.	..	4.	..
23	19	1.5	..	20.	..
24	90	4.6	.8	2.4	8.9
25	22	1.3	.7	5.4	4.5
26	40	1.2	.5	10.	1.

The above data seem to indicate that the care given varied more than would be entirely accounted for by local conditions. All the cars used journal oil and motor grease, and the amounts ranged from less than 1 gallon per car per month to 11 gallons. Eight car barns used less than 5 lbs. of motor grease per car per month, and seven more than 10 lbs. each.

The report then discussed the cost of lubrication in detail, showing 18 cents for 1000-car miles, on the foregoing data, represented the approximate cost of lubrication based on the present consumption. It was then suggested that an exhaustive test be made in at least three barns to find out the minimum possible cost on the gallon basis as against the car-mile basis. A reorganization of oil houses was suggested as follows:

A. The larger oil houses should be provided with tanks of from 2 to 5-bbls. capacity, so arranged by means of a skidway, that the oil barrels can be rolled in over the tanks and emptied by gravity through the bung hole. Some means should be provided for heating in cold weather, either by steam heat or a small resistance coil under each tank.

B. Floors should be kept clean, and small drip pans provided to catch drips; the tanks should have key faucets.

C. Oil tanks should be provided for soaking the waste, so arranged with a tray having a perforated bottom, that the wool waste or yarn used for packing the journal boxes can be lowered into the oil and allowed to soak for 24 or 36 hours. When thoroughly soaked the tray should be lifted and the surplus oil allowed to drain from the waste before being used in the journal boxes. Elimination of some of the smaller oil houses, the systematic use of records at all car houses, and the use of oil instead of grease on all motor bearings were recommended.

The general duties of the laboratory include co-operation with purchasing agents in the preparation of specifications, testing deliveries thereunder, special studies of material which has best met service conditions or which has failed, studies of preservative treatment of ties, poles, cross-arms and the examination of special supplies, such as brasses, bronzes, bearing metals, car wheels, trolley ears, trolley wheels, rails (microscopic and chemical), iron and steel, solder, galvanized wire, copper wire, zinc, tin, metal poles, cross-arms, varnishes, paints, feed water, boiler compounds, drinking water, life coverings, belt dressings, cordage, etc. In the study of paints and varnishes the questions of specifications, analysis of samples, character of film with regard to protective ability, size and nature of pigment as influencing durability and covering power are considered, and in the study of cements chemical and physical tests are made, as well as studies of water-proofing compounds applied to cement structures. Conductivity tests of trolley wire, strength and tension tests on cables, resistances and insulating materials, and studies of d. c. and a. c. electrolysis in the field and in the laboratory are also matters within the scope of the organization. The laboratory is equipped with a large number of devices specially interesting to chemists, including a platinum-lined Atwater bomb calorimeter, coal-sampling apparatus, refractormeters, viscosimeters of several types, special facilities for carrying forward simultaneously multiple analyses and treatment, the new Ives calorimeter for matching and giving a numerical value to pigments and colors generally, electric ovens, special electric heaters designed by Mr. Little for use with inflammable liquids, paper testing machines, small motors for model apparatus, and so on in great variety. A large technical library and filing department complete the facilities of the organization.

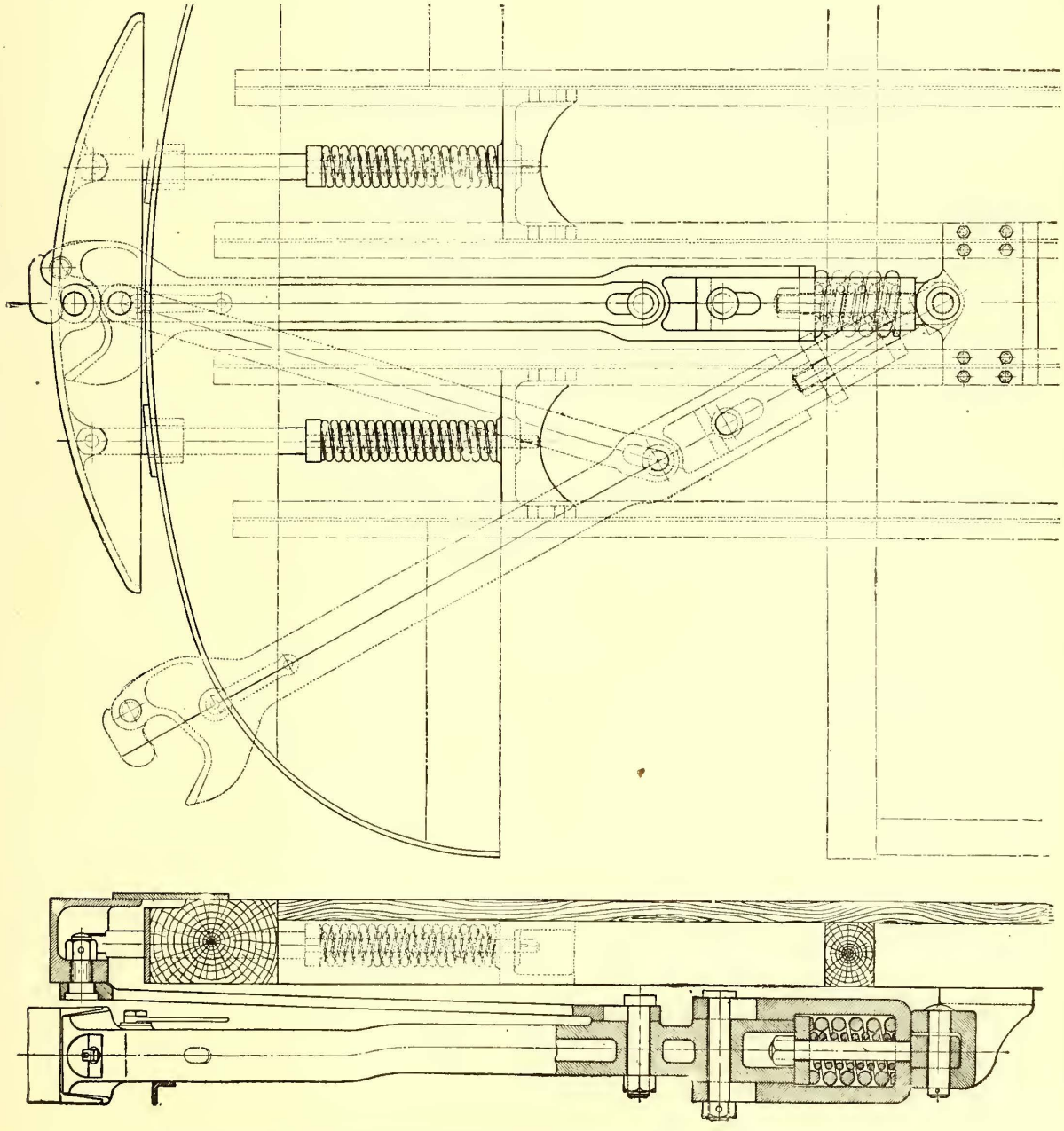
A TRUCK FOR HEAVY ELECTRIC SERVICE

Of special interest at this time is a new type of truck for heavy electric railway service designed by the New York Car & Truck Company, of Kingston, N. Y., along lines similar to those that have made for the success of this company's other products.

Briefly this truck is built on jigs, which are absolutely square, and is rigidly braced so it cannot possibly get out of alignment, with clearance and provision for taking up the wear at every point. The yokes are hand forged and machined and are provided with a channel-shaped wearing piece which protects the yoke from wear, making them practically indestructible. The truck is fitted with patented non-chattering brake shoe hangers of an approved pattern, over 5000 of which are now in operation, and it is especially adapted to use where a strong, easy riding truck is required to operate at high speed. The company now announces that it is in a position to make prompt deliveries of the new type of truck.

COUPLER FOR ELECTRIC RAILWAY SERVICE

An adaptation of the Janney M. C. B. type of coupler with radial movement, expressly designed for electric railway and interurban service, is being made by the McConway & Torley Company, of Pittsburg, as a result of the company's appreciation of the desirability of a close coupling and one which can be used interchangably with cars upon steam railroads, and as a result of the company's long experience with the Janney coupler, of which it is the sole manufacturer. The new coupler has a wide radial movement, meeting the requirements before mentioned, which is simple and easy to apply. The equipment has been worked out on the plan of using the full size M. C. B. contour coupler, but if desired, the same equipment can be made with coupler heads of the narrow gage type which are ¾ the size of the regular M. C. B. contour. It is the purpose of the company to have some model cars equipped with the coupler on exhibition at the convention of the American Street and Interurban Railway Association at Atlantic City.



PLAN AND SECTION SHOWING APPLICATION OF RADIAL COUPLER FOR ELECTRIC RAILWAY SERVICE

LOCATION OF EXHIBITS AT THE ATLANTIC CITY CONVENTION

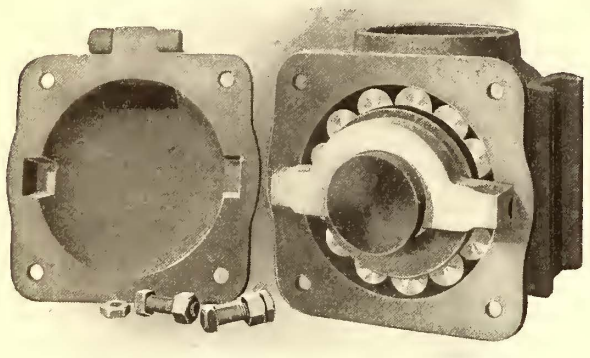
Preceding issues of the STREET RAILWAY JOURNAL have contained extended notices of the convention programme and exhibits. To enable the visitor to find the exhibits on the Steel Pier readily, a map is published on the inset supplement to this issue, showing the name and numbered location of every exhibit.

REPORT ON OHIO ELECTRIC INTERURBAN RAILWAYS

A tabulation of the reports of the interurban railway companies of Ohio, made by the State Railroad Commission, shows that the total capital stock of the companies is $115,000,000 and that the cost of the properties is approximately $171,500,000. The income of the companies for the year, in round numbers, was $5,000,000. Fifty-seven companies are operating, with a mileage of 2648. During the past year, eighty-three persons were killed and 1146 injured on the lines.

RECORD OF TWO TESTS ON A SYRACUSE CAR, TAKEN TO FIND THE SAVING IN POWER BY USING ROLLER BEARINGS

The theoretical saving to be secured by the use of roller or ball bearings has long been fully understood, but the actual benefits derived in practice are not so well known. Many tests have been made showing their value on ma-



VIEW OF ROLLER BEARINGS

chinery, but it is only recently that their use has been fairly tried in electric railway service. Some interesting results are now available regarding tests made on a trolley car in Syracuse, N. Y., for over four and one-half years. This car is fitted with the Merrick roller bearing, furnished by the Standard Roller Bearing Company, of Philadelphia. The bearing consists of a sleeve of steel which is slipped over and upon the ordinary car axle journal, without changing it in any respect, and upon which the rollers run, this construction preventing any wear whatever upon the journal. The thrust is cared for in the usual way by a "horseshoe" type of bronze thrust plate, so that no thrust is taken upon the rolls. It is simple in construction and has no parts that require special attention or care. An oil reservoir is provided into which the rollers run as they revolve around the shaft, and as they use very little oil, slight attention is required in this respect.

The great saving in power consumption is plainly indicated in the accompanying curves, covering the test run of two cars operated under practically the same conditions. The test was made on a three-mile run, which is nearly straight except for one short 90-deg. curve. Car No. 70 was equipped with roller bearings, while car No. 87 used the ordinary plain bronze bearings. The amperes and volts applied were measured by calibrated Weston meters and the power consumed included controller losses. Readings were taken every six seconds.

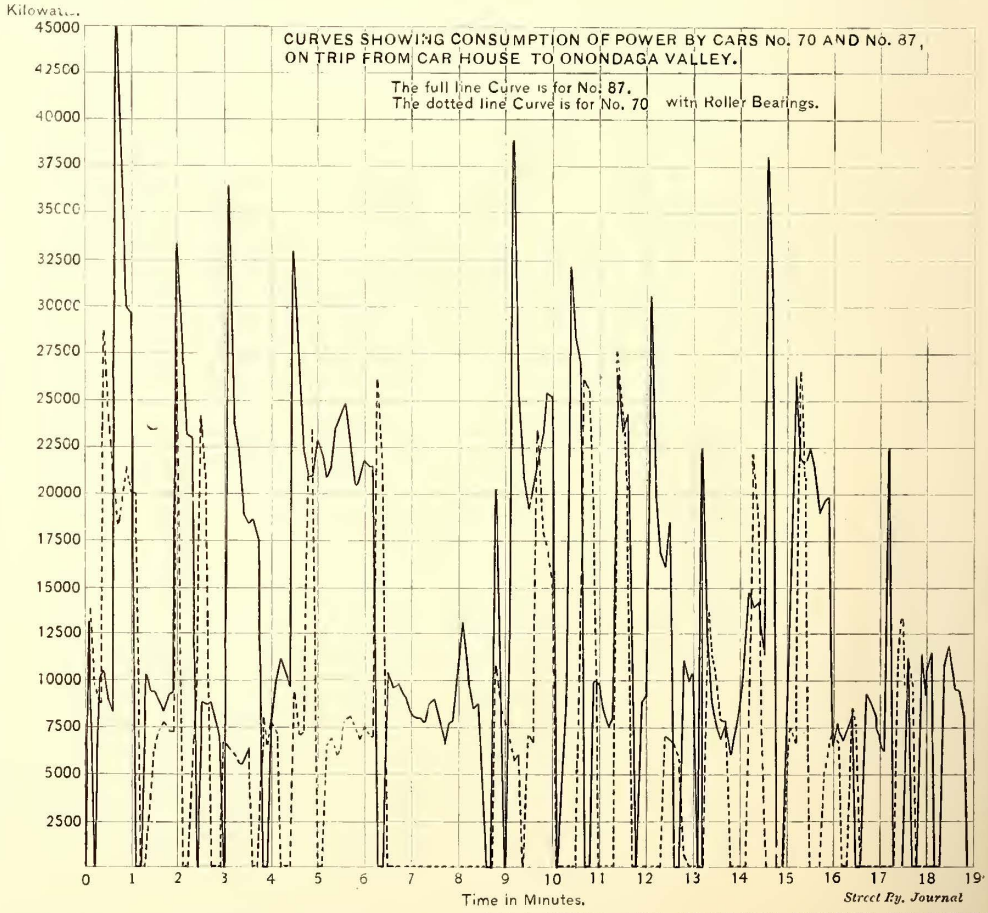
The time of runs and consumption of energy were as follows:

	Time in minutes.	Kw-hours.
CAR NO. 70.		
To valley	18.1	1.94
Return	16.7	1.16
Total time	34.8	total energy 3.10
CAR NO. 87.		
To valley	19.1	4.42
Return	16.1	2.03
Total time	35.2	total energy 6.45

The saving in power is estimated by the manufacturers to be equivalent to $260 per car per annum, in addition to which there is a very considerable saving in the wear and tear occurring on ordinary brasses. The roller bearings after running 250,000 miles show an average reduction in diameter or wear of .005 to .008 ins.

In considering the saving in power shown in the tests mentioned, other tests of roller bearings are interesting as confirming the fact that a very large percentage of power may be saved by a properly constructed anti-friction bearing. One test made by the Federal Government some time ago of an army wagon fitted with and without roller bearing axles demonstrated a saving ranging from about 52 per cent up hill to as high as 75 per cent on an asphalt drive.

It has been shown that an electric cab will run on one charge from 25 to 35 per cent further with roller or ball bearings than when using plain bronze bearings. In using shafting hanger bearings a recent test showed that eighteen heavy grinding machines, using 49 hp with the plain bab-



COMPARATIVE POWER CONSUMPTION OF CARS WITH AND WITHOUT ROLLER BEARINGS.

bitted bearing, used only 27 hp when roller bearing shafting hangers were used.

There are many advantages secured by the use of roller bearings in addition to the saving in power above noted. The consumption of oil is much less than with bronze bearings, and as the greatest saving by a roller bearing is in the starting of the load the car starts much more gradualiy and therefore with greater comfort to the passenger.

One very considerable advantage that should be taken into account in the use of roller bearings may be the adoption of motors of smaller size and consequent lower cost than are required at present. This results not only in the first cost saving, but in reduced weight of the complete car, with a corresponding reduction in wear and tear of all parts.

TOLEDO RAILWAY AFFAIRS

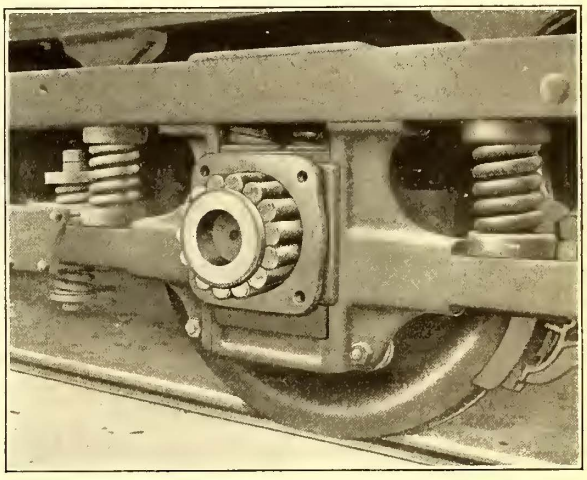
The directors of the Toledo Railways & Light Company will meet some time this week to take action on the semi-annual dividend. Although the company has been making money, it may be that the dividend on the common stock will be passed. Some of the directors believe that, owing to the high interest rate on money and the advisability of keeping up the improvements, it would be better to use the money for the latter purpose for the present.

CITIZENS TEAR UP TRACKS OF PEORIA RAILWAY

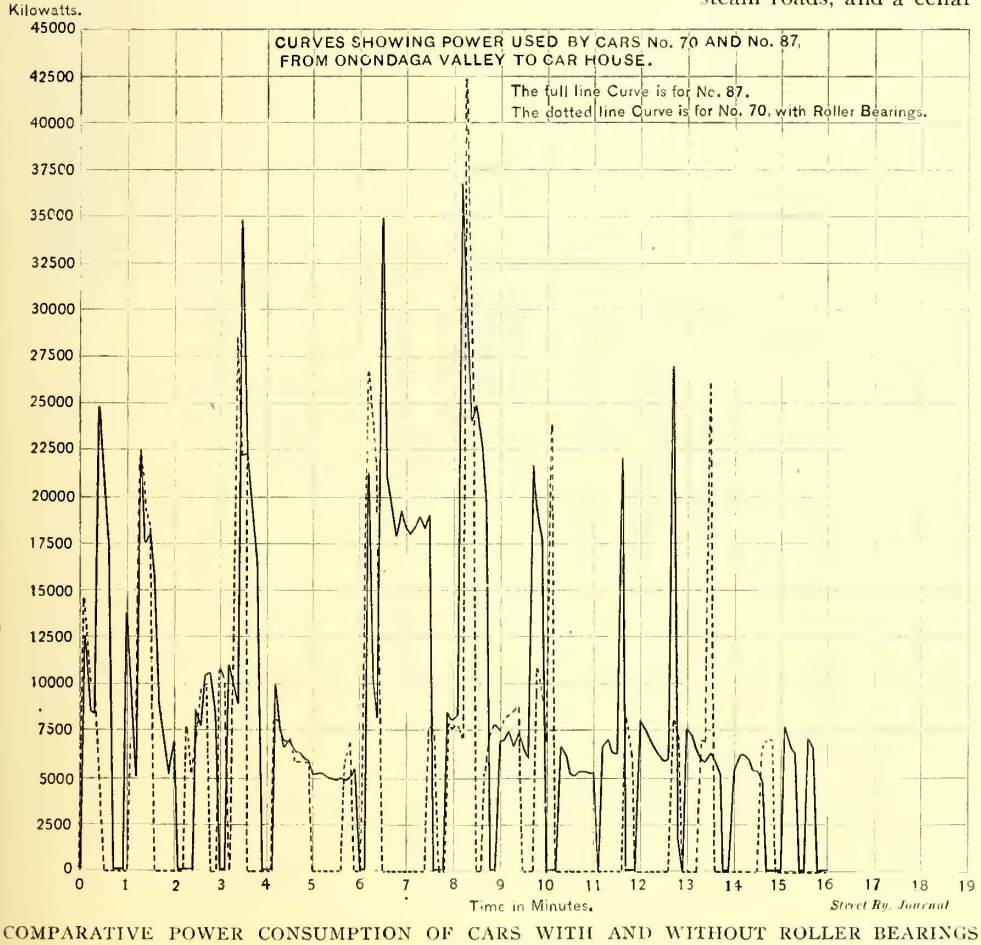
It is reported that citizens of Peoria Heights, a suburb, tore up 100 yards of the tracks of the Peoria (Ill.) Railway Company Oct. 8. The trouble grew out of a franchise, the citizens being dissatisfied with the terms offered by the company. Thirty deputy marshals are now guarding the tracks to prevent the company relaying its rails.

BOSTON STREET SUBWAY CONNECTION BEGUN

Erection has begun upon the steel structure connecting the southerly end of the Washington Street subway with the present elevated Y at Castle and Washington Streets. Two spans are in place at Oak Street, and a traveling jib crane is being erected on these in order to continue the construction by machine methods. A new masonry abutment has been practically finished to support the elevated structure where it crosses the Boston & Albany and the New Haven steam roads, and a cellar of solid concrete is completed opposite the steel already placed at Oak Street, to serve as foundation for the tracks where they leave the tunnel gradient and take the overhead level. All but two of the buildings in the path of the line have been razed, and all buildings cut through have been enclosed with a new rear wall. At the northern end of the tunnel it is probable that some special action of the Boston city government will be required to authorize the Transit Commission to take care of the heating of the City Hospital Relief Station in February, when the Commission plans to turn over the completed tunnel proper to the Boston Elevated Railway Company. The widening of the portal to accommodate six instead of four tracks will necessitate important changes in the boiler plant of the hospital, and the Commission is anxious to get a land transfer order from the Board of Aldermen which will give room for the construction of a new heating plant. The question of noise and vibration is still problematical, and the Commission feels that it is remedial only through the greatest care in construction, maintenance and operation of the six tracks beneath the building.



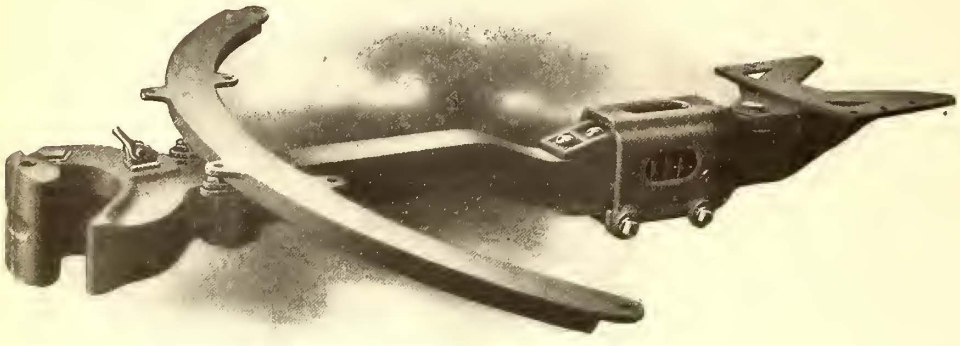
ROLLER BEARINGS ON TRUCK



COMPARATIVE POWER CONSUMPTION OF CARS WITH AND WITHOUT ROLLER BEARINGS

A COUPLER ALONG M. C. B. LINES ADAPTED TO ELECTRIC RAILWAY SERVICE

The demand created by the extension of the suburban electric railway and the building of the long interurban road for a thoroughly reliable coupler which would permit the operation of cars on short radius curves, and the intercoupling of electric cars with standard steam railroad equipment, has resulted in the development of a number of different types of couplers along standard M. C. B. lines to meet these requirements. One of these manufactured by the Washburn Steel Castings & Coupler Company, of Minneapolis, Minn., is the subject of this article. This coupler for traction work is of cast steel, and is the result of a special study of electric railway conditions made by E. C. Washburn, of the company. In fact, the coupler may be said to have been developed as the result of a request from the Pacific Electric Railway Company to the Washburn Company to apply its experience in building steam railroad couplers to the problem that confronted the traction company. The coupler found its first use on the Pacific Electric Railway in transporting cars of the company over steam railroad lines on their own wheels from St. Louis to Los Angeles, and largely as a result of this test and trials on the company's own system has been adopted as the standard of the company.



COUPLER ALONG M. C. B. LINES FOR ELECTRIC RAILWAY SERVICE

DETAILS OF THE KNUCKLE AND LOCK OF THE COUPLER FOR ELECTRIC RAILWAY SERVICE

The coupler so evolved is known as the L-type M. C. B. coupler. Briefly, it has a standard M. C. B. contour for the head, and will intercouple with all standard equipment. The coupler and rigging are so arranged that they will swing radially about a pin, connecting them to a standard radial drawbar anchor bolted to the center sills of the car by ¾-in. bolts. The drawbar is provided with a spring yoke draft box and a spring sufficient for handling three or four cars. Whereas the standard M. C. B. steam railroad coupler is open at top and bottom, the Washburn coupler has a top and bottom wall and a bearing face on one side. In addition, a lug on the knuckle forms a bearing face on the other side of the coupler. In this way the couplers present to each other faces with considerable bearing surface, an essential with swivel draw-bars. An I-bar at the top, which rides in the radial guide and supports the draw-bar at a point 12 ins. back of the knuckle pin provides a firm support no matter what position the cars may be in on a curve of more than 40-ft. radius. In the case of the Los Angeles cars the bumpers had to be especially prepared by bolting on timber extensions to support the radial guide, thus adding to the rigidity of the frame.

Two forms of standard draft rigging have been designed for use with the coupler. In one of these the draft box is bolted directly to the car body, while in the other the swivel is placed behind the draft box and the box turns with the draw-bar. With the former the thrust does not come directly against the spring, but with the latter the buffing and pulling does come straight on it. In both types one spring enclosed in a circular draft box serves to cushion both the buffing and the pulling.

It is extremely simple to uncouple this type of coupler as an uncoupling lever, on which slides a single link for engaging the uncoupling pin, is provided bent to the same radius as the buffer plate, and so arranged that the handles are easy of access from either side, no matter what the position is of the cars on the track when the train is stopped.

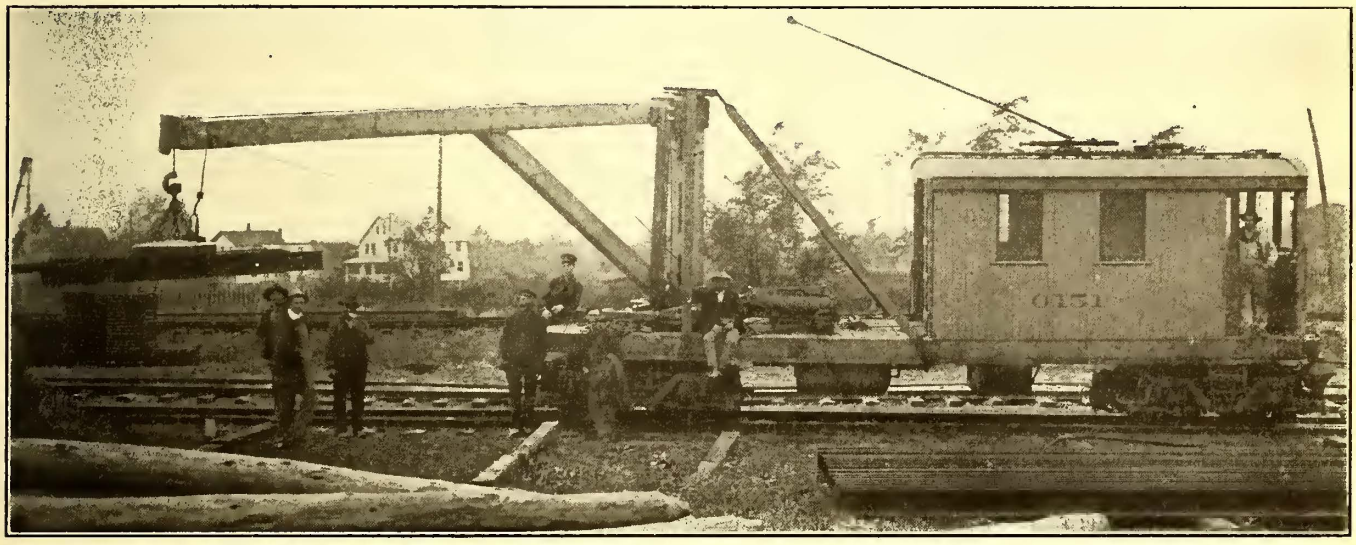
In connection with the coupler, it is interesting at this time to record that in the trip of the train of 18 cars equipped with the coupler, from St. Louis to Los Angeles, a total of 2717 miles was traversed to New Orleans and 2007 miles over the Southern Railway from New Orleans to Los Angeles. The circuitous route was taken to avoid the climb over the mountains. The train, exclusive of the engine, had a length of 954 ft., and each car weighed 23 tons. A special short line rate of 18 cents per car mile made the freight charges per car amount to $297.70.

INTER-POLE ELECTRIC LIFTING MAGNETS

Recognizing the possibilities of the electric lifting magnet for industrial purposes, the Cleveland Armature Works, of Cleveland, Ohio, inaugurated a series of experiments extending over several years, which has resulted in a lifting magnet of peculiar design, termed the inter-pole lifting magnet, two types, of which the bell magnet and the flat magnet are being manufactured in order to meet all conditions of service. The inter-pole bell magnet is used for loose detachable material, like scrap iron, turnings, borings, etc., and the inter-pole flat magnet for material with more or less flat surfaces and in larger pieces like rails, ingots, heavy castings, etc.

The inter-pole bell magnet consists of a heavily annealed steel casting which as the name implies is bell shaped. The magnetizing coils in this case are two in number, and so placed in relation to each other that they form a solenoid in two steps, separated by an iron ring and the so-called inter-pole. The result of this arrangement is an extremely effective magnetic field acting with greatest intensity towards the center of the magnet and altogether confined within the sphere of the bell. The coils produce a solenoid effect, so to say, sucking the material up into the bell. The outer shell of the casting extends below the under face of the outside coil and a heavy shield of non-magnetic material bridges from pole to pole protecting the magnetizing coils and also serving to increase the air reluctance between poles, thereby increasing the effective lifting power of the magnet, and enabling matter being lifted to be deposited within a certain radius and not scattered over a large surface as otherwise would be the case. Various sizes of these inter-pole bell magnets are made. The largest size is 52 ins. in diameter, weighs 4900 lbs. and consumes an average of 20 amps, at 220 volts. This magnet will lift from 1000 to 1350 lbs. of sand-cast pig, about 1200 lbs. of plate scrap. Its maximum lifting capacity for one single piece is 15 tons.

As mentioned before, the works also manufacture inter-pole flat magnets designed on the same principle as the inter-pole bell magnet, but essentially to be used in handling larger pieces of material like heavy castings, billets or corded pig iron, etc. The accompanying illustration shows this magnet as used on a derrick car in electric railway construction work, one of the many branches where it can be advantageously used.



INTER-POLE LIFTING MAGNET IN USE IN A RAILWAY YARD

Both types of lifting magnets are manufactured for any voltage desired, and the cable connections are interchangeable to make possible the use of either bell or flat magnet on the same crane installation. With each magnet is furnished a twin cable of sufficient length as well as an automatic "take-up" reel for same. This reel is operated by a spring arrangement entirely, independent of the crane gearing, and is usually placed on top of the crane carriage just above the hoist. The magnet itself is operated from the cage by a small circuit breaker also supplied with each magnet.

TWO NEW TRUCKS

The American Locomotive Works have recently brought out two new styles of trucks which will be shown at the Atlantic City convention. They are illustrated in the engravings on page 684.

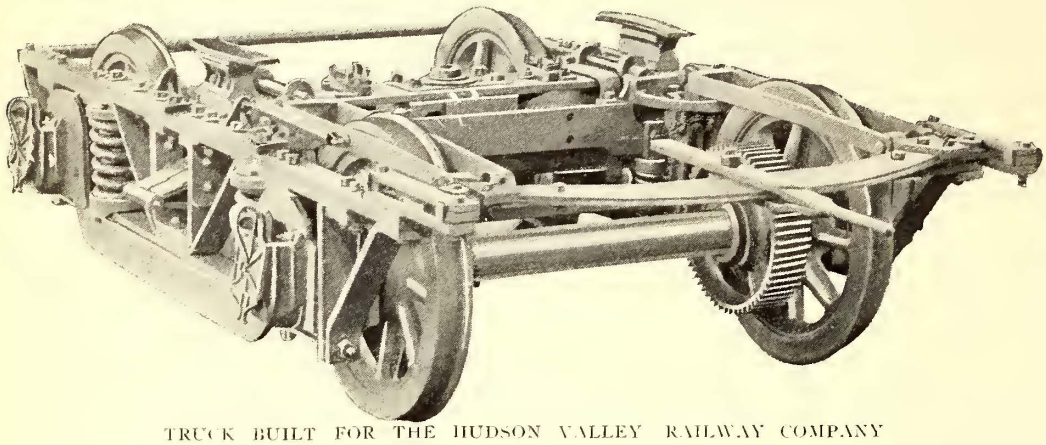
The truck shown in the first engraving was built for the Hudson Valley Railway Company. It is suitable for all types and makes of motors that are suspended inside of axles by either the rigid nose suspension on truck transom or suspension bars carried on coil springs. It may be built for any track gage, with wheel base to suit motors, and for carrying capacities at the center plate ranging from 15,000 to 16,000 lbs. This type is often referred to as the M. C. B. type of truck, because it embodies the standards adopted by the Master Car Builders' Association for high-speed trucks. The principal dimensions are as follows:

Gage of track	4 ft. 8½ ins.
Wheel base	6 ft. 6 ins.
Total length	10 ft. 4 ins.
Load carried at center plate	30,000 lbs.
Weight without motors, wheels or axles	7000 lbs.
Weight complete, without motors	10,500 lbs.
Wheels	34 ins. diameter
Axles	5½ ins. diameter
Journals	4¼ ins. x 8 ins.

It is built with a solid wrought-iron frame, channel-iron transoms, cast-steel transom gussets, swinging bolsters of the built-up type, and two bar equalizers. The transom gusses make a very rigid connection between frame and transoms, and integral with the gussets are brake hanger lugs and bearings for swing link pins, the design thereby eliminating numerous small parts that are usually bolted to the frame and transoms. The swinging bolsters are car-

ried on double elliptic springs although for trucks of greater capacities triple elliptic springs may be used. The wear or rubbing pieces between the bolster and the transom serve the double purpose of preventing the bolster from cramping or tilting in starting and stopping, and of transmitting the strains on the bolster through the transoms to the truck side frames without interfering with the free action of the bolster and springs. The coil springs carrying the truck on the two-bar equalizers are carefully calculated to suit the loads, including portions of truck and motor weights.

The details of construction are in accord with the best



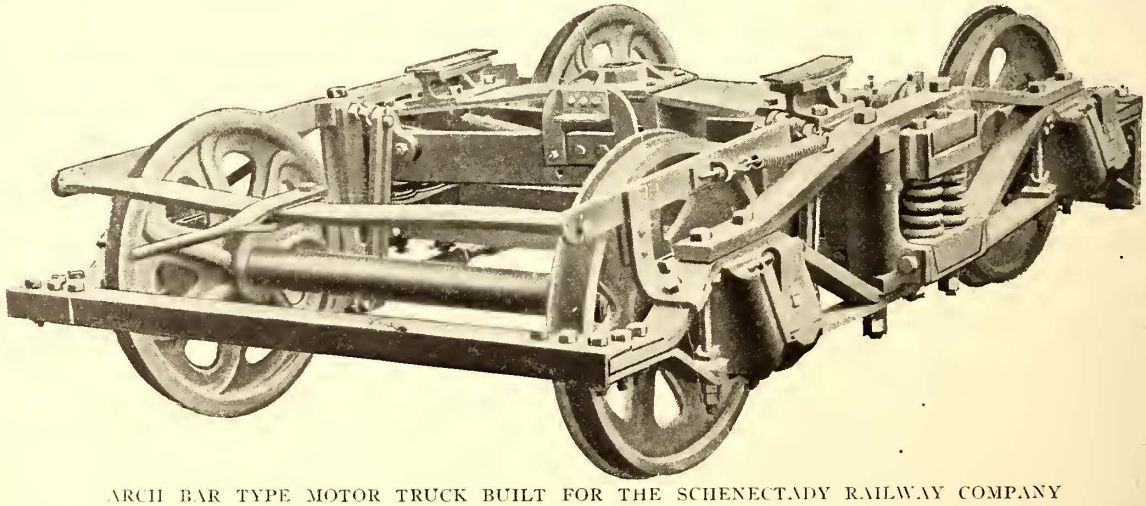
TRUCK BUILT FOR THE HUDSON VALLEY RAILWAY COMPANY

locomotive building practice. All bolt holes through frames are reamed, and bolts turned with a taper for a driving fit. All bent parts of frame are made to dies and formers. The transom channels are carried by lips or shoulders provided on the frame center braces, thus reducing the shear on the usual bolts or rivits through brace and transom. The pedestals are provided with steel plate wear pieces, tightly fitted to and covering all rubbing surfaces, and are tied together at the bottom by large bolts through the pedestal legs and iron thimble or spreader. All brake lever and hanger pins are made as large as possible to provide large bearings and are case hardened. Safety straps are provided over top of bolster, under spring plank and brake bottom connections.

The materials used are as follows: Frames, pedestals, equalizers, motor suspension bars, safety straps, swing links; and all brake hangers, rods and connections are of the best wrought iron. Transoms and spring plank angles are of structural steel shapes. Transom gussets, elliptic spring seats, motor spring seats, and swing link rockers are of cast steel. Outboard side bearings, springs, seats and caps, pedestal thimbles and brake shoes are of cast iron. Brake heads, brake connections and transom angle washers are of malleable iron. Journal bearings are of brass, lead lined. The journal boxes used on the truck illustrated were supplied by the T. H. Symington Company. The center plates and side bearings are of the Baltimore make and the wheels are Schoen.

The second engraving shows an arch bar type of motor truck built for the Schenectady Railway Company, and designed especially for freight and express service. This design has been developed with a view particularly towards strength, stiffness and simplicity, with all parts easy of access and a minimum number of wearing parts. The spring arrangement, as will be noticed, is intended particularly for strength rather than for easy riding, the former quality being the most essential characteristic in a truck of this type. As with the high-speed electric motor truck this arch-bar type is suitable for all types of motors suspended inside of axles by either rigid or spring suspension. Although the wheel base of the truck illustrated it 6 ft. 4 ins., this same type of truck may be designed with a minimum wheel base of 6 ft., and for carrying capacities at center plate ranging in weights from 1500 to 40,000 lbs. The bolsters are of the floating type carried on nests of four-coil springs at each end of bolster and seated on a heavy channel iron spring plank extending across and bolted to the bottom arch bar and bottom tie bar. The legs of the channel also bolt to lugs at the bottom of the cast-iron bolster guide columns.

The same practice in regard to workmanship has been followed in this truck as in the one designed for high speed, namely, all bolt holes through frame are reamed and bolts turned taper for driving fit and frames bent to dies and forms. Transom bars are carried on shoulders cast on the guide columns to which they are bolted. These transom bars carry the motor suspension as well as brake-hanger brackets. Inasmuch as this truck is designed for slow freight service the journal boxes are not suspended in pedestals but are securely bolted to the arch bars as on all M. C. B. arch-bar



ARCH BAR TYPE MOTOR TRUCK BUILT FOR THE SCHENECTADY RAILWAY COMPANY

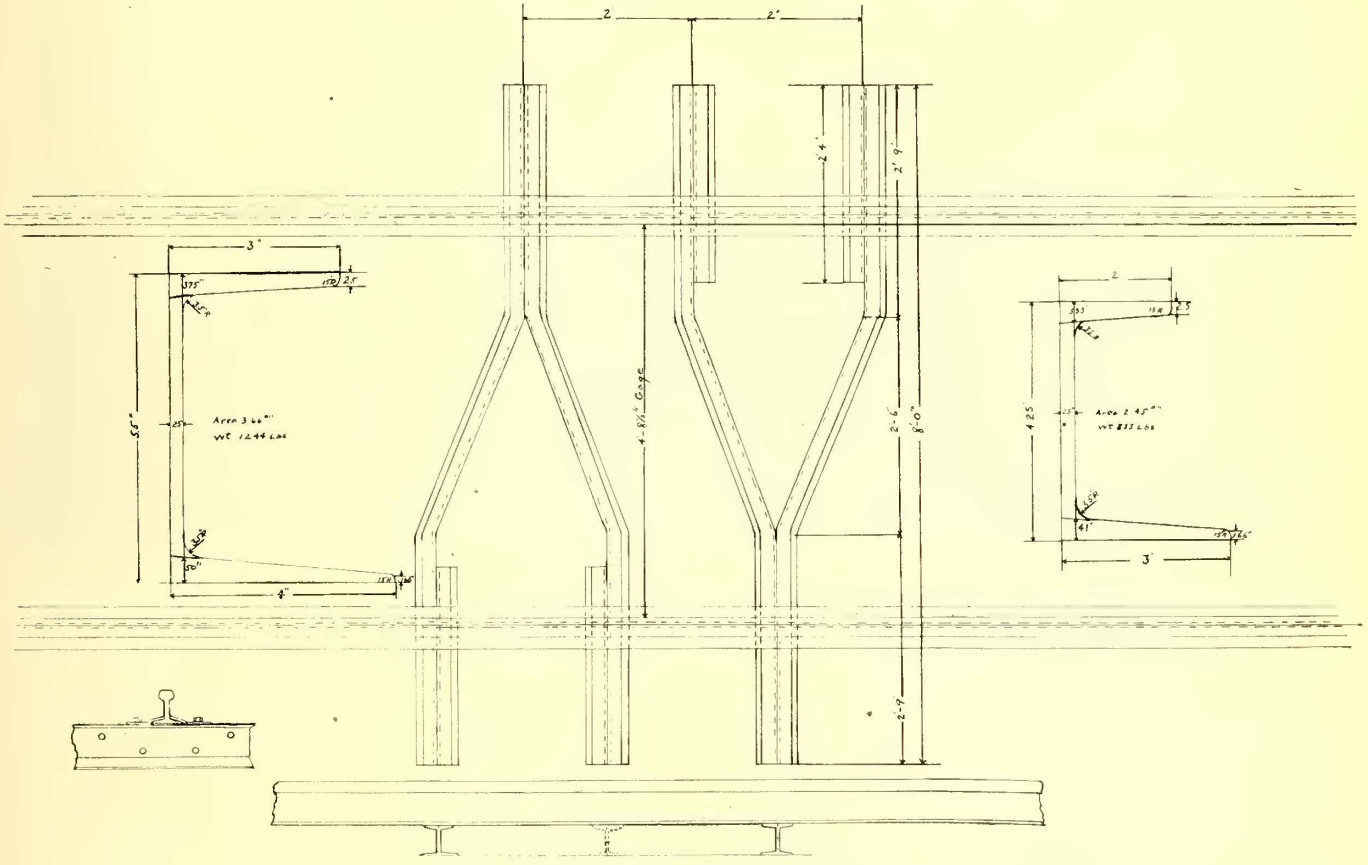
trucks. The ends of the bottom arch bar and tie bar are extended beyond wheels to receive angle iron end frame and securely bolted to same with steel plate corner gussets.

The materials used in this truck are the same as those for similar parts of the high-speed electric motor truck, and the general dimensions are given below:

Gage of track	4 ft. 8½ ins.
Wheel base	6 ft. 4 ins.
Total length	10 ft. 4 ins.
Load carried at center plate	28,000 lbs.
Weight without motors, wheels or axles	4800 lbs.
Weight complete, without motors	7200 lbs.
Wheels	33 ins. diameter
Axles	5 ins. diameter
Journals	4¼ ins. x 8 ins.

A STEEL TIE FOR ELECTRIC RAILWAY USE

The accompanying illustration shows the Benjamin steel tie for steam and electric railroads, the patents for



DETAILS OF STEEL TIE DESIGNED FOR STEAM AND ELECTRIC RAILWAYS

which are controlled by the National Brake Company, of Buffalo, N. Y. The construction of this tie is such that any longitudinal or lateral movement will be effectually prevented. The longitudinal movement is prevented by the ties being disposed in "V" shape. The position of these "V" shaped figures alternate so that the pressure of the ballast against the diagonal portions of the channel constituting the adjacent "V" shape will be in opposite directions, thus securely locking the ties. As no two bearings of the rails come opposite each other, creeping or lateral movement is impossible. Another important feature is the fact that the ties supporting one rail alternate with those supporting the other rail and no two rail bearings being opposite each other, the track is less rigid.

The construction of these ties is such that the necessary bearing surface under the rail has practically unlimited strength. Furthermore, the bearing in the center of the track being one-half the width overcomes any possibility of the tie to become center-bound. Of great importance is the mode of rail fastening. The plates or clamps being made with a shoulder adapted to bear against the edge of the base flange of the track rail, and with a portion adapted to rest on the base and extend to the web of the rail the track would be held to the proper gage in case the nut should become loose. The clamp not being more than three-eighths of an inch in thickness, it is said that the danger, in case of detailment, of the fastenings being sheared off, is overcome, as the tread of the wheel would clear the clamp and nut.

COMPLETED PLANT OF THE HOPE WEBBING COMPANY

Although the Hope Webbing Company, of Providence, R. I., has been building additions to its plant almost continuously since its inception fifteen years ago, the company found about a year ago that its facilities were inadequate to the demands made upon it for electric tapes and webbings, and it was therefore decided practically to double the old capacity. The old plant consists of five principal structures. Three of these, each 453 ft. long by 85 ft. wide, are used for weaving sheds. The other two structures are a preparing mill, built to five stories, 223 ft. x 84 ft., and a three-story structure 320 ft. long by 60 ft. wide, used for the offices, and the weaving and shipping departments. The new structures, commenced about a year ago, and now nearing completion, are on the south and west sides of the main plant. They consist of two one-story substantial brick structures with concrete foundation, each 453 ft. x 85 ft. Skylights of the latest construction are installed throughout the length of the new buildings and give the operators of the looms good light. In the old plant about 150 looms were devoted al-

most entirely to the manufacture of electric tape. In addition the looms in the new building will be devoted to the same work, so that the capacity of the company will be practically doubled. The looms to be installed in the new building will be of the double shuttle type, made by the Crompton-Knowles Company, of Worcester. They have double the capacity of the ordinary looms, so that the plant will be able for some time to come to supply promptly all demands of the trade. An extended description of the old plant was given in the Street Railway Journal for Oct. 13, 1906.

ROLLING STOCK FOR THE WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC RAILWAY

The Washington, Baltimore & Annapolis Electric Railway is rapidly approaching completion. Among the progressive features of the line are the fine cars to be used on it. The choice of rolling stock was influenced by the condition that four classes of service will be given, as follows: High speed with frequent headway between Washington and Baltimore; high speed service between Annapolis and Washington and between Annapolis and Baltimore; local service over the main line (termed the W. B. & A.), and the cross line (termed the A. W. & B.), and excursion business in trains to Annapolis and to Bennings race track, near Washington. The last item sometimes consists of steam coaches owned by the A. W. & B., or possibly obtained from connecting steam roads. In addition to this there are also freight trains on the A. W. & B.

COMBINATION CAR FOR THE WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC RAILWAY

Because of the different characters of service, including steam railway conditions and rolling stock, it was decided that all cars should have Master Car Builder couplers and automatic air brakes, even though such coupler makes it impracticable to operate in trains on city streets except by the use of a link or auxiliary radiating coupler. To avoid carrying several sizes of repair and maintenance parts, it was decided to have all trucks identical, except the truck springs. The motors are also alike, except in the number per car and the gear ratio. Owing to the good service necessary to compete with the steam railroads, and also owing to the fact that these cars will be for through operation, the seat spacing is unusually liberal, the seats long, with arm rests and high backs. Considerable aisle width will not be necessary for the character of service contemplated, whereas if such service were for short rides and frequent stops, shorter seats, less knee room, no arm rests and wider aisles would be preferable.

Careful attention has been given to the artificial lighting As the trolley voltage is 6600 and the W. B. & A. main line is double track 80-lb. rail, the line voltage over the entire a. c. portion of the system will undoubtedly be comparatively uniform and constant. The d. c. voltage also will be higher and more constant than is usually the case on interurban cars when operating in terminal cities. To obtain a satisfactory light for reading, and at the same time give a reasonable general illumination, 16-cp lamps are placed over each seat on small brackets extending slightly toward the center of the car from the inside of the lower portion of the deck sash. The lamps hang vertically and each bracket is provided with a holophane shade designed to give a uniform illumination three feet from the floor.

The floor of the car is covered with Greenwich, English, linoleum. The roof is covered with copper and grounded to the trucks.

The earlier design contemplated pantograph trolley for a. c. and two-wheel trolleys for d. c., the same being placed at the rear end of the car, two being required, because within the District of Columbia rail return is not allowed, and one wheel only being used when in Baltimore. The decision to use double-ended cars necessitated placing two trolley wheels at each end, and the car was designed also to carry a pantograph, but owing to results obtained by the use of trolley wheels on a. c. roads it was decided not to place the pantograph at present. Because of the foregoing, one trolley base at each end of the car has been insulated for high voltage, and later, if a pantograph should be installed, such trolley will be useful for emergencies, in addition to being in regular use when within the District of Columbia.

The general dimensions of the high-speed cars are as follows: Length of the body over corner posts, 51 ft, 1¾ ins.; length over spring buffers, 62 ft. 2¾ ins.; length smoking compartment, 12 ft. 7⅝ ins.; length general compartment, 38 ft., 6⅛ ins.; width car body, inside, 8 ft. 0.¾ in.; width over all, 9 ft. 0.¾ in.; height from bottom of side sill to top of monitor roof, 9 ft. 6 ins., and height from rail to top of monitor roof, 13 ft. 0.½ in.

The height was limited by an undergrade crossing.

The general plan comprises two end platforms with doors and steps on each side of same, with a toilet room adjacent to the vestibule of the main compartment, and with fifty seating capacity in such compartment. The smoking compartment seats sixteen. In one corner of this compartment the high-tension cabinet is placed. This cabinet contains protective and selective apparatus for the motor control circuits.

The platforms are on through sills, the floor being flush with the floor of the car. The side sills are 5 ins. x 7¾ ins., bolted to ⅝ in. x 7¾ ins. steel plate and 1¾ ins. x 6 ins. subsill. The center and intermediate sills are 6-in

No. 12.25 steel I-beams with 2⅝ ins. x 6 ins. fillers. The window arrangement is as shown by the illustration.

The ceiling is full Empire type. The interior finish is mahogany, the design being intended to furnish an exceptionally rich and attractive appearance with the fewest possible projections to catch dirt and designed to conceal shrinkage openings at joints.

The seats were furnished by the Hale & Kilburn Manufacturing Company. The reversible seats are No. 199 EE, pressed steel oval pedestal, wall and aisle ends and arm rests. The length over all of the seats is 38 ins., the cushions being 18 ins. wide with spring edge; the backs are corrugated with head roll 26 ins. high and provided with grab handles. All upholstery is in green leather.

The curtains are pantasote with Curtain Supply Company's Forsyth No. 88 fixtures, and the window fixtures are O. M. Edwards & Company's 7½ Dr. All glass for side and end windows and doors is plate, and the glass for the Gothic side and deck sash is cathedral. The Gothic frames are coppered zinc.

The cars are equipped with Crouse-Hinds Type AAC, d. c. headlights, Dayton Manufacturing Company's No. 8 gravity water closets, Ham air sanders, Edwards trap-door fixtures, Dayton Manufacturing Company's Rex individual parcel racks, Knutson No. 2 retrievers, Royal fire extinguishers, Adams & Westlake No. 187 signal lamps and Peacock type C hand brakes. The Wallace Supply Company furnished most of the bronze trimmings.

The trucks are Baldwin 90-40 M. C. B. type with 7 ft. 6 ins. wheel base, weighing 14,900 lbs. each. The wheels are Standard Steel Works steel tired, cast-steel centers 37½ ins. in diameter, each weighing approximately 1000 lbs., tires 2½ ins. x 5½ ins., 4¼-in. tread, 1 in. depth of flange and 1¼ ins. thickness of flange. The axles are 6½ ins. diameter, 7½ ins. at gear seat, the journals being 5½ ins. x 10 ins. The center and side bearings are Baltimore ball bearing; the journal boxes T. H. Symmington Company M. C. B.; brakes are inside hung, shoes and heads M. C. B. type, and the brake shoes are American Brake Shoe & Foundry Company's Diamond S.

The air-brake equipments are Westinghouse Traction Brake Company's A. M. M. automatic as to the braking mechanism, but the General Electric Company furnished the motor driven compressor C. P. 52, governor M. B. and wiring. The Westinghouse Traction Brake Company also furnished the automatic air couplers. The draw bars are Gould No. 65 M. C. B. head.

The electrical equipment of each car consists of four G. E., a. c. motors, each rated at 125 hp. Each motor weighs approximately 5800 lbs. and the auxiliary equipment per car weighs about 14,000 lbs. Under and to one side of the car a commutating switch is placed for changing from a. c. single to d. c. double trolley, or vice versa, at the District of Columbia line, required because of the use of double overhead trolley within the District. Selective switches are provided to change automatically from a. c. to d. c. operation, or vice versa, at the end of private right of way in Baltimore. From the car sills transformers, resistances, contactors, motor compressors, etc., are suspended.

Nineteen cars of the foregoing type have been provided and four local cars. The latter are of the same general character of construction as the through cars, but are 54 ft. 11⅜ ins. long over bumpers, and the body is divided into three sections, made up of a general passenger compartment, smoking compartment and baggage and express compartment. As these cars will make a large number of stops, consequently not only the schedule but also the maximum speed, will be materially less than for the through cars. Each car is equipped with two motors of the same rating as those used for the through cars.

It will be noted that the passenger carrying equipment is provided mainly for through service. It is expected that for the greater portion of each day fifteen-minute headway will be required for through service, but only possibly two-hour for local service.

In addition to the above cars, two box-car type locomotives will be furnished, the electrical equipment for each being four motors, with same rating as for the passenger cars, and geared for the same speed as the local cars. These cars have two sliding doors on each side, and also end doors to permit loading of theater scenery. The general dimensions of these cars are as follows: Length over buffers, 56 ft. 8 ins.; width over all, 9 ft. 0¾in., and height from bottom of side sills to top of roof, 9 ft. 4 ins. Flat cars, box cars, etc., are provided also for general purposes.

The Niles Car & Manufacturing Company is providing all the motor cars above described from plans and specifications prepared by the Roberts & Abbott Company, engineers, Bret Harter, assistant engineer, of the Roberts & Abbott Company, having special charge of same.

REGULAR PASSENGER CAR FOR THE WASHINGTON, BALTIMORE & ANNAPOLIS ELECTRIC RAILWAY

A NEW TYPE HARP WITH FLEXIBLE HEAD

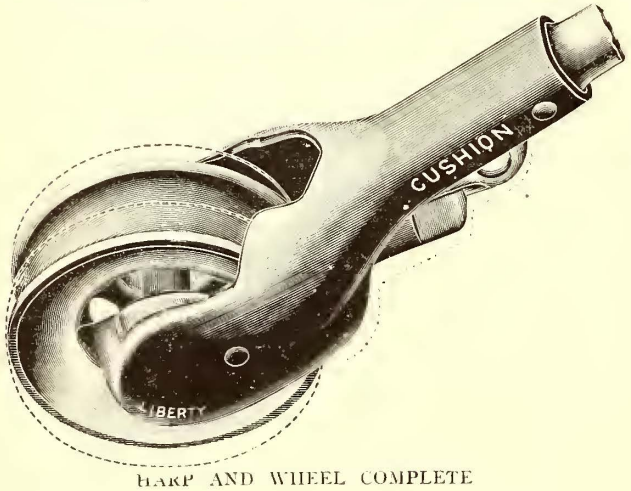
The Liberty trolley harp has been still further perfected by the manufacturer, the New Departure Manufacturing Company of Bristol, Conn., by which it is now offered in its modified form. The Liberty harp was first introduced several years ago, and marked a material advance inasmuch as it has a flexible head. The first harps were satisfactory devices, but it soon became evident that they could be improved, and after months of experimenting, the cushion shank was developed and tried out in practice. Finally, after operating successfully on a hundred or more roads the cushion harp was placed upon the market. Exhibited

at the Columbus Convention, the harp attracted a great deal of attention. Since that time it has been still further modified, and will be shown in its new form at the convention.

The harps are practically adapted for high speed and interurban roads. The cushion, which is conceded to be the feature of the harp, consists of two steel buffer springs located in pockets in the end of the shank, the outer ends of the springs being pressed against the inside wall of the harp shank. Under normal conditions the springs hold the harp virtually rigid with respect to the shank and the trolley pole. In passing over coupling

HARP WITHOUT WHEEL

sleeves, switches, circuit breakers, block signals, and other obstructions in the transmission wires, the harp is forced down against the action of the buffer springs and instead of the pole being thrown down and the wheel leaving the wire, the springs hold the wheel tight to the wire. In this way the shock is broken by the yielding of the harp, the rebound of the wheel is prevented and retention on the wire is secured. The spring is well housed within the shank of the harp and is protected from the weather and possible accident. The harps are made in rigid and flexible head. The



HARP AND WHEEL COMPLETE

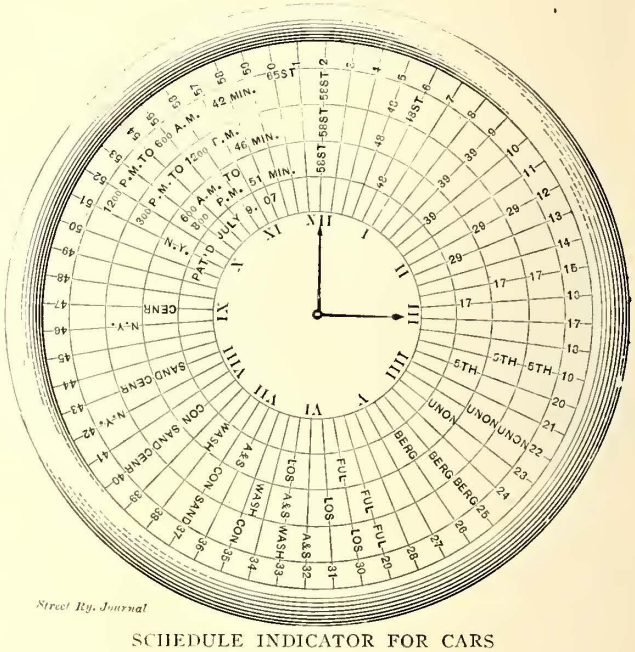
flexible head is a very simple device which allows the wheel to turn slightly, following the wire in taking curves. The wheels can be set and removed without the use of tools. Both the rigid and flexible head have the cushion shank.

The company also makes standard wheels of new metal, free from lead. A recent letter to the company from a New England railway says: "We have been using the two trolley harps and wheels which you sent us for trial and so far have found them altogether satisfactory, our men even making efforts to try to run the wheels off the wire on curves and not succeeding."

SCHEDULE INDICATOR FOR CARS

An ingenious device for giving the times for arriving at points or stations, to be carried on the front platform or in the cab of a car, has recently been invented by E. F. Reeves, superintendent of the New York & Brooklyn Bridge Division of the Brooklyn Heights Railroad Company, and is shown in the accompanying engraving. The use of a printed timetable is very inconvenient for motormen, and it is thought that if a device could be provided which is always open to inspection it would prove a great convenience.

The device consists of a moveable dial surrounding the face of a timepiece on which is set forth the route over which a car or train passes. The zero mark on the outer dial represents the terminal, and the outer dial is moved by hand until this zero mark comes opposite the minute hand on the timepiece at the minute the car should leave the terminal. The outer dial is then locked in position. After being set the device requires no further attention, as the minute hand on the watch points during the trip to the exact location on the line where car should be at all times.



SCHEDULE INDICATOR FOR CARS

This, it is thought, should greatly aid the motorman by relieving him of all calculations he is now compelled to practice in order to locate his proper position on the line, as well as the duty of frequently consulting his watch, which takes his attention away from his brake handle and controlling lever.

If desired a series of open circuits can be arranged in minute intervals to provide for a warning bell to be rung at all danger points on the line in advance of arrival, to call the attention of the motorman to a railroad crossing, drawbridge, reporting station, or other stopping point previously determined. These bell circuits would be closed by the minute hand of the timepiece, would conduce to safety in operation and can be made useful in other ways. The entire indicator is 5½ ins. in diameter and of convenient shape to drop into the coat pocket when out of service.

In the engraving shown the indicator is adapted for use on the Southern Division of the Brooklyn Heights Company, where the run is less than one hour in length. The operation of the indicator in that case is as follows: If the car is due to leave any one point, say Fifty-Eighth

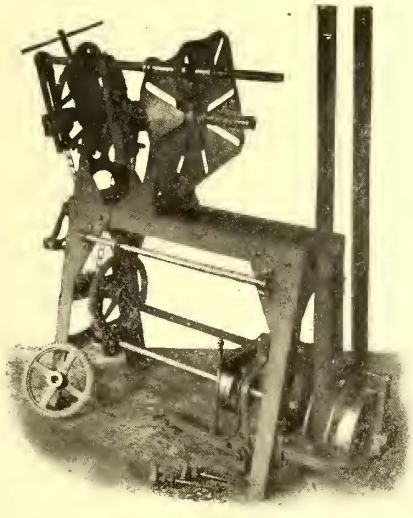
Street, on the even hour, the outside dial is moved around the face of the clock until Fifty-Eighth Street comes opposite XII. The outside dial is then locked in this position. Then as the minute hand travels around the face of the clock it will always be directed to the point on the route at which the car should be according to the timetable. When the runs are less than an hour the outside dial is divided into different sections, and when it is more than an hour the outside dial is marked with a spiral instead of a circle.

The inventor claims for his invention better intervals, less congestion at congested points, even distribution of loading, less accidents, increased revenue and no abuse in handling equipment, as the usual cause is removed.

FIELD AND ARMATURE COIL-WINDING ATTACHMENT FOR ARMATURE BANDING MACHINE

An attachment has been devised by the Device Improvement Company, of Hanover, Pa., for use with the Peerless banding machine which can be put on in a few minutes, and which greatly simplifies the winding of field and armature coils. Briefly, the device consists of a shaft and slotted face plate rigidly held down on the two heads, the shaft and face plate being driven by the clutch sprocket wheel and chain, similar to the armature in the banding operation. The same sensitive control applies, as well as foot control with positive brake for quick stopping and the two changes of speed instantly obtained by the change of gears.

Field and armature coils forms are very simple to make,



FIELD AND ARMATURE WINDING ATTACHMENT FOR ARMATURE BANDING MACHINE

and are bolted to face plate to be driven, in place of having iron centers with key way and keyed to the shaft. The slots in the face plate also facilitate any adjustments in the wire. One very prominent feature of this machine is the traveling guide wheel over which the magnet wire passes to the coil form, permitting accurate coils to be produced with ease. The hand wheel for guiding the magnet wire is adjustable according to the thickness of the field coils. The hub carrying the grooved pulley is threaded and is moved back and forward on the threaded rod, similar to the wire guide for band wire. Contrast this method of guiding wire to the hand method and the ease and accuracy will be fully appreciated. The finished field of armature coil can be removed from the face plate without disturbing any part of the machine. This machine used in connection with the company's tension machine forms a field and armature coil-winding device.

NEW EQUIPMENT FOR INDEPENDENCE, KAN.

Four semi-convertible cars for interurban service, three open and one baggage, built by the American Car Company, constitute the latest addition to the rolling stock of the Union Traction Company, of Independence, Kan., now building a line to connect Independence, Coffeyville, Caney, Meodesha and Cherryvale, a distance of 23 miles. The semi-convertible cars are of the combination passenger and smoking type. The chief dimensions of these interurban cars are as follows: Length over bodies, 34 ft. 4 ins.; over

INTERURBAN SEMI-CONVERTIBLE CAR FOR THE SERVICE BETWEEN INDEPENDENCE AND CHERRYVALE, KANSAS

crown pieces, 44 ft. 4 ins.; length of smoking compartments, 9 ft. 2 ins.; width over sills including sheathing, 8 ft. 4 ins.; height from floor to ceiling, 8 ft. 5⅝ ins.; from track to underside of sills, 36⅜ ins.; side sills, 4¾ ins. x 7¾ ins., with angles 3½ ins. x 6 ins. x ⅜ in.; end sills, 5¼ ins. x 13/16 in. The inside finish is of golden oak with ceilings of 3-ply birch. Leather seats with high backs and head rolls are furnished in the passenger compartments. The other compartments have seats of rattan of the same type. The trucks are of the No. 27-El type with 6-ft. wheel base. The 10-bench open cars which will be used for local service are 28 ft. 8⅜ ins. over the crown pieces, and are mounted on No. 21-E single trucks. Tthey are standard throughout. The baggage car measures 44 ft. over the ends and conforms to the general outline of the interurban passenger cars described.

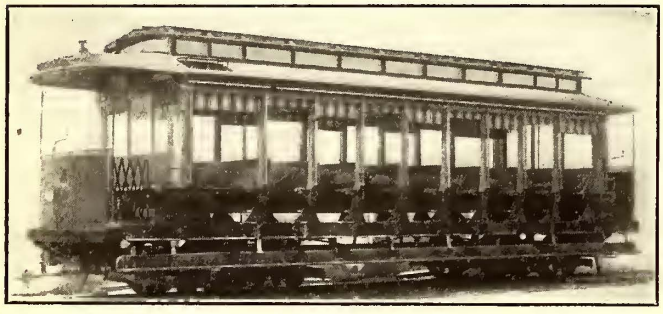
THE H. P. CAMERON COMPANY EXTENDS ITS PLANT

The H. P. Cameron Electrical Manufacturing Company, of Ansonia, Conn., finding its old plant entirely inadequate for its expansion decided about a year ago to secure larger and more commodious quarters where it could more promptly and advantageously serve its customers. A three-story building within a block of the railroad station was secured and an addition to this building has been erected and new machinery installed throughout. The first floor is devoted to stock and shipping rooms, so arranged as to give the best advantage to the handling of stock and shipping of goods. The second floor contains the machine shop. The machines for stamping and sawing commutators are placed in the center of the floor, while the machinery for the turning out of assembled commutators is arranged along the sides of the building. The third floor is devoted exclusively to the manufacture of mica insulation. The company operates its own mica mines and uses its own product in the articles which it manufactures. Although this company turns out large quantities of assembled commutators, its specialty is the manufacture of commutator segments, which are made to specification from hard-drawn copper bars. If a manufacturer prefers his segments sawed, they are sawed to ex-

act size; if stamped, dies of various types and sizes are provided for that purpose. A laminated type of segment for large generators and motors has been developed and machinery for its manufacture has been provided so that these segments are turned out in any size and quantity desired, each segment being an exact duplication of the original.

NARRAGANSETT CARS FOR COLUMBUS, GA.

The J. G Brill Company recently shipped to the Columbus Railroad Company, of Columbus, Ga., three of its patented Narragansett type of cars, to be run between Columbus, Phoenix City and Girard, Ala., a distance of about twenty miles. The additional step on these cars, which is formed by an extension to the lower outward extending flange of the Z-bar sill, making an upper step 8½



OPEN CAR FOR COLUMBUS, GA.

ins. wide, is well suited to excursion travel and will play an important part in the transportation of the persons to Wildwood Park and similar places. The Columbus Railroad Company is one of the Stone & Webster properties, a number of which are now using Narragansett type cars.

The chief dimensions of the Columbus cars are as follows: Length over crown pieces, 34 ft. ⅜ in.; width over sills, 7 ft. 5 ins.; over posts at belt, 8 ft. 3 ins.; height from floor to ceiling at center, 5 ft. 9 ins.; side sills, 8 ins. x 3 ins. x ½ in. Z-iron. The trucks used under the car bodies are No. 27-G1 and two motors of 40-hp. capacity each are used per car. The cars have the regulation push-over seats and are standard throughout. Curtains are provided at the bulkheads, which is an usual feature. Folding gates, gongs and signal bells are among the specialties furnished by the builders.

PROPOSED PHILADELPHIA SUBWAY

The Philadelphia Subway Terminal Railway Company has received a charter to construct a subway for railroad purposes in Broad Street, from the north side of Filbert Street to a point near North Philadelphia Station, where it will connect with the Pennsylvania's Germantown and Chestnut Hill branch. It is estimated that the subway will cost from $10,000,000 to $15,000,000 and be about four miles long.

OHIO DECISION ON STREET RAILWAY CONSENTS

According to a Supreme Court decision, rendered Oct. 7, a city council has the right to give a street railway company consents for city property abutting on streets traversed by the railway line. The decision was in the case of Taylor Emerson against the Forest City Railway Company, of Cleveland, in which it was sought to declare the franchise of the company on East Fourteenth Street illegal on the ground that without the city's consent to the cemetery property it did not have a majority of the front footage on the street. The company admitted that this was true, but contended that the city had the authority to give its consent to the use of the streets in front of the cemetery property. This contention, it seems, is upheld and the ruling of Judge Beacom is sustained.

AN EMERGENCY AIR VALVE FOR APPLYING BRAKES AND DROPPING FENDER

The Consolidated Car Fender Company, of Providence, R. I., has perfected an emergency air valve designed with the idea of making more certain the dropping of the fender in all cases of an impending accident or collision. It is apparent that any cause for dropping the fender would also be a cause for stopping the car. Naturally the motorman's first thought and act in an impending accident or collision is to stop his car; in either case the fender should be down. The emergency valve applies the brakes and simultaneously drops the fender entirely independent of the regular valve. Another feature of the valve is that, its purpose being for quick stops in emergency cases, the motorman is not likely to use the regular valve to the emergency point so often, thus saving wear and tear on the brakes and the flattening of the wheels.

SEMI-CONVERTIBLE CARS ADOPTED AS STANDARD FOR GALESBURG & KEWANEE ELECTRIC RAILWAY

When the Galesburg & Kewanee Electric Railway Company placed its recent order of cars with the G. C. Kuhlman Car Company, it was the purpose of the company to secure a car that could be adopted as standard, and the semi-convertible type was finally decided upon as the best suited for a local service such as exists in and between small towns where the runs are short and the traffic light except at certain hours of the day. The initial order was for three cars of this type and R. H. Hayward, general manager, in a recent report on the performance of the new cars, states

VESTIBULED SEMI-CONVERTIBLE CAR FOR THE GALESBURG & KEWANEE ELECTRIC RAILWAY

that both management and public are well satisfied with them.

The Galesburg & Kewanee Electric Railway Company is a reorganization of the Galesburg & Oneida Railway Company, and is building an electric railway 40 miles in length of which 5 miles (the local line in Kewanee) are already in operation. The line as projected will connect Galesburg, Wataga, Oneida, Altona, Galva, Wethersfield and Kewanee, serving all told a population of about 36,000. The new cars are typical examples of single-track Brill semi-convertible cars and are standard throughout. The chief dimensions are as follows: Length over end panels, 21 ft.; over crown pieces, 31 ft. 4 ins.; width over sills including sheathing, 7 ft. 8½ ins.; size of side sills, 3⅝ ins. x 5 ins.; end sills, 3½ ins. x 8⅜ ins.; sill plates, 12 ins. x ⅜ in. Width of aisles, 22 ins.; length of seats, 35 ins. The interiors are finished in cherry, with ceilings of maple. The trucks are of the No. 21-E type with 7-ft. 6-in. wheel base.

FINANCIAL INTELLIGENCE

Wall Street, Oct. 9, 1907.

The Money Market

There has been no material change in the local money market during the past week, rates are for practically all classes of accommodations, ruling at the highest points recorded for several months past. The advance in call money rates to 10 per cent resulting from the calling and shifting of loans preparatory to the Oct. 1 interest and dividend disbursements was followed by a sharp reaction in the rate for demand money to 5 and 5½ per cent. This reaction was undoubtedly due in a great measure to the return to mercantile channels of the moneys disbursed on the first of the month, and to the intense dulness prevailing in the general security market. Time money, however, has ruled decidedly firm, and rates for all maturities extending from sixty days to six months command the full legal rate of 6 per cent and a commission, bringing the total charge to the borrowers up to 6½ per cent. Very little business, however, was reported in this branch of the market, borrowers generally being disposed to draw their requirements from the call money market. On the other hand, the banks and trust companies are not at all disposed to offer with any degree of freedom, and the small amounts of money appearing in the market come almost entirely from individual lenders. At the present writing, there is nothing in the situation to warrant the belief of any material easing off in rates for money for fixed periods in the near future. The Secretary of the Treasury continues to deposit government moneys with the national banks in this city, and at the principal interior points, and the present condition of the Federal Treasury makes it practically certain that these deposits will be increased from time to time. The demand for money at all of the principal Western and Southern points continues brisk, the shipments from this center during the week ending Oct. 5, being the largest since the beginning of the outward movement of money. The indications are that the demand from those sources will continue for some time to come, or until the grain and cotton crops have been moved. The banks have also sustained losses as a result of the excess revenues of the United States over disbursements, and on account of the collection of taxes by the city of New York.

The foreign exchange market ruled steady, notwithstanding a rather liberal export movement of wheat and cotton, but the belief in foreign exchange circles appears to be that in the near future shipments of our commodities will assume much larger proportions, and will result in a decidedly easier exchange market. The European situation continues comparatively easy. Private discount rates at London are still substantially below the official rate, but in well-informed quarters it is not expected that any change in the Bank of England minimum rate will be made in the near future, especially so as the Bank of England will probably be called upon to furnish a substantial amount of gold to finance the Egyptian cotton crop. Sentiment at Paris was also reported as more cheerful.

The bank statement published last Saturday was somewhat disappointing, inasmuch as the loss in cash amounted to $7,261,100, or about $2,000,000 more than was indicated by the preliminary figures of the week's currency movements. Loans decreased $11,283,100, due in part to the previous week's liquidation in the securities market, and to the transfers of loans from the banks to other institutions. Deposits decreased $18,490,400. The reserve required was $4,622,600 less than in the preceding week, which, deducted from the loss in cash, diminished the surplus reserve by $2,998,500. The surplus now stands at $2,648,075, as against $9,425,125 in the corresponding week of 1906, $4,286,175 in 1905, $12,636,900 in 1904, $16,577,125 in 1903, $1,527,350 in 1902, $560,025 in 1901, and $6,241,900 in 1900.

The Stock Market

It is safe to say that fully 75 per cent of the business now being transacted on the floor of the Stock Exchange is professional, and that the vast majority of recognized commission houses are virtually idle. Besides, the so-called investment firms are doing little or no business, the spurt in investment securities which followed the somewhat phenomenal rise in the New York City 4½ per cent bonds having subsided. In some exceptional instances prices have recently shown wide fluctuations, but generally speaking, the variations have been very meager, and, while somewhat irregular at times, the market has displayed wonderful steadiness in view of the dulness. Money has ruled considerably firmer, both on call and on time, the former having advanced at one period to 10 per cent, and there have been other developments in the situation which ordinarily would have caused greater or less weakness in security values. However, the liquidating movement has obviously run its course, and the existing short interest has served as a formidable backlog to the entire market.

The so-called Hill stocks have played a prominent part in the week's movements. The increase in the Great Northern dividend, and expectations of a similar happening in connection with Northern Pacific, had a strengthening influence on these stocks, and incidentally aided the balance of the list. The expectations concerning the Northern Pacific dividend, however, were not realized, and in the closing days of the week disappointment on this score had a temporarily depressing effect upon the entire list. Developments relative to the copper situation have not been particularly novel, although the reduction of the Anaconda dividend, as well as that of the Rio Tintos Company, in London, and the popular belief that the Amalgamated directors will follow a similar course, kept this phase of the situation more or less prominently in the public eye. Considering the prevailing conditions in the copper industry, and the prevailing idea that a further recession in the iron and steel trade is imminent, the shares of the industrial concerns have exhibited remarkable firmness, which is, no doubt, accounted for by the fact that in their recent sharp decline they have discounted all there is of an unfavorable nature in the situation.

Generally speaking, the local traction shares have maintained a comparatively firm tone, and at times have given evidence of an advancing tendency. This applies with particular force to Brooklyn Rapid Transit, which gathered considerable strength from the publication of the company's favorable annual report, as also from rumors of purchase of control by the Pennsylvania Railroad, and from revived talk of a probable early dividend. The announcement that the Metropolitan Street Railway, following the example of the New York City Railway, had gone into receiver's hands, had no appreciable effect on the Inter.-Met. securities, for the reason, no doubt, that all such unfavorable events have long since been discounted in the market.

Philadelphia

The intense dulness prevailing in the general securities markets during the past week was reflected to a very great extent in the dealings in the traction shares. Trading in this group was extremely light, and, while prices moved with more or less irregularity, the net changes in most instances were slight. Philadelphia Rapid Transit was the active feature, about 2,000 shares changing hands. Opening at 19¼, the price ran off to 18⅜, but at the close there was a sharp advance to 20⅛. Union Traction was strong, in sympathy with Philadelphia Rapid Transit, the stock advancing a point to 52. United Companies of New Jersey lost a point from 238½ to 237½, and Consolidated Traction of New Jersey ruled at 66½. Philadelphia Traction was dealt in at 87 and 87¼ for small amounts, and Philadelphia Company common sold at ⅜.

Chicago

The only development of importance in the Chicago traction situation during the week was the organization of a committee composed of bondholders of the various Chicago traction companies. It is understood that the object of the committee is to insure the co-operation of the various committees already organized, and to protect the interests of the various bondholders in the reorganization of the Chicago Union Traction Company, an early settlement of the questions at issue is looked for. The local traction issues have been very quiet during the week, and prices show material change. Union Traction common sold at 2½, Metropolitan Elevated preferred at 62, and South Side Elevated from 77 to 75, and back to 76½.

Other Traction Securities

The feature of the Baltimore traction market was the weakness in United Railway 4s, which declined from 84 to 83, on the exchange of about $45,000 bonds. The income bonds and the refunding 5s held about steady, the first named selling at 50¼ to 50, and the last named at 78; several hundred shares

of United Railway stock sold at 11½. Trading in the other traction issues was practically at a standstill. Lexington Street Railway 5s sold at 98. The Boston market was intensely dull and featureless. Transactions included Boston Elevated at 130 to 129, Boston & Worcester preferred at 60 to 59¾, Massachusetts Electric common at 12, preferred at 48 to 47½, West End common at 84, and the preferred at 100 to 98½.

Transactions in traction stocks have not been extensive on the Cleveland Stock Exchange the past week. The heaviest trading was done on Monday of this week, when 310 shares of Cleveland Electric changed hands, the lowest price of the day being an opening sale at 47¼, and the highest, a future delivery transaction, with the buyer agreeing to pay 49 in sixty days. The remainder of the trading in this security was at 47½, and at the close none was offered below 48. The previous selling price had been 49, and for some time there had been little demand for the securities. Northern Ohio Traction & Light sold in a small lot or two at 21½, but later in the week the bid price dropped to 20, with 23 asked. A small block of Aurora, Elgin & Chicago sold at 32, while the preferred was quoted at 73½ bid. One or two small transactions in Lake Shore Electric common took place at 7⅞, with 8 bid later on.

Security Quotations.

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

	Oct. 2	Oct. 9
American Railways	46½	46½
Boston Elevated	129	128
Brooklyn Rapid Transit	48	43
Chicago City	150	150
Chicago Union Traction (common) certificates	—	—
Chicago Union Traction (preferred) certificates	—	—
Cleveland Electric	50	45
Consolidated Traction of New Jersey	06	66
Detroit United	62¾	62½
Interborough-Metropolitan	8½	9¼
Interborough-Metropolitan (preferred)	24	24
International Traction (common)	—	—
International Traction (preferred) 4s	—	—
Manhattan Railway	116	115
Massachusetts Elec. Cos. (common)	11½	11½
Massachusetts Elec. Cos. (preferred)	47½	46¼
Metropolitan Elevated, Chicago (common)	19	19
Metropolitan Elevated, Chicago (preferred)	60	60
Metropolitan Street	34	30
North American	57	57½
North Jersey Street Railway	40	40
Philadelphia Company (common)	39½	38¼
Philadelphia Rapid Transit	18½	18¾
Philadelphia Traction	86½	86½
Public Service Corporation certificates	—	—
Public Service Corporation 5 per cent notes	92	92
South Side Elevated (Chicago)	77	76
Third Avenue	42	36
Twin City, Minneapolis (common)	92½	92
Union Traction (Philadelphia)	49¼	51

Metals.

According to the "Iron Age," the pig iron production is continuing at the recent gait. There has been a modest accumulation of stocks of pig iron in some sections, but, generally speaking, furnace yards are bare. The markets throughout the country are dull. While in some quarters a slight improvement in the volume of orders for finished material has been observed, others complain that the volume of business for forward delivery is very small.

A further decline has taken place in copper, and apparently every effort to support the metal has been given up.

A PLAUSIBLE IMPOSTOR

It has been brought to the attention of the editors of this paper that a man who was some time ago defrauding members of the mechanical, electrical and engineering fraternities in this country has recommenced operations. It is advisable, therefore, to publish his description again and warn all readers against being deceived. He is an Englishman, about 30 years of age, 5 ft. 7 or 8 ins. in height, slight build, light complexion, and has crooked teeth. He generally represents himself as the son of some large manufacturer or other important man in England, over here on business. He is very well posted as to the names of products and manufacturers on both sides of the Atlantic, is very plausible, and, as a rule, after gaining the confidence of the men upon whom he calls he tells a story about having been robbed and asks for a loan anywhere up to $100 which is intended to tide him over until he can get money from his father to whom he has cabled. Any one who will capture this man and hand him over to the police will earn the gratitude of a large number of concerns in this country that have suffered from the man's impositions.

THE SITUATION IN CLEVELAND

The Cleveland Electric Railway Company again began selling seven tickets for a quarter last Wednesday morning, without previous announcement or notice of any kind. The decision upon this point was reached at a meeting of the board of directors held the day before. A statement was prepared by President Andrews for the newspapers, in which he says that the action was taken in order that the people might become acquainted with the proposition the company has made, seven tickets for a quarter and transfers, with double transfers on the crosstown lines. Outside of the features relating to underground terminals at the public square and rapid transit lines in the various directions needed, the voters may now be able to determine the merits of the offer of the old company by experience. When the company was operating on this fare some months ago, the transfer privileges were not so liberal as those included in the offer of settlement.

While this change was being made by the old company, Mayor Johnson was on the stand in Common Pleas Court, explaining that his plan would provide for three-cent fare only within the city limits, whether on the holding plan or not, and that the suburban towns would have to fight the matter out for themselves. Where they have agreements with the old company that the fare shall be the same at all times as that charged in the city, the contract would have to be observed on the holding plan, he said, but otherwise a fare, commensurate with the cost of service, would obtain outside of the city limits.

The taking of evidence in the trial of the injunction cases against the low fare companies was completed in Judge Lawrence's court last week, and the pleas of the attorneys were made. The strong points were summed up in rather plain terms by the attorneys. Mayor Johnson came in for comparison with Lincoln and Chase, in their work of securing money for the expenses of the Rebellion, and Morris, who financed the Revolution, on the one side, and a declaration that such a comparison profaned the names of these great men on the other. The Mayor's interest in the new company amounted to fathering the enterprise and acting as general manager, according to the declarations of the Cleveland Electric attorneys, and the statement was made that no official so bound up in private corporations as he was, could act for the best good of the people, if such action was against the ultimate success of those corporations. The decision of the court is expected some time this week.

On Monday evening, Oct. 7, the City Council adopted a resolution accepting $84,488.37 from the Cleveland Electric Railway Company for the use of Central Avenue and Quincy Street after the franchises had expired. This is the amount of the award made by Secretary H. J. Davies, of the Cleveland Electric Railway, and A. B. Dupont, of the Municipal Traction Company, some time ago. The meeting scheduled for a few days ago between these men was as much for the purpose of deciding whether the company made money at the 3-cent fare as anything else. Both filed letters with the Council, giving their version of the disagreement, as did President Andrews, of the Cleveland Electric Railway, who also asked that Bion J. Arnold, the street railway expert of Chicago, be appointed as one of the arbitrators. Mr. Davies asked to be relieved from further work on the board, and Mr. DuPont said he was ready to be replaced at any time.

On Monday Congressman Burton, Republican candidate for mayor, held conferences with both President Horace E. Andrews, of the Cleveland Electric, and A. B. DuPont, of the Municipal Traction Company, in an effort to clear up a number of points in the traction situation.

Judge Kennedy, of the Common Pleas Court, has sustained City Clerk Peter Witt's contention that he has a right to bring suit to prevent the Cleveland Electric Railway from spending money for the purchase of consents and fighting the Forest City Railway Company. The court said the company has no right to buy consents on streets in which the city has not granted it a franchise. Witt's petition will be heard on its merits on Oct. 15.

RESIGNATION OF H. H. VREELAND

Herbert H. Vreeland resigned hast week the position of manager for the receivers of the New York City Railway Company, to which he was appointed last month by Messrs, Joline and Robinson. It is understood that Mr. Vreeland will be succeeded in this position by Oren Root, vice-president and general manager of the New York City Railway Company. Mr. Vreeland has not resigned his offices of president and director of the New York City Railway Company, and will still act for the company and the receivers in a consulting capacity.. This was Mr. Vreeland's letter to the receivers:

Gentlemen: When you requested me to act as manager for the receivers, I felt that it was my duty without hesitation to comply and to remain in that position at least until permanent receivers were appointed. Now, however, I find that the demands upon my time due to my personal matters and to my connections with various other properties and interests are such as to make imperative the request, which I now make, that you accept my resignation as such manager.

I appreciate the evidence of confidence which was shown by my appointment, and I assure you that not only because of my official connection with the corporation, but on my own behalf, you shall at all times for yourselves and your representatives command of my services and advice along any lines which may be deemed of value to you in the difficult and complicated task which you have assumed.

The receivers' reply was as follows:

Dear Sir: We have your letter of this date tendering your resignation of the position to which you were appointed by us on Sept. 24 as manager for the purpose of attending to the physical operation of the properties in our charge as receivers under the order of the United States Circuit Court filed Sept. 24, 1907.

In accepting such resignation we beg to assure you of our appreciation of the services which you have rendered during the short time that you have been able to act with us, and shall not hesitate to avail ourselves of your kind offer to further assistance should occasion arise.

Mr. Vreeland received a hearty ovation at the annual meeting of the Metropolitan Street Railway Association, held Oct. 5 at Carnegie Hall. This is an organization of the employees of the system and Mr. Vreeland has been its president since he has been connected with the company. He referred to the official and legal complications which had arisen in the company's affairs and which made it necessary for him to give attention to matters which seemed of more pressing importance than those of operation. He said, however, that the men were well acquainted with the present manager of the property. He continued that his attitude toward the association and men would never change, and that he believed their organization the most efficient and loyal ever built up in any street railway system.

THE TRANSIT INQUIRY IN NEW YORK.

The Public Service Commission, at the hearing the latter part of last week, considered at length the details of the various accounts of the Metropolitan Street Railway Company and the New York City Railway Company.

The books of both the Metropolitan Street Railway and Metropolitan Securities were offered in evidence. The books of the Metropolitan Street Railway were opened in the spring of 1902, and the examination by the commission disclosed the names of all those who had received money from the corporation from the opening of the books down to date. The total paid to lawyers during that time amounted to $916,438.68, while the payments to Mr. Quigg for special services aggregated $217,307.77.

Mr. Quigg explained that the money received by him was used in connection with the various subway projects. Explaining how he spent the money. Mr. Quigg said:

"During the period beginning somewhat previously to the opening of this account, within which the Metropolitan interests were endeavoring to obtain the right to build and operate, or at all events to operate, a tunnel, they submitted to the Rapid Transit Commission plans for routes that were especially favorable to their scheme to give transfers from the new line of tunnel at every intersecting point with the surface lines. These plans were opposed by many other interests from time to time, or other plans were proposed by other interests that conflicted with theirs."

Mr. Quigg organized property owners' associations to help the fight, paid all the counsel fees and also circulated a petition through the East Side, which alone he said cost $50,000.

ANNUAL REPORT OF THE BROOKLYN RAPID TRANSIT COMPANY FOR THE YEAR ENDED JUNE 30, 1907

The pamphlet report of the Brooklyn Rapid Transit Company for the year ended June 30, 1907, just issued, shows the total earnings from operation to be $19,381,587, an increase of 4.92 per cent over the previous fiscal year. The percentage of operation to earnings is 59.16 per cent, as compared with 56.52 per cent for the year ending June 30, 1906. The net earnings from operation are $7,915,882, a decrease of $116,068. The amount of surplus after making all deductions is $2,002,598, equal to 4.45 per cent on the capital stock of the company. There were carried 511,839,437 passengers, an increase of 59,235,234, or 13.1 per cent over the previous fiscal year. The average gross earnings per passenger is 3.60 cents as compared with 3.89 cents for the preceding year, a loss per passenger of 7.5 per cent. The average net earnings per passenger (with no deductions for special appropriations or fixed charges) is 1.48 cents, as compared with 1.70 cents for the previous year. This deduction in net per passenger is accounted for partly by the increase of 41.2 per cent in number of transfers collected. The average number of cars operated daily for the twelve months ending June 30, 1907, is 2093, as against 1922 for the previous year, an increase of 9 per cent. The total passenger car mileage is 68,273,181, an increase of 4,615,858, or 7.2 per cent. In considering the increase in the average number of cars operated daily and the average number of passengers carried each day per car there should be taken into account the greater seating capacity of the cars placed in operation during the fiscal year ending June 30, 1907. Owing to lack of space the comparative income account and balance sheet cannot be published until next week's issue of the STREET RAILWAY JOURNAL.

In presenting the report President Winter has gone into the details of the various improvements in quite an extended way, taking up the work separately and not generalizing. In part, he says:

"One hundred elevated motor passenger cars have been ordered for delivery in the latter part of the year 1907. These cars will be equipped with two 200-hp motors, multiple unit control and air brakes. One special steel motor passenger car has also been ordered. One hundred and forty-three-surface convertible passenger cars and thirty freight cars (ten box and twenty gondola) have been received and placed in operation. The convertible passenger cars are each equipped with four 40-hp motors and air brakes. One hundred semi-convertible closed surface passenger cars have been ordered for delivery during August and September, 1907. These cars will be equipped with two 60-hp motors. Three hundred and sixty-four passenger cars have been vestibuled. Each surface car has been equipped with an additional fare register for the registration of transfer tickets. Specifications are being prepared for 100 additional elevated and 100 surface motor passenger cars."

Four sub-stations have been completed and put in operation. Plans are under way for the enlargement of the Bridge sub-station from 6000 kw to 13,000 kw capacity, and for two additional sub-stations, each of 10,000 kw capacity.

On June 30, 1907, the combined rated capacity of the power stations aggregated 73,660 kw, an increase of 15,000 kw over the previous year, or 25 per cent. The combined capacity of the sub-stations aggregated 47,000 kw, an increase of 13,500 kw, or 40 per cent.

Contract was entered into with the city on April 26, 1907, for the operation of elevated service across the Williamsburg Bridge to Manhattan. The city has laid tracks on the bridge and has under construction the Manhattan and Brooklyn terminals and extension of the structure on the Brooklyn plaza.

The Ninth Avenue depot and repair shop building is completed and in use. The new Maspeth depot, repair shop and office quarters, with club rooms, waiting room, etc., is nearing completion. A modern two-story building is under construction on Nostrand Avenue for track and line departments.

The aggregate taxes and impositions for 1907 are $2,252,000. The only taxes in litigation at the present time are those affecting the companies' tracks and lands constituting private rights-of-way, and special franchise taxes. As to the former, there is still to be paid, if the assessments stand in full, except as already reduced by decisions of a referee, $114,100.68, and there is reserved on the books for payment of this balance when determined $173,952.42, or an excess charge, if no reduction is obtained by litigation, of $59,851.74.

STREET RAILWAY PATENTS.

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

UNITED STATES PATENTS ISSUED OCT. 1, 1907.

867,401. Beamless Brake Mechanism; James B. McKiel, Marshall, Tex. App. filed July 9, 1907. A floating lever arranged between and pivotally connected to both brake and shoe levers, tension rods connecting the floating lever to the brake shoe levers and a tension rod for operating the floating lever.

867,406. Rail Bond; Lewis T. Pates, Upper Alton, Ill. App. filed Dec. 26, 1906. The bond has forked ends adapted to spread in divergent directions when they are driven into apertures in the rail ends.

867,415. Rail Bond; Frank W. Richey, Chicago, Ill. App. filed Dec. 5, 1902. The bond is made up of ribbons so bent as to avoid breakage by expansion and contraction of the rails, and pressed into copper heads.

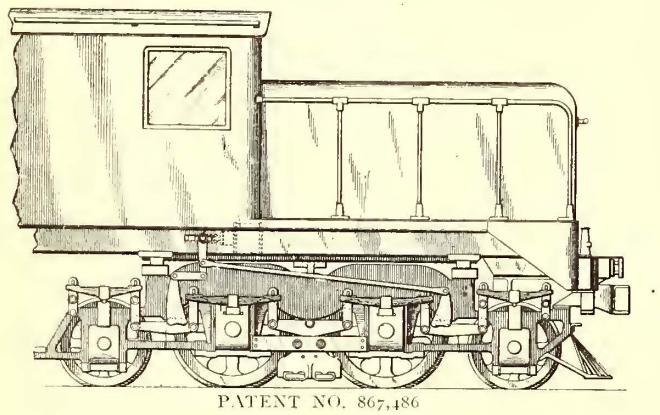
867,432. Pleasure Railway; Charles H. Smith, Chicago, Ill. App. filed Feb. 8, 1907. A gravity railway having a track with a descending course curved in one direction with respect to the direction of travel, followed by an ascending course curved in the reverse direction, and a water tank through which the track runs in shallow water, the sides of the tank having water encased in glass.

867,434. Track Sander; Joseph M. Smith, Worcester, Mass. App. filed Jan. 30, 1907. The sand drops by gravity into a casing having a worm wheel wherein which, when rotated, carries the sand to the discharge pipe.

867,448. Signalling System for Railways; Louis H. Thullen, Edgewood, Pa. App. filed June 23, 1906. Relates especially to signal systems for railways the track rails of which are included in and form part of the return path or conductor to the generator for the current employed for propelling motor cars along the railway.

867,482. Locking Mechanism for Controller Handles; Archibald S. Cubitt, Schenectady, N. Y. App. filed Jan. 2, 1906. Relates to the mechanical construction of the handle of the controller, having a locking lever depressed by a button on the handle.

867,486. Electric Locomotive; Samuel T. Dodd, Schenectady, N. Y. App. filed Feb. 18, 1907. Has driving-wheels and



PATENT NO. 867,486

idlers and means operative upon a predetermined variation of load on the driving motors for varying the distribution of weight on the wheels.

867,506. Amusement Apparatus; Otto Hermann, Philadelphia, Pa. App. filed Nov. 19, 1906. Comprises an inclined track having an outwardly and upwardly-inclined portion, and a landing so related as to cause the descending car to spring outwardly and upwardly, front end foremost, turn a complete somersault in space, and become reversed end for end, and descend on the landing.

867,528. Point Shifter for Tramways and the Like; George D. A. Parr, Leeds, England. App. filed Aug. 18, 1905. A clockwork device released by an electromagnet so as to cause successive actuations of the switch point in alternate directions.

867,533. Air-Brake System; Henry N. Ransom, Cleveland, Ohio. App. filed July 10, 1905. Details of an improved air-brake system by which the brakes may be operated either by straight air pressure controlled by an operator, or will act automatically in an emergency.

867,563. Automatic Block Signaling System; Daniel J. McCarthy, Wilkinsburg, Pa. App. filed Aug. 16, 1907. A block signal system of the type employing danger and caution signals and track rails energized by an alternating current in separate block sections. Uses alternating-current relays.

PERSONAL MENTION

MR. ANDRAL VAN has been appointed claim agent of the Houston Electric Company, Houston, Tex., to succeed Mr. M. D. Fields, resigned.

MESSRS. HAROLD WALLEM and C. F. Schrotte, of the engineering department of the Siemens-Schuckert Werke, of Berlin, are on a tour of this country, studying high-tension developments.

MR. C. C. LINES, heretofore superintendent of construction of the Beloit (Wis.) Traction Company, has resigned, effective at once, to become connected with Fairbanks, Morse & Co., at Beloit.

MR. E. W. NORRIS has resigned as chief engineer of the Newport News & Old Point Railway & Electric Company of Hampton, Va. Mr. Norris has been chief engineer of this company since the road was constructed several years ago.

MR. V. R. HUGHES, who resigned recently as chief engineer of the Pueblo & Suburban Traction Company, Pueblo, Col., to accept a similar position with the Northern Colorado Power Company, Denver, Col., has been appointed master mechanic of the American Beet Sugar Company, at Las Animas, Col.

MR. JOSEPH O'HARA has resigned as superintendent of the Aurora, Elgin & Chicago Railroad Company, with headquarters at Wheaton, Ill., to accept a position with the Washington, Baltimore & Annapolis Electric Railway. Mr. O'Hara was formerly connected with the Eastern Ohio Traction Company, Cleveland, Ohio.

MR. HARVEY M. LITTELL, recently general manager of the San Antonio Traction Company, has resigned from the street railway business to enter that of automobiles. On Oct. 1 his connection was announced with the Harry S. Houpt Company, of New York. This company is the agent for the Thomas automobiles, and has its headquarters at Broadway and Sixty-Third Street.

MR. C. L. CADLE, until recently superintendent of the Electric Railway Improvement Company, of Cleveland, has resigned to become electrical engineer with the Rochester Railways Company, of Rochester, of which Mr. E. J. Cook, formerly of Cleveland, is general manager. Mr. Cadle formerly served under Mr. Cook as superintendent of battery stations for the Cleveland Electric Railway.

MR. FRED A. STOWE has been appointed assistant to President T. E. Mitten, of the Chicago City Railway Company. Born in Chicago, Aug. 29, 1872, he graduated from the University of Iowa in 1892, and subsequently took a post-graduate course in political economy at the University of Chicago, and in law at Northwestern University, Evansville, Ill. He then engaged in journalistic work, first on the Chicago *Tribune*, and then on the Chicago *Chronicle*, on which he remained as political editor for ten years.

MR. J. C. McPHERSON, assistant superintendent of the northern division of the Pacific Electric Railway Company, has been appointed to the position of superintendent of the Los Angeles Inter-Urban Railway Company. Mr. McPherson will have his headquarters in Los Angeles, where his jurisdiction will extend over a number of the city lines and the Glendale, Tropico, Casa Verdugo and San Pedro lines. The appointment went into effect Oct. 1. Mr. McPherson has been connected with the Huntington interests for the past eleven years. Before coming to California, Mr. McPherson was connected with the Santa Fe Company, with headquarters at Albuquerque and Las Vegas, N. M. Mr. J. F. Turner, who has been superintendent of the Mt. Lowe division, with headquarters at Echo Mountain, has been promoted to the position of assistant superintendent of the northern division, with headquarters in Pasadena.