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Of this issue of the Street Railway Journal, 8000 copies are printed. Total circulation for 1906 to date, 187,800 copies, an average of 8164 copies per week.

Cross-Overs on City Systems

The extent to which cross-overs should be installed in city trackage is a matter of considerable uncertainty at times. All special track work is more or less of a nuisance in a large city, but in most cases it is impossible to avoid it. Right-angled crossings and Y's at street intersections where routes pass or diverge cannot well be dispensed with if the traffic is to be handled with any flexibility, but in the case of the cross-over from one to another of two parallel tracks the situation is very different. Unless it be in front of a terminal, car house or repair shop, the city cross-over has little excuse for being unless it is installed as a preventive of traffic stagnation in times of emergency.

Every cross-over in a street railway track slows down the speed of an approaching car and interposes a series of vicious hammer blows upon the equipment at each passage which are seldom enjoyed by the passengers or helpful toward reduced maintenance. At the same time, when a blockade occurs beyond a cross-over in an important piece of urban track there is no doubt that the special construction which in normal operation is dubbed a nuisance often proves to be invaluable. A golden mean should therefore be practiced in laying out cross-overs in the tracks of a large city system, with provision for the most trying emergencies. As for the smaller blockade on branch lines there is little need of special cross-over facilities here, and if the cars on the main line can be diverted through parallel streets, it would seem that even here emergency cross-overs can be largely, though not entirely, eliminated.

Alternating-Current Motors in Repair Shops

The vast majority of motors used in street railway repair shops are of the direct-current type, but the development of single-phase motors for car service and the building of roads which are alternating-current propositions throughout, except for the generator excitation, opens an interesting question with respect to the repair shop. On a purely a. c. road, should one install a rotary or motor-generator set for shop service, or is it a better plan to stick to the alternating motor, which has yet to win its laurels in extreme variable-speed machine tool driving?

The decision in a case of this kind depends to a considerable degree upon the amount of variable-speed work which the shop is likely to handle. Generally speaking, the street railway repair shop can be operated satisfactorily without a great speed range in its individual tools, for the reason that the machine-tool work required is fairly constant in character. The work of car maintenance calls for about the same operation one week as the next. Turning, grinding and planing take place on material which is fairly even in quality, and the necessary speed changes can, as a rule, be obtained by mechanical means. For a shop which can be operated with machines group-driven from constant speed motors, the ordinary induction motor with a short-circuited secondary winding ought to satisfy every requirement. Everyone knows the greater ability of the induction motor to withstand severe conditions, and even abuse, in comparison with the usual designs of direct-current motor, although the latter machine has made some wonderful records in the last few years.

For ordinary variable speed work, the single-phase induction motor of the repulsion type is making a name for itself under all sorts of conditions, and there is little ground of hesitation to equip a shop with these machines. Thoroughly satisfactory speed control over a range of certainty from about 30 per cent to 40 per cent of full speed to normal can be had with this type, which is being developed to meet all usual conditions, in conjunction with speed cones and gears. If a speed range of four to one or six to one is wanted, without mechanical changing, it would probably pay to install a small motor-generator set for the machines in question. The first cost of alternating motors is likely to run considerably higher than that of direct-current types, but it is a constant source of loss to be obliged to depend upon a motor-generator for shop service. Certainly if the series-alternating motor is equal to the exacting variable-speed demands of car service —and it looks as though it were—the repair shop problem ought not to be difficult to solve with the equipment now on the market, to say nothing of that likely to be designed in the near future.

A Question of Single-Phase Traction

One of the numerous side issues of the alternating motor traction proposition is the probable effect upon telephone and telegraph systems. No definite reports on the subject have as yet been made public, although a number of single-phase lines are and have been for some months in operation. We are not at all disposed to make gloomy predictions, but there certainly will be a serious question raised ere long that will have in some fashion to be settled. It does not take a long memory to run back to the time when the new-born trolley system was hailed with choice invective for its use of the grounded current. An acrimonious season followed which ended in the general adoption of metallic circuits for the telephones, a great improvement in service quite irrespective of the moving causes. The grounded circuit was bad, and in course of time would have been abolished, though we make bold to suggest that it would still be widely used in local service except for the certainty of trouble from trolley circuits. Then with the increase of the alternating-current system came renewed limitations which will well be remembered by those who had a hand in the battle of the systems fifteen years ago. Not only was the alternating current deadly at long range, but it was going to be fatal to telephoning and should be kept out of town, in fact off the earth. But it came, and we have not been able to discover that it has done anything in particular to the telephone service when properly arranged.

Undoubtedly one hears, so to speak, a sort of substratum of murmuring like the drone of a bagpipe, particularly in bad weather, but it is seldom of much account. The single-phase trolley, however, is another matter. Ordinary a. c. circuits are generally pretty well balanced in themselves, and it is only some of the wandering arc circuits that are much in evidence. In these a. c. roads there is a single wire suspended in the air and the return is through the earth. The conditions for interference are thus singularly favorable, and the current being heavy there is ample energy to make itself felt even on lines at some little distance. In spite of this we do not see why a properly installed complete metallic circuit should be seriously interfered with. Many transmission lines carry telephone circuits within a few feet of wires carrying very heavy a. c. current and still maintain fairly good conditions of service. Such lines are of course sensitive to balance, and a little leakage produces large results, yet a double conductor accurately transposed gives good service. Undoubtedly we shall at first hear a good deal about the terrible effects on telephones. In the long run we fancy that history will repeat itself and it will be found that a little caution in planning line work will practically obviate any serious results. An auxiliary overhead return on the railroad lines might help out in extreme cases, and this is a remedy easily applied. Ordinary telegraph service should hardly be effected at all, although it is possible that high-speed systems with automatic transmission might feel the induction. It is certainly one of the factors which must be considered in the a. c. traction question, and for a time it may make itself felt. That it will be permanently a grave element in the situation we are hardly disposed to think.

Five Years of Elevated Operation in Boston

On June 10 the elevated system of the Boston Elevated Railway Company will have been in operation five years. From time to time we have described the various improvements in the equipment and service which the company's experience has shown to be desirable, so it is scarcely necessary to refer to them in detail at this writing, or to mention the novel features introduced. It was to be expected that the operation of a system possessing so many new and untried features would be extremely instructive to transportation engineers, and there has been no disappointment on this score.

Two points of special importance stand out in bold relief as the first half-decade of elevated train service in Boston closes. The first is the skill with which the component parts of a most intricate transportation system have been co-ordinated into a complete and uniform whole. Surface-car routes, elevated, subway and tunnel lines have been brought into close relation by a large number of transfer points; connections have been in the main quickly made, and even the terminals have been little more than way stations. Short interval service on all important lines has reduced the congestion of platforms and passageways close to an irreducible minimum, and the addition of numerous explanatory signs, maps, etc., at the stations, has largely reduced the difficulty of the transit problem from the standpoint of the passenger unfamiliar with the geography of the Boston system.

The other point is the influence of the physical characteristics of the elevated division upon the equipment. We think it has been pretty thoroughly demonstrated that the Tremont Street Subway is no place for economical train operation, and believe that the removal of the trains to the new Washington Street Tunnel upon the completion of that route will be followed by a pleasing reduction in the wear and tear of the rolling stock. Rapid transit urban service cannot in the nature of things be produced with an energy consumption in watt hours per ton mile as low as that of an interurban line with few stops, but there is no reason why the service given upon a fairly straight and reasonably level tunnel track should not be much less expensive from the power consumption and maintenance standpoints than that in a subway characterized by sharp curves and frequent heavy grades. Nothing emphasizes the wear and tear of the present equipment more than the necessity for grinding every wheel on the elevated system about every two weeks. The problems of maintenance of way have been equally interesting on the Boston Elevated, and have furnished railway engineers with no small amount of material having important bearing upon the wear of rails on curves and in special work. The road has provided an excellent test ground for improvements in multiple unit control and brake systems, studies of motor heating, pneumatic door operation and the like.

As the free bodily transfer in effect at various stations between the trains of the elevated division and the company's surface cars precludes anything like an accurate statement of the number of passengers carried by the elevated cars during the five years, we must turn to the car mileage to realize the safety with which the road has been operated. The revenue mileage of the elevated cars for the five years aggregates 33,500,000, or about one-third the distance from the earth to the sun. In handling the volume of traffic which this mileage infers, not a single passenger has been killed through the fault of the company, and there have been few, if any, accidents of consequence. Such a record is certainly cause for congratulation.

Interurban Railways and Suburban Service

The extent to which an interurban railway terminating in a large city should adapt its schedules to the requirements of purely suburban service is an interesting question at the present time. The distribution of the rolling stock to reap the maximum number of through and local fares is naturally the desire of every progressive manager, but it is sometimes difficult to know how this can best be accomplished.

Conceptions of what passenger transportation ought to be in the vicinity of densely populated communities are becoming broader, and in many quarters there is a growing demand for a class of service which will reduce to a minimum the amount of walking necessary at each end of the line in passing between home and office. The feeling is becoming apparent in some cities that the great steam railroad terminal stations are more satisfactory to through passengers than to commuters, although, in cases where these large terminals are located near the heart of the business district, there are some notable exceptions. It is a well-known fact that in some of the large steam railroad terminals suburban passengers are daily obliged to walk nearly a thousand feet each way between their trains and the station entrances, to say nothing of the walk to the local station at one end of the line and the pedestrian tour between the terminal and the office on arrival at the city. It is not uncommon for 50 per cent or 60 per cent of the entire time of transit between office and home to be occupied in walking to and from the train. In the winter season, the complicated interlocking switches of the most costly and elaborately designed steam railroad terminal yard are often an easy prey to the snow storm, with complete paralysis of suburban traffic resulting.

From the earliest days in which electric cars were run into suburban territory, one of their greatest advantages to the public has been the continuity of the ride between the suburban street corner and the different points of the business district. This fact, coupled with the lower fare and greater frequency of service, as compared with the steam road, has been responsible for the diversion of a large traffic from the steam lines to the suburban trolley routes. The expansion of the suburbs, however, has forced the commutation limit farther and farther away, and the advent of interurban lines has resulted in a demand of increasing intensity for higher-speed service between remote suburbs and all parts of the business district. The purely suburban electric line, operating entirely upon the highways, cannot supply the kind of service needed, nor can the steam railroad, leaving its commutation passengers far from their destination, satisfy all the requirements. It remains for the interurban line, operated in part at least upon a reserved or private right of way, to offer the compromise facilities wanted. Neither of the old forms of transit meets all modern needs with exactness. What is essential is the cross-country speed of the steam road, with the distribution facilities now offered by the local trolley lines in the city proper.

The solution of the problem depends more upon the roadbed than upon anything else. In localities where land is cheap this means a private right of way; where land is costly the cars must be operated upon the highway. Time is more a factor than the cost of the trip in cents. Without the right of eminent domain, the interurban line cannot strike boldly across the fields and woods and furnish essentially high-speed service. This question has been settled in many States, but is still pending in others, which are endeavoring to determine the public need of high-speed interurban facilities. The tendency of the entire age is away from transportation facilities which are inconvenient; which stop every few rods along the route, or which stop at a few points in the remote districts only to fall short of broad distribution in the terminal cities.

The division of interurban cars between local and through service is a matter depending almost entirely upon the conditions prevailing upon the system. The through service should in any case be adequate for the traffic normally offered; if anything, it should be ample enough to allow a steady expansion of business—to encourage the creation of new travel. If the system offers good opportunities for local and suburban service, the road should operate cars enough to at least take care of the local traffic upon its own lines. If the interurban cars are handled by another company in one or more of the terminal cities, the number which it is advisable to operate in the city service will depend largely upon the traffic agreement reached, and the willingness of the passengers to transfer at the end of the interurban company's own lines of track. As a general thing, transfers are to be avoided as far as possible in deference to the wishes of the public, but it is frequently out of the question to carry every passenger in the interurban-suburban territory to the city business district without change of cars, unless the city company's cars operate under a traffic agreement upon the interurban company's suburban territory. The more remote suburbs can be treated as tributary to the main interurban line in many cases, passengers being carried to the center of the city by the through cars of the interurban line. Only a careful analysis of the conditions will enable the most profitable arrangement of schedules to be prepared, but the interurban line which can pick up the passenger near his own door and carry him to the center of the business district at high speed—say, 40-m. p. h. or 50-m. p. h. maximum, —is well in line to secure traffic which even an electrified steam road with a terminal remote from the business center cannot capture. High average speed outside and few stops within the outlying residence sections of the terminal city are of prime importance.

THE POWER TRANSMISSION LINE AND THIRD-RAIL SYSTEM OF THE LONG ISLAND RAILROAD—I

BY W. N. SMITH

The high-tension electric transmission line of the Long Island Railroad constitutes the means of distributing to its sub-stations the electric current generated in the Long Island City power station of the Pennsylvania Railroad Company, described in the STREET RAILWAY JOURNAL for April 7. As the transmission system was naturally governed as to dimensions and length by the number of sub-stations and their location with reference to the power house, it is proper to preface a detailed description of it with some general remarks on the arrangement of the power transmission and distribution system, as required properly to meet the demands of the electrically-operated traffic on the Long Island suburban lines.

The lines first equipped comprise the Atlantic Avenue Division, between Flatbush terminal and Belmont Park, and the Rockaway Beach Division, between Woodhaven Junction and Rockaway Park. The equipment of this latter division has also been extended to enable electric operation via. Far Rockaway to Valley Stream.

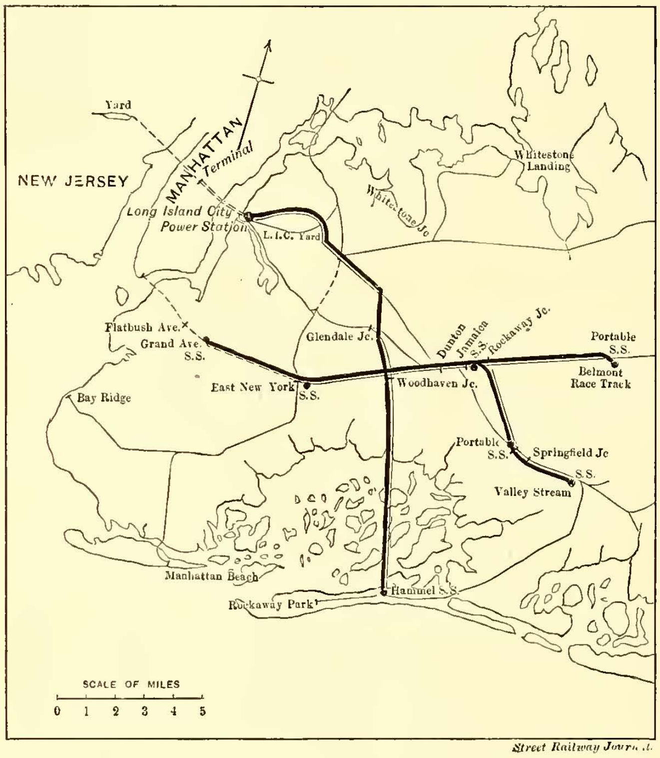


FIG. 1.—MAP OF TRANSMISSION LINES OF LONG ISLAND RAILROAD

A study of the traffic conditions to be met by the electrical equipment upon these divisions resulted in a preference for sub-station sites at Woodhaven Junction, East New York, Flatbush Avenue, Rockaway Junction and Hammel. These were ultimately selected as permanent sub-station locations, except that Grand Avenue, about one mile out from the terminal, was later on substituted for Flatbush Avenue. Since the original installation described in this article was completed, a sixth sub-station has been located at Valley Stream, receiving its power from an extension of the overhead line by way of Springfield Junction.

Two portable sub-stations, as illustrated in the STREET RAILWAY JOURNAL for Nov. 4, 1905, were also provided as the most economical method of supplying current for the very heavy periodic traffic to and from the Metropolitan race track south of Jamaica, and the new Belmont Park race track, about five miles east of Jamaica. These loads occur for two hours each day, for periods of two weeks, twice a year.

The portable sub-stations consist of 100-kw rotary-converter outfits, complete with transformers and switchboard, each mounted in a heavy steel box car. A lightly constructed house, built of structural steel and enclosed with expanded metal and concrete, is provided at each site to enclose the terminals and shelter the portable apparatus when in use. From Rockaway Junction sub-station, one branch of the high-tension transmission line is run to the portable sub-station terminal house built at Belmont Park, and another to that at Springfield Junction.

In reaching a decision as to whether the overhead or underground type of construction should predominate, a very careful study was made of the record of experience in operating lines of great length and of large carrying capacity. It appeared that the troubles in overhead lines were generally from the following causes: Wind, lightning and sleet storms, or structural weaknesses of poles, cross arms, pins, and insulators, or outside interference, either from branches of trees or mischief makers and thieves; and very rarely, by heat from a conflagration close to the route.

In case of conduit construction, it was found that breakdowns were generally due either to capacity effects causing extraordinary voltages, or to depreciation of cable sheaths from electrolysis, or to short-circuits by reason of mechanical injury, imperfect insulation or failure of joints; and occasionally to overloading or to gas explosions in manholes.

Comparing the causes and effects of the troubles in the two classes of construction, the general conclusion was reached that, while an overhead line is liable to more frequent interruption through minor troubles than an underground line, the interferences with continuous operation on an underground line, when they do happen, are likely to be of a more serious character, and of longer duration. Experience showed conclusively, that the principal causes of interruption to service in overhead circuits could be prevented by proper attention to mechanical sufficiency in the overhead structures; a characteristic which, though necessary, has frequently been overlooked in the past. Although underground construction might have been preferred, could its cost be brought down to something like an equality with overhead costs, financial considerations favor the adoption of the overhead type because its cost is only a fraction of that involved in high-tension cable and conduit work, and because its reliability is assured when properly installed. Overhead construction was, therefore, adopted wherever it was usable.

The topography of the system is such that Woodhaven Junction sub-station becomes a natural distributing center between the power house and the other sub-stations, and it was, therefore, decided to make it the objective point of a main power transmission trunk line, which should bring directly to it the entire output of the power station for distribution among the sub-stations. The problem of line construction was therefore to build a trunk line from the main power station to Woodhaven Junction, with two branch transmission lines running along Atlantic Avenue, between Grand Avenue and Rockaway Junction, with two subordinate branches from Rockaway Junction to the two race tracks, and a third subordinate branch running directly south from Woodhaven to Hammel sub-station, across the Jamaica Bay trestle. Fig. 1 is a map showing the route followed by the transmission lines.

The general conditions controlling the location of the power transmission lines were such as to render difficult the construction of certain parts of it. Although the railroad right of way is, in most places, available, it is not always straight, and is sometimes so narrow as to make it difficult to meet the usual and desirable restrictions, with respect to close proximity of the line to telephone and electric light wires, trees, and other abutting property, which are commonly regarded as conducive to safety in operation. Although the expense of underground cable construction precluded the possibility of recommending it uniformly for all locations, nevertheless, the impracticability of constructing high-tension overhead lines in thickly populated sections of Brooklyn and Queens, required recourse to underground construction in two sections of the line. One of them comprises 1⅛ miles of main trunk line, from the power station to Dutchkills Street, and the other traverses Atlantic Avenue, between Flatbush terminal and Dunton, just west of Jamaica. Except where submarine cables were used, at the Broad Channel and Beach Channel drawbridges in the Jamaica Bay trestle, the remainder of the transmission line is of the overhead type of construction.

The trunk line as originally built carries five circuits from the power station to Woodhaven Junction sub-station, running in an eighteen-duct conduit line to Dutchkills Street, thence on a line of steel poles which follows the right of way of the Main Line Division, to a point about due north of Glendale Junction, where it bends to the south across the fields for about a mile, until it strikes the Rockaway Beach Division, which it follows to Woodhaven Junction. A branch line of three circuits runs westward from Woodhaven Junction to the East New York sub-station, two circuits running thence to Grand Avenue sub-station, all these being run in underground conduits. To the east of Woodhaven Junction there are two circuits run underground to Dunton, where the transmission is changed from underground to overhead, continuing easterly on steel poles to Rockaway Junction sub-station. The branch circuits from Rockaway Junction to the portable sub-station terminal buildings at Belmont Park and Springfield Junction, are carried on wooden poles running along the Main Line and the Montauk Division, respectively, to their destination. Southward from Woodhaven two circuits follow the Rockaway Beach division across the Jamaica Bay trestle to Hammel sub-station. These circuits are carried on a line of steel poles to the southern outskirts of Ozone Park, half a mile or more from the sub-station, and the remainder of the distance on wooden poles.

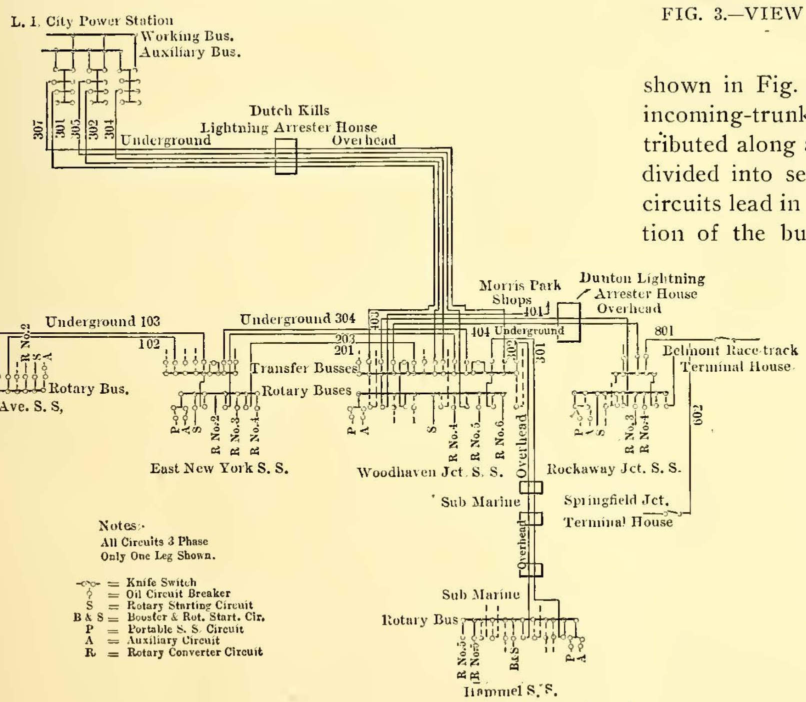


FIG. 2.—OUTLINE DIAGRAM OF CIRCUITS

The general arrangement of the transmission circuits is shown in Fig. 2. It will be noted in this diagram that the incoming-trunk line circuits at Woodhaven Junction are distributed along a set of bus-bars called the "transfer bus," and divided into sections from which the outgoing transmission circuits lead in various directions. It is possible by manipulation of the bus junction switches to operate these circuits separately or together, from outlying sub-stations all the way back to the power station. The same general arrangement is carried out in a smaller degree by similar transfer buses at East New York and Rockaway Junction.


FIG. 3.—VIEW OF PUMP HOUSE ON MAIN CONDUIT LINE, NEAR LONG ISLAND CITY

The lengths of the various sections of the transmission lines are as follows:

Conduit section of trunk line, power station to Dutchkills Street, 1.12 miles. Overhead trunk line, Dutchkills Street to Woodhaven junction, 7.85 miles. Conduit section, from Woodhaven to East New York, 3.23 miles, and from East New York to Grand Avenue, 3.04 miles, Woodhaven to Dunton, 1.7 miles. Overhead, from Dunton to Rockaway Junction, 1.73 miles; Rockaway Junction to Belmont Park, 3.71 miles; Rockaway Junction to Springfield Junction, 3.35 miles; Springfield Junction to Valley Stream, 2.57 miles; Woodhaven Junction to Hammel, 6.98 miles.

The total mileage of conduit lines now in use is therefore 9.09, and that of pole lines, 26.19 miles.

CONDUIT CONSTRUCTION

The duct line leading from the manhole directly outside of the Long Island City power station, runs out Fourth Street to West Avenue, thence to Sixth Street, which it follows to the railroad tracks. Thence it runs along near the northern edge of the railroad right-of-way to the arrester house at Dutchkills Street. Between the power station and the railroad tracks, the construction involved no serious complications, except such obstructions as are frequently met with in city streets. The remainder of the line involved not only some blasting through a ledge of rock, but was also rendered especially difficult because much of it was situated below the level of the ground water, which, for a large part of the distance, was nearly at the surface, so that special provision for the drainage of the ducts and manholes was necessary. The manholes in this part of the line are connected by a line of 8-in. sewer pipe laid beneath the ducts and entering the manholes about 18 ins. from the bottom, thus forming a catch basin to prevent silt or other foreign matter from getting into and clogging the pipe. This conduit line is so pitched as to bring all the drainage into three sumps, one located at the power station, one about one-half mile from it, and the third near the Dutchkills Street end of the conduit line. These sumps are kept pumped out by electrically-driven submerged centrifugal pumps, automatically controlled, and discharging into the city sewer system. An illustration of the pumping house at the Dutchkills sump is shown in Fig. 3.

FIG. 4.—CONDUIT MANHOLES CLOSE TO TRACK, ATLANTIC DIVISION

This conduit line is constructed of single vitrified-clay ducts, 18 ins. long, with square holes 3 13-16 ins., inside measurement, and walls 3/4 in. thick. They were designed especially for the construction, and the ducts are 7-16 in. greater diameter than usual in order to facilitate the installation of the three conductor high-tension cables, which are nearly 3 ins. in diameter. A single duct was preferred to multiple ducts because of the thicker wall between ducts, which is better able to resist heat in case of a possible short-circuit. A square hole, with rounded corners, was preferred as affording space for dirt and pebbles to slide to one side, instead of being dragged along underneath the cable and injuring the sheath, as would be the case if round ducts had been used. The ducts are laid in cement mortar in such a way as to break joints in all cases, and are surrounded on the top, bottom and sides by a covering of concrete 4 ins. thick, composed of one part Portland cement, two and one-half parts of sand and five parts broken stone. The ducts are arranged three wide and six high.

The foregoing type of duct construction was adopted after duly considering the merits of various other types of ducts.

Manholes for drawing in and splicing the cables are located 400 ft. apart on straight work and a shorter distance on curves. The standard manhole for straight-line work is 8 ft. long, 4 ft. wide, and 6½ ft. high, inside dimensions. The corners are cut off, so that a horizontal section of the manhole resembles an elongated octagon. The side walls at the bottom are 12 ins. thick, and at the top 6 ins. thick, reinforced with expanded metal. The manholes are built of concrete, having a composition the same as that surrounding the ducts. An opening at the top is 25 ins. square, and is closed by two covers, the inner one of which can be locked, clamped, and packed gas tight if found desirable. Where, as sometimes happens, it was necessary to locate a manhole underneath the railroad tracks, it was strengthened by inserting additional I-beams in the roof. When the conduit line was placed between the edge of the right-of-way and the tracks, the limited space available made it necessary to change the shape of the manholes, which was done by making the side away from the tracks perfectly straight, and about on a line with the outside row of ducts. The interior arrangement was in every case such that cables could be spliced and carried across from one duct to another without introducing any sharp bends or leaving the cables unsupported.

During the construction of the conduit line out of Long Island City through the wet ground, it was necessary to line the trench with 3-in. tongued and grooved sheathing, and to use sump pumps continuously to remove the water. The sheathing was left in place at the completion of the work.

The conduit system on Atlantic Avenue comprises two kinds of construction. The portion lying between Atkins Avenue and Dunton, a distance of 4.4 miles, is in general identical with the above described construction for the main transmission line. It is installed on the south side of the tracks near the edge of the right of way. On this part of the construction the soil is of a very light sandy nature, so that the system is sufficiently drained by providing openings at the bottom of the manholes. As shown in Fig. 4, this section of the conduit construction was very close to the railroad track, in fact, the track overhung it for a good part of the distance, so that it became necessary to support the railroad track (which was in continual use) on one edge of the excavation, requiring a large amount of careful shoring to insure safe operation. The Atlantic Avenue Improvement conduits are built of four-way vitrified-clay duct, 36 ins. long, with square holes 3⅜ ins. on a side. These ducts are laid in cement mortar, the joints being first covered by a wrapping of cotton cloth saturated in Portland cement grout. Where the ducts are laid beneath the surface of the street, the assembled ducts are surrounded by a wall of concrete, 3 ins. thick on the sides and 4 ins. thick on the top and bottom.

On the Subway portion of the Improvement, the manholes for the conduit lines consist of niches in the side walls, 5 ft. wide, 8½ ft. in length, and 15 ft. high. These manholes are accessible from the street through regular manhole openings, and can also be reached from the Subway, as the side nearest the tracks is closed only by a rolling steel shutter.

On the other portions of the Atlantic Avenue Improvement the manholes are built of concrete, and are generally oval in form, 7 ft. long, 5 ft. wide, and 6½ ft. high, inside. The roof of this type of manhole is supported by I-beams, having an opening through it 24 ins. square closed by two covers, one of which can be locked gas tight. The manholes are located not more than 400 ft. apart. Where necessary, several of them are provided with a sump and automatically controlled electric-driven pumping apparatus. The pumps are of the submerged vertical centrifugal type, with 3-in. discharge, and when running at 840 r. p. m. will deliver 300 gals. per minute. They are controlled by an automatic starting device operated by means of floats, which prevent the water from rising above a certain height. The discharge pipes are connected to the city sewerage system. The motors are of the direct-current type, of 5½-hp at 220 volts.

UNDERGROUND CABLES

The underground high-tension cables are of the three-conductor type, each conductor having a cross section of 250,000 circ. mils, and being composed of thirty-seven copper wires. Each conductor is covered with a wrapping of impregnated paper, 7-32 in. thick. The interstices between the insulated strands are then filled in with jute insulation and another layer of 7-32-in. thick paper insulation is wound over the entire group. The outside sheath is 9-64 in. thick, and is composed of lead, with about 1½ per cent of tin added. The completed cable is 2⅞ ins. outside diameter. Each length of the cable was tested at the factory by applying 30,000 volts between each pair of conductors, and between each conductor and the sheath. After the cable was installed in the ducts and joined up ready for service, it was again tested by applying between each pair of conductors 30,000 volts, and between each conductor and the sheath 27,000 volts for a period of 30 minutes.

At each end of every high-tension cable there is sweated on a spun-brass end-bell, which is filled with "No. 67" GE compound, to properly seal the ends of the cable and prevent injurious static discharges. The end-bell is about 7¾ ins. in diameter, and about 7 ins. high. The three conductors are brought out separately through a wooden head in the end-bell, after being wrapped with varnished cambric tape, and are surrounded by micanite tubes, to give additional insulation.

At the drawbridges in the Jamaica Bay trestle, the cables are of the armored submarine type, and the conductors are insulated with 7-32 in. of rubber around each strand, with another 7-32 in. of rubber around the group of three. This insulation is composed of 30 per cent pure Para rubber, and is covered with a sheathing 9-64 in. thick, and composed of lead with about 1½ per cent of tin added. Over this is an armor of No. 4 B. & S. galvanized-iron wires laid spirally on the outside of the lead covering, with a thin layer of jute between the lead and the armor. There are two such cables at each drawbridge.

The high-tension cables are located in the lower portion of the conduit system wherever possible with the idea of separating them from any other cables for different purposes which may be installed subsequently. They are carried around the sides of the manholes in racks. The minimum radius of bend in this type of cable is 18 ins. Where exposed in the manholes, and at the sub-station terminals, the cables are wrapped with a layer of hard-rolled asbestos mill board, ⅛ in. thick, and outside of the asbestos mill board there is a wrapping of asbestos listing 2 ins. wide, laid on until it averages ⅜ ins. thick. The whole is then wrapped with galvanized-iron tape, 1-64 in. thick and ½ in. wide, laid on with edges overlapping. At each manhole, there is a strip of sheet copper sweated on to the lead sheath and brought out through the wrappings, to allow of grounding the cable should it be necessary to protect it from electrolysis.

Before the cables were pulled into the ducts, a wooden mandrel, 3 ft. long and 3⅛ ins. in diameter, was pulled through, to insure a clear passage.

At the Jamaica Bay drawbridges, the armored cables were laid across the channel and allowed to settle to the bottom. A diver then arranged them so that they were properly separated, and they were sunk into the mud by means of a water jet, supplied by pumps at 100-lbs. pressure. By means of this jet, the diver was able to scour out a trench wide enough to contain the cables, 4 ft. below the bottom of the channel. This method of installation was preferred to dredging because of the difficulty which would have been encountered in attempting to dredge the trench through the fender piles on either side, and because of the rapid current through the channels, which would fill with sand a trench so dredged immediately after excavation, unless the cables should be laid during the dredging process, which is obviously impracticable.

There is in all about 25 miles of high-tension underground cable installed, besides 418 miles of armored submarine cable.

ARRESTER HOUSES

The vulnerability of underground cables to lightning and to other static disturbances which may be set up in the transmission line, require that the outlying ends of transmission cables exposed to lightning discharges be provided with protective apparatus. Wherever the underground cable section of the transmission line is jointed up with the overhead system, lightning arresters and choke coils are installed, suitable houses being provided to shelter this apparatus. There is one of these houses on the main transmission line at Dutchkills Street, Long Island City, and another at Dunton, on the branch line running east of Woodhaven. Smaller houses

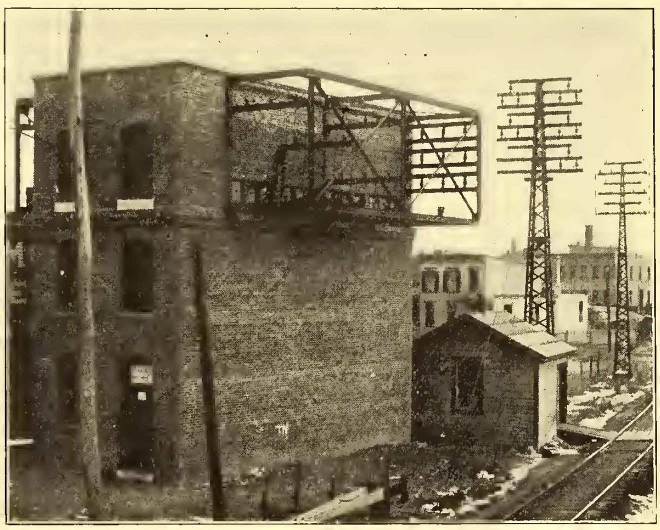


FIG. 5.—ARRESTER HOUSE AT DUTCHKILLS STREET

were also provided for the same purpose at the two drawbridges.

The house at Dutchkills Street is a brick structure, a photographic view of which is shown in Fig. 5. This at present contains room sufficient for eight outgoing overhead circuits, which leave the house four on a side. The general design of the transmission line is such that the circuits on one side of the poles can be shut down for repairs without shutting down those on the other side, and this idea was carried out in the construction of the arrester house, so that there would be no confusion possible between live conductors and dead conductors whenever it might become necessary to do any repair work on the line. The arrester house is 33½ ft. in length, 17½ ft. wide and 30½ ft. high, inside, and is constructed of brick, with a concrete floor and roof. The disposition of the apparatus in the interior is shown in Fig. 6, and it will be noted that the steel beams supporting the apparatus extend to the outside of the building, forming a series of racks for the support of the transmission cables, which are dead ended upon them. The arresters are all provided with knife switches, so that they can be readily disconnected from the circuit. A choke coil is also provided in series with each main circuit, and another knife switch between the choke coil and the cable bell, enabling the cable to be entirely disconnected from the overhead line. The disposition of the material is such as to economize space, and at the same time makes each circuit capable of ready access without the necessity of incurring risk from other apparatus, in case it needs repair. Wood has been entirely omitted from the construction of this

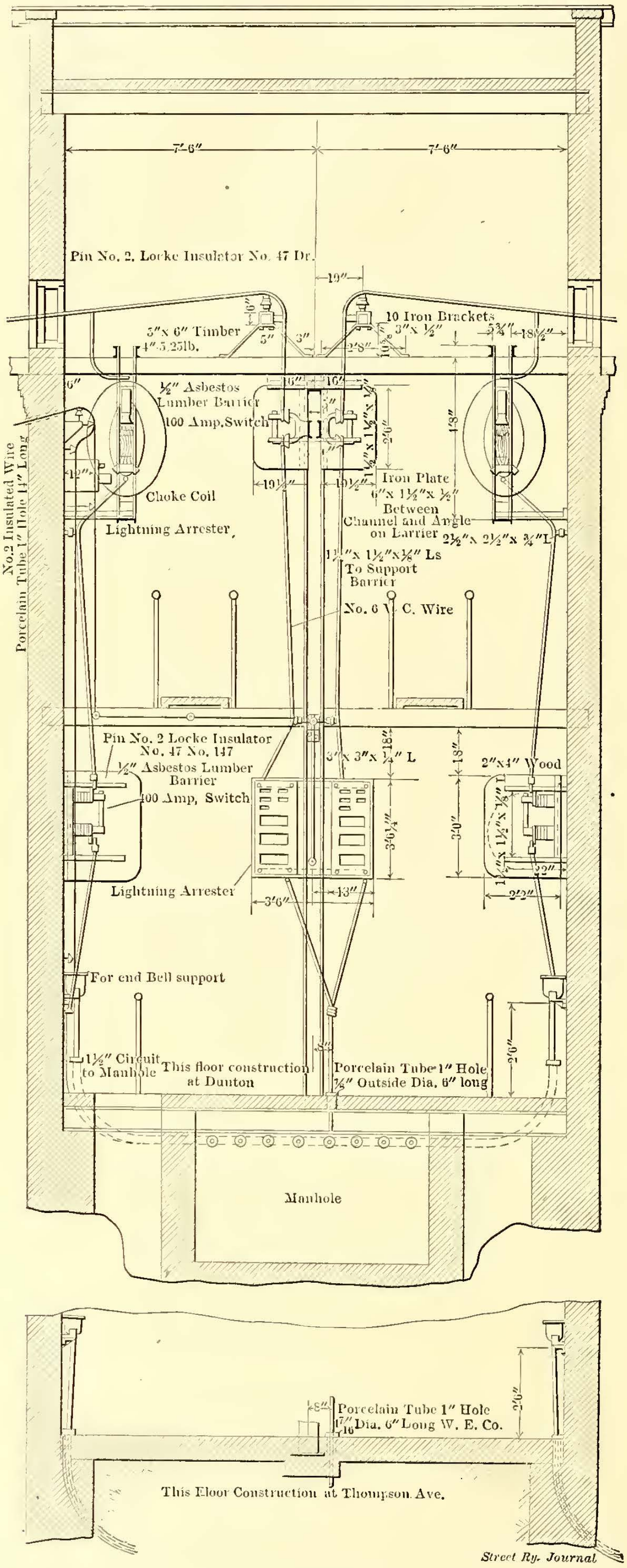


FIG. 6.—CROSS-SECTION OF LIGHTNING ARRESTER HOUSE. MAIN TRUNK LINE

arrester house, making it fireproof. The incoming cables are carried through the floor by means of ducts reaching to the last manhole in the conduit line, and are arranged along the wall, running through switches and through the choke coils to the various outlets along the various portions of the outside walls. The arresters are mounted on either side of the steel framework in the center of the building, and the ground connections all run to a single ground lead, consisting of 5½ square feet of copper plate buried in the ground between layers of crushed coke. The arresters are of the Westinghouse low-equivalent type, mounted on marble slabs, which in turn are carried upon porcelain insulators.

The outgoing cables on each side are anchored on a strain pole after leaving the racks upon the sides of the building, which in themselves are not intended to carry the longitudinal stresses of the overhead cables.

The openings in the side of the house through which the cables run, are 18 ins. square, enclosed by two glass plates ⅜ in. thick, and separated 5 ins. with 2½-in. holes in the centers, through which the cable passes without touching the glass. A thin disk of brass, 2½ ins. in diameter, is attached to each wire midway between the glass plates, and thus pre-

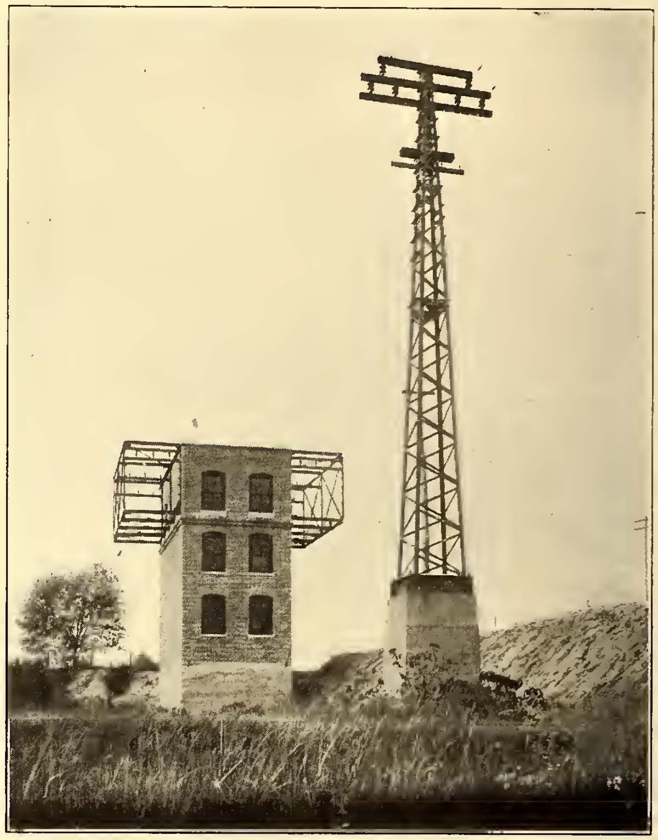


FIG. 7.—ARRESTER HOUSE AT DUNTON AND ADJACENT STRAIN POLE

vents the direct access of rain or snow through the openings. Standard straight-line insulators are used for supporting the bare wires inside of the building.

A house similar to the foregoing is located at Dunton, where the branch transmission line running eastward from Woodhaven is changed from conduit to overhead construction. The design of this house and the arrangements of the apparatus inside it are identical with the one above described, but with capacity for six circuits instead of eight. An illustration of this house is shown in Fig. 7.

At the drawbridge channels in Jamaica Bay, three houses are provided to shelter similar apparatus. Each of these consists of a steel framework covered with expanded metal and concrete side walls, and a corrugated copper roof resting upon a pile foundation. The method of entrance of wires is similar to that above described, and the strains of the overhead line are taken by a separate anchorage, composed of four poles braced together, forming a stiff wooden tower, which carries the longitudinal strains of the line without guying. The pile foundation is protected from ice by clusters of fender piles suitably located around them. There are two of these houses at Broad Channel, and one for the north side of Beach Channel, as the south end of the submarine cable at the latter place after passing to the shore runs through ducts directly to Hammel sub-station, which is only a few hundred feet from the drawbridge. A photographic view of the arrester house at Broad Channel is given in Fig. 8.

OVERHEAD-LINE CONSTRUCTION

The overhead construction is of the most substantial character. Up to about five years ago, the line construction of almost every electric railway and power transmission system was patterned after the standards which were evolved from telegraph construction practice where the conditions were not particularly exacting, and the penalty for breakdown was not great. The absolute necessity for reliability in a transmission line that serves a public utility of such magnitude as the Long Island Railroad, requires a stability in all parts of the construction that calls for the exercise of engineering skill and foresight to a greater extent than has hitherto been usually brought to bear. To give the continuous service which conditions demand it is necessary to construct a line in which the chance of failure of any part is reduced to a minimum, and that cannot be torn down or seriously disabled, except through some extraordinary catastrophe which would compel the temporary suspension of railroad operation. Consequently, instead of building a pole line by rule of thumb methods, all lines of engineering experience were brought to bear upon the problem with the object of carrying its mechanical sufficiency and stability to a degree of perfection that would afford the least possible chance for a shutdown from any of the usual causes.

There are two general divisions of the overhead consturction, the trunk line between Dutchkills Street and Woodhaven Junction, and the branch lines between that point and the other outlying sub-stations. The trunk line, shown in Fig. 9, is built of steel poles, and the branch line between Dunton and Rockaway Junction, through which the latter sub-station and two portable sub-stations are fed, and upon which the circuits to stations not yet constructed may eventually run, is also equally important with the trunk line, and is

FIG. 8.—ARRESTER HOUSE AT BROAD CHANNEL DRAWBRIDGE

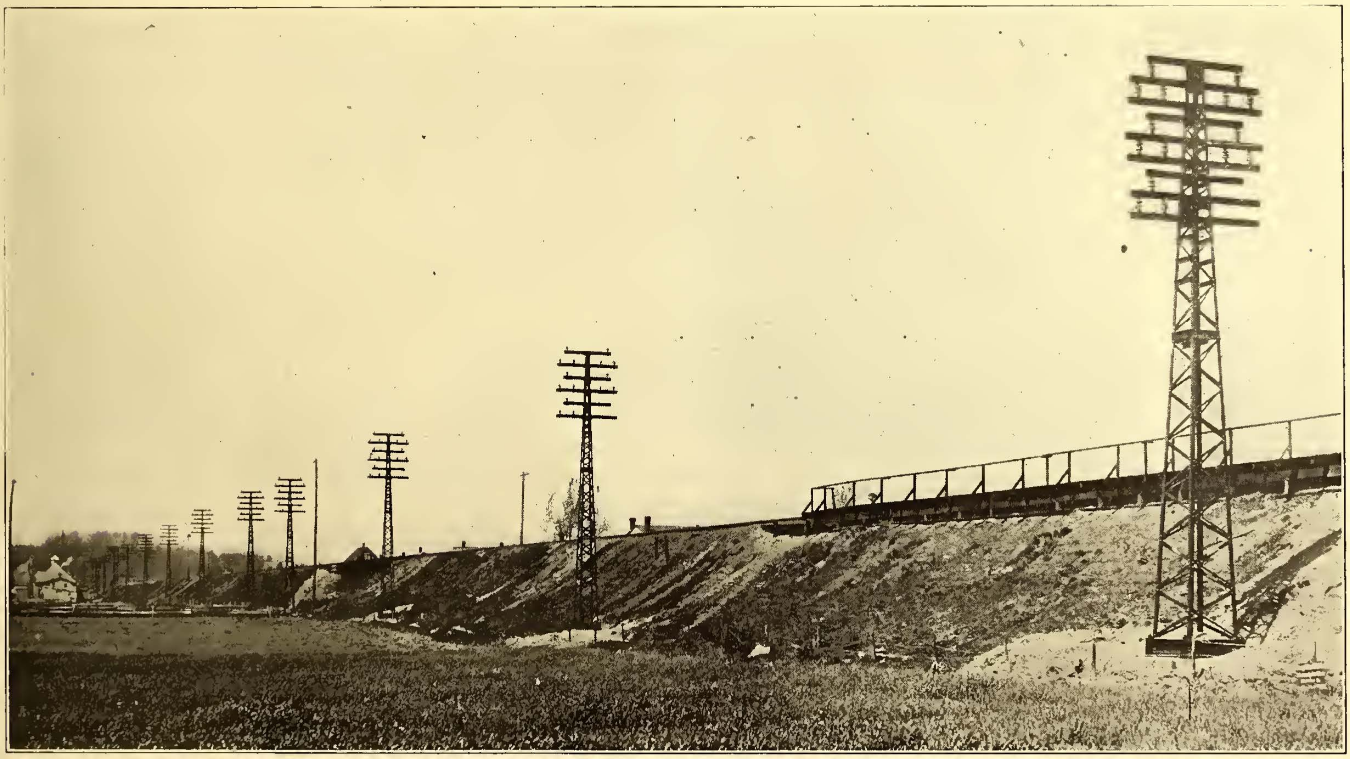


FIG. 9.—MAIN OVERHEAD TRUNK LINE NEAR WOODHAVEN JUNCTION

therefore built of steel. From Rockaway Junction, the branch pole lines to the separate outlying sub-stations are of wood, as shown by Fig. 10. From Woodhaven Junction south the poles are of steel to the southern outskirts of Ozone Park, because of the rather exceptional height at which the cables have to be carried to clear other wires, but from Ozone Park to Hammel they are of wood.

The pole lines have not been duplicated for the sake of greater security, as is sometimes done where plenty of room is available for pole lines, and where other conditions make it desirable. It was decided that a sufficient degree of insurance would be obtained by constructing a single-pole line in the most substantial manner. The suburban lines of the Long Island Railroad form several loops or meshes of a net work which may afford an opportunity for the construction of additional transmission lines by other routes, should future conditions require such a development.

The trunk line is designed to carry eight three-phase transmissions circuits, consisting of three 250,000-circ. mil cables each, together with eight low-tension cables of 500,000 circ. mils each. As the latter, when installed must be 25 ft. above the ground, and as there must be a reasonable clear space between the low-tension and high-tension circuits, no argument is required to demonstrate the necessity for using steel-tower construction to carry such an unusual weight of overhead conductors.

The branch line transmission circuits, however, are not intended to carry more than two three-phase transmission circuits and four low-tension cables on a single line of poles. This condition enabled the use of wooden poles, of which an

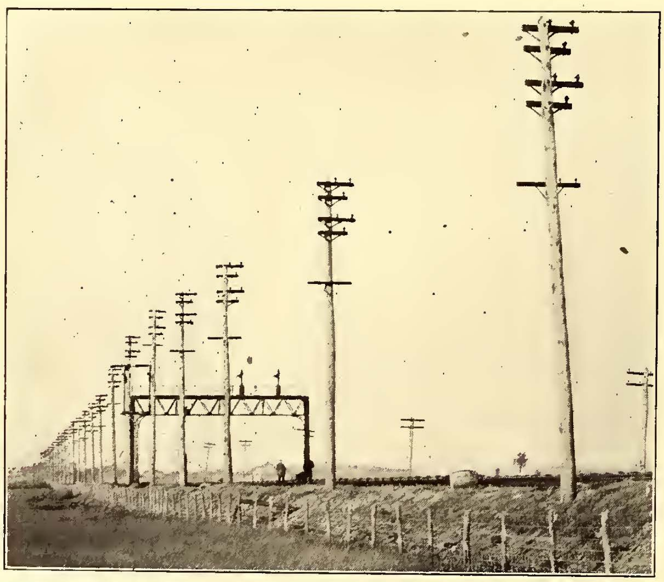


FIG. 10.—WOOD POLE CONSTRUCTION, LOOKING NORTH FROM JAMAICA BAY

extra heavy type was selected in order that the idea of stability might be consistently carried out.

STEEL POLES

The steel poles are of various sizes to meet different conditions. They are all designed to carry twenty-four 250,000-circ. mil cables, on their upper portions, and underneath them an additional load of eight 500,000-circ. mil low-tension cables which local regulations require to be at least 25 ft. above the ground. The spans between steel poles average 150 ft. in length, except where turning corners or carrying the cables over railroad tracks. The poles when fully loaded as above, are able to carry safely a weight of 4500 lbs. of cable.

The steel poles are built of four corner angles, connected together by angles and plates forming a lattice type of construction. They are tapered uniformly to the top on two sides and to within about 7½ ft. of the top on the other two sides, the taper being ⅜ in. per ft. This taper is uniform to the bottom of the pole and is the same for all lengths of poles. The tops are in every case 6 ins. x 11 ins. At the bottom the corner angles are tied to a base composed of plates and channels through the corners of which the four anchor bolts pass.

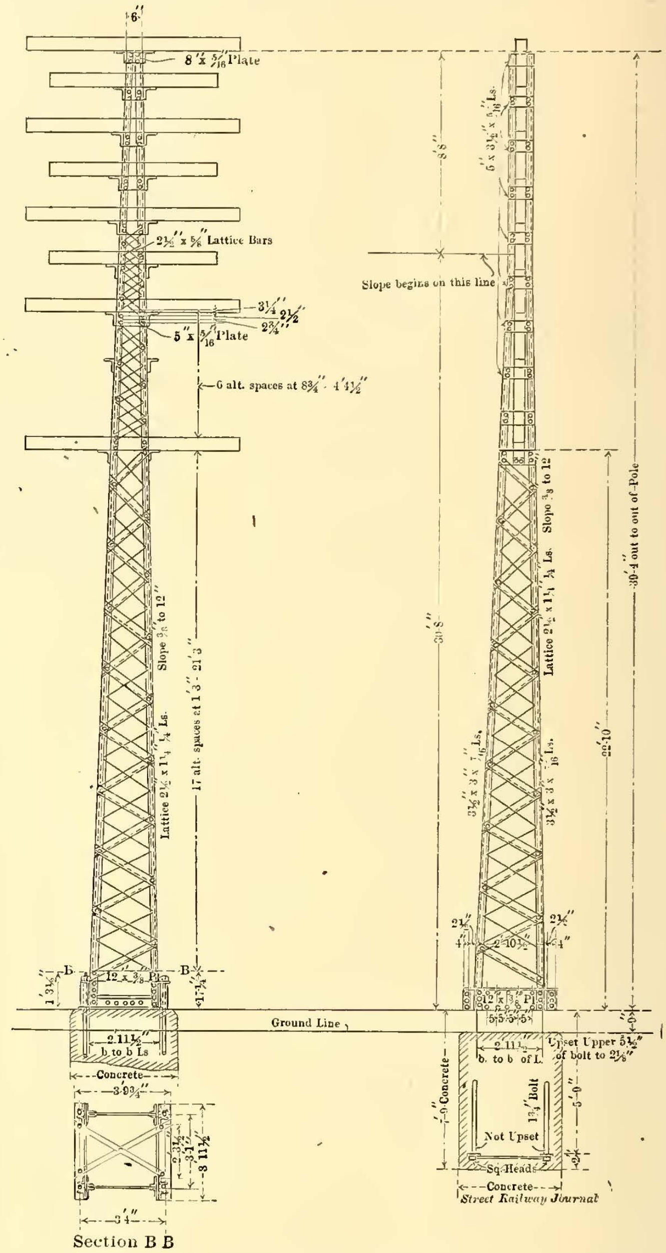


FIG. 11.—39-FT. 4-IN. STEEL POLE FOR STRAIGHT-LINE AND CURVE CONSTRUCTION

This forms a sort of box construction around the base of the pole, and greatly increases its stiffness and stability. This type of construction enables a foundation to be built, and the anchor bolts set at any convenient time independent of the delivery of the poles. This permits the most desirable degree of flexibility in the organization of the pole-setting force, thus dividing it into practically two separate gangs, neither of which is hampered by the movements of the other.

The standard poles are made in four lengths, increasing by 5 ft. from 39 ft. to 54 ft. in length, the 39-ft. pole being the standard, the other lengths being only used where necessary. On account of the above mentioned uniform taper, the sizes of the bases vary from 3½ ft. x 4 ft. to 4½ ft. x 5 ft., depending on the height of the pole. The foundations are therefore proportioned accordingly. From a detailed survey of the line, the length and the location of every pole was determined upon before construction began, and every foundation built to fit the size of pole assigned to that particular location.

The poles are designed to withstand a wind pressure at right angles to the line corresponding to a wind velocity of 100 miles per hour. This was calculated from data obtained in the Berlin Zossen high-speed railway tests, which showed the pressure on a flat surface due to a wind velocity of 100 miles per hour to be about 27 lbs. per square foot, which applies to the flat surfaces of poles and cross-arms. For the projected area of cylindrical conductors, one-half of this value or 13½ lbs. per square foot was the factor used for the above wind velocity.

For standard straight-line poles, without side strains other than wind pressure, the corner angles are 3 ins. x 3 ins. x ⅜ ins. For the heavier strains at curves and corners, the general design of the poles is the same, but they are given greater strength by using heavier corner angles.

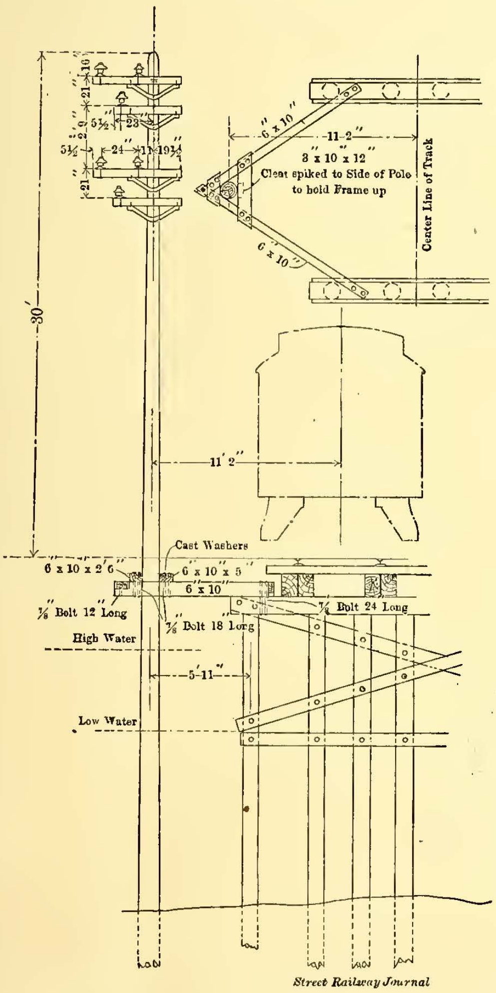


FIG. 12.—HIGH-TENSION POLE CONSTRUCTION ON JAMAICA BAY TRESTLE

The design of the curve poles was made dependent on the distance by which the curve pole is offset from a straight line joining the two poles on either side of it. For offsets up to 6 ft., the corner angles of the pole construction are 3½ ins. x 3 ins. x 7-16 ins., while the offsets between 6 ft. and 10 ft., the corner angles are 3½ ins. x 3 ins. x ½ in. A drawing of the curve pole is shown in Fig. 11.

The foregoing types of pole are each designed in the four lengths. By reason of the uniform taper, an extra length does not result in an increase of the size of the corner angles, but only in the enlarged dimensions of the base. The moment of resistance at the base is thereby increased in proportion to the height of the pole.

Besides the standard poles above described, designed to meet the ordinary conditions, an extra heavy pole was designed in three lengths. This type is called the strain pole, and is used for offsets up to 32½ ft., for turning sharp corners, or for anchoring the line at special points. These poles are similar in design to the standard poles, but the taper is uniformly increased to ½ in. to the foot, and all four sides taper uniformly all the way to the top, which is 8½ ins. x 12 ins. The base of the 41-ft. pole is about 5 ft. square, that of the 51-ft. pole being about 5 ft. 9½ ins. x 5 ft. 11½ ins. The corner angles of these strain poles are 4 ins. x 4 ins. x 9-16 in.

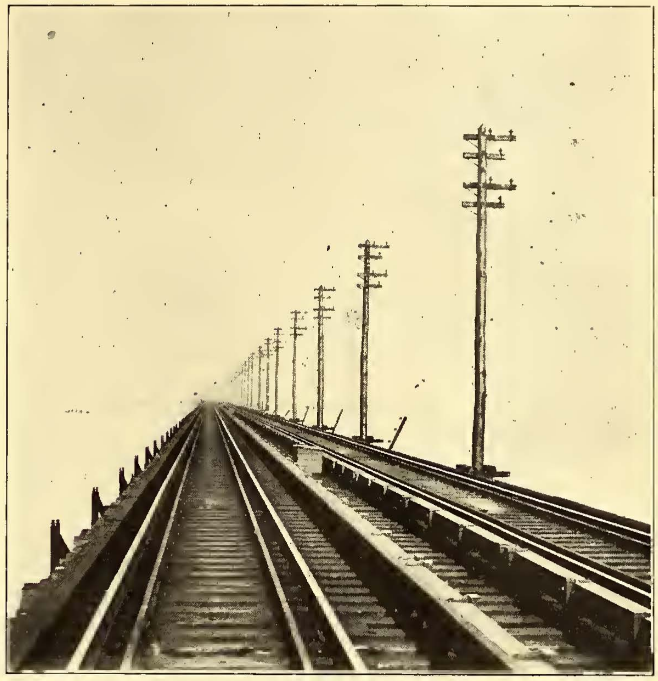


FIG. 13.—WOODEN-POLE CONSTRUCTION ON JAMAICA BAY TRESTLE

All the poles are designed to withstand the side strains on 150-ft. spans due to the offsets above specified. For greater offsets the length of span is shortened. At all sharp turns, three poles of the heavy-strain type are used, two to take the longitudinal strains and guyed back to the base of the middle pole, which takes the side strains due to the offset.

The three first-mentioned standard types of poles were designed to take the necessary side strains without guying. The longitudinal strains due to anchoring the lines are so great, however, that the strain poles used for anchorage are guyed fore and aft to the bases of the adjacent poles with 7-16-in. galvanized steel cable. On some sharp curves the poles were guyed laterally as an additionl precaution, using 7-16-in. guy cable and Stombaugh guy anchors.

The construction of the steel pole includes angle-iron seats for the cross-arms which pass through the pole structure, the weight of the cables holding the cross-arms down on the seats and requiring only the simplest type of fastening, which consists of two ¾-in. "U" bolts, which clamp the cross-arms immovably to its seat. The use of the ordinary type of cross-arm brace is rendered unnecessary.

The ability of the steel pole to act as a lightning rod is turned to advantage, and each pole is thoroughly grounded to a copper plate beneath the foundation and connected to one of the anchor bolts by a copper wire.

The poles were transported from the steel works without "knocking down," and were erected whole upon their foundations with the aid of a gin pole. After erection, cement grout was run underneath the base and the pole permanently set by tightening the foundation bolts. There are now in position in the line 358 of the standard straight-line and curve poles, and nineteen of the heavier type of strain poles.

POLE FOUNDATIONS

The size of the concrete foundation varies with the height and character of the pole. For the straight-line pole the dimensions are 4½ ft. to 5 ft. square, averaging 8 ft. deep, with 1⅜-in. anchor bolts. For the curve poles, the foundations averaging from 4½ ft. x 6 ft. to 5½ ft. x 7 ft. 3 ins. on the side faces, with a depth of between 7 ft. 9 ins. to 8 ft. 9 ins., and employing 1¾-in. anchor bolts. Strain pole foundations are from 7 ft. to 8 ft. square, and from 9 ft. to 10 ft. deep, and employ 1⅞-in. anchor bolts. The tops of foundations are usually about 9 ins. above the ground level. After the poles were all set and the line construction entirely completed, the box-shaped bases of all the steel poles were filled with concrete, brought up to a pyramidal form, as shown in the pole drawings.

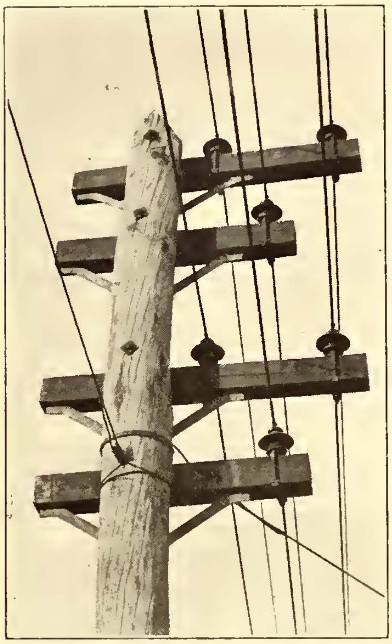


FIG. 14.—METHOD OF ATTACHING CROSS-ARMS AND INSULATORS IN WOODEN-POLE LINE CONSTRUCTION

WOODEN POLES

The wooden poles are of two kinds; chestnut, which is the standard for ordinary work, and creosoted yellow pine, which is used only along the trestle over Jamaica Bay. The chestnut poles are 45 ft., 50 ft., and 55 ft. in length, and 25 ins. in circumference at the top. The creosoted poles are from 60 ft. to 80 ft. long, with the same dimensions at the top, and treated with 15 lbs. of dead oil of coal tar per cubic foot of timber. Creosoted poles are all set 15 ft. into the bottom of the bay, by means of a water jet. They are all set so as to have the tops 30 ft. above the rails and are located far enough away on one side of the trestle to obviate any interference with the wires on the part of the pile driver that is used to renew the piles of the trestle bridge. These poles were braced to the trestle with creosoted yellow-pine timber, and a drawing of the pole and its setting is shown in Fig. 12. A general view of the pole line construction on trestle is given in Fig. 13.

This method of pole construction along the trestle was adopted only after a most careful consideration of various ways that were proposed for carrying a line across the bay. A separate trestle, carrying a line of conduits made up as when laid in a trench, was found too expensive. A pole line directly supported on the existing trestle would not afford the necessary clearance from traffic. Various plans were made for driving piles alongside the trestle and then splicing transmission poles to them, but even this construction, though practicable, does not compare in simplicity or durability with the long pole in one piece, which by the aid of a water jet can be driven down into the mud butt first, instead of being treated as an ordinary pile, and driven point first.

This portion of the line is exposed in winter to a very severe strain, due to the movement of ice with the tide. The poles were set during a very severe winter, and the strains due to the ice were, at times, sufficiently great to cause the trestle to be moved out of line in places, but the poles set as above described successfully withstood the action of the ice. For a large part of this distance, the trestle runs across a series of low islands, which are covered with water at high tide only, so that it was difficult to reach them during construction, but, with very few exceptions, the poles were set by a floating pile-driving apparatus without going on the trestle or interfering with train operation.

The total number of steel poles employed is 377, of chestnut 490, and of creosoted yellow-pine poles 264.

CROSS-ARMS

The cross-arms are of yellow pine, 5-in. x 6 in. cross section, housed on top to a 12-in. radius, and they are painted with one coat of asphaltum paint. The method of attaching them to the steel poles has already been described. On the wooden poles they are gained 1 in. into the pole and held by one ¾-in. through bolt with 2-in. square washers, as shown in Fig. 14. Bracing, though unnecessary on the steel poles, was effected in the case of wooden poles by angle-iron braces made in one piece of 2-in. x 2-in. x ¼-in. angle, bent into V-shape. For standard steel poles the arms are 7 ft. and 9 ft. long. For steel strain poles, they are 7 ft. 10 ins. and 10 ft. 6 ins.

The two circuits on the Jamaica Bay trestle and on the

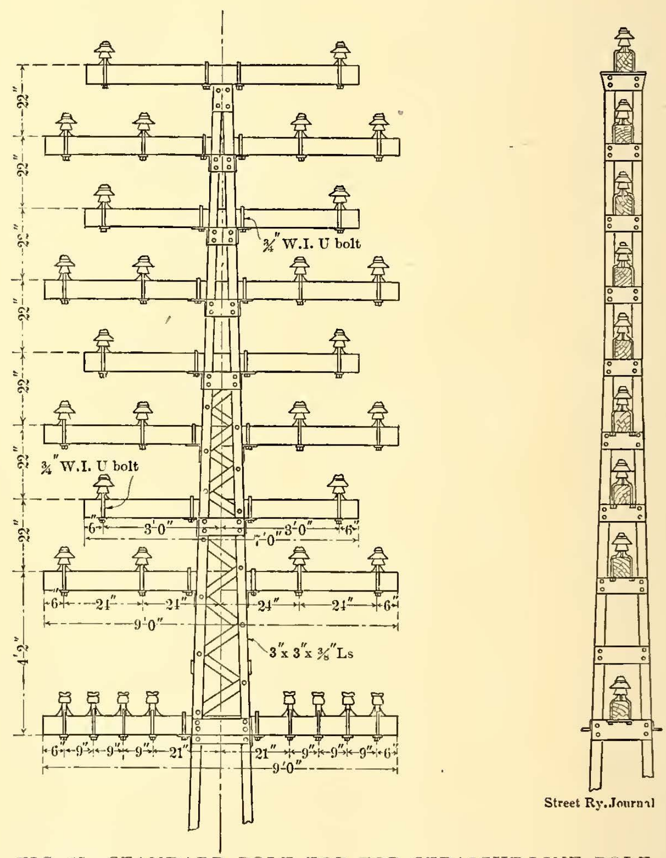


FIG. 15.—STANDARD POLE TOP FOR STRAIGHT-LINE POLE

line immediately north of it, were carried one above the other on two sets of cross-arms on the side of the pole, the cross-arms being flush on the side of the pole opposite to the circuits. On the trestle itself, the circuits were both on the side of the pole away from the track, in order to get them as far as possible outside the sweep of the pile driver used to replace piles in the trestle bents. On the main line, to the north of the trestle, however, this position was reversed because, on account of the four tracks here laid, the poles had to be set as far as possible toward one side of the right-of-way, and there was not room enough to carry the wires on the outside of the pole without overhanging the adjoining property. The cross-arms here are 4 ft. and 5 ft. long, but the standard bracing and fastenings are used.

On the steel-pole line, the apex of the triangle, at the points of which the wires are carried, is placed on top, while on wooden-pole portions of the line the apex is at the bottom. The latter position is that generally preferred for the arrangement of high-tension circuits, as it allows repair men to get up more easily between the circuits. On the trunk line, however, the necessity for carrying the maximum number of circuits made it desirable to reverse the usual order, and the apex was accordingly placed on top.

The drawing in Fig. 15 shows the design adopted for the pole top for the standard trunk-line pole on straight line and curves, and the arrangement of the insulators. Fig. 16 shows the corresponding arrangement for the standard wooden-pole top; Fig. 12 illustrates the unbalanced type pole top used on the Rockaway Beach Division. Fig. 17 shows the arrangement of the pole top for the strain pole.

PINS

The insulator pins consist of malleable-iron castings clamped to the cross-arms by means of U-bolts threaded through the body of the pin, and held by a plate fitting over

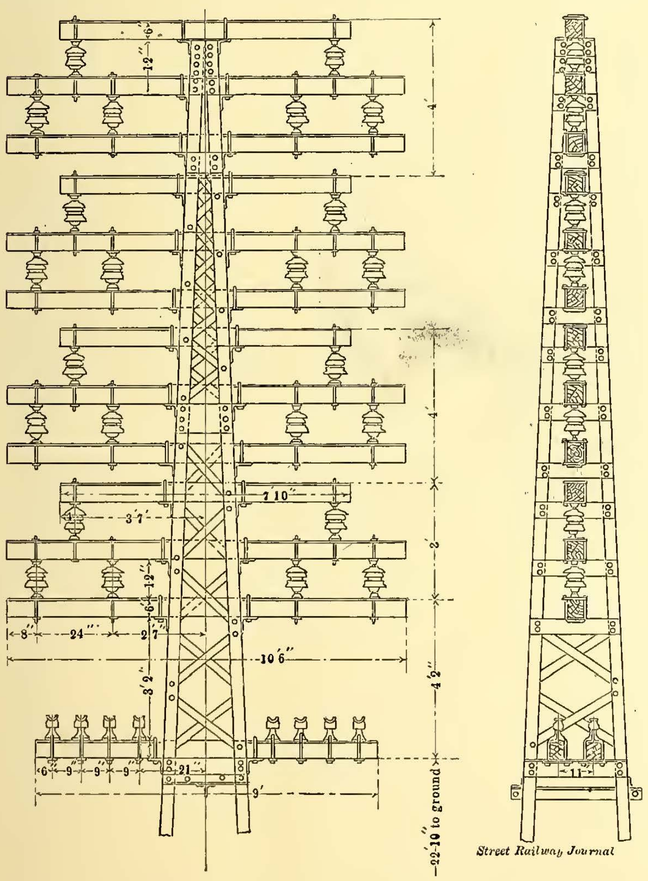


FIG. 17.—STANDARD POLE TOP FOR STEEL STRAIN POLE

the U-bolts and against the cross-arm. This type was first used on this transmission line, and represents a new departure in pin design, inasmuch as by its use all boring of the cross-arm is avoided. The strength of the cross-arm is maintained, and the depreciation resulting from entrance of moisture through holes bored in the arm from top to bottom, is obviated. The form of pin used is also of much greater strength than is possessed by a pin in which the bending moment where it enters the arm has to be met by small cylindrical cross section, which in case of the iron pin is sometimes not more than 3/4 in. in diameter, and in a wooden pin, 1 1/2 ins. to 2 ins. The strongest part of this pin is at the base where it joins the cross-arm. It admits of easily following up any shrinkage of the cross-arm (which cannot be done in a pin which is set in a hole in the cross-arm), as all that is

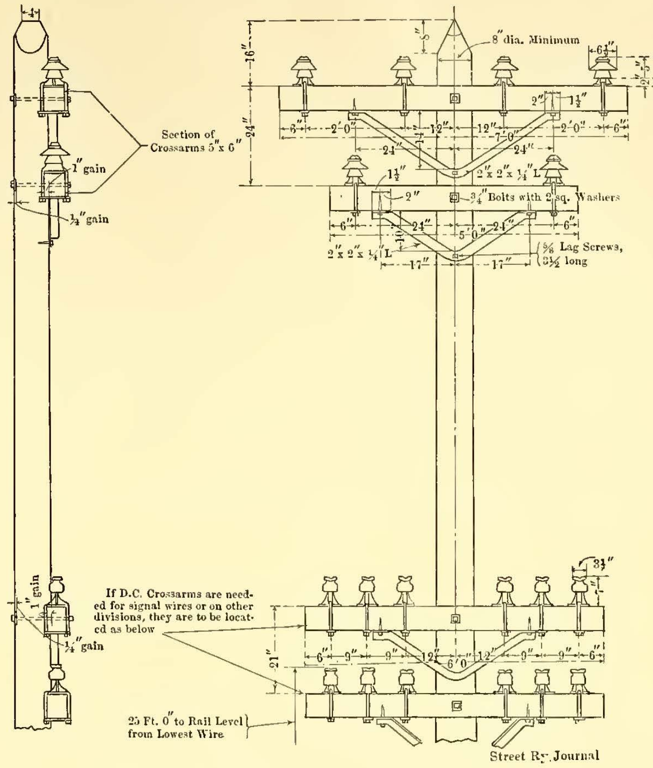


FIG. 16.—STANDARD WOOD POLE

necessary, if the pin comes loose, is to tighten up the nuts on the underside of the clevis.

INSULATORS

The straight-line insulators are 6 1/2 ins. in diameter and 5 ins. high, made of porcelain in two parts, cemented together. The insulators are colored with a brown glaze to render them less conspicuous. They are designed particularly for the conditions here imposed. The pin and insular together carry 250-circ. mil cable 6 1/2 ins. above the cross-arm. The ties are made of ordinary soft copper wire, tied on top.

The tests to which the insulators were subjected at the factory include a rain test at 30,000 volts, and a salt water flash test of 50,000 volts for two minutes. The insulators were further obliged to pass the test of plunging them into hot water and then into ice water without cracking. After the insulators were erected, and the cables strung upon them ready for operation, they were tested by applying 30,000 volts between the conductor and the ground for 4 minutes. The insulators underwent all these tests successfully.

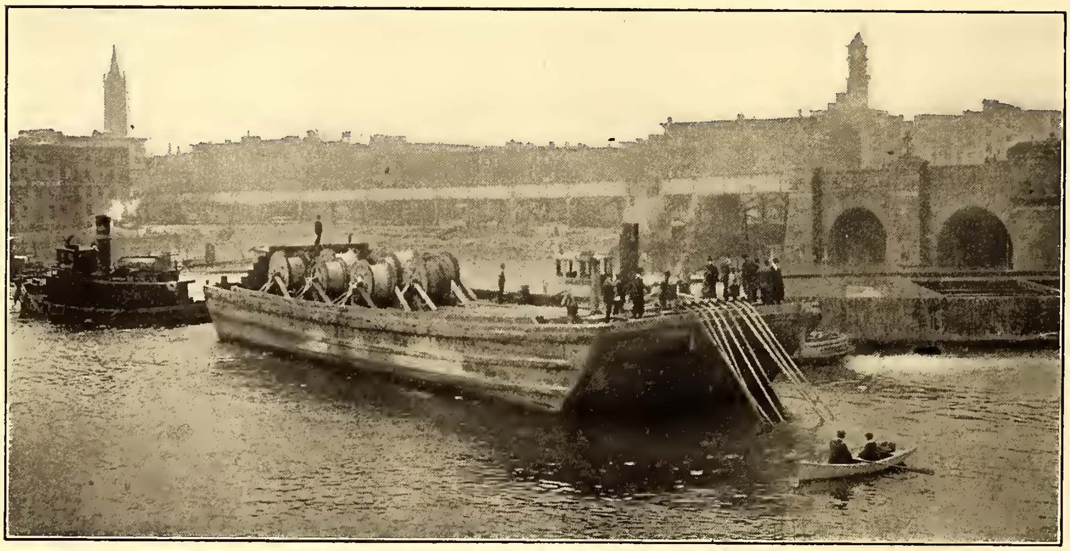
The strain insulators are of the "spool" type and made in one piece, 7 1/2 ins. in diameter and 8 ins. high. Each strain insulator has two petticoats, one above and one below the point where the wire is attached. A 1 1/8-in. x 12-in. steel pin is cemented in the center of the insulator, and this steel pin rests in sockets at the top and bottom, which are firmly clamped by U-bolts to the cross-arms. This obviates the boring of arms, and thus preserves consistency with the design of the straight-line insular pins.

The Western & Atlantic Railroad has announced a reduction of fare between Atlanta and Marietta, Ga., to a figure competitive with the rate charged by the new trolley line.

CABLE-LAYING ACROSS THE HARLEM RIVER

A very important work in laying power cables was carried out May 12, when the New York Central & Hudson River Railroad laid nineteen cables under the Harlem River just east of its railroad bridge. The work was carried out under the direct supervision of W. H. Rodier, superintendent of construction of the Safety Insulated Wire & Cable Company, and in the presence of E. B. Katte, electrical engineer, and J. D. Keiley, assistant electrical engineer of the New York Central & Hudson River Railroad Company.

The following is a description of the cables: Four lengths, approximately 730 ft. each, of a 3 conductor No. 4-0; each conductor was composed of nineteen strands of tinned copper wire insulated with 13/64-in. wall of 30 per cent fine, pure, para rubber, taped. The three conductors thus insulated and taped were laid up with jute, covered with 13/64-in. jacket of same compound, then covered with tape, 9/64-in lead sheath juted and armored with No. 4 B. W. G. galvanized steel wire, and finished with two layers tarred jute over all. These cables were tested at 40,000 volts for 5 minutes, and showed an insulation resistance of 2000 meghoms per mile. The weight per foot is approximately 18 lbs., and the outside diameter 3⅞ ins. These cables were designed for the New York Central working pressure of 11,000 volts.



METHOD OF LAYING CABLE ACROSS THE HARLEM RIVER

There were also five lengths, approximately 750 ft. each, of 1,000,000 circ. mil. cable composed of 91 strands, insulated with a 7/64-in. wall of 30 per cent pure para rubber, taped and covered with 9/64-in. lead, juted and armored with No. 4 B. & S. galvanized steel wire, and with two layers of jute over the armor. These cables were tested at 5000 volts for half an hour, and are designed for working pressure of 600 volts. The insulation resistance is 500 megohms per mile. The weight of these cables is approximately 12 lbs. per foot; the outside diameter is 2 9/16 ins.

There was also one length, 730 ft. of 1,250,000 circ mil. cable composed of 127 strands, and with approximately the same specifications as the 1,000,000 circ. mil. cables. The weight is approximately 13 lbs. per foot, and the outside diameter is 2 11/16 ins.

There were also four cables, 700 ft. long, of 1,250,000 circ. mil. bare wire, composed of 127 strands, and with a weight of approximately 4 lbs. per foot.

There were also three cables, 710 ft. long, each for signal cables, to be used under the General Railway Signal Company's contract.

There were also two cables in 750 ft. lengths of telephone cable; one ten pair and one thirty pair.

The power cables were manufactured by the Safety Insulated Wire & Cable Company; the telephone cables by the John A. Roebling Sons' Company, and the signal cables by the Okonite Company. Owing to the exceptional facilities of the Safety Insulated Wire & Cable Company, the armoring and finishing of all the cables was done at the works of the latter company.

The accompanying view shows the method of laying followed. Eight cables were laid at a time—probably the first time this number has been laid successfully. To insure that they were in proper position in a trench that had already been dredged across the river, a diver was sent down, and his investigation proved that all the cables were in exact position.

NEW ENGLAND STREET RAILWAY CLUB

The May meeting of the New England Street Railway Club was held in Boston at the American House on the evening of the 24th, with President Winsor in the chair. The usual dinner preceded a paper on "Rubber," by George W. Knowlton, of Boston. Mr. Knowlton presented a large number of stereopticon views of rubber plantations in South America and other parts of the world, showing also factory views and samples of rubber treated in various ways. He spoke briefly of the value of rubber for insulating purposes, and pointed out the influence of the world's demand for this product upon the price. It is doubtful if the price will ever go below $1 per lb., the present figure being about $1.35. About 50,000 tons of rubber are now produced annually.

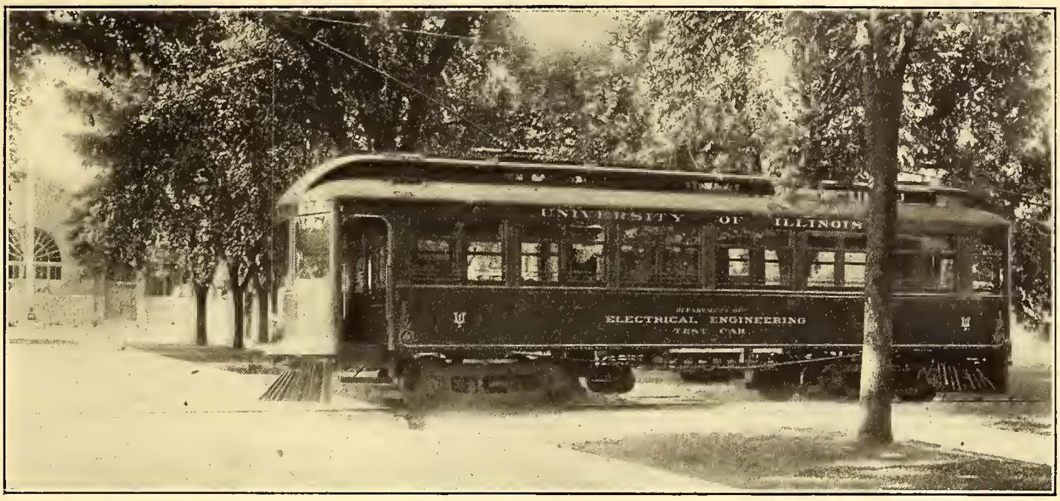
The June meeting of the club will probably be a water excursion to Quincy and Nahant. It is hoped to arrange for the club to visit the works of the Fore River Ship and Engine Company at Quincy, and also the Quincy Point power station of the Old Colony Street Railway, closing the afternoon with a dinner at Nahant, and leaving the evening free for a trip to Wonderland Park at Revere Beach.

The Grand Rapids, Grand Haven & Muskegon Railway Company has announced that all mileage books issued over the road will be withdrawn from sale. In place of the mileage books the company will issue a coupon book containing coupons to the value of $2.50, which will be sold for $2. These coupons will be good for the payment of cash fares on the cars at the cash rate, no amount less than 10 cents being accepted. Commutation books, good only for the purchaser and containing 50 rides on a 30 day limit, between Grand Rapids and stations west of Grand Haven, will be issued at the rate of 1¼ cents per mile.

THE UNIVERSITY OF ILLINOIS ELECTRIC TEST CAR

The department of electrical engineering of the University of Illinois has recently added to its equipment a car, of the regular interurban type, which is being used in making various tests on the lines of the Illinois Traction System. The car body was built by the Jewett Car Company, and the principal dimensions are as follows: Length over body, 34 ft. 4 ins.; length over all, 45 ft.; width over all, 8 ft. 4 ins.; height from underside sill to top of roof, 9 ft. 6 ins.; distance between truck centers, 22 ft. 4 ins.

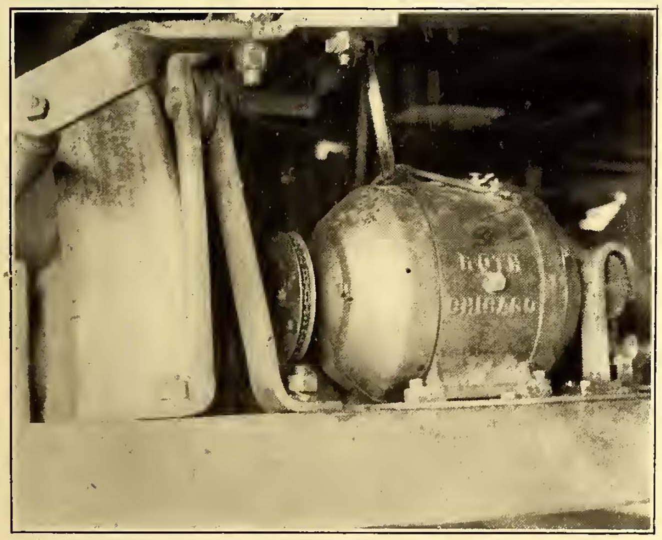
The car is divided into two compartments, one 22 ft. 6 ins. long and the other 11 ft. 10 ins. The larger compartment is furnished with a desk, filing cases and chairs in lieu of the usual seats. The smaller compartment contains an instrument table and some of the electric control apparatus which in common practice is placed under the car.

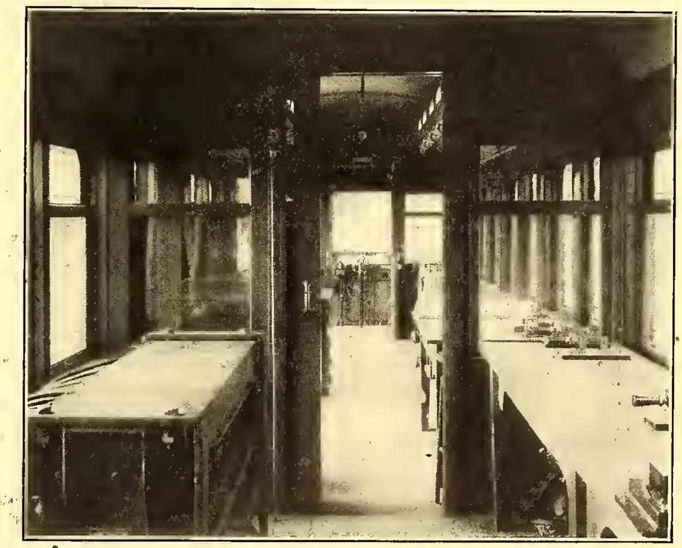


TEST CAR USED BY THE UNIVERSITY OF ILLINOIS

The trucks are of the C-60 type of the Standard Steel Car Company, with the exception that the wheels on one truck are rolled steel and were supplied by the Standard Steel Company. The wheel base is 6 ft. 4 ins. and the wheels are 33 ins. in diameter and have the M. C. B. tread and flange. The motive power equipment consists of four No. 101-D Westinghouse motors with a nominal rating of 40 hp, and the gear ratio is 22:62.

The electric control equipment is the Westinghouse unit switch system of multiple control. The switch group, circuit breaker, reverser, limit switch and line relay are hung in the smaller compartment for the purpose of observation under running conditions, and the cables used for connecting these pieces of apparatus and the motors are laid in a transit-lined space between the car floor and a false floor. The brake system is the straight air system and the compressor, compressor motor governor, brake cylinder and storage tank were supplied by the National Electric Company. Hand brakes have also been installed for use in case of emergency.


SPEED-INDICATOR GENERATOR


SWITCH GROUP AND INSTRUMENT TABLE

Two DeFrance automatic air sanders and a simplex headlight are also used.

The instrument equipment consists of an integrating wattmeter for measuring the total power supplied to the motors, an integrating wattmeter for measuring the power supplied to the compressor motor, a G. E. graphic recording ammeter in the motor circuit, and a G. E. graphic recording voltmeter which is generally used to record the trolley voltage, although by means of a voltmeter plug board on the instrument table the voltage on any individual motor armature or field may be recorded. A switch with ammeter leads connected to it has been placed in the circuit of each motor so that the current in each individual motor may be obtained at any time by connecting the ammeter leads to an ammeter and opening the switch.

The speed is obtained in two ways. First, by an autometer made by the Warner Instrument Company, Beloit, Wis. This instrument is geared to the axle, and besides indicating the miles per hour also records the mileage per trip and the total mileage. The speed is also indicated electrically. This is accomplished by having a $\frac{1}{2}$-kw 10-volt generator driven from the axle by a chain drive and separately excited by means of a storage battery. In the generator armature circuit is connected a resistance coil of about one ohm resistance in series with the low tension coil of a 1-kw transformer ratio 20-1 and a low-range ammeter. This ammeter has been carefully calibrated and a curve plotted which gives the miles per hour for all currents. The high-tension coil of the transformer is

ARRANGEMENT OF LARGER COMPARTMENT

connected to a low-range voltmeter with a zero center scale. This voltmeter has been calibrated for acceleration and gives excellent results.

Both the speed and acceleration are recorded by means of pointers which are moved by hand and made to follow the movements of the needles, the pointers being connected by a small steel wire to pens on the recording tables. Pens time every five seconds and every fourth revolution of the axle, while another pen is operated from push buttons and is used to special points such as stations, etc. To obtain the degree of curvature on the curves a small drum has been bolted to each bolster, and these drums have been arranged to rotate with any relative motion between the car body and the trucks. These drums are connected by means of a small steel wire to pens on the recording table, and records of curves are automatically obtained.

Two theses are being prepared by seniors on results obtained on the car, and indications point to very satisfactory results. One thesis deals with the consumption of power on different schedules varying the number of stops, time and rate of acceleration. The other takes up the question of increase of power consumption due to curves and also goes into the question of the time lost on curves and the speed at which different curves may be taken.

As stated, the track of the Illinois Traction System has been used in making the different tests, and it is owing to the courtesy of the officials of the Illinois Traction System that the university has been enabled to perform these tests and also give the students some idea of actual traction work.

INTERIOR, SHOWING TABLE ON WHICH ARE RECORDED SPEED ACCELERATION AND CURVE

BLOCK-SIGNAL SYSTEM OF THE NEW YORK CENTRAL ELECTRIC ZONE

As announced in the STREET RAILWAY JOURNAL several months ago, the contract for all block-signaling and interlocking in the electric zone of the New York Central and Hudson River Railroad has been awarded to the General Railway Signal Company of Buffalo, N. Y. Besides being the largest signal contract ever awarded, this work represents an important advance in the art of signaling. Both block and interlocking work will be all-electric, operated by current taken from a power line running the whole length of the system. All track and signal circuits will be operated by alternating current; the only batteries to be used will be storage batteries for the operation of interlockings, which will be charged by an a.c-d.c. motor generator drawing current from the power line. In comparing proposals, the New York Central Railroad Company gave special consideration to safety and reliability and economy of operation, and also to quickness of delivery and erection, and the selection of this system was made only after the most systematic and careful deliberation.

At terminals and on short sections at interlockings, it was practicable to give up one of the rails of each track for signaling purposes, but for the greater part of the system it was of considerable advantage to the electric traction system to allow both rails of each track to be used for the return current.

The system offered by the General Railway Signal Company, and known as the "Young System," was adopted. Alternating current is used for track circuits in connection with reactance bonds, permitting the passage of the direct propulsion current freely through both of the running rails, while preventing the flow of the alternating current which is used in signaling. This two-rail system was deemed best suited to the conditions.

Track plans showing the spacing and arrangement of all signals were prepared by the railroad company, and together with specifications were submitted to all the signal companies capable of handling the work. Separate bids were requested for the block signaling and the interlocking work.

To assist in finally deciding the system to be adopted, bids for block signaling were requested in eight different forms covering both normal clear and normal danger systems, all-electric and electro-pneumatic design, and either with one rail of each track given up for signaling purposes or with both rails left available for power return. Bidders were encouraged to make suggestions as to design and requirements of specifications, so that the specifications might not be considered to act as a restriction on the exercise of their best skill. In canvassing the proposals the Signal Committee of the New York Central Lines was called into consultation, and every feature was gone over in detail.

The work included by the contract covers what is known as the electric zone, extending from the Grand Central Station to Croton, on the Hudson Division, a distance of thirty-five miles, and from Mott Haven to White Plains, on the Harlem Division, a distance of nineteen miles. Throughout this distance there will be four main tracks, and the work includes about 3000 interlocking levers and 1400 track circuits, aggregating about 250 miles. The work to be undertaken at the present time covers only that portion of the road to be electrified this year, which carries the work from the Grand Central Station to High Bridge, on the Hudson Division, and to Wakefield on the Harlem Division.

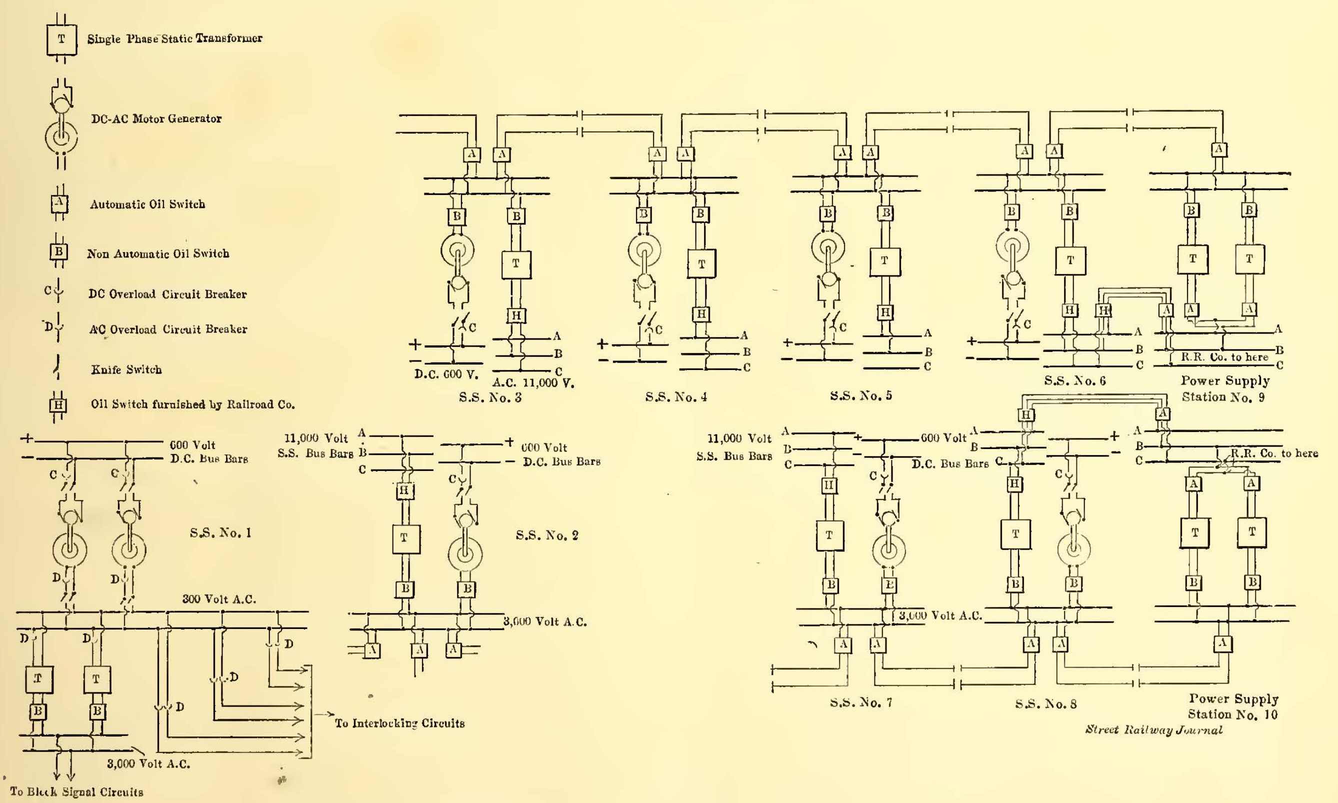


FIG. 1.—DIAGRAM OF CONNECTIONS FOR POWER-SUPPLY EQUIPMENTS FOR AUTOMATIC BLOCK SIGNALS AND INTERLOCKING

Power for operating the signal system will be taken from the two main power stations of the company at Port Morris and Yonkers, which deliver three-phase alternating currents of 25 cycles and 11,000 volts, and from the various sub-stations which deliver direct current at 666 volts to the third rail for operating purposes. These sub-stations are also equipped with the transformers for the signal service, delivering alternating current at 3000 volts to the signal transmission line, which although extending the entire length of the district to be signaled, is cut half way between each pair of sub-stations, thus making that portion of the line fed by each sub-station entirely independent of the adjoining one.

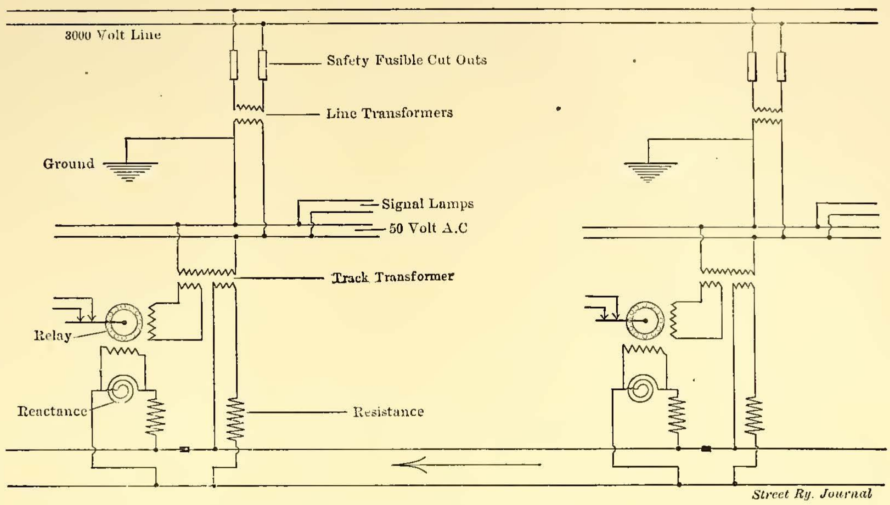


FIG. 3.—TYPICAL A. C. TRACK CIRCUIT, ONE RAIL GIVEN UP FOR SIGNALING PURPOSES

The apparatus in each sub-station is properly protected with automatic and hand-operated switches, and to insure operation, should the alternating current fail, d.c.-a.c. motor generators taking current from the storage battery system installed in each sub-station for use of traffic, will continue to feed the signal transmission line with alternating current, and the signal system will continue to work under all conditions under which traffic will be operated. A synchronizer is installed between the transformer and the motor-generator set.

The 3000-volt transmission line consists of No. 0 bare cop-

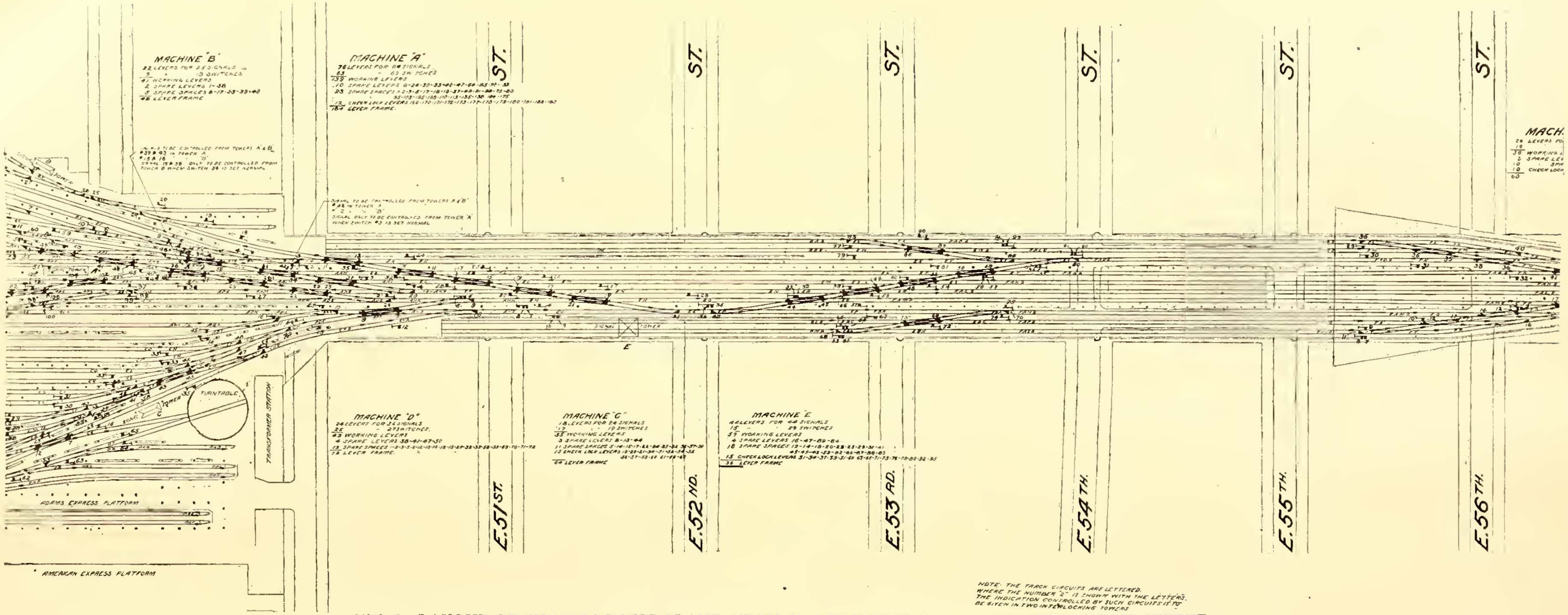


FIG. 2.—LAYOUT OF INTERLOCKING PLANT, FROM FORTY-NINTH STREET TO FIFTY-SIXTH STREET

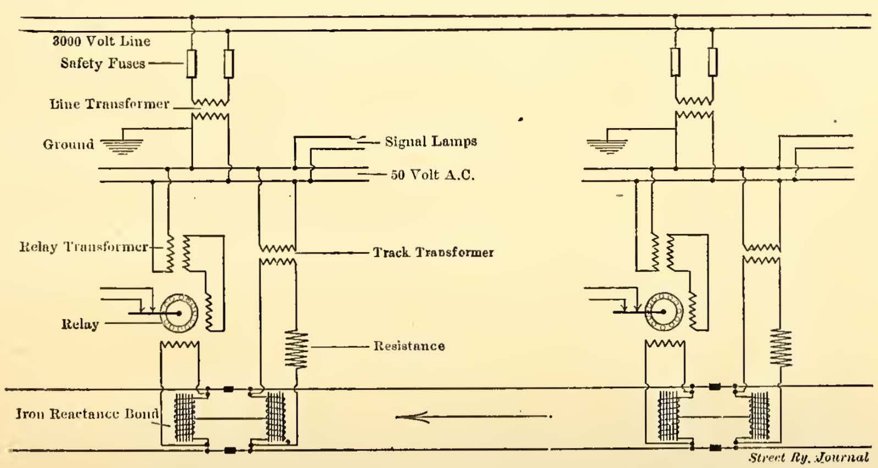


FIG. 4.—TYPICAL A. C. TRACK CIRCUIT, ONE RAIL GIVEN UP FOR SIGNALING PURPOSES

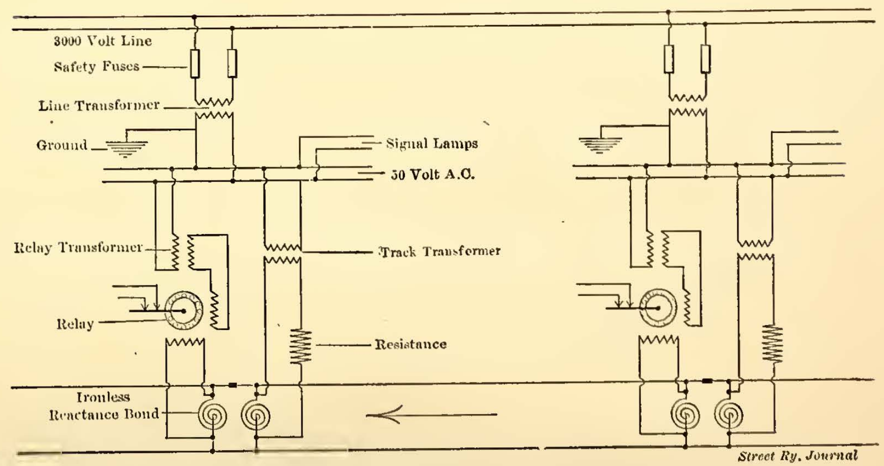


FIG. 5.—TYPICAL A. C. TRACK CIRCUIT, TWO-RAIL RETURN, USING IRONLESS REACTANCE BONDS

per wire, carried on the pole line and in the conduits used for the main transmission system, and the signal bridges are equipped with extension brackets, with cross arms, for convenience in running wire lines to signals.

For the operation of signal circuits, signal motors, indicators, and signal lighting, the 3000-volt current is stepped down 50 volts, through transformers placed on signal bridges or transmission line poles. The secondary of the transformer is provided with a ground connection, formed by burying a 2-ft. x 3-ft. x 1-16-in. copper plate, to which is brazed a No. 4 B. & S. gage copper wire.

For track circuit operation the voltage depends on the length of track circuits, and varies from 1½ volts for circuits of 200 ft. to 8 volts for circuits of 5000 ft. The reduction from 50 volts to the track voltage is made by a transformer provided with four taps, which will permit of one type of transformer being used on all track circuits. The diagram of connections for power supply equipment is shown in Fig. 1.

In laying out the block signaling plan, the length of the block was determined by the braking distance. For speeds not exceeding 45 mph the blocks were made 1200 ft. long; for speeds between 45 mph and 60 mph, 2500 ft., and for speeds over 60 mph, 3000 ft., the average length of the long blocks being about 3200 ft. All blocks have a full block overlap. A distant signal is provided for each home signal. On account of the density of traffic and the necessity for quick operation the clearing time of signals is limited to three seconds. A typical arrangement of the block signals is shown in Fig. 2, covering the section from Forty-Ninth Street to Fifty-Sixth Street.

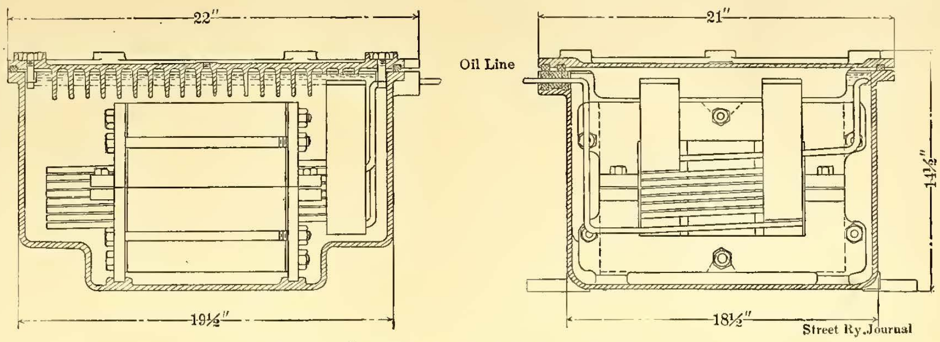


FIG. 6.—REACTANCE BOND AND CASE

The track circuits are of three types, as shown in Figs. 3, 4 and 5. Where they are 500 ft. or less in length, and where the drop in potential in the length of the track circuits is not greater than 50 volts, the "one rail" system is used, and one rail of the track is given up for signaling purposes and the arrangement shown in Fig. 3 is used. There being no direct current on the signal rail it is not necessary to use any reactance bonds.

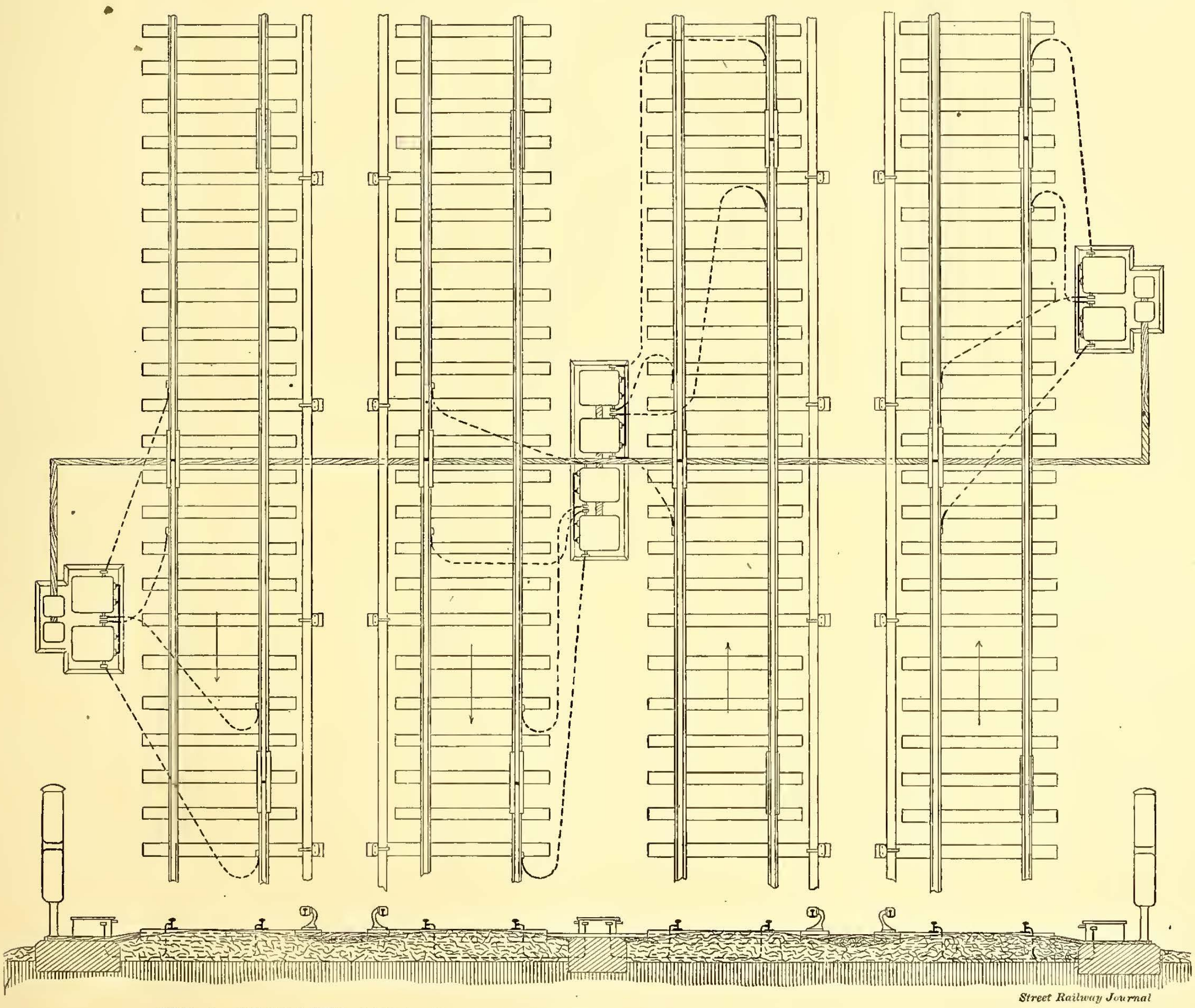


FIG. 7.—PROPOSED ARRANGEMENT OF REACTANCE BONDS, SHOWING FOUR TRACKS

On all track circuits over 500 ft. in length, the two-rail system is used, and both track rails are employed for the return of the direct power current. On all of these circuits it is necessary to use the reactance bonds, by which the connection is made around the insulated rail joints, permitting the direct current used in operating to pass, while impeding the alternating current used for track circuit work. The insulated rail joints are of the Weber pattern, with a steel angle plate on the inside.

On track circuits between 500 ft. and 1600 ft. in length the two-rail system is also used, and the reactance bonds consist of a copper bar 1 in. in cross section and 50 ft. long coiled in eight turns around an iron core, as illustrated in Fig. 6, the arrangement of the circuit being as shown in Fig. 4.

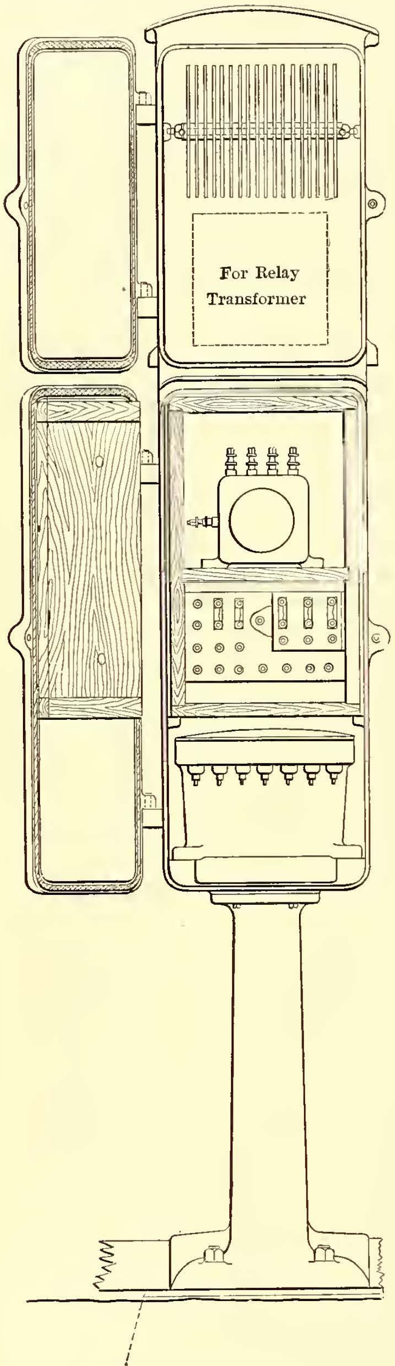


FIG. 8.—RELAY AND TRANSFORMER BOX

The use of two styles of bonding was determined by the cross-bonding for the electric traction system. The Engineering Department of the railroad company determined that the distance between such cross-bonds should not exceed 1600 ft. For blocks that are 1600 ft. or less in length the type of bond shown in Fig. 6, allowing cross-bonding at the ends of the track sections, was best suited to the conditions. For track circuits over 1600 ft. in length, where a cross-bond between one rail of each track was required every 1600 ft., the ironless reactance bond illustrated in Fig. 5 is the least expensive and the one to be used.

In Fig. 7 is shown the proposed arrangement of the reactance bonds on all four tracks, and also the connections from the bonds to the rail, which consist of bare stranded copper cable of 1,200,000 circ. mils. Specifications require that the connections shall not be made within 2 ft. of the rail joint, and that 2 ft. of slack shall be allowed to provide for creeping of rails.

All of the reactance bonds are enclosed in water-tight cast-iron boxes, set on foundations, and the boxes are filled with oil to carry off the heat generated. The bond is designed to permit the continuous passage of 3000 amps for each rail of the track without injurious heating. The casing of the box is made to cover the terminals and connections to the rail to keep them from being tampered with.

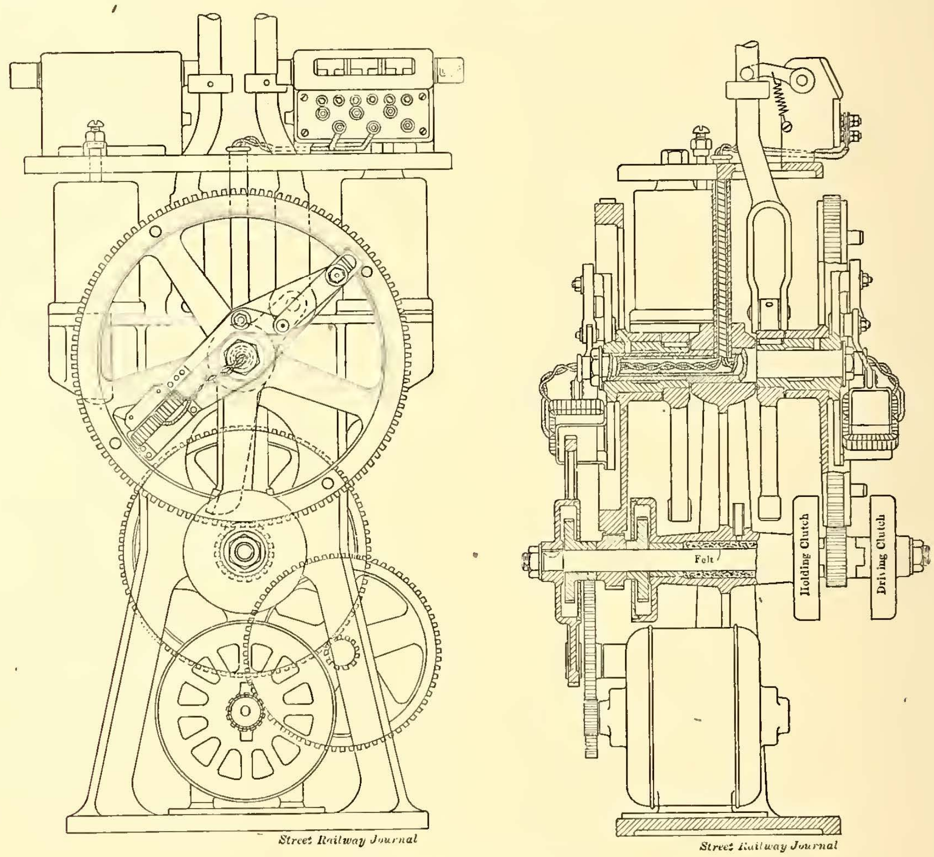


FIG. 9.—MECHANISM OF SIGNAL

It will be seen that the block sections are of two types, the one-rail and the two-rail systems. In the former the propulsion current flows along the continuous rail, and in the event of a defect in the continuous rail, this current must avail itself of the conductivity of adjacent tracks, through the cross bonding.

In sections of the two-rail system each of the traffic rails of a track forms separate and independent conductors, so that if one rail is interrupted, the other would act as a return conductor, even if there were no cross-bonding to adjacent tracks.

The track relay is of the induction motor type with two field coils. One coil is energized by the 50-volt signal operatig current which gives the greater part of the energy required to magnetize the fields and armature. The other coil is energized by the current from the track rails, and this current need only be strong enough to give sufficient magnetism to rotate the armature. The armature revolves through an angle of 37½ deg., during which movement the contacts are separated through 23½ deg., and made up through 14 deg., thus giving a good rubbing contact. Especially hard carbon is used for the fixed point of the contact, while the moving point is of platinum. As the controlled current is an alternating one, there is little sparking, althrough currents of from 2 to 3 amps. are used.

The box containing the track relay and transformer and the grid resistance is shown in Fig. 8. This box also has a plug in which an electric light can be cut in for use in night inspection.

The signals are to be of the General Railway Signal Company's motor-operated type, with mechanism placed in the base of the signal mast, and worked by a single-phase alternating motor of ¼ hp, using current at 50 volts. The general arrangement of the mechanism is shown in Fig. 9. The slot mechanism is exceedingly simple, and under alternating current operation is very quick in releasing.

The signals are of the 60-deg. two-position type, using New York Central standard spectacles and blades, which impose on the signal motor a load equal to the lifting of a 17-lb. weight, at a distance of 4 ft from the center of the shaft. With this load the motor will clear the signal in from two to three seconds. The New York Central Standard signal blades have square ends for home signals at interlockings, and pointed end blades on automatic home-block signals. The circuits by which signals are controlled are shown in Fig. 10, which calls for a full block overlap, and the control of the distant signal through a circuit breaker on the home signal. The signal lamps are of 4 cp, working on a 50-volt circuit, and are connected in parallel with a fuse cut out, to allow any lamp to be disconnected, without affecting other lamps supplied on the same circuit. The filament of the lamp is wound in a small circle, to bring the point of maximum illumination within the focus of the lens.

The signals to be used in the Park Avenue tunnel will consist of lights only, without any moving parts whatever. Electric lights will be arranged in a box behind lenses of proper color, and the current for the lamps will be directly controlled by the relay contact. Lamps giving the proper color for the stop or caution indication will be lighted when the track relay contact is closed.

With this installation the colors used by the New York Central for the night signal indication will be changed in the electric zone, and instead of using white for proceed and green for caution, the system of using green for proceed and yellow for caution will be used for the first time on this line.

The interlockings are of the standard type, manufactured by the General Railway Signal Company. Direct current furnished from storage batteries is used to operate the switch movements and signals. As usual with this type of apparatus the indication is given by the current formed by the motor, which on completing its stroke at the signal or switch movement, is changed to a generator and gives sufficient current to release the lock of the lever of the machine. Typical interlocking circuits are shown in Fig. 11.

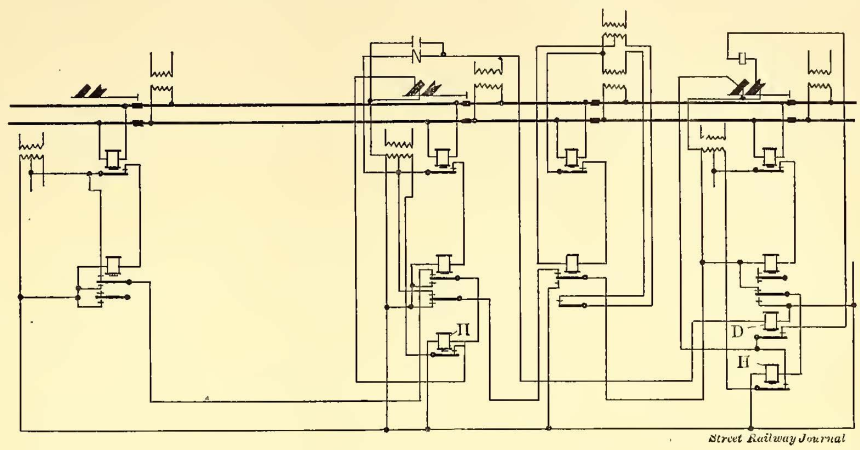


FIG. 10.—A TYPICAL SIGNAL CIRCUIT, POWER SUPPLIED BY TRANSFORMERS

The current to change these storage batteries will be obtained from an a.c-d.c. motor generator set, taking current from a transformer fed from the 3000-volt signal transmission line and furnishing current of 150 volts. The storage battery consists of fifty-five cells of capacity varying from 80 amp-hours to 320 amp-hours, according to the number of daily lever movements to be made. The average time between charging will be four days. The motor generators with switchboards will be placed in the basement of tower buildings and a separate battery-house will be provided to keep the fumes of the batteries away from the signalmen and the apparatus in the towers.

The interlocking machines are of the usual type made by the General Railway Signal Company, and are provided with

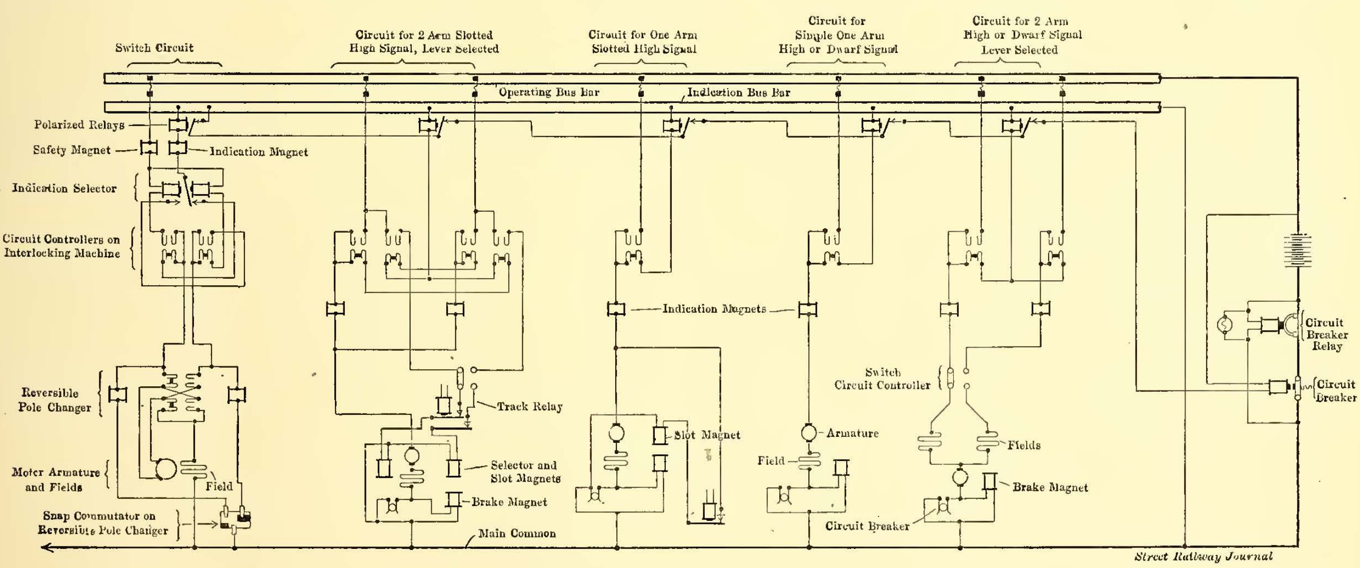


FIG. 11.—TYPICAL INTERLOCKING CIRCUITS

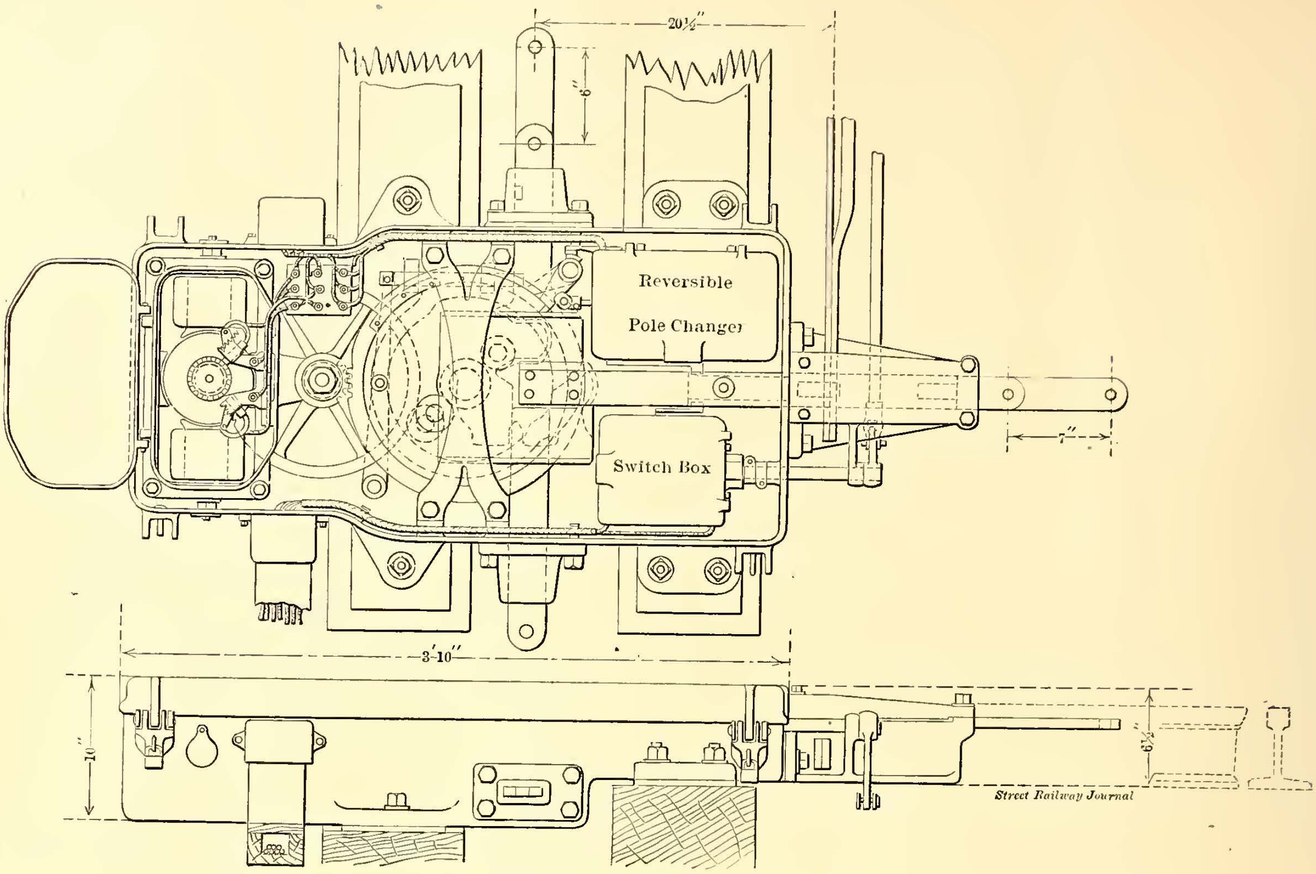


FIG. 12.—SWITCH-MOVEMENT MACHINE

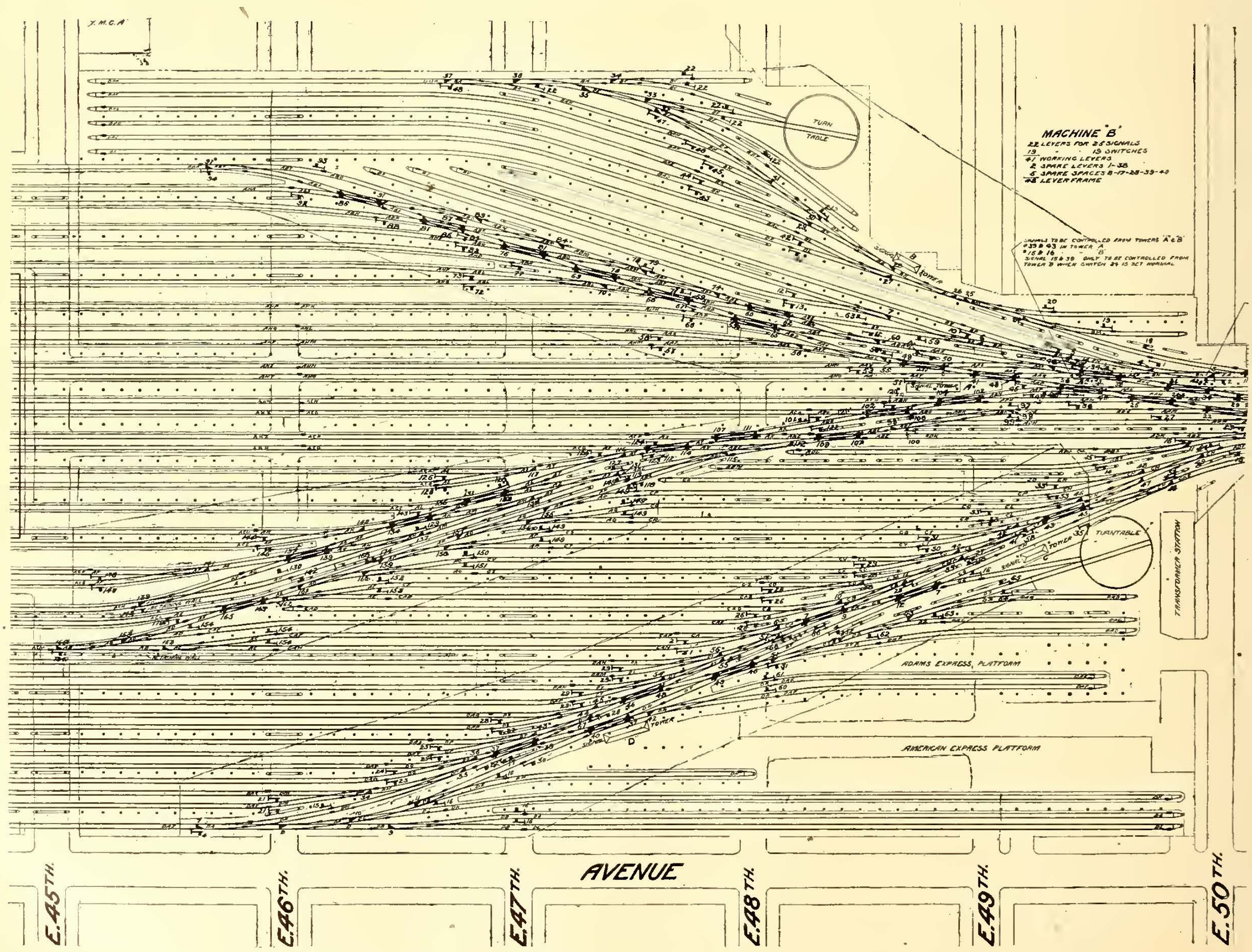


FIG. 14.—INTERLOCKING PLAN, GRAND CENTRAL STATION

a latch for each lever to require a definite action on the part of the operator to change the position of the lever. The lever handles are colored according to their functions. There will be a separate lever for each high signal arm and no selectors will be used.

The interlocking signals will be of the General Railway Signal Company type with dynamic indication current return. These signals, where slotted, will return to the stop position when the current through the slot magnet is open, but the return indication from the signal motor is not received at the lever until the lever is restored to the normal position. The operating circuits for the signals are run through controllers on all facing switches in the main line, insuring that the switches are properly set before the signals can be cleared.

Block signals on the same mast with distant signals are controlled by a lever in the machine requiring the block signal to be changed to the stop position before a signal can be cleared for a reverse movement on the main line.

The advance signals for each track, although operating as automatic block signals, are controlled from the interlocking and are provided with a square end blade to enable the signal man to hold a train, if it is desired to do so.

Approach locking will be provided for all main-line switches. This locking becomes effective when a train has reached a point at least one mile in the rear of the distant signal.

To permit the signal man to change the route for a train, in case of a mistake in setting it up, a mechanical screw release is provided. This will allow the releasing of the lever and changing the route on the expiration of a time interval of 1½ minutes after the signals have been returned to the stop position. A counter reading to five figures is to be placed on all high signals to register the number of movements.

The movement to be used to operate the switches is of an entirely new type and is shown in Fig. 12. With the small clearance under the third-rail contact shoe, a mechanism that will not project above the top of the running rail is absolutely necessary. This movement is enclosed in a neat casing with the gear and escapement crank horizontally arranged. The reversible pole changer and indication switchbox are also enclosed in the casing with the switch mechanism, protecting these parts and giving an exceedingly neat appearance to the apparatus.

The movement is fitted with an improved locking device which, in the case of the plunger catching on the locking rod, as it will do if the switch does not lock up properly, will release the plunger, allowing it to stop while the main part of the movement completes its stroke. The arrangement prevents the motor from forcing the plunger through the lock rod in case it should not have come to the proper position.

The type of dwarf signal to be used is a new one, the signal arm being moved by a motor mechanism arranged horizontally at the base of the post. With this apparatus the indication will be returned to the lever by the current generated by the motor instead of by battery current, as is required with a solenoid mechanism.

In this installation the use of detector bars is practically abolished, a few only being used on the outside rail on sharp curves. Short electric track circuits are provided in their place, effecting the locking of the switches during train movements by controlling the locks on the switch levers. The use of these short-track circuits with the controlling wires to the interlocking machine, makes possible at small expense the use in the interlocking tower of illuminated track indicator. It will consist of a track plan of the interlocking painted on a piece of ground glass with the track circuit sections divided on the back of the glass into separate compartments in which are a red and a white electric light. When the track section is occupied a red light will be shown on the indicator plan, and when unoccupied a white light will be shown.

In places like the Grand Central Terminal, where the tracks will be entirely roofed over, it will not be possible for the signal man to observe the movements of many of the trains; and an indicator of this kind is an absolute necessity to enable him to keep in touch with the situation. A plan of the signaling in the upper or express level of the Grand Central Terminal is shown in Fig. 14. As in the Park Avenue tunnel,

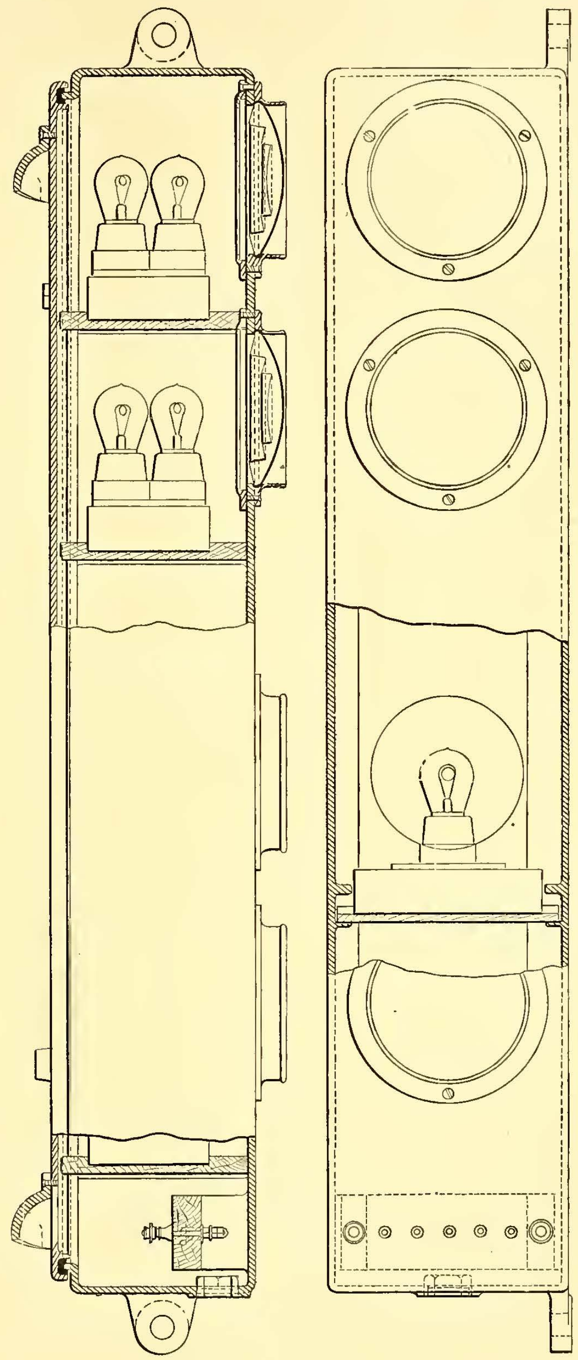


FIG. 13.—LAMP SIGNAL

the signals in the Grand Central Station interlocking will be shown entirely by lights without any blades or moving parts. In this interlocking work, however, the lever for the signal completes the circuit for the lamps to give the proper color for the indication required. The signal towers will be of brick and of very attractive design, with as much window space as possible.

REPORT OF THE ELECTRIC RAILWAY TEST COMMISSION—II.

REVIEWED BY LOUIS BELL PH. D.

The tests of the Commission on the subject of Air and Train Resistance Tests are particularly valuable for being conducted on ordinary standard trucks and with standard high-speed motor equipments for interurban cars. The subject is one which has provoked great discussion, and the many formulæ which have been brought forward have been exceedingly divergent. Of course, so far as air resistance alone is concerned, the results of the Berlin-Zossen tests leave little to be said regarding the absolute value of the normal coefficient, since these tests were extended to a range of speeds entirely beyond the scope of the Commission's tests. On the other hand, the Commission made a thorough trial of various forms of front and rear vestibules, actually weighing the resulting pressures, and the results give very valuable information about these important features of design. In the matter of train resistance, the data obtained have great practical utility as pertaining to the usual constructions of track and trucks, while the Berlin-Zossen work was confined to tests made with roadbed and cars highly specialized for use at extreme speeds.

Taking up first the air resistance tests of the Commission, the striking fact appears at the outset that the air resistance obtained at the lowest speed was higher, and that at all the other speeds lower than the values given in the Berlin-Zossen work, when the flat-fronted car is considered. The air coefficient in the foreign tests is 0.0027 V^2, while the Commission's results give about 0.00225 V^2 for 40 m. p. h. and above, with considerable increase at 20 m. p. h. and 30 m. p. h. Such an increase appears to be without a proper physical basis. An inspection of Fig. 201 of the Commission's report suggests that the eight runs from which the coefficient for the flat-fronted car were obtained should have been more critically examined. A single aberrant observation appears to have had undue influence upon the curve at higher speeds, and if this were rejected the discrepancy would be greatly reduced. However, it is clear from these results that 0.0027 V^2 is at least a conservative value for the higher speeds.

Another very interesting feature is the very great beneficial effect obtained by the use of parabolic and parabolic wedge fronts, much greater than has heretofore been believed, although the general fact is well known. The results of the air resistance tests seem to leave no doubt as to the value of a properly shaped front and rear on a car even at speeds as moderate as 50 to 60 m. p. h. It is a pity that similar data could not have been also obtained for considerably higher speeds, at which the Berlin-Zossen tests would suggest a smaller difference, due to shaping the front, caused, perhaps, by variation in the stream lines from various fronts as the speed rises.

This much is clear at all events, that air resistance at high speeds is much less formidable than was once supposed, and can be kept to moderate limits even for speeds much greater than are now customarily employed. At very high speeds, it would seem advisable to give the rear of the car as well as the front a parabolic wedge shape, since the suction effect becomes very perceptible. The value of the parabolic wedge front becomes very evident in view of the fact that the power used to drive a flat-ended car at 50 m. p. h. was actually sufficient to run the same car at 75 m. p. h. when equipped with a parabolic wedge vestibule. The criterion of equality of input leaves no room for debate upon the subject.

The train resistance tests made by the Commission are interesting as embodying the method of measurement from motor input and efficiency, but they also tend to show some flaws in this method. If one plots upon Fig. 162 of the Report, showing the car resistance derived from various published formulæ, the data given by the tests reported on the opposite page, those for instance of the test car with standard vestibule, the result is very singular. The curve thus drawn shows an absolute term in the resistance formula more than double the magnitude of that found in any of the recorded formulæ, in fact, approximately 13 lbs. per ton. For a track of 70-lb. T-rail in first-class condition such a value is evidently inadmissible on any theory of track resistance yet advanced. This difficulty appears in all the tests with the car Louisiana, whatever the shape of the vestibule. The runs with car 284 show the same failing in a less degree. Putting the car resistance into the usual form, $A + BV + CV^2$, the tests cannot be satisfied by any value of C compatible with the air resistance tests, save by giving improbable values to A and B, and particularly the former. There are indications, too, that A and B cannot be taken as rigidly constant. On all the facts presented in this section of the Report one is rather drawn to the conclusion that the reduction to tractive effort via the motor efficiency led to errors at the lower speeds. Such may easily occur by taking the combined motor and gear efficiency at somewhat too high a value when working under practical conditions at moderate speed. On the other hand, coasting experiments seem to give exaggerated values of car resistance at the higher speeds.

The general value of car resistance from these experiments runs about midway between the values derived from the formulæ cited, and may probably be regarded as conservative for interurban cars like those tested. It could hardly be expected to be as low as the resistances found in the Berlin-Zossen runs, where the car was heavy, track was exceptionally good and the trucks were rigorously balanced for high-speed running. On the other hand, it is very much lower than the enormous figures found in the coasting experiments of Davis at high speed. The figures for the various runs are somewhat discordant, owing to the varying conditions that can hardly be taken into account. Their value lies in the fact that they well represent service conditions and variations of conditions in interurban railroading. The last word has by no means been said on car and train resistance. At great speeds, when air resistance is considerable, a tonnage formula can be obtained only by an air resistance term including both car area and car weight. Otherwise, as in case of the Berlin-Zossen formula quoted, the values deduced for light cars will be too small. The same reasoning applies to other formulæ based on heavy trains or on locomotives. Any tonnage formula is bound to run to high values for light cars. The term in V^2, to judge from the values in this Report and the Berlin-Zossen tests, was not over 0.0027 for its basic coefficient, and would take the general form

$$0.0027\,k\,\frac{A}{T}\,V^2,$$

k being the form coefficient for the front. The value of k from this Report may be as low as 0.25, but should be confirmed at higher speeds, since the other available data make it considerably larger. The absolute term A of the typical formula should hardly exceed 4, and the term in V shows every indication of being very variable with balance of running gear, flange friction, condition of track, and so forth. In view of the large values of A and B indicated by this report, experiments by other methods, such as towing through a dynamometer and a long cable, would be very desirable additions to our knowledge.

MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

The annual convention of the American Institute of Electrical Engineers was held last week in the auditorium of the public service building of the Milwaukee Electric Railway & Lighting Company, said to be the largest and finest railway terminal building in the world. In addition to the auditorium the building contains offices of the departments of the company, dining rooms, small halls, committee rooms, billiard rooms and bowling alleys. It is also used as a terminal for the interurban electric lines of Milwaukee, and this portion of the building is provided with waiting rooms, check rooms, news stands, reading rooms and a lunch counter. A description of this building will appear in an early issue of this paper. Many congratulatory remarks were extended to John I. Beggs, president of the Milwaukee Electric Railway & Lighting Company.

The convention of the Institute extended from May 28 to May 30 inclusive, and four of the papers relating to electric railway engineering are published below. In addition Prof. T. M. Gardner of the University of Illinois presented a paper on the educational value of an electric test car in which he described the car of the University of Illinois. A description and illustrations of this car are published on another page of this issue.

AUTOMATIC ENGINE STOPS

The author, Charles M. Hemenway, stated that automatic stops bear the same relation to steam engines and turbines that safety valves do to boilers or circuit-breakers to dynamos. Most of them are designed merely to stop the engine mechanically in case of over-speed. There is a growing tendency toward the use of electric current to trip the engine stops, thus allowing them to be operated from any number of points. In all cases when it would be impossible to reach the throttle promptly, the automatic stop is invaluable.

One stop is designed to be attached to the governor column, and upon being tripped electrically, opens a steam valve, allowing steam to enter a small cylinder against a piston which raises the governor balls to their maximum position, thereby cutting off the supply of steam to the cylinder. This is a reliable stop, and in connection with a speed limit device is very effective.

Other forms are applied to special valves which must be placed in the steam line and operated as an auxiliary to the main throttle valve. The valve in these forms is usually closed by steam pressure, the steam being admitted to some small cylinder and moving a piston in closing. These forms have many points in their favor, but care must be taken to keep them in order, and the expense of inserting a special valve in a steam line already erected is rather great.

Another type of engine stop operates directly upon the throttle valve and can be easily applied to any engine without interfering with its regular work. This stop is bolted to the engine frame at any convenient place, and is attached to the valve stem by means of a sprocket wheel and chain. As the valve is opened, a cable, to one end of which is attached a weight, is wound on a drum on the stop and is held by a pawl which engages in a ratchet wheel. When the stop is tripped electrically the weight is released, revolving the sprocket wheel and thus closing the valve, a dash-pot in the stop forming a cushion to prevent jamming the valve. This, in connection with the speed limit, forms a very satisfactory device, and as gravity is depended upon for doing the work there is nothing that is likely to fail in operating.

Another engine stop also operating on the throttle and connected to it with a sprocket wheel and chain, similar to the one just described, is operated by a small electric motor. This is more expensive on account of the motor and the necessary generating apparatus. The current can be taken from busbars; but in order to insure reliability it is advisable to have the engine furnish its own circuit. This kind of stop is particularly desirable on units having 12-in. valves, or larger.

To insure protection for all contingencies, an automatic vacuum breaker is wired in the circuit with each of the engine stops where condensing engines are equipped with this safety device, so that if the engine should be shut down automatically, the automatic vacuum breaker will operate simultaneously with the engine stop opening the exhaust to the atmosphere.

SELF-EXCITATION OF SYNCHRONOUS CONVERTERS

W. L. Waters read a paper on the subject of shunt and compound-wound synchronous converters for railway work. By the use of a sufficient inductive reactance in the supply leads and a series winding on the magnets of the converter the terminal voltage of the machine will rise as the load comes on, so that a synchronous converter may be compounded in a manner similar to that employed with direct-current generators.

This system, whch gives automatic control of the voltage, is obviously extremely useful and convenient. Unfortunately, however, the system presents a number of disadvantages in practice: a series winding is needed on the converter magnets, artificial reactance coils are practically always needed to insert in the alternating-current line so as to bring its reactance up to the required value, and there is need for extra switchboard arrangements. This means increased complication and cost and a loss of efficiency. A compound-wound converter costs about 7 or 8 per cent more than a shunt-wound converter. Reactance coils usually cost about 5 per cent as much as the converter. The efficiency of the system is lowered probably 1 to 2 per cent. Moreover, the system is more complicated, and in consequence more liable to break down. There is also liable to be trouble in operating the system. A series field winding on a synchronous converter is always a source of danger on account of the liability of its reversing. When starting a converter the series field coils can be short-circuited and the danger at that time avoided; but if the attendant forgets the short-circuiting switch at any time, there is liable to be trouble.

The results from the over-compounding of synchronous converters are not always satisfactory, due to the fact that as solid steel field magnets are always used, the magnetism cannot change quickly, and there is often a considerable time lag before the voltage changes to correspond with the change in the load. However, when the converter is flat-compounded instead of under or over-compounded, the result is more satisfactory, as the natural tendency of the solid poles is to hold the magnetism and the voltage constant.

In small sub-stations which are supplied from comparatively small power stations, the effect of the variation in speed of the engines often masks all of the results of the compound winding. Moreover, this method of compounding is often a nuisance. The power factor of the system very often varies widely with the load. A shunt-wound converter, however, tends to keep the power factor the same at all the loads. In any case the power factor can be adjusted by means of the field rheostat without in any way upsetting the regulation.

The result of all the complication and disadvantages of a compound-wound converter with reactance coils is that often after the system has been in operation for some time the series magnet coils and the reactance coils are cut out and the converter is run as a straight shunt machine.

Probably the best system for general work is to have shunt-wound converters, standard transformers and no reactance coils. The converters should be overexcited somewhat so as to keep the introduced wattless currents leading at all times, and then the machines should be left to take care of themselves, the excitation being adjusted in case they fail to divide the load properly.

COMMUTATION POLES IN DIRECT-CURRENT MOTORS

C. H. Bedell, of the Electro-Dynamic Company, discussed the design of direct-current shunt motors as influenced by the use of the inter-pole. After outlining the limitations in output which are soon reached when no special means are employed to control the field distribution, descriptions were given of the advantages attending the use of small auxiliary poles placed midway between the main poles with pole faces covering the region of commutation.

In order that the proper commutating field may be obtained that would vary with the load, the inter-poles are wound with the necessary number of turns and connected in series with the armature, while the main poles are wound with a shunt winding. Thus when the load on the armature is heavy, the ampere-turns on the inter-poles are large, resulting in a powerful commutating field; and when the armature load is light, the excitation of the inter-poles is light, resulting in a weak commutating field. That is, by this construction a heavy commutating field is provided when required, independent of the main field strength, and this commutating field varies with the load.

The question may be asked whether the same excitation is required on the inter-poles for a given load, for both high and low speeds. Experiment has proved conclusively that if the excitation of the inter-poles is correct for high speeds it is also correct for all lower speeds. Although the same number of lines of force are sent into the armature from an inter-pole for a given load, irrespective of the rate of rotation, yet the electromotive force generated in the short-circuited coils in the armature is proportional to the rate of rotation. Thus a high electromotive force is provided for the very quick reversal of the current at high speed, and a much lower electromotive force is provided for the slower reversal at the low speed.

In the designing of machines along the old lines, some of the dimensions are limited by the sparking condition. For example, it will not do to put more than a certain number of ampere-turns per inch of periphery on the armature, as a larger number produced too great armature reaction. Similarly it will not answer to have too small an air-gap for the same reason. With the inter-pole construction these conditions do not obtain, for no matter what the armature reaction may be over the face of the main pole, the inter-pole always gives the proper field for commutation. It follows, therefore, that radical changes in proportions may be made, materially reducing the size of the machine.

The change in the relative amount of iron and copper in the armature makes quite a change in the form of the efficiency curve. As the amount of iron is less, the hysteresis and eddy-current losses are less. The increased amount of copper makes I_2R armature loss greater. The full load efficiency is practically the same as in the standard motor, but on light loads the efficiency is increased. The motors, therefore, show a much better efficiency under varying loads approaching the condition of the all-day efficiency of the transformer.

The author stated that by the use of the inter-pole the following advantages were obtained: A powerful commutating field is provided to assist the carbon brushes in resisting the sparking tendency, and this field is independent of the main field. The intensity of the commutating field is proportional to the load on the armature. The brushes are placed on the neutral line, and in consequence the machine is perfectly reversible, and may operate either as a motor or dynamo without shifting the brushes or changing any of the connections. A large number of ampere turns per inch of periphery is permissible, also small air-gaps, resulting in a large output for the material used. The form of the efficiency curve is better suited to tne average load.

ELECTRICAL CONNECTIONS FOR POWER STATIONS

Mr. Rushmore, in a paper read at the Milwaukee meeting of the American Institute of Electrical Engineers, discussed the principles governing generators, transformers, lines, bus bars, switches, etc. Among other things he said that the number of generators, if a one-plant system, should never be less than four, preferably five; and beyond that, as few as conditions will admit.

Generator voltages increase with capacity; 2300 volts if standard up to about 2000 kw.; above which 6600 volts is desirable. Above 5000 kw, machines may be wound for 11,000 volts, 60 cycles, and 13,200 volts, 25 cycles. With certain capacities, speeds, and frequencies, 22,000 volts are permissible. The cost of switches is closely connected with generator voltage and capacity. In many cases, transformers may be omitted and power distributed directly from the machine.

Generator regulation has a direct bearing on the rating of switches employed. A very good regulation makes more difficult the opening of the circuit and produces an explosive action which is undesirable. When considered in view of the increased expense, a regulation better than 8 per cent or 10 per cent for power transmission has few compensating advantages, if a comparatively straight saturation curve is employed. A star generator winding is almost universal; occasionally the neutral is grounded. Generators will stand short-circuit conditions for some time, so that automatic generator switches are unnecessary. A circuit-breaker should not be used in the generator field, although one with a reverse-current trip is desirable when exciters are run in parallel. The exciter field-switch may be automatic instead of the high-tension switches, if the results are allowable.

At least two transformer banks should be used, and duplicate lines fed to any sub-station where the continuous supply of power is essential. If a large number of generators are installed, it may be desirable to make a unit of one transformer and two generators. In other cases, the number of transformers is entirely independent of that of the generators. If it is desired to avoid high-tension switching and the use of current transformers on the high-tension side, the transformer bank may sometimes advantageously be made a unit with the line. The transformer bank can always equal the generator capacity, but the reverse is not true. It is desirable, whenever possible, to have the transformer banks make a unit with either the generator or line.

The transformer connections to be used are not definitely decided by conditions, and the use of the star or delta on the high-tension side is still a matter of discussion. The subject is too large to be discussed at length here. As a matter of fact, experience shows that either system, if properly installed and carefully operated, will give satisfaction. The writer, however, believes that in most cases of high-voltage transmission, the preponderance of advantage is on the side of the grounded star connection. There are, however, cases where the delta is preferable. A delta low tension may be almost called standard.

The use of single or of three-phase transformers is a matter of building design, transportation, cost, reserve capacity, and repairs. In the case of many large units, it costs no more to have a spare three-phase unit than a single phase and, if a transformer-generator system is used, the disablement of a three-phase transformer is no more serious than one of a single-phase bank, unless the load be carried on two transformers. The matter of cost can be calculated for each case, and there is always a dividing line where the relation of cost is reversed. Three-phase transformers are more difficult to transport. A reserve unit in either case is necessary.

In many cases, a local low-voltage distribution is necessary, and two or more voltages can often be run from the same transformer bank with simplicity of connection and low cost as compared with the installation of separate banks.

A switch must withstand the electrical stresses, carry the current, and be able to open the circuit under the worst conditions to which it will be subjected. Standard insulation is for at least 2.5 times rated voltage. Current-carrying capacity is in accordance with the two-hour overload rating of generators and transformers. Recommendation is sometimes made that two oil-switches be placed in series to open together, although they close separately. With the well-deserved reputation of modern oil-switches, now long past the experimental stage, the advisability of this is unquestionable. To allow for testing switches, before using two in series, is a great advantage.

GENERATOR SWITCHES

Generator switches control and protect the generator. Like all other switches in a power house, the conditions to be met, and the proper type and rating to be installed, depend not only upon the output and characteristics of the machine, but also upon the general connection system, the capacities and action of other switches, and the plan of operation. With a selector, bus-bar, or low-tension transformer switch in series, possessing automatic overload features, the generator switch is preferably non-automatic. Sometimes it is equipped with reverse-current relay, but this is not recommended as—the relay being dependent on voltage for operation—it is not reliable under short-circuit conditions. Occasionally, where conditions demand it, an inverse time-limit relay is employed. With more than two generators on a bus-bar section, this will cut out the injured machine. If the generator switch is non-automatic, it will have less to open than the line-switch, and a less expensive type can be used. It should, however, be able to open the normal short-circuit current of all generators, less one, on a bus-bar section. With two electrically operated switches in series, both may be tried before being finally closed, and the one without the automatic feature may be used for synchronizing. Where no low-tension bus-bar is employed, or only a transfer bus-bar used, the generator switch may be omitted; this is frequently done in railway generating stations where the number and size of units permit of a generator-transformer unit combination. Not infrequently the desire for symmetry is the reason for installing all switches of the same general type.

SELECTOR SWITCHES

A selector-switch may be defined as one which will throw a circuit on any of two or more sources. It may be used for generator, transformer, line, or bus-bar. With duplicate bus-bars and single-throw switches, two are necessary to allow a circuit to be thrown on either bus-bar. If it is not necessary to throw them under load, air-brake disconnecting switches may be used.

Selector-switches are frequently automatic with an inverse time-element giving practically instantaneous trip under severe short-circuit conditions.

TRANSFORMER SWITCHES

Both high and low-tension transformer switches are used in stations with many units. Both may be tripped from a differential relay which operates only in case of internal short circuits. The current-carrying capacity of transformer, as of other switches, is equivalent to the two-hour overload rating of generators. In some arrangements the oil-switch is omitted on the high-tension side of the transformer, and an air-break disconnecting switch used. If a transformer-line unit combination is employed, the high-tension switch may be omitted. With an automatic line-switch, that on the transformer is made automatic only for internal troubles, the overloads being cared for by the attendant.

BUS-BAR SWITCHES

Bus-bar switches, which tie the various units of a bus-bar, are used for paralleling in case of transfer bus-bars. Where no necessity exists for operating under load, an air-break disconnecting switch may be all that is needed; in other cases, an oil-switch is used. Where automatic features are desired, an inverse time-limit relay may be used which, in a station consisting of unit systems, will entirely isolate the unit in trouble, which should also be simultaneously cut off from the sub-station. In parallel operation, these switches are used for synchronizing. It is sometimes arranged to have the same overload relay trip both the low-tension bus-bar and generator switches.

LINE SWITCHES

Switches for outgoing lines may be considered of first importance, most disturbances being external to the station and necessarily removed under emergency conditions. They are to disconnect all line and distribution troubles, and consequently are subjected to severe conditions. They should always be of ample capacity. With more than two transmission lines, automatic features are desirable and, in combination with automatic sectionalizing switches in the sub-station, will cut out a disabled line.

SECTIONALIZING SWITCHES

Most of the remaining switches in a station may be less expensive and of smaller capacity, if the high and low-tension sectionalizing switches are fitted with instantaneous relays. These switches, opening before the others, reduce the capacity which a switch must handle. The bus-bar may be sectionalized in a number of places, and simple disconnecting switches may be used if conditions of operation permit. For a station of large capacity, operating in parallel, an oil-switch with instantaneous time feature should be used.

RELAYS

Small stations may rely upon an operator. Large plants need automatic switches.

Relays are electrical devices which operate switches at predetermined points. They allow sensitiveness of operation to be combined with powerful action. Alternating-current relays may operate for overload, reverse current, reverse phase, and low voltage. The time element may be instantaneous, inverse time-limit, or definite time-limit, and the action may be to either open or close an auxiliary circuit. Overload and reverse current relays may have any time attachment. Reverse-phase and low-voltage relays are usually instantaneous. "Circuit-closing" relays imply direct-current switch actuation; and "circuit opening," alternating current from current transformers.

Instantaneous relays are used at points of load, and to sectionalize the bus-bars at both generating and sub-stations, and relieve switches with time-limit attachments from opening total generator capacity; also, where fire risk is great, and a disconnection of part of the load is preferable to temporary disturbance. If used on feeders, a switch of maximum capacity is necessary to open the large circuits existing during initial short-circuit conditions. Most systems are subject to disturbances and it is better, as a rule, to allow such disturbances rather than cut off the power.

Inverse time-limit relays protect apparatus from injurious heating by excessive overloads. When placed on parallel feeders, they will cut off the faulty one, and may be used on generator switches instead of reverse-current relays, which are not satisfactory under short-circuit conditions. Generator switches are preferably non-automatic.

With unit systems the transfer bus-bar switch is usually operated by an inverse-time relay. An inverse-time relay is also used when large variations of load occur in starting of synchronous or induction motors. Definite time-limit relays are used, and occasionally placed so that they open switches in sequence, beginning with the remote load until the trouble is removed. They are used on line-switches and for disconnecting transformers in conjunction with instantaneous relays on bus-bar sectionalizing switches, and inverse-time limit of bus-bar switches.

The use of the time-limit feature of relays is subject to some personal equation.

Reverse-current relays are theoretically desirable on generator switches, and to protect sub-stations with multiple feeders, but practically they are not satisfactory.

Low-voltage relays are employed mainly on motor switches to ensure having resistance in series when starting, or the proper controller connections at such time. The time function is instantaneous.

Reverse-phase relays, which are usually of the instantaneous type, are used to trip a switch in case of improper motor connections.

Relays are now to be had which are entirely reliable and, if given proper inspection, adjustment and care, add greatly to the satisfactory operation of a large plant.

A double bus-bar throughout, sectionalized, is the most flexible arrangement, and many plants are so constructed. A single bus-bar subdivided, with jumpers, comes next and for many conditions is sufficient. With a generator, transformer, and line unit, high and low-tension transfer bus-bars are all that is necessary. If generator and transformer units are used with a large number of feeders, a low-tension transfer bus-bar and duplicate high-tension bus-bar are desirable. Where a large number of generators are used, the low-tension bus-bars may be dispensed with. Occasionally two generators are used with one transformer bank, in which case the low-tension bus-bar need not be continuous. A sectionalized bus-bar can be used for the same purpose as a duplicate arrangement, but lacks the flexibility of the latter. In high-tension stations, the cost of the oil-switches becomes an important factor, and every effort is made to keep their number as small as possible.

There is evidently no fixed rule by which the bus-bar arrangement can be definitely decided; any decision being a matter of judgment between conflicting tendencies of cost, convenience, reliability and safety.

The Brooklyn Rapid Transit Company has adopted the plan of giving transfers through men stationed at the important intersections, instead of through the conductors. This will allow the conductors more time to run the cars and look after passengers.

PRESENTATION OF A MEMORIAL TABLET TO JOHN I. BEGGS, BY OFFICERS OF THE NATIONAL BRAKE & ELECTRIC COMPANY

It will be recalled that the financial embarrassment of the old National Electric Company led to the appointment as receiver of John I. Beggs, the president of the Milwaukee Railway & Electric Company. His efforts in reorganizing this company under the name of the National Brake & Electric Company were so successful that upon the termination of his receivership and trusteeship the officers of the company, in recognition of his services, presented Mr. Beggs a bronze tablet which bears the following inscription: "Presented to John I. Beggs, trustee of the National Electric Company, of Milwaukee, by the officers of the company as a mark of esteem in the manner in which he handled the company and its employees during the twelve months the National Electric

MEMORIAL TABLET TO MR. BEGGS

Company was under his management, April, 1905, to May, 1906." The names of the officers inscribed on the tablet are: J. H. Denton, general superintendent; R. P. Tell, secretary and treasurer; S. I. Wailes, general sales manager; W. L. Waters, chief engineer.

An interesting account of the business done under Mr. Beggs' management follows. Mr. Beggs was appointed receiver May 15, 1905. At that time the company had unfilled orders on its books totaling $557,932.59. Orders taken from May 16, 1905, to the time of the trustees' sale on March 26, 1906, amounted to $865,148.91, and unfilled orders on hand on March 26, 1906, amounted to $367,228.62. The total amount of shipments made during his trusteeship and receivership amounted to $1,055,862.88. When Mr. Beggs was appointed receiver cash on hand amounted to $20,597.67. During his trusteeship he collected the sum of $1,172,400.31, and disbursed the sum of $1,053,494.60, having a balance in bank on date of sale of $139,503.38. These expenditures include payments on preferred claims amounting to $166,892.37.

The Boston & Worcester Street Railway proposes to run the first express passenger electric service into Boston as soon as it has completed the double tracking of a short section of its road. There was a section of 4½ miles where a double track has heretofore been impracticable. Now the road has the right to double track all but 2 miles of this section, and has asked for the right to complete its double tracking. The proposition is to run a car each way at morning and at night, covering the 44 miles in 1 hour and 50 minutes.

INDIVIDUAL RECORDS OF SHOP REPAIRS

It will be recalled that at the St. Louis convention a joint committee of the American Railway Mechanical and Electrical Association and the Street Railway Accountants' Association of America recommended a set of blanks for keeping shop records and accounts, and after considerable discussion the report as presented was accepted, with the official endorsement of both associations. (The report of the joint committee and the forms recommended will be found in full in the STREET RAILWAY JOURNAL for Oct. 15, 1904.)

In line with making a practical application of the recommendations presented by the committee, H. H. Adams, superintendent of shops of the United Railways & Electric Company, of Baltimore, Md., shortly after the convention instituted a card-index system of keeping individual repair records, based upon the action of the associations, with such modifications as were deemed desirable to meet the practice in vogue in the Baltimore shops. This is entirely in accordance with the sense of the joint session, as the report of the committee was intended only to present general principles, and was approved subject to such modifications in any particular form as each company might find necessary for its own individual uses.

Mr. Adams concurs in the opinion expressed at the St. Louis meeting, that individual car, truck and armature records are desirable, but believes that care must be exercised in not making the system too complicated or trying to show too many things on one set of blank forms. Repair shop accounting can be very easily overdone; that is, a point may be reached where the labor of keeping up the records will not only make a serious increase in the general shop expenses, but, and this is a very important consideration, if the records are too intricate, there will be a temptation, in the rush of more important work, for the men to become lax in keeping up the records and thus render the system useless in accomplishing the purposes for which it was planned. In instituting the individual record system at the Baltimore shops the idea has been to avoid making it too elaborate or too burdensome to keep up, and at the same time to furnish records that will be of actual value to the foremen and the men handling the repair work. It is essentially a system for reference purposes.

Form D76-12-6-1904-2000 THE UNITED RAILWAYS & ELECTRIC CO.

RECORD OF REPAIRS Car No. 334 Body Brill 30'5"

CAR BODY REPAIRS															PAINTING								
Date In	Date Out	Overhauled	Accident Repairs	Panels Repaired	Corner Post Repaired	Side Post Repaired	Sash Repaired	Dasher Repaired	Vestibule Repaired	Hood Repaired	Sills Repaired	Platform Repaired	Seats Changed	Car Converted	Burnt Off	Painted and Varnished Outside	Cleaned, Touched Up and Varnished	Cleaned and Varnished Inside	Painted Roof	Painted Floor	Painted Truck	Mileage	Names of Workmen
1/27/05	2/8/05		✓				3		1	1							✓						Plitz – Wagner.
8/23/05	9/1/05		✓	✓													✓						Burgess – Wagner.
9/5/05	9/5/05													✓									Young-Kaste-Volkel
11/1/05	12/12/05														✓	✓		✓	✓	✓	✓		Rapp-Ward-Litz-Rae

CARD FOR KEEPING RECORD OF REPAIRS TO INDIVIDUAL CAR BODIES, UNITED RAILWAYS & ELECTRIC COMPANY, OF BALTIMORE

For these records, there was adopted a good, heavy quality of cardboard stock, the individual cards measuring 9¾ ins. long x 7 ins. high. In considering the form which was recommended as Form 10 by the joint committee, combining on one card the record of repairs to trucks, car bodies and electrical equipment, it was deemed advisable in order to simplify matters and meet the needs of the Baltimore company to subdivide this record into three parts, and three separate card indexes are maintained to keep these records. In other words, there is one card for car body repairs and painting, another for truck repairs, including wheels, and a third for electrical equipment. The fourth card shown in this connection is the armature record. By referring to the forms recommended by the joint committee, it will be seen that the individual items suggested under each of the several headings have been followed in the main, although certain modifications in the wording and, in some instances, other items not included in the recommended forms, have been introduced in the Baltimore system in accordance with the latitude endorsed by the joint resolution.

Form D77-12-6-1904-2000 THE UNITED RAILWAYS & ELECTRIC CO.

RECORD OF REPAIRS Car No. 347 Truck Brill Max. Traction.

TRUCK																	
		WHEELS															
Date In	Date Out	No. 1 Driver	No. 2 Driver	No. 1 Pilot	No. 2 Pilot	Axle Numbers	Diameter of Axle	Diameter of Journal	New Journal Brasses	Brake Shoes Shop	Brake Shoes Barn	New Brake Chain	New Sterling Sprockets	Brake Rod and Turn Buckle Thread Inspection	General Overhauling	Mileage	Names of Workmen
3/21/05	3/21/05			18666 16834	16887 16792	3263 -2228				OK		OK	OK	OK	OK.		Fuller – Jones.
4/26/05	4/26/05	19269 19214	19484 19296			3613 2359	5"		OK	OK		OK	OK	OK			Miller – Barton.
6/3/05	6/3/05										✓	✓					Brady.

CARD FOR KEEPING RECORD OF REPAIRS TO INDIVIDUAL TRUCKS AND TRUCK PARTS, UNITED RAILWAYS & ELECTRIC COMPANY, OF BALTIMORE

The company has followed, however, very closely the main principle involved in the joint committee's report, namely that the list of repairs should be minutely itemized and printed at the head of suitable columns, so that the records can be kept with the minimum amount of writing and clerical work, and the larger part of the entries can be made by either a cross or a check mark without additional writing. An important feature of the official forms recommended in this connection is the adding of the name of the workman who executed the particular repairs, and this column has been embodied in the Baltimore system and is conscientiously adhered to, as it has been found of prime value in fixing responsibility for any particular repair job. In some of the forms presented by the committee space was left for inserting the cost of repairs, but this has been entirely omitted in the Baltimore record, upon the grounds that the keeping of costs properly belongs in another department and would but add another complication if embodied in these particular shop records.

THE UNITED RAILWAYS & ELECTRIC CO.

RECORD OF REPAIRS Car No. 347 Truck Brill M.T. Motors W.H. 56 Controllers K 11

ELECTRICAL EQUIPMENT

Date In	Date Out	Armatures No. 1 Motor	Armatures No. 2 Motor	Fields Ren'd No. 1 Motor	Fields Ren'd No. 2 Motor	Gears Ren'd No. 1 Motor	Gears Ren'd No. 2 Motor	Armature Bearings No. 1 Motor	Armature Bearings No. 2 Motor	Axle Bearings No. 1 Motor	Axle Bearings No. 2 Motor	Gear Case	Resistance	Clearance Inspected	Controllers Overhauled	Switches Inspected	Trolleys Inspected	Heaters Inspected	Electric Bells Inspected	Mileage	Names of Workmen
3/21/05	3/21/05	70261	70024	OK OK		OK	OK	2 RBL	2 RBL	2/7 RBL	1/7 RBL	OK	OK			OK	OK	OK	OK		Shoul-Fitzgibbon-Evans & Rase
4/26/05	4/26/05					OK	OK			OK	OK	OK	OK			OK	OK	OK	OK		Miller-Barton-Evans
10/24/05	10/25/05	70164	70001					2 RBL	2 RBL				3 R Boyd			OK	OK		OK		Dyson-Haslip-Hutchins

CARD FOR KEEPING RECORD OF REPAIRS TO INDIVIDUAL ELECTRICAL EQUIPMENT, UNITED RAILWAYS & ELECTRIC COMPANY, OF BALTIMORE

individual equipment. With the present system of individual car and armature records, it is quite possible to check closely all the repair work done in the shop; to obtain a measure for keeping track of the use of equipment by the operating department; and also to get at the respective merits or demerits of any particular type of equipment. Under the old system, a particular armature might come into the shop two days after it had been repaired, and every two or three days thereafter for a long period without detection unless somebody in the shop happened to recognize it as an old friend. Or again, one particular car might come in a dozen times a month with blown controllers, and the trouble would be repeatedly repaired without anyone thinking to look deeper and find the cause for the recurrences of the defect. With the aid of the individual records, every car, and all of the essential parts of each car, are under constant surveillance by everyone who happens to refer to the card records. If the number of entries starts to assume untoward proportions, the fact glares everyone in the face who looks at the card, and it cannot go

THE UNITED RAILWAYS & ELECTRIC CO.

ARMATURE RECORD Armature No. 50115 Type W.H. 49 Date New 1898

Car No.	Date In	Date Out	Rewound	Coils put in	Coils Repaired	Open Circuit Repaired	Leads Repaired	New Commutator	Commutator Repaired	Commutator Ground Repaired	New Mica Rings	New Flash Rings	New Heads	Bands	New Bearings	Commutator Turned	Shaft Straightened	New Shaft	New Pinion	Keyway	Mileage	Names of Workmen
21	3/19/03	7/21/03													✓	✓			✓			Walters - Upp.
"	7/21/03	4/30/04													✓	✓						Walters
"	4/30/04	1/6/05													✓	✓						Walters - Murray.
"	1/6/05	5/1/05	✓					✓					1	5	✓	✓						Ebaugh-Carter Walters
26	5/17/05	6/30/05		✓									1	5	✓	✓						Carter-Wise-Walters
290	7/15/05	7/16/05											1	4								Carter-Shillenberg
1283	7/16/05	7/28/05					✓						1	2	✓	✓						Taylor-Dorsey-Walters-Upp
2253	7/30/05	9/11/05			1								1	5	✓	✓						Krouse-Dorsey-Walters-Upp

CARD FOR KEEPING RECORD OF REPAIRS TO ARMATURES, UNITED RAILWAYS & ELECTRIC COMPANY, OF BALTIMORE

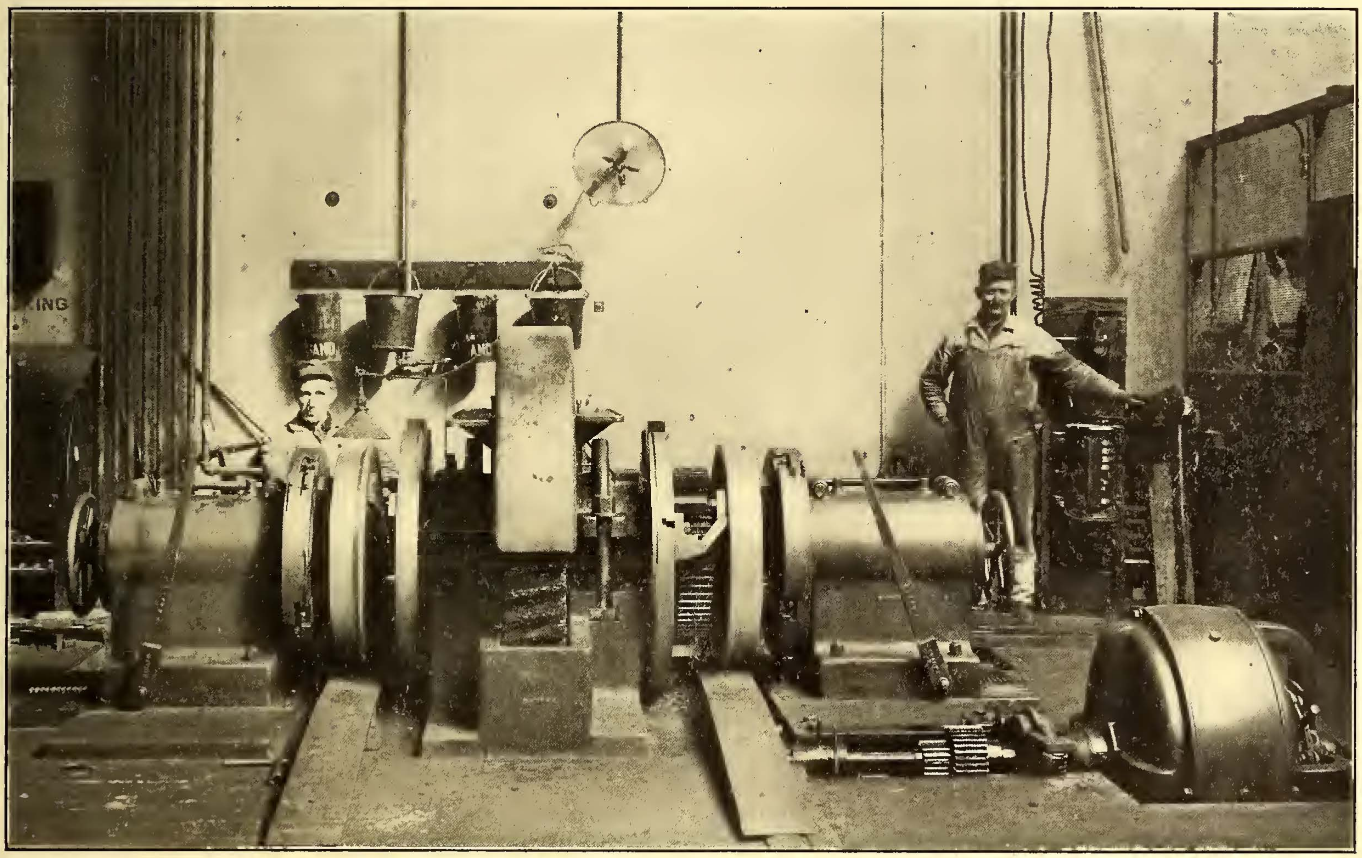
on very long before proper steps are taken to get at the root of the matter.

Referring to the advantages in general of keeping individual records of this nature, the opinion of Mr. Adams, based upon actual experience, is valuable. He finds that the results secured are of such value as to far more than compensate for the slight cost and trouble necessary to keep the records up to date. Under the former method, where the records were kept by classification of repairs, and no separate account was made of the actual repairs to individual cars, trucks and armatures, much had to be left to the memory of the foremen and there was no means of checking up the performance of individual equipment. This paper is indebted to Mr. Adams for his courtesy in permitting the presentation of the record forms devised for use in the Baltimore shops.

J. R. Harrington, general manager of the Canton-Akron system, has placed in effect on this system a standard steam railroad time-table giving each car a train number and providing passing points and making a distinction between different classes of trains.

NEW STEEL-TIRED CAR WHEEL LATHE

Owing to the increased use of steel-tired wheels on interurban and street railway equipment, the problem of keeping these wheels in good condition is seriously confronting electric railway men at the present time. The material of which steel tires are made is exceedingly hard to turn, especially when there are flat spots, as these are like glass when sand and dirt have become fused into the tire. The Niles-Bement-Pond Company, of New York City, has for many years given especial attention to the needs of the steam railroads for apparatus that will satisfactorily turn steel tires, and of late has adapted its heavy-duty wheel lathes to meet the conditions encountered in electric railway practice. The engraving reproduced in this connection illustrates the new Pond steel-tired car-wheel lathe, built for service in the repair shops of the Interborough Rapid Transit Company, at One Hundred and Forty-Eighth Street and Seventh Avenue, New York City.



WHEEL LATHE FOR TURNING STEEL-TIRED WHEELS AT SHOPS OF INTERBOROUGH RAPID TRANSIT COMPANY

The question of getting power enough in the machine to turn steel-tired wheels is simple when compared with the difficulty of holding wheels rigidly so that the full power of the machine can be used in the tools. In the lathe illustrated, special saw-teeth drivers engage the tire directly, the teeth of the drivers being forced directly into the tire by set screws. On the other side of the tire, chuck jaws grip it firmly, so that the tires are wedged between the driving plates and the face plates of the machine, thus doing away with any chance for chatter or vibration. The machine is driven by a very large central gearwheel. A section of this gear is made removable, so that the wheels can be rolled in. This construction makes a very compact machine and one of great power.

This type of machine has long been used by the steam railways for turning their steel-tired equipment, and it has been modified so as to be adapted for electric railway use. As many of the wheels in electric cars have a driving gear on the axle, provision is made for this feature, and the patented drivers are arranged to reach out over this gear and engage the tire. The illustration shows a pair of these wheels in place in the lathe. The lathe has capacity of from seven pairs to twelve pairs of steel-tired car wheels, for a day of ten hours. The actual time of taking out a pair of wheels and putting in another pair should not be more than six minutes to ten minutes, with wheels convenient to the lathe.

In order to get the highest rate of production, it is necessary to have the lathe supplied with a full set of tools, including flange tools and forming tools for the tread, as well as to have conveniences for getting the wheels to and from the lathe.

The Niles-Bement-Pond Company recommends the following procedure in handling wheels in connection with the Pond steel-tired wheel lathe:

The lathe should be set level with the floor, and provided with a pit in front for the convenience of the operator. It is also desirable to have tracks, which may be made of ⅝-in. x 2-in. bar iron, planed with a groove for the wheel flanges, leading to the lathe so that the wheels may be rolled in absolutely central. Air lifts may be used to transfer the wheels from the longitudinal track to the crosstrack, or the wheels may be brought into the shop on a special truck from which they can be rolled off onto the cross-tracks. If the journals need truing, the wheels first go to the journal lathe.

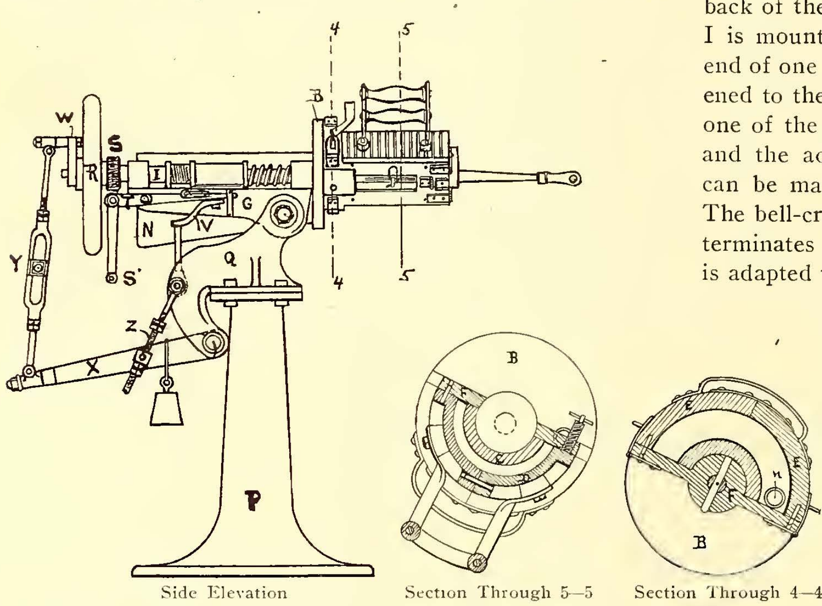
In putting a pair of wheels in the car-wheel lathe, first the bushings should be put on the journals, then the wheels rolled in, and the tail stocks brought up and clamped and the journal chucks screwed up. Next, the chuck jaws are brought out, gripping the tires firmly. The tails of the special sure-grip drivers are placed so as to bear against the strips on the driving plates, and the grip pieces are forced directly into the tires by screwing up the set screws. The tires are thus firmly wedged between the driving plates and the chuck-jaws.

The smallest wheel having been selected, cut in to lowest spot. Mark slide rest, withdraw tool, move rest to outside of tire and run tool in to mark on slide rest. Start cut and caliper, making other wheel same size. Using a 5-16-in. to 7-16-in. feed, run across the tread with whatever speed the tool steel and the hardness of tire will allow, usually between 10 ft. and 15 ft. per miute. The tread will be roughed out in about eleven revolutions. Withdraw tool to height of flange, 1⅛ ins. Feed across top of flange about three revolutions. With the same tool rough down back of flange, one revolution, and rough down front of flange one revolution. All this is done at one setting of the tool.

Next apply scraper to tread of wheel, smoothing it up in two revolutions, but this operation can frequently be done in one revolution if correct size is gotten on roughing cut. The rest is now in correct position for finishing the flange which is done by means of forming tools. About two revolutions are required for each side of flange. Finally apply chamfering and beveling tool to outside of tread, finishing it in about two revolutions. The wheels are now finished and the rests are in the right position for the next pair.

DEVICE FOR CASTING BRONZE BEARINGS

It is known that any molten metal poured into any wet sand mould will oxidize. This is caused partly by exposure to the atmosphere and also to the oxidizing effect of the steam generated when the hot metal comes in contact with the wet sand. Even when great care is exercised by the use of skim gates and in the pouring, it is virtually impossible entirely to prevent the oxides formed within the metal from passing through the gate in the form of scum and becoming imbedded in the castings. The entrained or embedded oxide in



Side Elevation Section Through 5—5 Section Through 4—4

FIGS. 1, 2 AND 3.—DETAILS OF DEVICE FOR CASTING BRONZE BEARINGS

castings is especially undesirable and injurious to castings intended for bearings.

The Lumen Bearing Company, of Buffalo, has developed a machine for casting Lumen-Bronze bearings, in which the aim has been to attain two objects: first, to produce a machine whereby full and perfect castings could be made economically by the use of permanent metal moulds, and second, to make castings which would be entirely free from entrained scum or metallic oxides.

The invention consists of a method of making castings by the use of moulds in which the mould and gate are movable relatively to each other, and mounted in such a manner that the part of the mould remote from the gate is filled in advance of the part adjacent to the gate. The filling of the mould is an even and continuous operation, in that the metal flows into the mould without spattering or having its surface film broken, resulting in a clean casting, since no part of the interior of the casting has been exposed to the air during the process of forming. The metal flows from the reservoir beneath its surface and is, therefore, perfectly skimmed before it enters the mould, and the metal is cast at the lowest possible temperature at which the mould will fill completely. It is stated the castings are free from shrinkage, cracks or other imperfections and entirely without entrained oxide or scum. The corrosion of a molten metal flowing into a hot metal mould is naturally very slight, and for the fact that the surface film remains unbroken, even this slight oxidation remains on the outside of the casting.

Referring to the accompanying drawings, the machine consists of a pedestal (P), upon which is mounted a special-shaped bracket (Q), to which is pivoted a yoke (G) that is free to move in a vertical plane. The shaft I is supported in the yoke G, and it has mounted upon one end the hand-wheel R and the worm-wheel S, by means of which the shaft is rotated; on the other end of this shaft, beyond the face plate B, is mounted the mould, which bears against the face plate. The reservoir N for holding the molten metal is shown in Fig. 2, and is fastened to the rear side of the face plate B. On the lower arm of the bracket Q the lever X is pivoted, and its opposite end carries an adjustable turn-buckle tilting rod Y; near the middle of the arm X is a lug through which the rod Z slides; rod Z is provided with adjustable nuts. Near the middle of the rod Y is mounted a handle shown in Fig. 1. The other end of the rod Y is connected by means of a universal joint to the eccentric W upon the end of the shaft I, back of the hand-wheel. On the middle portion of the shaft I is mounted a spring, one end of which bears against the end of one of the two adjustable sleeves, one of which is fastened to the shaft. The other end of the spring bears against one of the lugs of the casting G. By means of this spring and the adjustable sleeves, therefore, any desired pressure can be maintained between the mould and the face plate. The bell-crank T is pivoted near its center, one end of which terminates in a bearing for a worm shaft, the worm of which is adapted to engage with the worm-wheel S. The other end of the worm-shaft is provided with the crank-handle S^1. The opposite end of the bell-crank T is actuated by a spring tending to engage the worm with the worm-wheel. The extreme end of this bell-crank is free to move vertically in a guide. Attached to the same end of the bell-crank is the arm V, adapted to engage the adjustable stop V^1, which disengages the worm from the worm-wheel when the tilting portion of the machine is in the position as shown in Fig. 2.

The cast-iron plate F, Fig. 3, has a tapered socket on one end, to which is pinned the shaft I. This plate F constituting a part of the mould, has mounted upon it the remaining necessary parts. The part C is a half-cylidrical shell of an inch or more in thickness and is made of a 94 per cent. copper alloy. This constitutes the mandril upon which the casting is made. Attached to one end of it (Fig. 2) is a handle by means of which the mandril is manipulated. D is made in two halves and forms the outer casing of the mould. Both parts are made of cast iron and are provided with radiating ribs. The collar E is made of pure copper, and forms the part of the mould against which the heavy flange is cast.

The different parts of the moulds are fastened together in any convenient manner by means of hinges, dowel-pins and hasps, so as to permit the different parts to be taken apart and re-assembled quickly while in a heated state. The reservoir N is lined with asbestos cardboard. The cardboard is first cut to exact pattern and is then placed in position while soaked with water; the end pieces are put in last and firmly pressed in position, after which the seams are wiped over with asbestos cement. The gate or opening (n) through the face-plate B, leading from the reservoir N into the mould, is also lined with asbestos flush with the front face of the face-plate. The lining is then dried by filling the reservoir with pieces of live coke from the furnace; after it has been thoroughly dried, it is then in condition to last for weeks.

When the machine and the mould are in position as shown in Fig. 2, the reservoir N is filled with the required amount of molten metal. The operator then places his left hand on the handle Y and the right hand on handle S. He then tilts the machine until the lug on the arm X is brought in contact with the upper adjustable nuts on the rod Z, and, at the same instant, begins to turn the crank S^1. This causes the shaft I carrying the mould to rotate evenly and uniformly. By means of the eccentric W, the tilting of the mould is gradually and uniformly increased until the shaft I is turned through a half revolution. At this instant the handle Y is moved down and the machine is brought back to the position as shown in Fig. 1, by means of which the worm is automatically disengaged from the worm-wheel and the operator is enabled to quickly complete a revolution of the mould by the use of the hand-wheel, and then by means of a wooden plug he pushes the solidifying plug of metal in the gate (n) in the reservoir N. The mould is then opened up by releasing the fastenings. The collar E and the outside casting D are then removed. The mandril C, having the casting adhering to it, is next removed, and by gently tapping the casting against a block upon the floor, the casting is easily removed from the mandril. The mandril C and the collar E are then dipped into a tub of water for a short time, not long enough, however, to cool them completely, but so as to retain sufficient heat to dry them almost instantly the moment they are withdrawn from the water. The different parts of the mould are then asembled, and, after refilling the reservoir with an additional amount of molten metal, the machine is ready for making the next casting.

As the first metal enters the mould it flows in a line parallel with the cylindrical portion of the casting. The nuts on the rod Z are so placed that, if the tilting were not increased, due to the eccentric W, the entire mould would fill while the metal was flowing parallel to this cylindrical part. It is obvious, however, that it would be impossible to fill a mould completely under these conditions, and therefore it is necessary that the tilting of the mould be gradually increased by some such means as the eccentric W. This causes the end of the mould remote from the gate to gradually fill in advance of the end adjacent to the gate. The machine is adjustable throughout for the making of castings of this general style, though they may vary as to size and proportions. The weight of the arm X is adjustable so as to counterpoise the weights

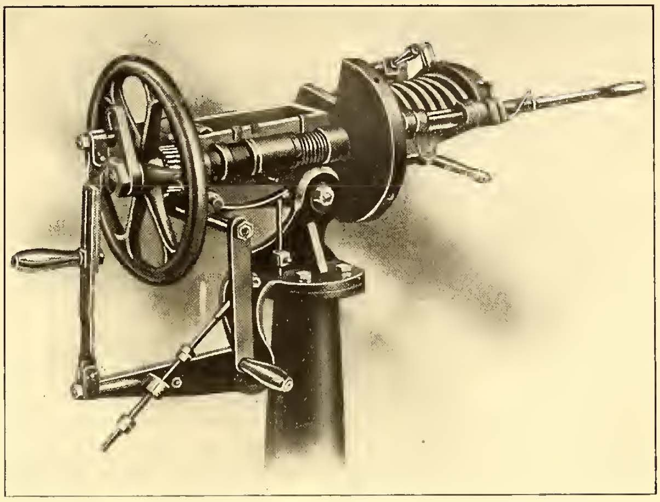
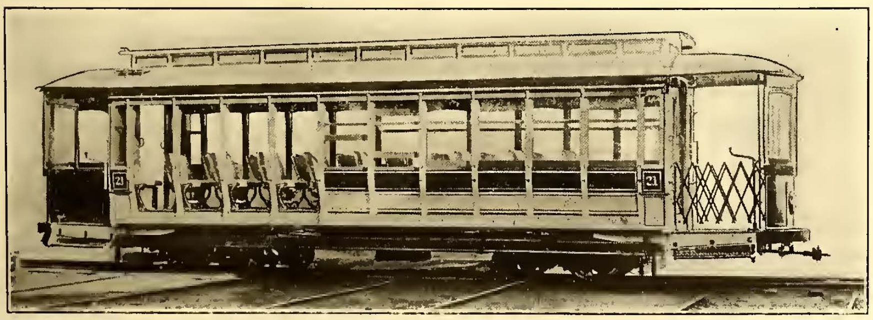


FIG. 4.—MACHINE FOR MAKING BRONZE BEARINGS

of the different moulds. Although the surface of the face-plate is perfectly smooth and at right angles to the shaft I, it was found, nevertheless, that a spring action is necessary between the two, owing to the fine fins that are liable to form at the edge of the gate. Each casting requires a mould especially designed for its own requirements, as the part of the mould against which the heavier part of the casting is made requires a greater chilling effect, and for this reason must be made of metal having a greater chilling capacity. In these experiments, for the sake of comparing the different metals and alloys for their "chill effect," it was assumed that the product of the co-efficient of heat conductivity multiplied into the specific heat of any one metal or alloy represented the relative value of its "chill effect." All results seemed to verify the correctness of this assumption.

CONVERTIBLE CARS FOR ROANOKE, VA.

The accompanying illustration shows a convertible car recently put in operation by the Roanoke Railway & Electric Company, and received from the J. G. Brill Company.



CONVERTIBLE CAR FOR ROANOKE, VA.

The new cars measure 28 ft. 4 ins. over the end panels, and over crown pieces 38 ft. 4 ins.; panel over crown piece, 5 ft.; width over sills, 7 ft. 3¾ ins.; width over posts at belt, 8 ft. 2 ins.; over grab handles, 8 ft. 9½ ins.; sweep of posts, 5 ins.; height of car from rail over trolley board, 11 ft. 8 ins.; size of Z bars sills, 8 ins. x 3 ins. x ½ in.; size of end sills, 4¾ ins. x 8 ins.; thickness of corner posts, 3⅝ ins.; thickness of side posts, 3⅜ ins. The cars embody the Narragansett step feature, which makes it easy for passengers to get on and off the car, providing as it does a double step within and over all limits of a single step. This is not very clearly shown in the illustration, due to the angle at which the car was photographed. The step is formed by an extension to the lower outward extending flange of the Z bar sill, making an upper step 8½ ins. wide; the posts are secured to the sill by malleable iron brackets, through which they are bolted, and are also held by strap bolts through the lower flange. The finish of the cars is natural quartered oak; the ceilings are of the same wood, decorated; seats with double grab handles; other specialties are: Folding gates, angle iron bumpers, alarm gongs, radial drawbars, etc. Another feature is the Brill portable vestibule, which, as will be readily understood, is particularly suitable to this type of car. The style of truck is the Eureka maximum traction, with wheels having a diameter of 33 ins. and 20 ins. Two 40-hp motors are used per car.

EXPRESS CAR FOR THE ILLINOIS TRACTION SYSTEM

An account was published in the STREET RAILWAY JOURNAL for May 26, 1906, of some elaborate cars recently completed by the St. Louis Car Company for the Illinois Traction Company, of Danville, Ill. This company is planning an extensive system in Southern Illinois, and expects to conduct a considerable freight and express business. For this purpose five freight and express cars have recently been secured from the St. Louis Car Company, and one of them is illustrated herewith. The general dimensions of this car are as follows: Length of carbody over all, 39 ft. 9 ins.; width over sills, 8 ft. 6 ins.; width over all, 8 ft. 10 ins.; height of body, 9 ft. 8 ins.; height from rail to top of roof, 12 ft. 10⅝ ins.

The car framing is of the most substantial construction. The bottom framing consists of six sills of yellow pine, each sill measuring 5 ins. x 7½ ins. The car bolster is of the flitch type trussed. There are two needle beams of oak 5½ ins. x 7 ins., placed 9 ft. 1½ in. centers and two side truss rods 1¼ ins. diameter attached to the bolster. As shown in the illustration, the cars are framed for monitor roof with ventilators, which are glazed with D. S. A. glass. The hoods are finished in the steam-coach style with no vestibules. The car is not provided with windows, but has on each side one sliding door 6 ft. wide and 6 ft. 3¼ ins. high. The bumpers are of oak faced with 9-in. x ½-in. steel plates. The floors are of 1½-in. thick oak which are placed crosswise of the car. The cars are lighted by one circuit of five incandescent lamps.

THE NEW EXPRESS CAR FOR THE ILLINOIS TRACTION SYSTEM

The cars are equipped with air brakes, also with the St. Louis Car Company's vertical malleable iron wheel brake, the St. Louis Car Company's heavy-type radiating drawbars, and are mounted on Diamond frame freight-car trucks having a 5-ft. wheel base.

The Toledo Urban & Interurban Railway is preparing to offer better facilities for the through Dayton-Toledo Limited service, which was instituted recently. Six right-angle curves north of Findlay are to be lengthened so that they can be taken at high speed, and this will save several minutes. The company is also going to install a dispatching system. Its block-signal system has been very satisfactory, but the other roads in the interline arrangement have no means at present of knowing whether a car on this portion of the run is late or out of service. When these improvements are completed, it is probable that the running time for 162 miles will be cut down to five and one-half hours, saving twenty minutes over the present schedule. The through freight business over these lines is increasing with the passenger business, and the company will erect a large freight station in Findlay.

A FOUR-TRACK LINE ON THE PACIFIC COAST

Orders have been given by Henry E. Huntington to begin work at once on the project for four-tracking the Long Beach line of the Pacific Electric Railway system as far as Watts station, and to rush operations to completion as rapidly as can be done. This will give Los Angeles the only four-track trolley line west of New York, and will be the culmination of plans that have been under consideration for nearly a year. More than eight miles of double track will be built, and the right of way has already been secured. At the present time the Pacific Electric Company is running more than 600 cars a day over the Long Beach line and its connections,—the Whittier, Santa Ana, Newport Beach and Wilmington-San Pedro lines, and traffic is daily becoming more congested. As the Whittier line branches off at Slauson Junction and the Santa Ana line at Watts, it is not until the latter station is reached that this crowded condition is relieved. It will be no surprise to the company to find that the four-track system will have to be extended in less than a year.

After the work of four-tracking to Watts has been completed the next step will be that of building a line from Santa Ana to Newport Bay to connect with the line just completed to that point from Newport Beach, and known as the East Newport Branch. The East Newport line, which was opened to traffic only a few days ago, is two miles long, from Newport Beach east across the Southern Pacific tracks to the bay. It makes the Newport Beach line the longest of the entire Pacific Electric System,—forty miles. The schedule time from Los Angeles to the end of this line is 1 hour and 15 minutes. From Mount Lowe, the farthest point north, to the farthest point south and east on the Pacific Electric system the distance is 55 miles. The new East Newport line building was encouraged largely by the fact that private enterprise had decided to make a big beach resort out of the bay town and has built a large pavilion and skating rink; also that the Pacific Electric has just finished work on a power plant at the point where the new line crosses the Southern Pacific tracks. Mr. McMillan, to whose offices as traffic manager have also been shifted the offices of H. S. Kneedler, industrial and advertising manager of the company, admits that the Santa Ana-East Newport line is a possibility, but is not in the plans of the company for the immediate future.

The Connecticut Railway & Lighting Company has resumed the service stripe system among its employees. Hereafter the men who have been employed by the company will receive one long stripe for every five years of service. One short stripe will be worn by the three years' employees.

FINANCIAL INTELLIGENCE

WALL STREET, June 6, 1906.

The Money Market

There has been a decided change for the better in the monetary situation during the past week. The payment of the first installment amounting to about $10,000,000, on the Pennsylvania note issue, the payments on account of new stock issues, and the June 1 interest and dividend disbursements were made without causing the slightest disturbance in the local market. About the only effect of these extraordinary demands was to hold rates for time money steady, but at the close the tendency was toward a lower level. Early in the week the banks and other lenders were not disposed to offer money for fixed periods with much liberality, but later on offerings became free, and were reflected in a sharp decline in the asking rate for over the year money. The improvement was due to the heavy arrival of funds from San Francisco and other Pacific Coast points, and the assurance that the receipts of money from that center will assume much larger proportions during the current week. From May 11, the date of the beginning of the return flow, up to the present time, upwards of $11,000,000 have been received, and in banking circles it is estimated that about $10,000,000 more will be received from the Pacific Coast this week. This heavy inward movement, together with the usual receipts from other Western and nearby points, will materially strengthen the position of the New York City banks, and is expected to be reflected later on by a general lowering of interest charges. The demand for money has been confined almost entirely to the call loan department, borrowers generally being inclined to draw their immediate wants from this source, rather than to commit themselves for fixed periods. In some instances stock commission houses have reloaned their unemployed balances. Foreign exchange has ruled firm, thus preventing the importation of gold from Europe. Gold amounting to $1,500,000 was, however, engaged in Australia for shipment to this center, and this amount was made immediately available for market purposes, the engagement having been made before the announcement by the Secretary of the Treasury that no further advances would be made on gold engaged for import. The European market continued to improve, and it is expected that the governors of the Bank of England will soon order a reduction in the official discount rate. The bank statement published on last Saturday was not up to expectations. Loans increased $2,152,400, despite the inactivity in the stock market. Deposits increased $4,019,300. The increase in cash of only $1,126,700 was due to the fact that about $5,000,000 which was received from San Francisco did not figure in last week's operations. The reserve required was $1,004,825 larger than in the previous week, and deducting this from the gain in cash, left the surplus $121,875 larger than in the preceding week. The surplus now stands at $6,816,025, as against $6,050,275 in the corresponding week of 1905, $31,760,675 in 1904, $4,775,650 in 1903, $11,285,575 in 1902, $13,341,500 in 1901, and $20,123,275 in 1900.

Money on call loaned at 5 per cent and at 2 per cent, the average rate for the week being about 3½ per cent. Sixty and ninety-day money was quoted at 4½ per cent, four to seven months' at 4¾ to 5 per cent.

The Stock Market

The stock market has improved very materially during the past week, not only in recording a higher range of values, but in developing a decidedly better feeling with regard to the future. During the first half of the week prices worked up gradually, but toward the close the buying became more aggressive and the advances were of greater proportion. This change in sentiment is the result of easier monetary conditions, due to the return of a large amount of money from San Francisco and other Pacific Coast points, and the assurance that the movement to this center will continue heavy during the current week. Other important developments included the publication of the government report on cotton, which was regarded bullish from a railroad standpoint, as indicating a large crop and increased prosperity for the South, and the publication of the annual report of the Amalgamated Copper Company, which, superficially, appeared unfavorable, but, as a matter of fact, did not reflect the true conditions. General conditions are highly encouraging. Great activity continues in the iron and steel industry, the consumption being equal, if not larger, than in 1905; railroad earnings show substantial increases over those of previous years, and reports from the Western traffic managers of all the leading roads are that the volume of business is larger than in several months, and all indications point to a steady growth in the volume of traffic. Crop prospects are good, and with easy money the outlook is much brighter for an active bull speculation. Pool activity has been largely in evidence during the week, and while ordinarily this is not regarded with favor, it has served to lift the market out of the rut of inertia and to develop a better feeling. Noteworthy strong features of the week have been Reading, Union Pacific and Southern Pacific, the buying of the last named being on expectations that the company will in the near future make some distribution to the shareholders. Colorado Fuel, American Smelter, Amalgamated Copper and many of the minor industrials also displayed considerable strength. Congress is expected to adjourn the latter part of the month, and with this out of the way the situation will be much clearer.

In the local traction group, Brooklyn Rapid Transit has been active and strong, having advanced on increasing earnings. It is said that the company continues to purchase property in the neighborhood of Coney Island.

Philadelphia

Extreme dullness characterized the market for local traction issues during the past week. Dealings included less than a dozen issues, none of which displayed any degree of activity, but prices generally displayed firmness. Philadelphia Rapid Transit was the leading feature, about 2500 shares changing hands at from 26 to 26½. At the end of the week, the company announced a call for a payment of $5, payable on July 10, which will make the stock $25 paid. Following the announcement the stock sold off fractionally to 25¾. Consolidated Traction of New Jersey was quiet but firm, less than 300 shares changing hands at from 82 to 82¼. Upwards of 300 shares of Philadelphia Traction sold at 98¾, and 200 shares United Traction of Pittsburg preferred brought 77⅛. Union Traction was dealt in to the extent of about 1000 shares at prices ranging from 63 to 63½. The company has declared the usual semi-annual dividend of $1 per share, payable on July 1. Philadelphia Company's issues were very quiet, about 1000 common changing hands at 50½ to 51, and odd lots of the preferred at 49¼. Small lots of American Railways brought 51½ to 51⅜. Other sales were: United Companies of New Jersey at 263, and Railways General at 6¾.

Chicago

Dealings in the tractions at Chicago were fairly active, and prices generally held firm. North Chicago rose from 44½ to 47 on the purchase of about 500 shares. West Chicago brought prices ranging from 36 to 37½ for about 300 shares, while the debenture bonds sold at 65. Upwards of 500 shares of Union Traction common changed hands at 5 and 4¾, while several hundred shares of the preferred brought 13½ and 13¼. South Side Elevated sold at 96 and 96½ for 250 shares. Northwestern Elevated sold at 26, and Chicago & Oak Park brought 6¼. Other transactions included Metropolitan common at 27 and the preferred at 70.

Other Traction Securities

Very little activity developed in the Baltimore tractions, and apart from United Railway free incomes, which fluctuated sharply, the dealings were devoid of special feature. Opening at 73½, the free incomes advanced to 74½, but on the announcement that the coupon on the bonds due June 1 would not be paid, the price ran off to 72½. The passing of the June 1 coupon brings the total amount of interest due on the bonds up to about 10 per cent. Upwards of $275,000 bonds were dealt in. Certificates representing bonds deposited sold at 71¾ for $5,000. United Railway 4s sold at 92¼ to 92⅛ for about $27,000. Other transactions included $20,000 Norfolk Railway & Light 5s at 99, Baltimore City Passenger 5s at 103¾, Knoxville Traction 5s at 106¾, and Augusta Railway & Electric 5s at 104. The feature of the Boston market was the strength in Massachusetts Electric issues, the common advancing to 20¾ on purchases of about 800 shares, while the preferred rose from 68½ to 70⅜ and closed at 70, upwards of 900 shares being traded in. Otherwise the trading was dull and featureless. A small lot of Boston Elevated changed hands at 153. Boston & Suburban common rose from 21¾ to 22¼, while the preferred sold at 69¼ and 70. Other sales were: Boston & Worcester common at 37, the preferred at 88; West End common at 98 and 97½, and the preferred at 112½ and 11. Dealings in the New York curb market have been very light, due to the fact that all of the active issues have been transferred to the Stock Exchange. Public Service Corporation 5 per cent notes sold at 97½ and interest for $10,000, and $2,000 New Orleans Railway 4½s brought 90.

Cincinnati, Newport & Covington continues very active in Cincinnati, about 1800 shares changing hands at between 73¾ and 75, the closing figure indicating a lull in the upward movement which has been going on for several weeks. The Cincinnati Street Railway sold for 143¼, a fractional decline. Toledo Railways & Light sold at 33½, also a slight decline. Cincinnati, Dayton & Toledo 5s sold at 93, a fractional advance.

Tractions were inactive at Cleveland. Northern Ohio Traction & Light led in the selling, several lots changing hands at 30½, which was two points lower than before the recent dividend was announced. The consolidated 5s of this company sold at 100¼. Aurora, Elgin & Chicago common came into demand on news of greatly improved earnings since the consolidation. It sold at 34¼, and advanced to 35 the early part of this week. Cleveland Electric sold at 78½. A small lot of Lake Shore Electric common sold at 15¾, and early this week another lot at 16. Western Ohio receipts sold at 14, a mark three points lower than last sale.

At Columbus, Columbus Railway & Light, after a reaction to 83, worked up to 85. Columbus Railway common sold at 102½, and the preferred at 111. Scioto Valley Traction common continues to move upward, and sold last week at 38. Small lots of the preferred changed hands at 93½.

At Toledo last week there was a sale of $152,000 of Toledo & Indiana 5s at around 60, and of $180,000 Toledo, Ann Arbor & Detroit 5s at 20. The bonds had been hypothecated by the Hirsch Construction Company, which built these roads and failed some months ago. The first-mentioned company is paying its interest while the second-mentioned road is in an unfinished condition.

Security Quotations

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

	May 31	June 6
American Railways	52½	51½
Boston Elevated	153	153
Brooklyn Rapid Transit	81⅞	84
Chicago City	160	170
Chicago Union Traction (common)	4½	4½
Chicago Union Traction (preferred)	13	13
Cleveland Electric	81	81
Consolidated Traction of New Jersey	81	81½
Detroit United	94	94
Interborough-Metropolitan Co. (common)	50⅜	50¼
Interborough-Metropolitan Co. (preferred)	84	84
Interborough-Metropolitan Co. 4½s	—	—
International Traction (common)	59	59
International Traction (preferred), 4s	80	80
Manhattan Railway	152	152
Massachusetts Elec. Cos. (common)	20	20⅝
Massachusetts Elec. Cos. (preferred)	69	70⅜
Metropolitan Elevated, Chicago (common)	27½	27½
Metropolitan Elevated, Chicago (preferred)	69	69½
Metropolitan Street	a114	a114
Metropolitan Securities	—	—
New Orleans Railways (common)	32	32
New Orleans Railways (preferred)	80	80
New Orleans Railways 4½s	88¾	88¾
North American	97¾	98
North Jersey Street Railway	27	27
Philadelphia Company (common)	51	51
Philadelphia Rapid Transit	26	25½
Philadelphia Traction	98¾	98½
Public Service Corporation 5 per cent notes	95	95¼
Public Service Corporation certificates	69	69
South Side Elevated (Chicago)	96	96½
Third Avenue	128½	129¾
Twin City, Minneapolis (common)	116	115¼
Union Traction (Philadelphia)	63	63
West End (common)	—	—
West End (preferred)	—	—

a Asked.

Metals

The "Iron Age" says, the market for steel-making pig iron continues stiff. Outside of some further buying of foundry iron by pipe makers in Eastern Pennsylvania, the volume of business in iron for melters has been very light throughout the whole country. The associated Birmingham makers are firmly holding at $14, but outside makers are shading this 25 cents. Moderate sized orders for rails for this year's delivery are still being entered. Japan has again appeared in our markets as a buyer of bridge material and of rails. German iron and steel makers have been putting up prices rather sharply, and reports from England have been more encouraging.

Copper metal holds firm at unchanged prices. Lake, 18¾ to 18⅞c.; electrolytic, 18⅜ to 18⅝c., and castings, 18¼ to 18⅜c.

CONSOLIDATION OF PENNSYLVANIA COMPANIES

Under the title of Pittsburg, Harmony, Butler & New Castle Street Railway Company, with a capital of $3,000,000, the following street railway lines now operating, or to be built in Allegheny, Butler and Lawrence Counties, have filed notice of merger in the State department, at Harrisburg. Pittsburg & Harmony, $500,000; Thornhill, $250,000; Callery & Evans City, $609,000; Evans City, $326,000; Butler & Harmony, $400,000; Pittsburg, Harmony, Butler & New Castle, $300,000; Elwood City & Hazledell, $300,000; Elwood City Electric, $9,000; Wayne, Electric, $6,000; New Castle & Harmony, $300,000. The officers of the new company are: Stanley C. Vickers, of Pittsburg, president; Harry Ethridge, of McKeesport, vice-president; E. M. Balsinger, of Pittsburg, secretary; Mark G. Hibbs, of Crafton, treasurer.

RHODE ISLAND SECURITIES SALE OFF

Recent rumors concerning changes in the ownership of the Rhode Island Securities Company, which controls practically all the trolley lines in Rhode Island, have been set at rest by a statement by President Marsden J. Perry, saying that while President Chas. S. Mellen, of the New York, New Haven & Hartford Railroad, had opened negotiations for the control of the company such plans have now been abandoned on account of the declination of his proposals by the present owners of the company, the United Gas Improvement Company, of Philadelphia. At one time, President Perry states, an agreement was reached as to the terms of a possible sale, but President Mellen encountered difficulties causing much delay, with the result that the present owners called the deal off.

ADDITIONAL STOCK FOR TWIN CITY RAPID TRANSIT

The directors of the Twin City Rapid Transit Company have authorized an additional issue of the company's common stock. Privilege will be given to holders of preferred and common stock to subscribe at par for the new common stock to the extent of 10 per cent of their respective holdings as registered on June 11. The subscription privilege may be exercised on June 18 next, and will terminate at the close of business on July 6. Warrants to subscribe will be mailed to stockholders or may be obtained from the Farmers' Loan & Trust Company, New York. Warrants for fractional shares, which will pass by delivery, will be convertible into full share warrants in amounts of $100 or multiples thereof. An instalment of 50 per cent must be paid in at the time of subscription, and the remaining 50 per cent will be payable on or before August 15. Full paid warrants will be exchangeable for stock certificates when presented to the Farmers' Loan & Trust Company on and after August 15. Such certificates will carry all subsequent dividends.

BION J. ARNOLD TO REPORT ON ADVISABILITY OF SUBWAY IN CHICAGO

The City Council Committee on local transportation of Chicago, at a meeting May 31, employed Bion J. Arnold to make a report on the advisability of subways, the underground trolley and the overhead trolley, with reference to a general settlement of street railway situation by the city with the traction companies. Mr. Arnold informed the committee that he would be able to report in about ten days. In answer to Mayor Dunne's query as to how long it would take to get a subway in operation in the downtown district, Mr. Arnold stated that it would be three years before cars could be run. In his opinion it will be necessary to use the overhead trolley for a time, in order to obtain quick rerouteing of cars and improvement in the transportation facilities. President Mitten, of the Chicago City Railway, and General Counsel Gurley, for the Union Traction Company, informed the local transportation committee that they had not yet arrived at figures for the value of their lines to be used as the basis of negotiations for permanent settlement. Mr. Gurley stated further, that he could have his figures ready in about ten days, while President Mitten stated his would not be completed before the middle of June. An ordinance to electrify the cable lines of the Chicago City Railway was considered by the committee, and it was agreed that the city should receive a compensation of $20,000 a year from the company. President Mitten stated that if the lines were equipped with electricity, about five months would be required to put the new system in working order, and he added further that the best of the cable trailers would be utilized as trolley cars.

The arguments in the suit between the North and West Chicago Street Railway Companies, and the Union Traction Company have been completed in the Federal Court. The argument has been largely confined to the question as to whether the Union Traction Company or the underlying companies were responsible for the floating indebtedness of $3,300,000 which is now charged up to the underlying compaines. In view of the fact that an early decision will facilitate the negotiations of the companies with the city, Judge Grosscup will decide upon the several questions involved as soon as possible.

Arguments in the suit brought by the North Chicago and West Chicago Street Railroad Companies against the Chicago Union Traction Company for annulment of the leases of the North and West companies to Union Traction were concluded before Judges Grosscup, Humphrey and Anderson Friday, June 1.

"We will try to settle the general principles as quickly as we can," Judge Grosscup told the lawyers at the end of the arguments.

Attorney Henry S. Robbins' attack on the veracity of W. W. Gurley, general counsel for the Union Traction Company, caused John P. Wilson to take the witness stand and tell the court that while he (Mr. Wilson) was acting as attorney for the protection committee of the North and West Side stockholders he was told by Mr. Gurley that the notes representing the floating debt of the companies had been retired. This testimony was in opposition to the charge of Mr. Robbins that Mr. Gurley had deceived the North and West interests.

The decision of the court will concern not only the continuation or cancellation of the leases, but also the liability for the $3,406,000 of floating debt as between the Union Traction interests on the one side and the North and West interests on the other.

FATAL TROLLEY ACCIDENT AT PROVIDENCE

Eleven persons are dead, a score seriously and another score slightly injured as the result of the overturning of an open electric car at Moore's Corner, in East Providence, at 1 o'clock Sunday morning, June 3. More than 100 young men and women, members of a Catholic society, who had been passing the evening at Crescent Park, a pleasure resort on the Providence River, 6 miles below Providence, were on a chartered car returning to their homes in Providence, Olneyville and Thornton. At Moore's Corner the track curves sharply at the foot of a long but not particularly heavy grade. Fog prevented a clear view of the road ahead, and an electric arc lamp at the corner is said to have been hardly visible. Realizing the peril, the motorman applied the brakes and reversed the motors in an effort to prevent an accident, but the car left the track and was overturned. Seven of the passengers were pinioned beneath the car and instantly killed. Immediately those who escaped with little or no injury began the work of rescue.

FIRE IN THE NEW YORK SUBWAY

A fire occurred at 5:45 p. m., June 1, in the New York subway, between 107th and 108th Streets, in which three empty cars were badly burned. At this point of the subway there are three tracks, of which the middle is used for storage purposes. Four empty cars were standing on this track and an empty train was run on to the track from the north. The cars collided, three of the trucks were derailed and the platforms of three of the cars were smashed in. The trucks were not thrown across the third rail, but short circuits were caused in the three cars with the demolished platforms and arcing occurred in several places. The middle car of the three injured was of steel construction, while the other two were of the first type installed by the Interborough Rapid Transit Company, and were of wood with copper sheathed sides. The fire from the combustible material in the burning cars created considerable excitement, and traffic was stopped for some time while the firemen put out the fire by pouring their streams through the openings from the street above. Automatic devices for tripping the circuit breakers in the sub-stations are located in the subway every 400 ft., and 4 minutes after the cars came together two of these devices were pulled almost simultaneously at the 103d Street and 110th Street stations, cutting out this section of track. The lights in the subway are on a separate circuit and were not affected except those directly above the cars, where the cables were burned and where the heat burst some of the globes. This did not occur, however, for over half an hour after the collision. The accident demonstrated the superiority for subway operation of steel cars, but it also showed that the copper sheathing on the wooden cars was a considerable protection against fire.

PREPARING INTERLINE TARIFF RATES

John H. Merrill, secretary of the Central Electric Railway Association, has begun the work of compiling interline rates for the various roads in Ohio, Michigan and Indiana, which are allied with this association. The work will be taken up in districts for the lines radiating from certain centers. Mr. Merrill's first work is the compilation of interline rates for the routes between Indianapolis, Dayton and Columbus, and Indianapolis and Toledo. The idea is to compile a tariff sheet which will show the rate between any two points in this district. The fact that there are, in a number of instances, several routes between certain points, complicates the task. For instance, between Indianapolis and Toledo, there are eight routes over which it is possible to travel, and each route must be shown and the rates given. Mr. Merrill's first compilation shows simply the sum totals of the local rates between these points; no attempt being made to reduce the rates so as to come below the steam lines in cases where the steam roads have a considerably shorter route between two terminals. This gives the steam roads a lower through rate in spite of the lower rate per mile offered by the electrics, and reductions will have to be made in many cases to secure through business. It will be necessary for each of the roads concerned in the through rate to make some reduction in its pro rata in order to get below the competing steam rate. The situation is further complicated by reason of the fact, that the steam roads in Indiana have a 3-cent per mile rate, while in Ohio, as the result of recent legislation, the steam rate is 2 cents per mile.

Incidentally, there is another phase to the Indianapolis situation which may or may not cause trouble. It will be remembered that about two years ago, before many of the lines in this district were connected up, several of the electric lines made alliances for interline business with the Clover Leaf Railroad, and the reduced rates which resulted caused storms of protest from the steam roads and threw considerable business to the electrics. Now, that roads in Western Ohio have secured an inlet to Toledo, and are giving fast limited service, with connecting limiteds for Indianapolis, the Ohio roads find the aforesaid alliance a drawback to the routeing of through business over their lines, and they want the Indiana roads to withdraw from their "unholy alliance" and send their Indianapolis-Toledo business by the "all electric" route. The Indiana roads are unwilling to do that at present, fearing it would cut off some of their business.

As soon as the Indianapolis tariff is compiled, Mr. Merrill will take up the question of through rates out of Toledo, Detroit, Cleveland and Columbus. The aim is to provide every station agent in the three States with tariffs which will enable him to sell through tickets to all points without having to call upon the general office for information concerning rates and routes.

DETROIT UNITED AFTER LONG DISTANCE BUSINESS

Officials of the Detroit United Railways, who attended the meeting of the Central Electric Railway Association at Dayton recently, said that the company is going after the long-distance traffic by instituting through limited service from Toledo to Port Huron, Mich., a distance of 130 miles. Heretofore the company has operated two limited trains a day between Detroit and Port Huron. For some time past the Detroit, Monroe & Toledo Short Line has been planning to institute limited trains between Toledo and Detroit. Now that the Detroit United has acquired the short line the service will be made a through one. Much faster service will be made possible by reason of the fact that a turbo-generator of 2000-kw capacity is soon to be installed in the Monroe power station of the Short Line, while another unit of the same size is to be installed in the New Baltimore station of the Detroit United. Both the Short Line and the Detroit United have recently purchased some very fine cars, and it is the intention to run them in three-car trains. Each train will be made up of a combination baggage and smoker, a passenger car and a parlor-chair car. It is claimed that the heavy traffic to the pleasure resorts at Port Huron and vicinity will warrant this equipment. It is also the plan to run the chair cars through from Port Huron to Cleveland over the Lake Shore Electric Railway, making a run of 250 miles, which will be the longest electric run in the country. It is stated that the Toledo-Port Huron service will be started in June.

EVERETT-MOORE SYNDICATE BUYS TWO LINES

The Everett-Moore syndicate of Cleveland, whose financial embarrassment in 1902 affected the entire traction situation of the Central West, has practically regained its prestige. Indications are that it will soon have under its control all the interurban lines sold at that time which were in operation or under construction.

Two months ago the Detroit United secured control of the Detroit, Monroe & Toledo Short Lines, thus giving the Everett-Moore syndicate a line which it had under construction at the time of its embarrassment. The Cleveland, Painesville & Ashtabula Railway, which had been laid out by the Everett-Moore people as an extension of the Cleveland, Painesville & Eastern, and was afterward built by Cleveland people who bought the right of way, now comes back to the Everett-Moore syndicate. The syndicate bought 6000 shares of the stock, paying cash for it at $20 per share. The road will be operated in conjunction with the Cleveland, Painesville & Eastern, and the cars will run through from Ashtabula to Cleveland. This gives the syndicate an unbroken line from Ashtabula, Ohio, to Port Huron, Mich., of about 305 miles.

As intimated in a recent issue, the syndicate has been negotiating for the purchase of the Canton-Akron system, and it is now announced that the deal has been effected, and that these properties will be turned over within the next thirty days. The Everett-Moore syndicate had arranged to acquire this property shortly before its financial difficulties. After the embarrassment the Tucker-Anthony people of Boston took the road back again and now for the second time it passes to the control of the Everett-Moore syndicate. The Canton-Akron Railway, the Canton & New Philadelphia Railway, and the Tuscarawas Traction Company, which are included in the deal, will be consolidated and will then be taken over by the Northern Ohio Traction & Light Company. The Northern Ohio Company will guarantee the underlying and consolidated bonds of these properties, and will increase its capitalization to $8,000,000, giving its stock in exchange for that of the acquired properties.

Recent rumors from New York have intimated that the New York Central interests had arranged to purchase the Lake Shore Electric Railway along with other lines between Cleveland and Erie. This is positively denied by the members of the Everett-Moore syndicate. While admitting that the New York Central interests may get control of these properties some time in the future, it is pointed out that the syndicate has just regained control of the roads, and it will now carry out its original plan of operating and developing them.

It is interesting to note that while the Everett-Moore syndicate has regained control of all the interurban properties owned at the time of its embarrassment, it has just sold the bulk of its holdings in the independent telephone properties, in which it was formerly a very heavy investor.

EASTERN OHIO TRACTION COMPANY REORGANIZATION

The property of the Eastern Ohio Traction Company will not be foreclosed as intimated would be done some weeks ago. The stockholders who objected to the original reorganization plan calling for an assessment of approximately $38 per share have agreed to another plan providing for an assessment of about $32 a share, payable in installments. In order that the road may be taken out of receiver's hands as quickly as possible, a new company, to be known as the Cleveland, Youngstown & Eastern Railway Company, has been incorporated to take it over. Incorporators are: A. M. Snyder, H. Clark Ford, A. A. McCaslin, H. M. Roberts and E. G. Derr. The company will proceed at once with the building of a cut-off from Chagrin Falls to Garrettsville in accordance with an agreement made with the Mahoning & Shenango Valley Traction Company, which will build from Leavittsburg to Garrettsville to connect with the line to Cleveland, thus giving a comparatively straight line from Youngstown to Cleveland. The new lines will be constructed for high-speed service, with a view to competing with the steam roads from Cleveland to Youngstown. The company will also double-track the line from Lee road to South Euclid, which will enable it handle the large suburban traffic over this route to better advantage.

WORK TO BEGIN ON PITTSBURG SUBWAY

Announcement has been made in Pittsburg that the Pittsburg Subway Company, otherwise known as the Frick-Mellen-Cassett-Oliver-Flinn syndicate, will ask the City Councils within a month for rights of way for the proposed subway. The new road is expected to cost $20,000,000, based on the cost of the construction of the New York subway. It is proposed to start work immediately.

REPORT OF THE PARIS METROPOLITAN RAILWAY

The annual general meeting of the Paris Metropolitan Railway Company was held on May 12. In the report of the directors it was stated that with the opening of line No. 2 (south part) the first section of the railway, comprising, roughly, an ellipse trisected lengthwise by two irregular lines, was completed. After referring to the several lines under construction the report goes on to state that on account of the intense traffic on the existing lines, especially at intersecting stations, a duplication of certain of the present lines is necessary. Steps have been taken to bring this question before the City Commission. The lines in service throughout 1905 included an average of 31 km, and during rush hours a 3-minute service was maintained over the three lines in service, by means of 305 motor cars and 378 trailers. The cars in construction number 149, all mounted on swivel trucks, and of these fifty-six were motor cars. The question of elevators for the deeper level stations has been settled, and stations of more than 12 m. below the surface will be provided with elevators. There are only a few stations at this depth. The ventilation of the deeper level stations has also received attention, owing to repeated complaints of the traveling public. The total number of employees of all grades belonging to the company was 2730.

The total gross receipts of the company for 1905 amounted to frs. 26,194,136, and the expenses of operation were frs. 11,353,482, giving a ratio of 43.44 per cent against 42.50 per cent in 1904. This gives a net profit of frs. 14,840,654, out of which sum about 60 per cent is payable to the city, representing interest on the capital expended in the construction of the line. The net profits remaining the company, therefore, amounted to frs. 6,443,747, giving net receipts per kilometer in service of frs. 202,927, against frs. 200,104 in 1904. The average fare per passenger amounted to fr. 0.1728.

The capital expenditure of the company to the end of 1900 was frs. 85,938,425, an increase of frs. 13,572,127 over 1904. The capital of the company is frs. 75,000,000, and there is a special reserve fund (created after the disaster of August, 1903) of frs. 1,363,885. The shares are of frs. 250 each, and a dividend of frs. 19 per share was declared, as against frs. 20 for 1904. The same rate of dividend could have been paid if frs. 121,000 were included from the sums brought forward from 1904. It is proposed to make a further issue of capital next month (June) of 50,000 shares, and a larger issue in 1907, this to take care of new lines to be handed over by the city for service.

The present power station of the company has reached its capacity, and power is being purchased in increasing quantities from outside sources.

AN IMPORTANT IMPROVEMENT AT LOS ANGELES

According to George E. Pillsbury, chief engineer of the Pacific Electric Railway Company, a "shorter short line" will be in operation between Los Angeles and Pasadena sometime in the fall. The new cut-off is from Aliso and Anderson Streets to a point on the Pasadena short line, and besides being a little shorter in point of mileage than the short line, the new line is through private right of way, thus permitting cars to run at greater speed, and allowing the use of more cars than at present. The idea of the cut-off was considered by Mr. Huntington a year or more ago, but has taken shape only in the last few months. A large force of workmen has been engaged in grading, and now the contractors are waiting for the steel work of the bridge, which is being set up in this city. This bridge is to be a fine steel and concrete structure. Grade crossings, prohibited by law, are avoided by an under crossing at Macy Street, and an overhead crossing over the Southern Pacific Railroad at Alabama Avenue, and it is here that this magnificent bridge is being erected.

CONVENTION OF THE MASTER CAR BUILDERS' AND MASTER MECHANICS' ASSOCIATIONS

These conventions are to be held this year in Atlantic City. The Master Car Builders meet June 13, 14 and 15, and the following program has been adopted:

June 13. Discussion on the following reports: "Revision of Standards and Recommended Practice," "Tests of M. C. B Couplers," "Composite Design of Coupler," "Cast-Iron Wheels," "Triple Valve Tests." Topical discussions on the following subjects: "Circumferential Variation Allowable in Mating Wheels," "Piece Work on Freight Car Repairs," "Should Not the Practice of Hinging the Running Boards at the Ends to Uncover Ice Hatches on Refrigerator Cars be Abandoned?"

June 14. Discussion on the following reports: "Brake-Shoe Tests," "Air-Hose Specifications," "Brake-Beam Specifications," "Axle Limits," "Revision of Rules for Loading Long Materials." Topical discussions on the following subjects: "Should Not the Uncoupling Chains of Passenger Equipment be so Arranged as to Guard Against the Uncoupling of Cars in Transit by Passengers Who May be on the Platforms?" "Advisability of Splicing Center Sills on Cars of 50,000 Lbs. or Less Capacity, in Order to Perpetuate the Cars for Two or Three Years Longer, With the Least Possible Expense."

June 15. Discussion on the following reports: "High-Speed Brakes," "Height of Brake Staff," "Combination Automatic Couplings for Steam Heat, Air Brake and Air Signals," "Location of Ladders," "Tank Cars." Topical discussions on the following subjects: "Methods of Handling Car Scrap and Usable Material," "Desirability of Adjusting Brake-Pressure to Light and Loaded Cars," "Better Fitting Up of Couplers, Even to the Point of Machining, or at Least Drilling the Pivot-Pin Hole Through Coupler Lugs and Knuckle, With Knuckle in Place and Tail of Knuckle Forced Against Lock, and Proper Contour Preserved Under this Condition."

The American Railway Master Mechanics' Association will meet June 18, 19 and 20, according to the following program:

June 18. Discussion on the following reports: "Reports of Committees on Shrinkage Allowance for Tires, and Design of Wheel Centers," "Flexible Stay-Bolts." Topical discussions on the following subjects: "Is not Boiler Pressure of 185 lbs. Better Than 200 lbs. for Locomotives?" "The Necessity of Proportioning Brake-Pressure to Wheel Loads," "Is it Practical to Use the Prosser Tool in Roundhouse Running Repairs?" Paper on "Valve Gears for Locomotives."

June 19. Discussion on the following reports: "Locomotive Tests of Pennsylvania Railroad at St. Louis Exposition," "Water Softening for Locomotive Use," "Locomotive Front Ends," "Mechanical Stokers," "Classification of Locomotive Repairs," "Engine House Running Repair Work on Locomotives." Topical discussions on the following subjects: "Grease vs. Oil in Driving Box Cellars," "The Relation of Roundhouse to Shop and Road," "The Best Roundhouse Organization for Properly Taking Care of Locomotives," "Distortion of Wheel Centers and Tires Out of Round, Due to Heavy Counterbalance on 100-Ton Engines." Paper on "The Modern Locomotive Injector."

June 20. Discussion on the following reports: "Locomotive Lubrication," The Use of Cast-Iron in Cylinders," "Electricity on Steam Railroads." Topical discussions on the following subjects: "To What Extent Should an Engine be Repaired in the Main Shop, and What Class of Repairs Could be Made to Advantage in the Roundhouse?" "Relative Advantage of the Piston-Valve as Compared with the Slide-Valve," "Is the Walschaert Valve-Gear an Improvement Over the Stephenson Link Movement?" Papers on "Best Method of Welding and Repairing Locomotive Frames Without Taking Down or Removing from Engine." "Fire Kindling, Cost of Material, Labor and Time Kindling Fires in Locomotives Using Either Anthracite of Bituminous Coal."

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED MAY 29, 1906

821,611. Trolley for Electric Railways; Edward F. Creevy, Chicago, Ill. App. filed July 11, 1900. The conductors are round cables, and the contact devices are provided with wheels or rollers which engage the cable.

821,616. Actuating Mechanism for Car Brakes; Ethan I. Dodds, Pullman, Ill. App. filed Sept. 18, 1905. A brake-shaft having one or more friction discs movable therewith, a rotatable brake handle having one or more friction discs movable therewith, cam devices serving to force the friction discs together and the handle is turned forwardly, and means preventing backward movement of the shaft.

821,617. Car Brake Operating Mechanism; Ethan I. Dodds, Pullman, Ill. App. filed Sept. 18, 1905. The brake-shaft is provided with a friction surface, the brake handle having an integral co-operation friction surface, and means to force the friction surfaces together to secure an operative frictional connection between the handle and shaft as the former is moved.

821,618. Operating Mechanism for Car Brakes; Ethan I. Dodds, Pullman, Ill. App. filed Sept. 18, 1905. Friction surfaces between the handle and shaft are forced into engagement by a compression member carried by the handle and slidable on the shaft and a thrust member pivotally mounted on the shaft to co-operate with the compression member when the handle is turned forwardly.

821,719. Trolley; Minas H. Kashian, Amesbury, Mass. App. filed Sept. 26, 1904. Provides a removable tread and special lubricating boxes in which the axle is journaled.

821,767. Railway Signaling System; Louis H. Thullen, Edgewood Park, Pa. App. filed Jan. 12, 1906. The motors for working the signals are operated by a three-wire polyphase system, the circuits of which are closed by relays operated by short circuiting the track rails. The latter are normally maintained at a direct-current difference of potential.

821,768. Controller Regulator; Joseph V. E. Titus, Keokuk, Ia. App. filed April 11, 1904. A device for retarding the movement of the controller in the "on" direction, including means arranged to render it operative continuously while the operating circuit is on, and means for rendering the device inoperative when the operating circuit is broken to permit an unimpeded movement of the controller.

821,801. Electric Railroad Signaling Device; Henry A. Hoeschen, Omaha, Neb. App. filed May 2, 1905. The car wheels engage a lever adjacent the rails which transmits a signal and operates a current generator when the train is moving in one direction, but not when the train is moving in the opposite direction.

821,835. Railway Signal; William A. D. Short, Lexington, Ky. App. filed Sept. 14, 1905. A signal casing having a transparent face, an opaque background and a semaphore indicator arranged to operate in front of said background. An opening is provided in the background having a lamp therein and a colored transparent disc arranged to operate behind the opening and in front of the lamp.

821,914. Automatic Electric Signaling Device for Railway Switch Systems; David C. Wolfe, Lyons, Kan. App. filed Aug. 9, 1905. An arm depending from the locomotice engages a special trolley adjacent to the track rails and completes a signal circuit to the cab.

821,916. Railway Signaling System; Azel Ames, Jr., Cleveland, Ohio, and John S. Hobson, Edgewood Park, Pa. App. filed Feb. 24, 1906. Details of a block-signal system employing track rails, energized to direct current difference of potential and polarized relays to give the overlap feature.

821,923. Railroad Signal; Walter C. Burton, Fitchburg, Mass.

App. filed Sept. 30, 1905. A box adjacent the track rails has a magazine of torpedoes, and an electromagnetic feeder impels the torpedoes in the path of a plunger depressed by the train whenever desired.

822,028. Railway Signaling System; Jacob B. Struble, New York, N. Y. App. filed March 7, 1905. Employs batteries for the motor signal which are of high electromotive force, and has means for opposing the counter electromotive force to such batteries for the energization of the track rails, whereby the latter are maintained at a low potential difference.

822,055. Tramway Point; William Kneen, London, England. App. filed Dec. 27, 1904. Two levers extending longitudinally of the track, and each depressible on its pivot or fulcrum, and connections for imparting movement from each of said levers to the other and to the switch rail, whereby depression of one lever elevates the other and moves the switch rail in one direction, and vice versa.

822,230. Switch-Throwing Device; Thomas J. Colburn, Argenta, Kan. App. filed Oct. 27, 1905. Details of a depressible switch-throwing lever on the platform of the car.

PERSONAL MENTION

MR. W. J. GOODENOUGH has been appointed purchasing agent of the Chicago & Milwaukee Electric Railroad, with headquarters at Highwood, Ill.

MR. L. J. WOLFE, of Cleveland, president of the Aurora, Elgin & Chicago Railroad, sailed last week from New York for Europe. He will be gone six months.

MR. C. G. GILPIN, superintendent of the Mill Creek Valley line, of Cincinnati, has been appointed assistant general superintendent of the Cincinnati Traction Company.

MR. E. A. TURPIN has resigned as purchasing agent of the Chicago & Milwaukee Electric Railroad to become associated with A. L. Drum & Company, consulting and constructing engineers, of Chicago.

MR. J. M. ENRIGHT, who has been superintendent of the Maumee Valley Railways Company, has been appointed assistant superintendent of the Toledo Railways & Light Company and the Maumee Valley Company.

MR. WALDO G. PAINE, formerly traffic manager of the Coeur d'Alene & Spokane Railway Company, has been appointed general passenger agent of the Inland Empire Railway system, with headquarters in Spokane.

MR. FRED SURTEES has been appointed superintendent of the Cincinnati Interurban Railway, succeeding Mr. H. Gordan Gilpin, who has been appointed assistant general superintendent of the Cincinnati Traction Company.

MR. JOHN F. COLLINS, superintendent of the Toledo Railways & Light Company, has been appointed superintendent of the Maumee Valley Railways Company, in addition to his duties as superintendent of the Toledo Company.

MR. W. P. SAWYER has resigned as general manager of the Auburn & Turner Electric Railway, of Auburn, Me. Mr. Sawyer will resume the position of manager of the Eastern Electric Express Company, with which he formerly was connected.

MR. EDWARD J. DAVIS, for several years passenger agent of the Columbus, Buckeye Lake & Newark Traction Company, with headquarters at Columbus, has resigned to become assistant traffic manager of the Columbus, Delaware & Marion Railway.

MR. JOHN E. BREAK, superintendent of the London Street Railway, of London, Ont., who has been with the company for twelve years, has resigned. He is succeeded by Mr. E. Whittaker, assistant superintendent. Mr. Break resigned to go into business for himself.

MR. W. S. McCALL, for several years general sales agent of the St. Louis Car Company, has been appointed vice-president of the company, which office was made vacant by the resignation of Mr. H. F. Vogel, as previously announced in the Street Railway Journal.

MR. L. J. SHLESINGER, former manager of the Muncie, Hartford City & Ft. Wayne Company, has been made superintendent of motive power for the entire Indiana Union Traction Company's system, vice Mr. P. J. Mitten, who is made master mechanic of the Union Traction Company's shops in Anderson.

MR. W. S. MILLER has been appointed manager of works of the St. Louis Car Company. Mr. Miller has been associated with the St. Louis Car Company for several years, having been in charge of the mechanical department as superintendent of tools and machinery. Mr. Miller is also manager of the Kobusch Automobile Company.

MR. J. McQUARRIE, for several years assistant manager of the Vancouver department of the British Columbia Electric Railway, has been appointed manager of the New Westminster department, with headquarters in New Westminster. The present manager, Mr. F. R. Glover, has been compelled through illness, to move to the interior of the country, where he will take up farming on an extensive scale.

MR. CABOT STEVENS has resigned as electrical engineer of the Edison Electric Illuminating Company, of Brooklyn, N. Y., to accept a responsible position with Messrs. Stone & Webster, of Boston, Mass. Mr. Stevens' first work in his new field will be at Columbus, Ga., where he will represent Messrs. Stone & Webster in the construction and operation of a large light, power and railway plant.

MR. F. A. BURKHART, a well-known steam road man, of Lima, Ohio, has been appointed district passenger and freight agent for the Schoepf syndicate property centering in that city. He will have charge of freight and passenger business on the Ft. Wayne, Van Wert & Lima Traction Company, the Lima & Toledo Traction Company, the line building from Lima to Bellefontaine and the Columbus & Lake Michigan steam road, and will report to Mr. D. G. Edwards, general traffic manager of the Schoepf syndicate, with headquarters at Cincinnati.

AT THE CELEBRATION of the seventy-fifth anniversary of the Koeniglich Preussische Technische Hochschule, of Hanover, Germany, the honorary degree of doctor of engineering was conferred on Mr. Ernst Koerting, the noted European engineer, and of the well-known firm of Gebr. Koerting, A. G. Koertingsdorf, Hanover, for his scientific researches and discoveries in gas engines, and other important branches of engineering. Dr. Koerting lives in Pegli, Italy. He is interested in a number of large enterprises in the United States, among them the De La Vergne Machine Company, of New York, as well as the Schutte-Koerting Company, of Philadelphia, and is at present sojourning in this country.

MR. C. M. CORY, auditor and treasurer of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., will associate himself with the Newman interests in the South as auditor of the operating department of Ford, Bacon & Davis. Mr. Cory succeeded Mr. C. O. Simpson as auditor of the Birmingham company last August. In this new position he will have full charge of the accounts of the Ford, Bacon & Davis Company, in Birmingham, Memphis, Little Rock, Knoxville, Nashville and Houston. Mr. Cory succeeds Mr. W. B. Brockway, of New York, and in turn will be succeeded by Mr. E. M. White, formerly assistant treasurer and secretary of the Birmingham Railway, Light & Power Company. Mr. E. C. Jolly succeeds Mr. White.

MR. EDGAR K. RAY, one of the most prominent street railway promoters in New England, and head of what is known as the Ray system of street railways in Rhode Island and Southern Massachusetts, died at his home at Elm Farms Wednesday, May 30. Death was caused by a complication of diseases which followed the amputation of Mr. Ray's right leg three years ago. He had been an invalid for nearly two years. Mr. Ray was a native of Franklin, where he was born July 17, 1844. He was educated in the public schools of his native town, at the Woodstock Academy, Woodstock, Vt., and at a commercial college in Boston. Beginning business life in cotton and woolen manufacturing interests, he emerged from them into other lines of activity, and two decades ago was instrumental in connecting Woonsocket and Pascoag with the Woonsocket & Pascoag Steam Railroad, which was later acquired by the New York, New Haven & Hartford Railroad. He was connected in an official capacity with numerous street railway, banking and manufacturing corporations. He was president and general manager of the Woonsocket Street Railway Company, president and general manager of the Columbian Street Railway Company, treasurer and general manager of the Milford, Attleboro & Woonsocket Street Railway Company, and treasurer and general manager of the Providence & Burrillville Street Railway Company. He was president of the Citizens' National Bank, of Woonsocket, president of the Elm Farm Milk Company, treasurer of the Putnam Manufacturing Company, of Putnam, Conn.; president of the Franklin National Bank, a director in the Franklin & Milford Railroad, a director of the Woonsocket Electric Machine & Power Company, president of the Ray Cotton Company, of Woonsocket, and a director in other corporations.