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Of this issue of the Street Railway Journal, 8000 copies are printed. Total circulation for 1906 to date, 196,000 copies, an average of 8166 copies per week.

Measuring Power Consumption at Cars

A frequent method of obtaining a rough idea of the power consumption of the rolling stock of a street railway per car-mile is to divide the total switchboard output at the generating plant by the total mileage in the time considered. This is well enough as far as it goes, but the fact is sometimes overlooked that such an estimate includes the losses in the overhead and return systems, and is therefore of very little use as a means of checking the actual performance of the rolling stock. It is pretty hard to take any intelligent action on the basis of so general a figure. If the feeder system remained unchanged from year to year, and if the bonding retained a constant resistance—or possibly conductivity is the better word—then a very approximate comparative idea of the power consumption per car-mile could be obtained by the method mentioned. The actual cost of power per car-mile is worth knowing, but for intelligent appreciation of conditions which may be improved, the recording wattmeter on the individual car certainly supplies the best information, and it is surprising that so few companies take advantage of their opportunities in this direction. The wattmeter tells the story a great deal better than a collection of hybrid voltmeter and ammeter readings on 20 second or 30 second intervals in a round trip, and it affords an excellent means of checking up the performance of individual motormen. While we are not prepared to say that it is as necessary to the motorman as the fare register is to the conductor, it supplies the same function, as it guards the treasury of the company against loss.

Meetings of Shop Foremen

On large interurban and city systems, where the cars are cared for in several different car houses and repair shops, the foreman of one shop or car house often knows nothing of what is going on in other car houses, and frequently is not even acquainted with the other foremen of the system. The consequence is that each foreman must work out for himself every little detail of operation, and the practice in the various shops consequently differs widely. This of itself is not only unwise, but it is noticeable that where the foremen are not intimately acquainted, there is often a tendency for one to "knock" on another's method of doing things or of turning out work. Nothing is more conducive to uniformity of practice and to good feeling among the foremen than to give the men opportunity to get thoroughly acquainted with each other, and this is best accomplished by arranging for periodic meetings of all the foremen. On many roads such meetings are held with very beneficial results. The comparison of practice possible at such meetings and the consequent adoption of the best is worth all the trouble involved. One mistake sometimes made, however, in the arrangement of such meetings is that they are often held in the evening after working hours. If the meeting takes the form of a dinner at the expense of the company, all well and good, but if the men are forced to give up an evening once or twice a month, without the company going to any expense in providing entertainment, the men often feel that the company is trying to get something for nothing, and consequently do not enter into the meetings with a spirit that promises the best results.

If no entertainment is provided, certainly the meetings should be held during work hours. Then each man will feel

that he is being called upon to discharge part of the duties of his position, and will enter into the spirit of the occasion with a better heart. Holding the meetings at such times, of course, requires the foreman to leave his shop or car house at hours when his services are required there, and this in turn is not very desirable.

A better method probably is to hold the meetings in the evening, and attempt to give the meeting the appearance of a social gathering, by providing a dinner or cigars, or at least go to some expense to show the men that the fact that they are giving their time to the company is being appreciated. Such meetings are valuable to a road, even if shop subjects are not discussed, simply because of the closer acquaintance the men gain with each other. Such an acquaintance is conducive to a better understanding at all times, and likewise fewer misunderstandings. It isn't hard to keep the conversation on shop subjects, if a little tact is used by a leader, and a discussion of these topics, with the consequent interchange of ideas among the men, is certainly conducive to better practice in general and to reduced maintenance expenses.

Operating a Single-Phase Road

We are glad to present to our readers a summary of the results obtained in the operation of the Bloomington, Pontiac & Joliet line. The data cover nine and a half months working, up to the beginning of the present year. Owing to extensions of line and equipment since then the conditions have not been uniform, but the period reported gives a clear notion of the situation existing during the period when 10½ miles of road were in regular use. The analysis of results is further simplified by the fact that power was purchased, so that the energy required for operation was measured and paid for without introducing any questions of station operation. The average amount per car-mile proved to be 2.1-kw-hours, certainly not a conspicuously large figure considering that the schedule speed for the 32-ton cars was 21 miles per hour. Assuredly there is nothing in this to cause unfavorable comment as to energy required. Of fundamental importance is the report on the maintenance of the electrical equipment of the cars. Here, if anywhere, one would expect to find trouble, due to the system. To be sure, on standard equipments one does not expect the first year to show heavy repairs, but on a new system anything radically wrong should certainly show up within a twelve-month. That not an armature coil or field coil was damaged during this period, and that no material trouble was noted in the operation or life of commutators or brushes, is a most hopeful sign. Trouble with brush holders is noted as occurring, a trouble not uncommon and well known to be easily remediable. The total amount of maintenance reported is $341.83 for nearly 50,000 car miles. It would have been very interesting had this cost been itemized, for obviously it is not all chargeable to brush-holder studs. We fancy, however, that it would prove to be made up of a lot of rather inconsequential items rather than to any general defects inherent in the equipment. All this is cheerful news. There are now in operation a respectable number of single-phase roads, and we have yet to hear any consensus of opinion regarding the development of faults. Whatever the future may bring forth, we are at least glad that the stagnant uniformity of electric traction has at last been stirred up. It is not so much the question between a. c. and d. c. motors that is important as that of high-voltage distribution on which the larger work of traction depends.

Incidentally we are interested to note the plans for the electrification of the Rochester division of the Erie Railroad. It is another case of a. c. work, following in general the lines of the New York, New Haven & Hartford Railroad installation, but with the significant variation that it is intended to operate upon the multiple-unit system, alleged inability to use which has been one of the accusations raised most loudly against a. c. traction. The last word has not been said on the subject of heavy electric traction, but if the advocates of high-voltage d. c. work, which admittedly has some attractive features, do not busy themselves, they will start with a serious handicap not easily to be overcome. On the evidence now available there is no reason to expect the failure of a. c. traction either on a large or small scale, and unless the advocates of high-voltage d. c. equipments get actively about reducing their system to practice, they will have to shoulder the burden of proof in the ensuing competition. Meanwhile we shall hope for further light on the operating expenses of the single-phase roads already in operation. Every bit of evidence of this sort is valuable, and the more in detail the better.

A Lesson in Substantial Construction

We commend to our readers the accounts of the electric system of the Long Island Railroad which are being published in these columns. The description of the power transmission line and third-rail system is completed in this issue, and other features will be described in subsequent editions. The installation as a whole is an admirable example of work done thoroughly and well, while following lines in general familiar. The problem before the engineers was to work within necessary and sometimes troublesome limitations and to produce a thoroughly reliable and efficient system. One of the first serious questions to be raised was that of overhead vs. underground construction. The decision turned upon the relative reliability of the two systems more than upon the relative costs, and we think the final outcome of a really substantial overhead line with cables used only when necessary for particular reasons, was the logical result of sound engineering. It is perfectly true that an ideal cable system is free from certain sources of interruption to which overhead lines are subject, but it is also true that cables have troubles of their own, and that when anything does happen on a conduit line, it is generally far more serious from the standpoint of continuity of service than an accident on an overhead line. The result of the decision was a system of pole construction that ought to prove singularly reliable. Most of the lines are built of substantial steel lattice poles, firmly set in concrete. The cross-arms, however, are of yellow pine, extra heavy and coated with asphaltum paint. This wooden cross-arm construction we regard as rather important as giving considerable additional security in the matter of insulation without any sacrifice of security. Certain steel tower lines in which the use of wood was avoided almost as a matter of conscience, have had so direful experience with their insulators as to indicate that a grave mistake had been made. Great care has also been taken on the Long Island system to protect the lines against lightning,

and especially to protect the cable terminals. It is well to observe that the lightning arrester houses installed for this purpose are completely fireproof in construction, and are big enough to accommodate apparatus for a considerable group of circuits.

The portion of the system most interesting to the traction engineer is undoubtedly the third rail with its supports and protection. The rail itself is of special section, weighing 100 lbs. per yard, and is of rather higher conductivity than most conducting rails, being equivalent to 1,650,000 circ. mils of copper. It is also insulated as the early third rails were not, with some proper regard of leakage, being supported every 10 ft. on vitrified clay insulators. The rail is housed in well-supported planking, with additional protection at the stations, and the experience with it has shown its value both in general safety and in useful protection of the rail. Such precautions are absolutely necessary on lines running as does this one through densely populated districts. The bonding of these heavy rails involved some special difficulties, finally overcome by the use of laminated copper with terminals riveted into the base of the rail. The east-bound and west-bound tracks of the system are interconnected only at a few places, and there through circuit breakers, and the system, as a whole, is pretty thoroughly sectionalized so that trouble originating at any point may be localized. In this particular, as elsewhere, the practical working details of the system with respect to continuity of service have been very thoroughly looked after. The ordinary interurban road with moderate traffic may occasionally take chances, but with the enormous service of the Long Island Railroad no precautions against interruption can be neglected. In this particular the construction described is a very valuable lesson.

Inspection of Cars by Motormen

One point in which a wide diversity of practice on electric railways is found is the extent to which motormen are required to know the apparatus of their car. On some roads all that is required of a motorman along this line is that he know how to cut out the motors by means of the switches in the controllers should they become grounded or refuse to work because of any other reason. Other roads, however, require that the motorman be a thorough electrician and be able to discover and repair a loose ground wire of a burned-off lead, to clean commutators, replace brushes and do other small jobs that would otherwise cause the car to be sent into the shop.

Some managements argue that "a little knowledge is a dangerous thing," and prefer that their motormen know very little about the electrical apparatus. It must be admitted that there are some grounds for such a stand. On a city system where cars are run under a very short headway, time does not permit of making any repairs at all on a disabled car. It is usually better simply to let the next car behind push the disabled car to the nearest siding without attempting repairs. In such an instance a motorman with a little knowledge of the apparatus might attempt repairs and cause delays by so doing. It is, moreover, difficult to provide an organization to educate the army of motormen in a city system so that they are competent to make repairs. Again, a motorman with but a few ideas about the equipment is likely in attempting to make repairs to damage the apparatus to a considerable extent and thus cause additional work to the shop force.

On long interurban runs, we venture to say that as a general proposition the more a motorman knows of the apparatus of his car, the fewer times his car will have to be taken off the schedule, and the shorter the delays when something goes wrong. The writer remembers an occasion where only a slight knowledge would have saved a needless trip. The report that a certain car was lying disabled at a siding about 35 miles distant was received at the shops. The passengers of the disabled car had been delayed an hour, and then put aboard the next car going in their direction. On reaching the disabled car the shop man simply cut out motor number 1, which had become grounded, and the car was run in with the remaining motor and could have been run several trips with it. A very little knowledge of the machinery in this instance would have saved considerable expense, and would have prevented several passengers becoming impressed with the idea that electric lines were less reliable in operation than steam railroads.

Some managements go even further than require a motorman to know the apparatus of his car. They insist on his taking care of his car to the same extent that engineers on steam lines are required to take care of their locomotives. This requires an inspection of bearings at the ends of the run, oiling trolley wheels and polishing the commutators at certain intervals, cleaning controllers, replacing worn-out brushes, and in general doing everything to keep the car in running order, except the heavy repair work that can only be done in the shops. This plan has many points in its favor. The motorman knowing he is responsible for the condition of the car is much more apt to do the inspecting in a more thorough manner than it is usually done in the shops. Moreover, the fact that there is only one car to inspect is likely to result in better inspection. When the shop man is compelled to go over several cars in succession, the work often gets monotonous, and he is then apt to do it in a careless manner.

The fact that the car is inspected several times a day may result in defects being found and remedied before serious damage is done. Inspection of the motor, for instance, might show a brush holder or a connection that was not tight, which, if not tightened before the end of the day, would probably work loose and result in a grounded machine. Again, if bearings are inspected at the end of every run of three or four hours, there is little likelihood of them becoming hot and causing delays usually resulting from such occurrences.

That the motorman may inspect the car in the manner suggested, it is necessary to allow a layover at one end of the run, preferably about every 4 hours. A half-hour interval is sufficient to make a very good general inspection of the car. Sometimes it happens that the time of arrival at a terminal necessitates such a layover, and again it might be necessary to add one car to the schedule in order to permit of a car being laid over a sufficient time to make inspections. It may happen, too, that a layover of less than an hour cannot be made. In such an instance, it might be well to add to the duties of the motorman and require him to replace trolley wheels, adjust brakes, repair controllers and do all the ordinary repair work on the car with the exception of changing armatures and bearings and doing such work as requires special apparatus.

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

BY W. N. SMITH

CABLES

The transmission cables are of 250,000 circ. mil stranded copper, and are fastened to the insulators with ties of No. 6 copper wire, 3 ft. long. Splices were made by cutting back the core of the cable and wrapping the outer layers of strands around the abutting cables, after the manner of the ordinary Western Union splice. All the joints were soldered. Where jumpers were used to lead into sub-stations or arrester houses, the ordinary half-connection joint was made and carefully soldered. The cables were strung for the most part by means of teams of horses and running lines of 1000 ft. or more in length, the cable reels being mounted on stationary stands.

FIG. 18.—STRINGING CABLE ON JAMAICA BAY TRESTLE

On the trestle, however, this method could not be so readily followed, and the cables were strung in the following manner: The reel of wire was carried on a flat car upon which was carried a boom, capable of being swung to one side to the position which would be occupied by the wires. At the end of this boom was a snatch block, through which the wire passed and by which it was guided on the cross-arm. The car was moved along slowly by a locomotive and wire paid out, and the boom being raised at each cross-arm so that the wire would drop down onto the arm. This method proved very economical, and is illustrated in Fig. 18. The total amount of overhead transmission cable erected, is 62.03 circuit miles, or 186.09 miles of cable.

No low-tension cables were required for the initial installation, except to connect up isolated sections of third rail where it became necessary to break the third rail at switches and crossings. There are, therefore, no low-tension cables on the poles at present, but when installed they will be carried upon heavy porcelain top-groove insulators and pins of the same general type as described above.

Wherever the power transmission circuits cross the highways or railroad tracks, special precautions are taken to insure against the possibility of a cable falling off a cross-arm and hanging down in position to endanger passing traffic. At such points the spans are shortened as much as possible. In some cases an extra straight-line pole is used in the line, and at other points a strain pole is placed on each side. Wherever the wires cross other electric circuits the high-tension wires are carried above the others, as their large size and strong mechanical supports make them less liable to fall upon others than would be the case if their positions were reversed. At all crossings, and over station platforms, and on the inside of curves, vertical angle irons, called "retainers," are bolted to the ends of the cross-arms, so that, in case of the insular breaking or cross-arm burning off, the wire cannot fall any distance away from its normal position. The detailed design of this device is shown in Fig. 19, and Fig. 20 shows the retainers in position on a pole carrying the trunk line over the tracks near Glendale Junction.

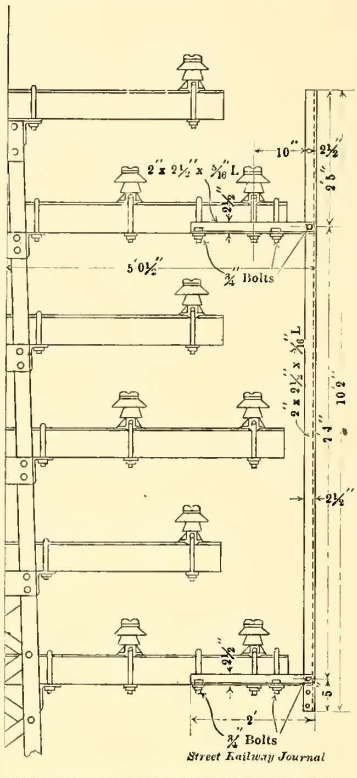


FIG. 19.—CABLE RETAINER FOR CURVE CONSTRUCTION

TELEPHONE LINE

After the line was finished, the railroad company installed a telephone line, which is carried on the same poles that support the power circuits, and connects the power house with all the sub-stations. It also has instruments connected to it and mounted in boxes at intervals of about 2000 ft., which are used by the men patrolling the line.

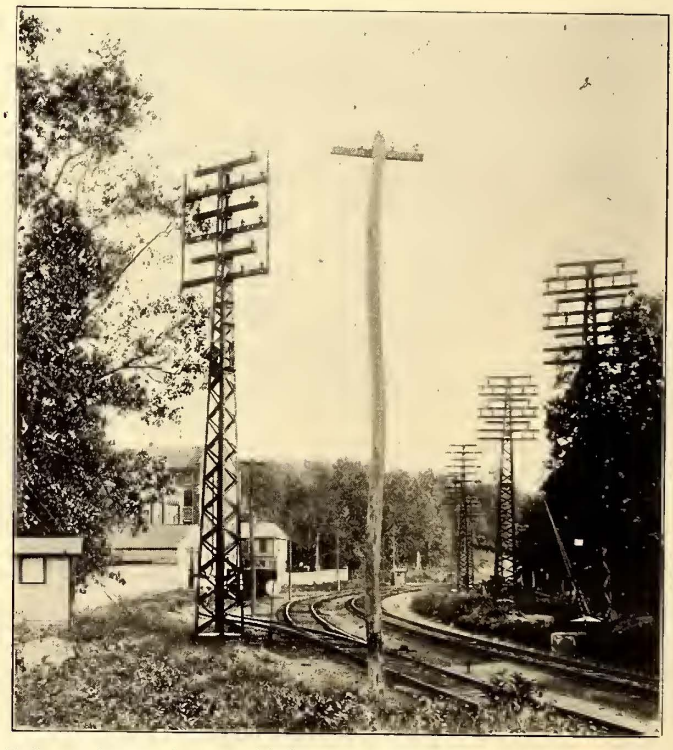


FIG. 20.—CABLE RETAINERS IN POSITION, TRUNK-LINE POLES OVER RAILROAD TRACKS

TERMINAL CABLE RACKS

At the Woodhaven and Rockaway Junction sub-stations, special terminal poles or racks are provided to distribute the overhead circuits along the face of the building parallel to the high-tension switching galleries in such a manner that the disposition of the cables after entering the building will be most convenient. The conditions to be met at such places were somewhat conflicting. The disposition of the circuits on the line poles is such as to enable those on one side of the pole to be shut down for repairs, while those on the other side are kept in operation, and it was desirable in leading the cables into the sub-station buildings to adhere as closely as possible to a disposition that would be consistent with this scheme.

The sub-station galleries were laid out for the most convenient subdivision of the high-tension bus into section for distributing power to the branch-feeder circuits, as above noted, so that it was necessary to lead certain circuits into particular openings in the side of the building without special regard as to whether that particular disposition was the most convenient for keeping the circuits clear and free from crosses outside of the building. An idea of the manner in which these conditions were met is best given by a photographic view, Fig. 21, being the terminal pole at Rockaway Junction.

The wires of the circuits, as they come from the trunk lines, are brought into the same plane, the upper circuits going to the top cross-arm, which is located at the rear or farthest end of the terminal pole. The next lower circuits are anchored directly in front of these, and so on, gradually working toward the front of the pole, and downwards from the top of the pole, as one circuit after another is added, thus obviating interference with working circuits when new ones are being erected. By an arrangement of jumpers, the outside circuits are led around without interfering with other circuits, and brought opposite their proper pigeon holes in the side of the sub-station structure. At Woodhaven Junction the trunk line reaches the station from the north, and the branch line running to Hammel leaves on the southern end of the same pole. The strains, therefore, balance each other to some extent.

At Rockaway Junction, the location of the sub-station is such that the entering circuits coming from the west had to be taken around to the east side of the building and distributed from the rack there situated. The entering circuits are kept on the west side of the cable rack next the building, while the outgoing circuits, which continue eastward, are kept on the east or outer side of the rack, thus preventing crosses and making it possible for either set of circuits to be repaired independently of the other set.

The terminal racks at both stations, consist, as shown in the photographic view, of steel truss bridges about 11 ft. wide, and practically as long as the side of the sub-station building, supported on lattice steel columns which are carried on concrete foundations. The wires are supported on standard insulators, which are carried on the regular type of cross-arms, sawed long enough to project over both sides of the truss, to which they are fastened by U-bolts, as they are on the standard poles. Where the cables are dead ended they are fastened to the strain type of insulator which is mounted in the manner before described. The adjacent poles on the trunk line are of the strain type, so as to relieve the terminal poles of longitudinal strains. Special cross-arms are provided where necessary to carry the jumpers that connect the dead-ended cables with the apparatus inside of the building, and they are led around in such a manner as to afford not less than 2 ft. of clear space between all wires and to minimize the risk to linemen when repairing circuits. Supports for plank runways are provided in the trusses to facilitate access for repairs.

At the larger lightning-arrester houses, the terminal-cable racks are integral with the building framework and project from the sides of the building, as shown in Fig. 5. The general arrangement of cross-arms and insulators is the same as above described; all circuits are carried with the cables in a horizontal plane, and the uppermost circuits run to the rear end of the rack, the jumpers being used to couple up to the interior apparatus.

In Fig. 8, of the lightning-arrester houses, at Broad Channel drawbridge, on the Jamaica Bay trestle, is shown the method of anchoring the longitudinal strain of the high-tension line. This anchorage consists of a tower-like structure of four creosoted poles, latticed and braced together with heavy timbers, the cables being dead ended on standard strain insulators in a horizontal plane, and jumpers being dropped down through the inside of the tower and across the lightning-arrester houses, through which they are connected to the sub-

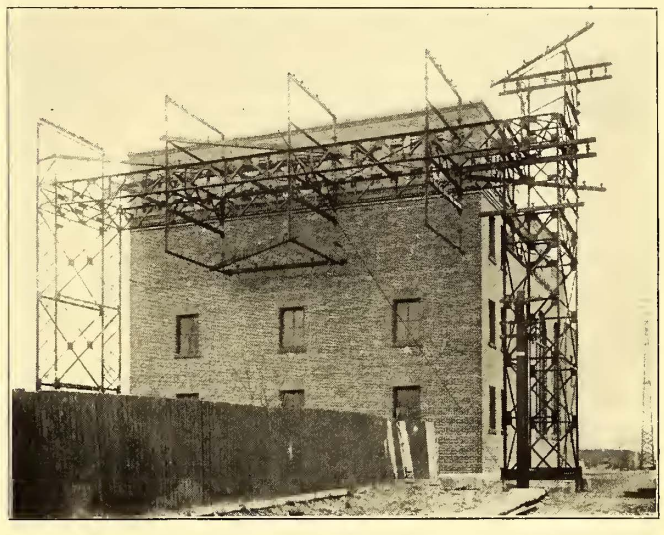


FIG. 21.—TERMINAL CABLE RACK AT ROCKAWAY JUNCTION

marine cables. This construction is strong, self-contained, and extremely simple, and enables side guying and end guying to be dispensed with.

TYPE OF THIRD-RAIL CONSTRUCTION

In the selection of the general type of third-rail construction adopted for the Long Island Railroad, the general requirements were that both the rail and the contact device must be suitable for collecting heavy currents at any speed. The rail must be so placed as to encroach as little as possible beyond the fixed clearances of the permanent way, and it must clear all forms of equipment in general use on the road. The design of mounting must be mechanically stable, and besides including good insulation, must provide a reasonable degree of protection to employees against accidental contact, and be proof against interruption of service by weather conditions.

It was also desired to settle upon a standard form and location of rail that would permit a free interchange of ordinary passenger and freight equipment between the Long Island Railroad and other roads in the vicinity.

A study of the equipment clearances pointed to the necessity of locating the third rail with its gage line 26 ins. from the inside of the gage line of the running rail, and its top at a height of 3½ ins. above the top of the track rail. After considering a great variety of designs, both of rails and contact shoes, it was decided to adopt the top contact type. In order best to combine the qualities affording protection to employees and immunity to weather troubles, it was decided to provide a horizontal type of guard extending directly over the rail, requiring the use of the slipper-type of contact shoe. With

this type of contact rail, a tee section was naturally adopted on account of its stability. The location of the contact rail, with reference to the track, was also governed by the fact that it could not be placed much farther away from the track rail without interfering with bridge gussets and other fixed objects, while, if placed higher, the guard would be interfered with by 50-ton hopper-bottom steel coal cars when heavily loaded.

RAIL

The rail used for most of the construction is a modified tee shape, weighing 100 lbs. to the yard, in 33-ft. lengths. The section is 4 ins. high, with a head 3 ins. wide, bottom flange 6 ins. wide, and web 1½ ins. thick. This particular shape was selected because of the limited vertical distance between contact and running rail required that the upper rail be of as low section as possible to provide maximum insulation distance to tie. In some cases, running rails were only 60-lbs. section, reducing the available distance from the top of the tie to the top of the third rail, to only 7½ ins. The section, therefore, is that of heavy rail squeezed out horizontally, with a broad base, adapted to prevent overturning. The section, together with the guard and the equipment clearances, is shown in Fig. 26.

The rail is of extra soft steel, as it will be seen by the following analysis:

Carbon	.08
Silicon	.074
Phosphorus	.074
Sulphur	.029
Manganese	.022

The resistance of the sample in the above analysis is by measurement of a 100-lb. section, equivalent to 1,650,000 circ. mils of copper.

All of the main-line tracks, including the elevated line, are provided with the 100-lb. third rail, excepting about 7½ miles, which are fitted with 70-lb. standard relaying T-rails. For side-tracking and unimportant spur work, 60-lb. relaying rails were used.

SPLICE BARS

Splice bars are of rolled steel, 18 ins. long, with four holes carrying bolts ¾ ins. x ¾ ins. They were rolled especially for the third-rail section adopted, and, as they are not subjected to unusual strains, they were made of the minimum weight suitable for a third-rail fastening. The unusual breadth of the base of the rail allows ample space between the splice-bar and the edge of the flange, to accommodate the head of the compressed type of rail bond. On the 70-lb. and 60-lb. rails such was not the case, and the splice-bars were notched out to accommodate the bonds.

INSULATORS

The contact rail is supported every 10 ft. on vitrified-clay insulators, set on extra long ties. The insulator consists of a cylindrical piece of vitrified clay, with a beveled flange projecting at the base and 2-in. hole through the center to aid in manufacture. A malleable-iron ring, having two projecting lugs and holes in each lug for lag screws, fits over the flange at the base of the insulator, two lag screws being used to fasten it to the tie. Resting on top of the insulator is a malleable-iron cap, which projects down over it for a distance of 1⅛ in., and has two ears 1¼ ins. long projecting upwards. The rail rests on top of the cap between the ears. With this type of insulator, no vertical strain comes upon it, due to the sagging of the tie when a train passes, as the rail is in no way directly attached to it. The design also facilitates the removal of broken insulators, as the whole device may be removed by taking out two lag screws in the base. As there are four different sizes of running rails and three sizes of third rails, the dimensions of the insulators are made in three sizes to suit the conditions. Two of them are 6 ins. in diameter, and 3⅞ ins. and 5 3-16 ins. high, respectively, the other being 4½ ins. in diameter and 3⅝ ins. high, but of the same general form. In this way, the proper height of third rail above the running rail is maintained.

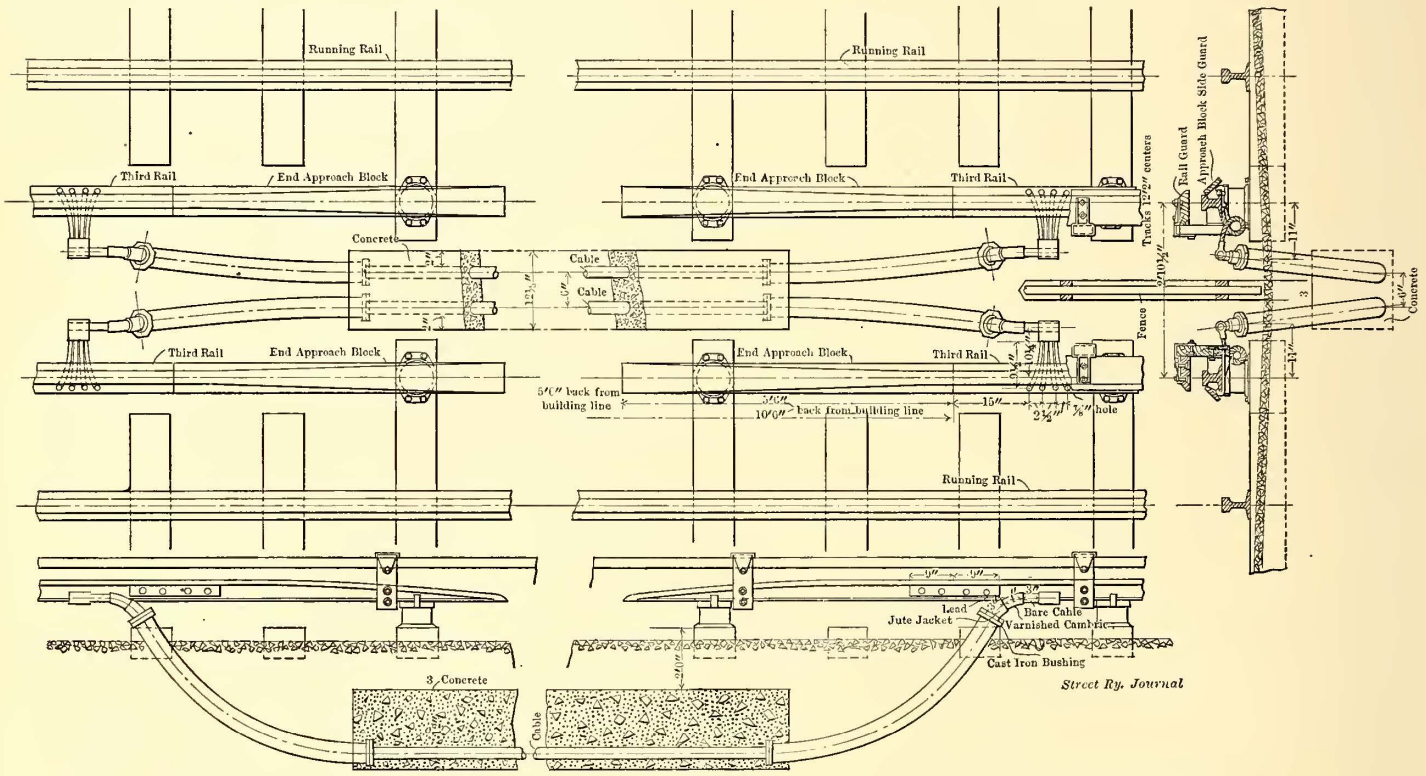


FIG. 22.—STANDARD ARRANGEMENT OF THIRD-RAIL CONNECTING CABLES AT PUBLIC CROSSINGS

APPROACH BLOCKS

The end approach blocks and inclines for lifting the third-rail shoes, are of cast iron. Two lengths are used. One is

5½ ft. long, and is employed on the main-line tracks, where the shoes must be raised and lowered at high speed. The other, which is 2½ ft. in length, is used only on spur track and sidings. The approach blocks are attached to the end of the rails by the regular splice plates, and are supported on standard third-rail insulators at their outer ends. The general design and arrangement of the approach blocks in position is shown in Fig. 22. The side approach blocks used at switches are of wood, and were chosen in preference to metal blocks because the blocks must project several inches sidewise from the third rail beyond the guard, exposing trackmen to danger if made of metal. The wooden block consists of a piece of maple, 1¼ ins. thick and 4 ins. wide, set at an angle of about 45 degs. on the side of the rail, as shown in Fig. 23. This strip of wood is about 14 ft. long, and is nailed to maple blocks which are set against the web of the rail, spaced at intervals of 2 ft. A 3-16-in. x 1-in. steel strap, which fits into the block, holds it securely in place, being fastened underneath the foot of the rail, and clinched over it, thereby avoiding drilled holes and unnecessary expense. Although subjected to severe service, the durability of these wooden side approach blocks has been satisfactorily demonstrated.

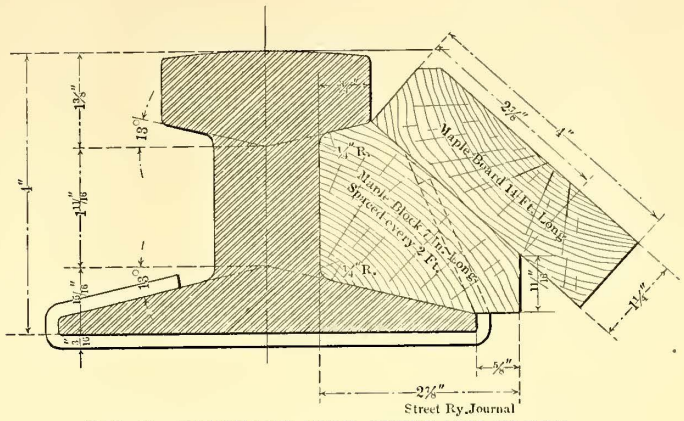


FIG. 23.—STANDARD SIDE APPROACH BLOCK

BONDS

The third-rail joints are bonded by laminated-copper foot bonds with plug terminals. They are of varying sizes, according to the weight of the rail to which they are applied, 300,000, 350,000 and 400,000 circ. mils sizes being employed. The holes for the plug terminals were punched in the base of the rail by hydraulic punches and the terminals riveted into the holes by hydraulic compressors. The terminals of the two larger sizes are ⅞ in. in diameter, and for the 300,000-circ. mil bonds they are 13-16 in. The terminals of the 300,000-circ. mil bonds and the 350,000-circ. mil bonds are 5 ins. apart when installed. The 400,000-circ. mil bonds are 10 ins. long between centers of terminals when installed. Fig. 24 is a drawing of the standard method of bonding a 100-lb. third-rail joint. All the work of punching and bonding was done after the rails were in place.

CABLE-JUMPER CONSTRUCTION

As at present installed, the third-rail system is not fed in separate sections from the sub-stations, but is treated as a continuous conductor between sub-stations, except where the

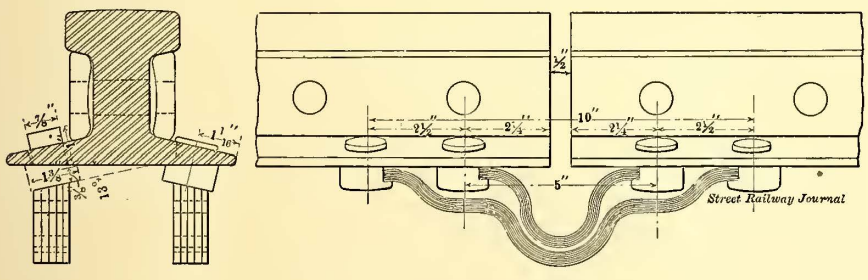


FIG. 24.—THIRD-RAIL BONDS

number of switches and cross-covers incidental to a station terminal or junction necessitates dividing it into sections that can be easily isolated from the remainder of the third rail should emergency require. There are no low-tension cables running along the tracks to reinforce the third rail at points distant from the sub-stations. To maintain the electrical continuity of the third rail where interrupted at switches and highway crossings, underground jumper cables are provided.

These cables are in three sizes, 500,000 circ. mils, 1,000,000 circ. mils, and 2,000,000 circ. mils. The cable is insulated with varnished cambric, 4-32 in. thick, which is covered with a lead sheath ⅛ in. thick for the 1,000,000 circ. mil and 2,000,000 circ. mil, and 3-32 in. for the 500,000-circ. mil cable. Outside of the lead there is a layer of prepared paper, and two layers of jute, wound on spirally in opposite directions and thoroughly impregnated with asphalt. This unusual precaution is taken to protect the lead from acids and alkalies in the soil, and from possible electrolytic action of return currents in the ground. The cable was subjected to a 3500-volt factory test. It is buried not less than 2 ft. below the surface of the ground, and, except where run under public highway crossings, a 2-in. plank laid on top of it constitutes its only protection. At highway crossings, however, a concrete matrix about a foot thick is substituted for the plank, in order to insure protection against injury in case the streets are opened by gas or water pipe workmen. Fig. 22 shows the standard arrangement of running and connecting up the jumper cables at public crossings. The ends of the cables come to the surface through curved 3½-in. iron pipes, fitted with regular conduit bushings, and extending about 6 ins. above the surface of the ground. The ends of the conductors are connected to the third rail by having sweated upon them special brass terminal lugs, each lug having sockets for four 400,000-circ. mil flexible cables. Short lengths of cable bonds, each with a copper plug terminal drop forged on one end, are soldered into the socket, and after pigtailing these terminals to provide flexibility, the plug terminals are compressed into holes in the base of the rail. The number of bonds used in each case varies with the size of the cable, being four for the 2,000,000-circ. mil cable, two for the 1,000,000-circ. mil cable, and one for the 500,000-circ. mil cable, in which case the bond is soldered by means of an ordinary sleeve connection to the cable.

Being very close to the ground level, and always exposed to the weather, these cable terminals are insulated with especial care. The lead and jute coverings are cut back for a distance of 7 ins. from the point where the cable enters the lug, and the insulation is cut back so as to leave 3 ins. of bare cable exposed. This space, as well as the 4 ins. of exposed insulation, is then wound with varnished cambric tape, applied with Sterling varnish between the layers. It is then coated with insulating paint and wound all over with adhesive tape, including the whole surface of the lug, thus leaving only the bond connections bare, and it then receives a final coat of insulating paint. The ends of the iron pipe are plugged with oakum around the cable, to prevent dirt from entering and to prevent movement of the cable in the pipe.

Wherever these third-rail jumpers are used to preserve the continuity of the regular third-rail system, they are made of

sufficient size to carry as much current as the rail. For the 100-lb. special rail, which is equivalent to 1,650,000-circ. mil copper, 2,000,000-circ. mil cable is used, the additional area being allowed to compensate for the decreased radiating capacity of the cables. For the 60-lb. and 70-lb. third rails, 1,000,000-circ. mil cables were used under same conditions. For the sidings short lengths of third rail, which only have to supply heavy currents momentarily, the size of the cable generally used is 500,000 circ. mil.

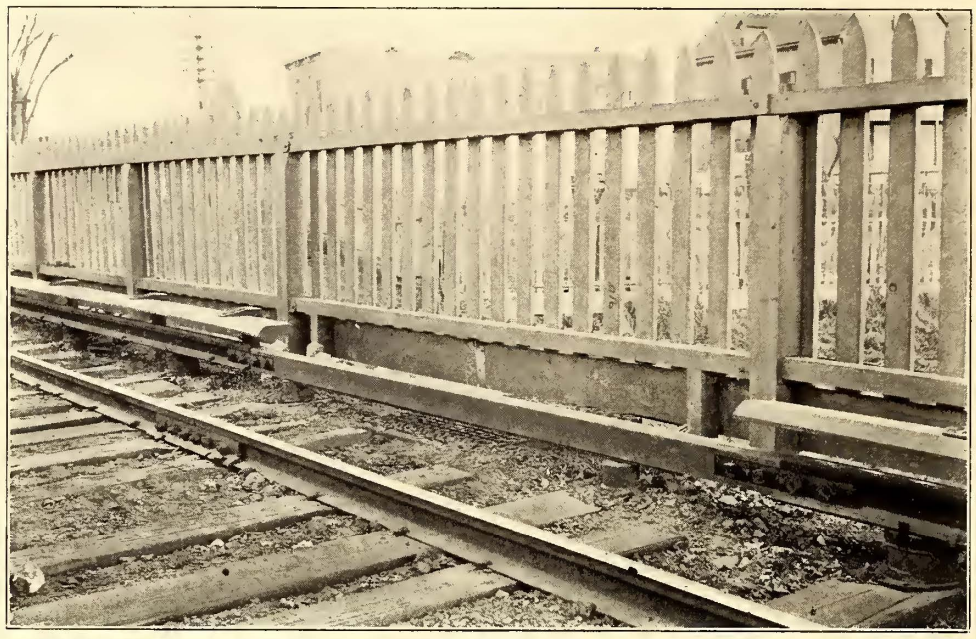


FIG. 25.—10-FT. BREAK IN THIRD RAIL OVER MANHOLE COVERS ON ATLANTIC AVENUE

For a portion of the distance on Atlantic Avenue, the manholes of the conduit system are directly beneath the third rail, the right of way being extremely narrow. To allow access to these manholes, the third rail is interrupted on either side of the manhole, and a removable wooden dummy rail inserted, consisting of a strip of oak 10 ft. long and 3 ins. x 4 ins. in cross section, as shown in Fig. 25. The third rail is made continuous by means of a cable jumper, similar to that described above.

THIRD-RAIL GUARD

The Stillwell-Slater type of guard was adopted for the third rail. It consists of yellow-pine plank, 1⅞ ins. thick, 7 ins. wide, placed above the rail, with 2½-in. clear space between the top of the rail and under side of the plank. The edge of the plank nearest the track extends ⅞ in. beyond the line of the third-rail head, and is beveled back to give the necessary clearance for running equipment. Each plank has a saw cut, ⅜ in. deep, in the middle of the underside to prevent warping. The planks vary in length from 14 ft. to 16 ft. The guard is supported directly from the third rail, there being four supports to each plank. The planks are butted together without splicing, so as not to interfere with the free expansion and contraction of the rail and to facilitate repairs. Fig. 26 shows the guard in complete detail. The supports consist of upright posts of oak and chestnut, 1⅞ ins. x 3⅞ ins. x 11 ins. long, carrying on top a malleable-iron cap, which fits down over the top of the post and is held to it by a carriage bolt. This cap has a projecting bracket against the under side of which the guard plank is fastened by two carriage bolts, with heads countersunk on the underside of the plank.

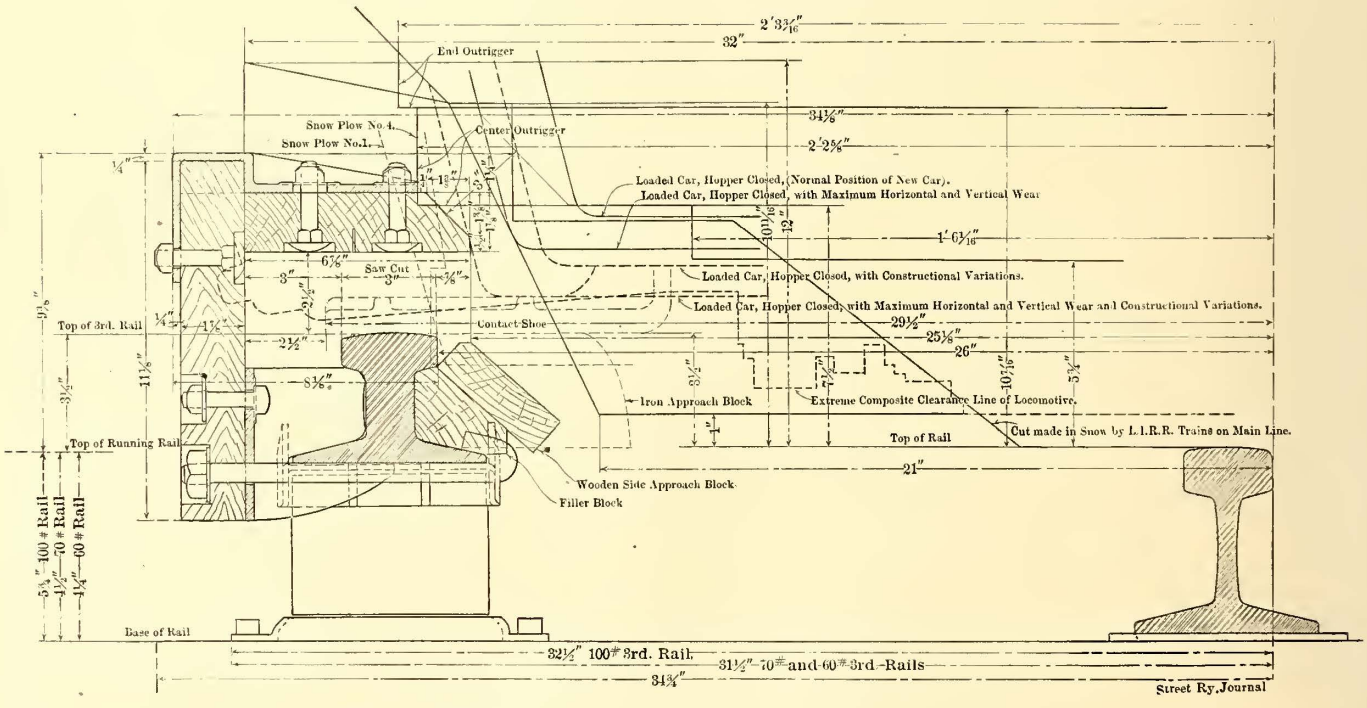


FIG. 26.—THIRD-RAIL GUARD AND CAR-CLEARANCE DIAGRAM

One of the bolt holes in the iron cap is slotted transversely, so that the plank may not split by shrinkage. The wooden post is carried on a malleable-iron casting, which fits closely against the web and around the bottom flange of the third rail, so that a single hook bolt, engaging with the bottom flange of the rail, firmly clamps the guard post.

Fig. 27 is an excellent view of the standard third rail and guard construction as it appears on top of the elevated structure on Atlantic Avenue.

Additional protection is provided for the third rail at stations. This additional protection consists of a yellow-pine strip, 4 ins. wide and 1¼ ins. thick, set on the outer side of the rail at an angle of about 45 degs. with the rail, and almost completely covering tne side of it. This strip is nailed to wooden blocks, fastened to the web of the rail in a manner similar to that used on the side approach blocks. Where necessary, this side guard is placed on both sides of the third rail, thus reducing the chance of workmen coming in contact with them. At station platforms protection is also provided against car shoes, whether there is a third rail close to the edge of the platform or not. This protection consists of a 2-ins. x 7-ft. yellow-pine plank supported by malleable-iron castings, the top being nearly on a level with the platform. These castings rest on the ties, and are spaced 6 ft. apart. This guard is so located that there is plenty of room underneath for the third-rail shoes. The arrangement at a platform where there is no third rail is shown in Fig. 28.

All the timber guards are painted with two coats of a good quality of weatherproof paint.

Experience, up to the present time, leads to the belief that the guard will prevent most of the troubles that commonly arise from sleet.

Fig. 29 is a photographic view of this same type of guard placed adjacent to grade crossings, together with the fences, cattle guards and gates usually employed by the railroad.

DRAWBRIDGE CONNECTIONS

At the drawbridges in the Jamaica Bay trestle, the third rail

FIG. 27.—STANDARD THIRD-RAIL CONSTRUCTION ON ATLANTIC AVENUE ELEVATED STRUCTURE

is interrupted, and to maintain this continuity three submarine cables are installed, one for each third rail, and one as a spare. These cables consist of 2,000,000-circ. mil copper core, insulated with 4-32 in. of 30 per cent Para rubber, incased in a lead sheath, ⅛ in. thick, and armored with one layer of No. 4 B. & S. galvanized steel wires, laid on spirally with a layer of jute covering. These cables were laid in the same manner as the high-tension power transmission cables, which have already been described. The short length of third rail on the drawbridge is connected by brass contact shoes, which make connections at each end of the draw when it is closed.

SYSTEM OF THIRD-RAIL CONNECTIONS

The cables connecting the third rail with the sub-stations

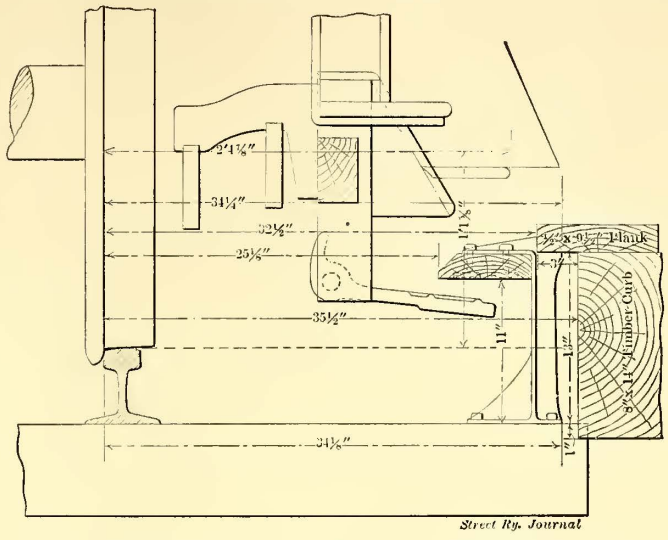


FIG. 28.—PROTECTION AT STATIONS FOR THIRD RAIL AND SHOES

are all of 2,000,000 circ. mils, and connections are made directly in front of the sub-stations. In some cases these short feeders are located in conduit, and in other cases laid directly in the ground in the manner above described for the crossing jumpers. Such cables when laid in ducts are insulated with 5-32 in. of paper, covered with a layer of sheathing, ⅛ in thick.

Near each sub-station, the third rail is interrupted by a 40-ft. gap. Should any section break down, it is then impossible for a single car to bridge the gap between the live rail and the grounded one, thus avoiding the possibility of injury to the car wiring and equipment. The east-bound and west-bound tracks are, in most cases, supplied by a separate set of feeders, and are not cross connected, except through the station bus-bars. Current can, therefore, be cut off from the section of either track lying between two sub-stations simply by opening the proper feeder switches in the stations at each end of the section.

In order that part of a section between sub-stations may be disconnected in case of emergency, instead of requiring the whole section to be thrown out of service, 1600-amp. disconnecting switches are installed at suitable intervals between sub-stations, and are cut into the third-rail circuit so that, by opening any two of them, the section between them can be cut out, though normally these switches are kept closed. They are generally located near the cross-overs, to enable trains to switch around the opened section on the other track. The switches are of the quick-break knife-blade type, and are located in wooden boxes fastened to the third-rail guard, as shown in Figs. 30 and 31.

In some instances fuses alone are installed. A view of the

4-ft. break in the third rail at a switch or fuse is given in Fig. 32.

Practically all the line is double tracked, excepting two stretches, which are four tracked, one on Atlantic Avenue, between Chestnut Street and Woodhaven Junction, and the other running south from Woodhaven Junction as far as the north end of the trestle. The third rails on the former of these two sections are supplied by separate feeders from Woodhaven Junction, and it is not cross-connected with the main-line tracks. South of Woodhaven, however, the third rails of the four tracks are cross-connected. Each of the four third rails has a separate feeder leading into Woodhaven Junction sub-station, but at the other end, near the trestle, the two east-bound tracks are connected together through a knife switch and a 2000-amp. circuit breaker, located in the switch house at one side of the track. The two west-bound tracks are similarly connected, so that in ordinary conditions they work in multiple. In case of a short-circuit, however, the circuit breaker will open, separating the tracks at that end, and this separation can be completed by throwing the switches in the sub-station.

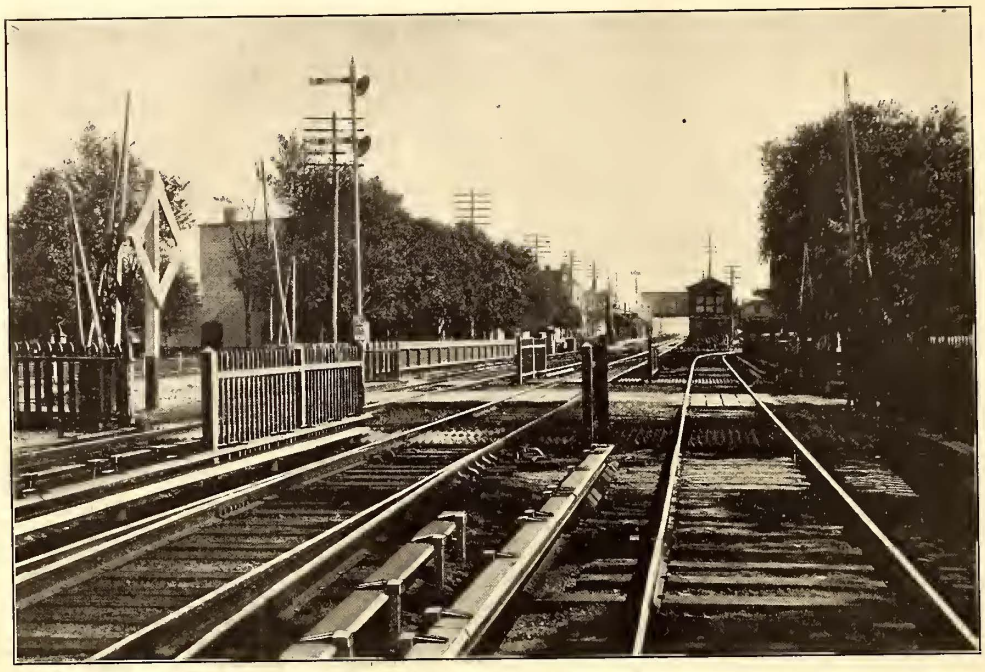


FIG. 29.—THIRD-RAIL CONSTRUCTION, FENCES, GATES AND CATTLE-GUARDS AT GRADE CROSSINGS, ATLANTIC DIVISION

The only place where the east-bound and west-bound tracks are connected together occurs at the entrance to the yards, at the Rockaway Park terminal, at Jamaica Station, and at the north end of Jamaica Bay trestle. At these points, the two tracks are tied together by a 2000-amp. switch, and circuit breaker, mounted under shelter conveniently located, by means of which they can be separated when necessary. This point being at the extreme end of a short section, no embarrassment can result to other sections of the line from this cross connection of the two tracks.

There are several very important places on the line where the arrangement of interlocking switches is such as to require special provision for cutting the third rail into sections. Woodhaven, Ozone Park, Jamaica and Hammel are points where the arrangement of intersecting and side tracks is such as to require this special treatment. Figs. 33 and 34 show the arrangement of the third-rail circuits at a rather complicated

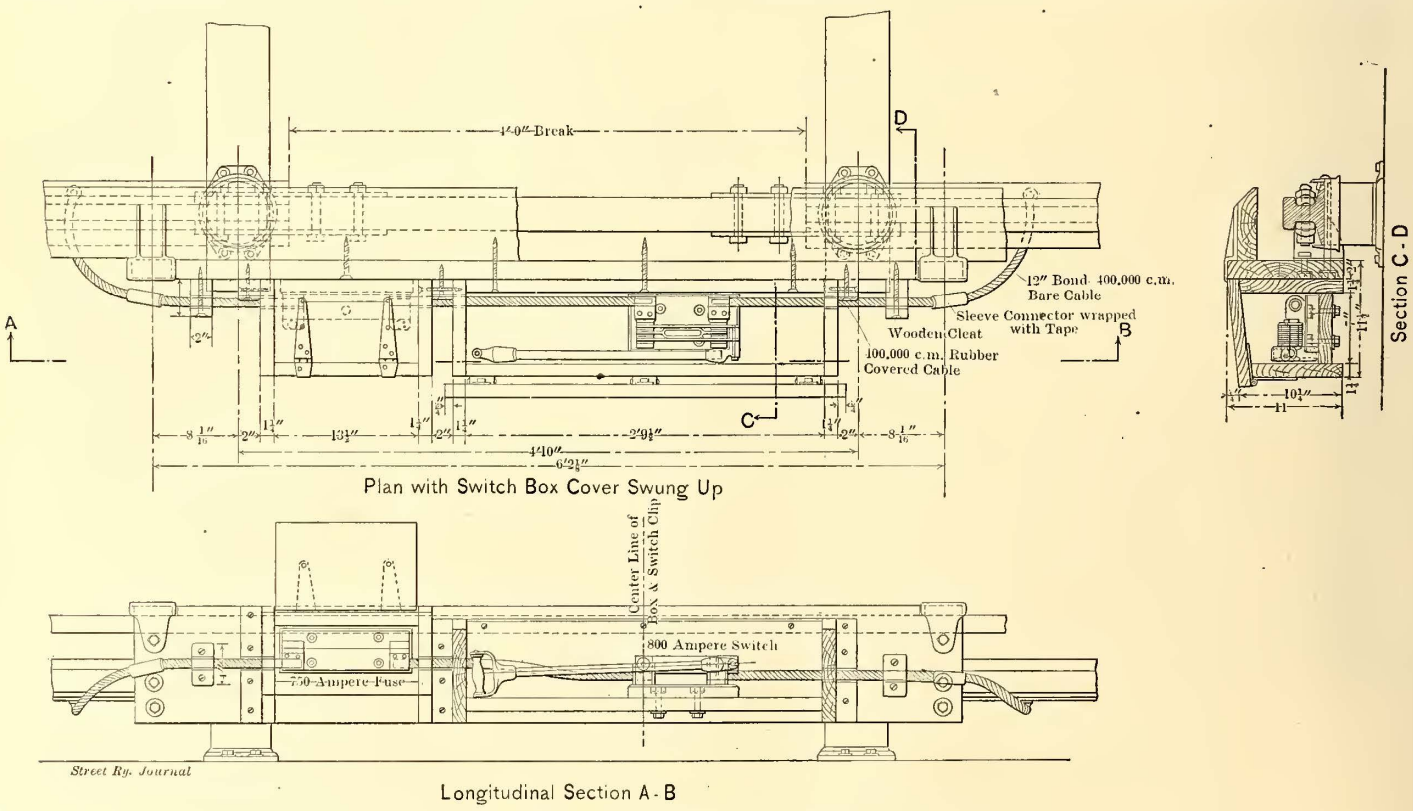


FIG. 30.—THIRD RAIL DISCONNECTING SWITCH AND FUSE

interlocking point, just east of Jamaica station. It will be noted that the main third-rail circuits are carried around this section by separated cables, which run through a small switch house standing beside the tracks, in which are located the switch and fuse board. As will be seen, by referring to the diagram, the main cables, which are of 2,000,000 circ. mils, are continuous, and feed the various disconnected sections of third rail lying within this section through two disconnecting switches of 1600-amps. capacity, from one of which branch out four separate cable connections, and from the other one eleven separate cable connections, to the smaller subdivisions of third rail lying within the section. These short sections of third rail are each fed by a 500,000-circ. mil

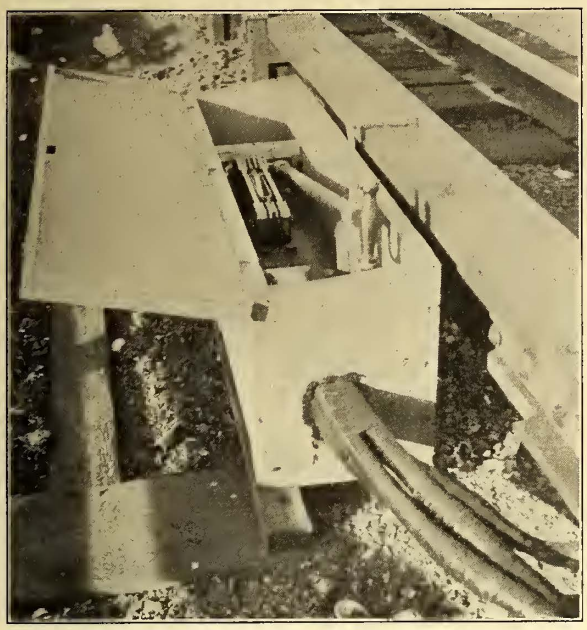


FIG. 31.—SWITCH IN BOX BEHIND THIRD RAIL

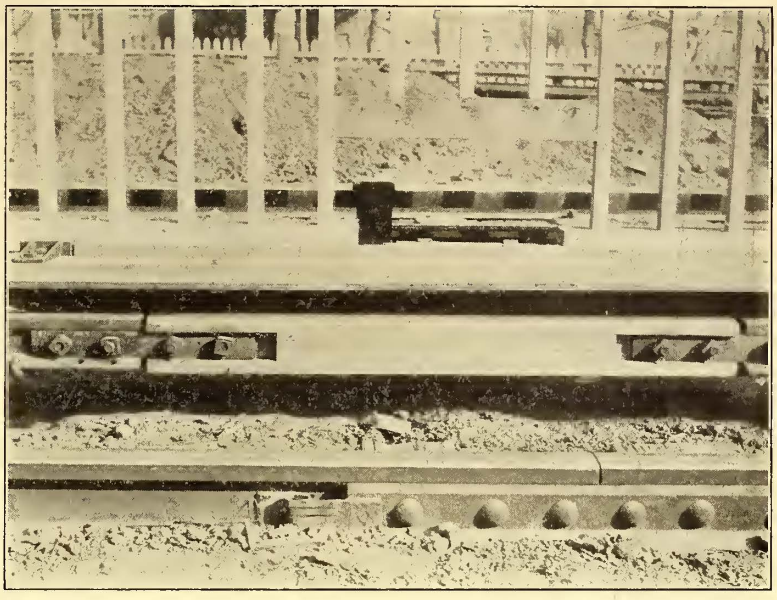


FIG. 32.—DUMMY RAIL IN 4-FT. BREAK AT FUSES AND SWITCHES IN THIRD RAIL

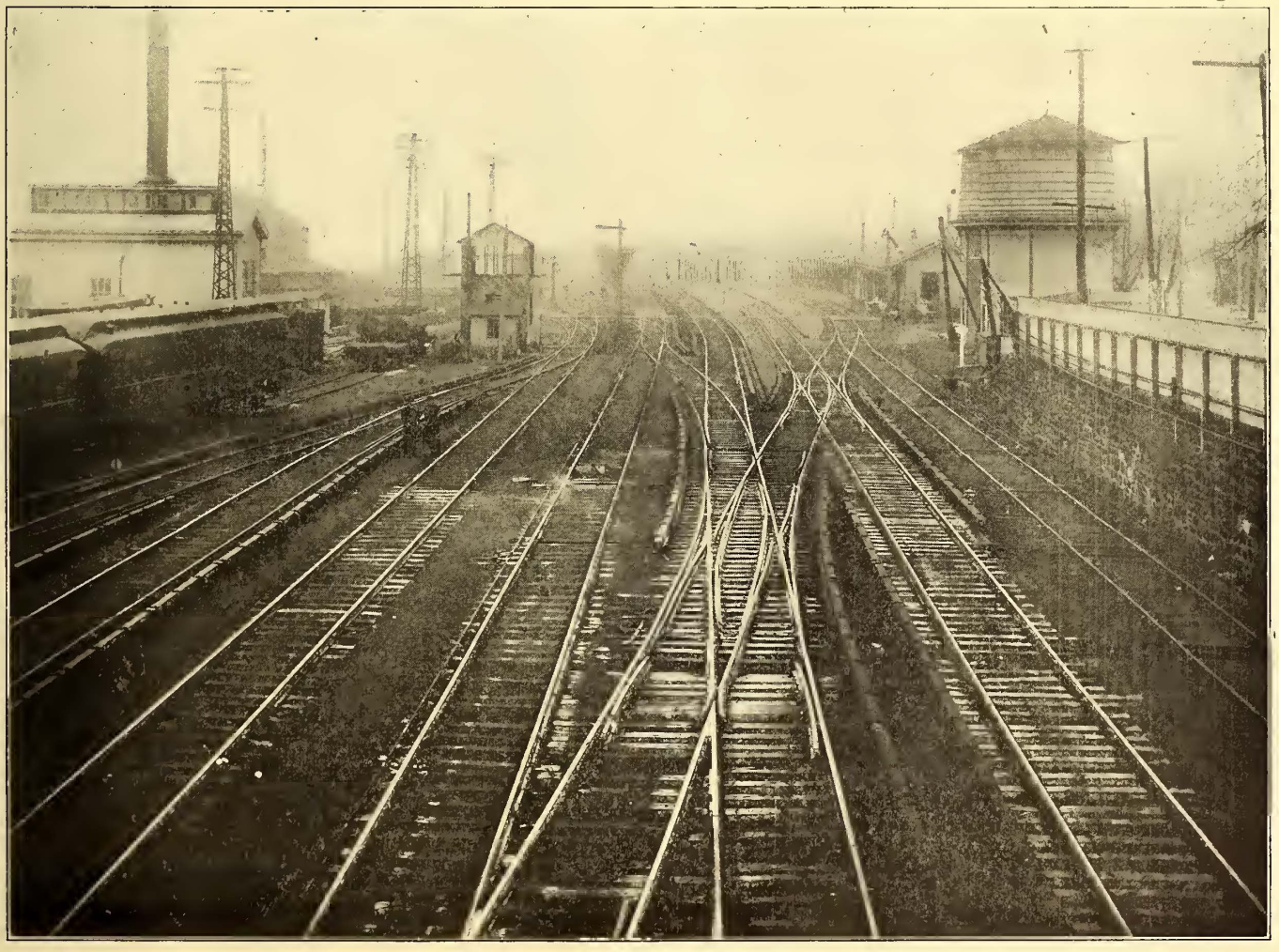


FIG. 34.—VIEW OF MAIN LINE AND SIDINGS, EQUIPPED WITH THIRD RAIL, EAST OF JAMAICA STATION

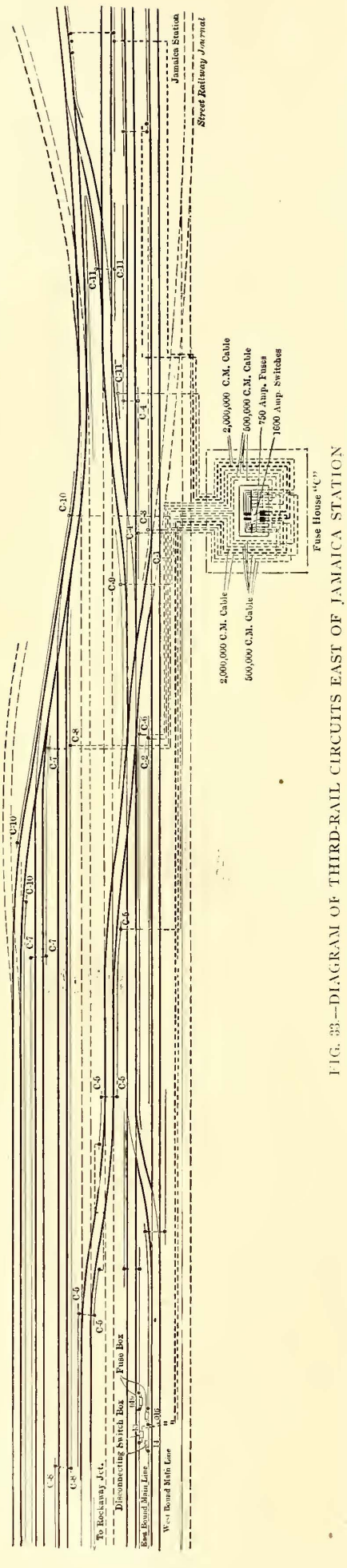


FIG. 33.—DIAGRAM OF THIRD-RAIL CIRCUITS EAST OF JAMAICA STATION

cable of the type described above. Fuses, through which they are attached to the main switch terminals, are of 750 amps. capacity, and consist of copper ribbon of the open-air type with a 10-in. break. Fig. 35 is a view of the interior of such a switch house, showing its equipment.

At points distant from the above-mentioned interlocking stations, the third rails on such tracks are fed through copper fuses and quick-break-knife switches, placed so that a fuse may be safely replaced. These are similar in type to the fuses in the interlocking stations, and are installed in wooden boxes fastened to the third-rail guard.

RETURN CIRCUIT

Both running rails of each track are used for the return circuit. On a considerable portion of the line an automatic block signal system is used, requiring the use of both running rails for its operation, so that a special method had to be used in order to allow the tracks to be used jointly as a power return circuit and for signal purposes. The signal system was developed by the Union Switch & Signal Company, and employs alternating current for the operation of the signals. With the aid of a special arrangement of bonding, to be described hereafter, the track is used for carrying both direct current and alternating current without the former affecting the latter.

About 20 miles of track on Atlantic Avenue are laid with 100-lb. T-rails. The remaining portion of the electrified system is laid with various weights of rail, running from 60 lbs. per yard to 80 lbs. per yard.

The problem of bonding the rail joints was solved by different methods on different portions of the line, depending largely upon the local conditions. The rails had been practically all laid when the work of equipment began, and the type of joint plate then in position had much to do with the various types of bonds employed.

It was found impossible to install bonds of sufficient size beneath the splice bars already in use. Foot bonds could not be used on the elevated portions of the Atlantic Avenue Improvement, because this track had supported joints, and where the tracks were laid on the surface, they could not be used, because the leakage through them would unfavorably affect the operation of the signal system. Over a portion of

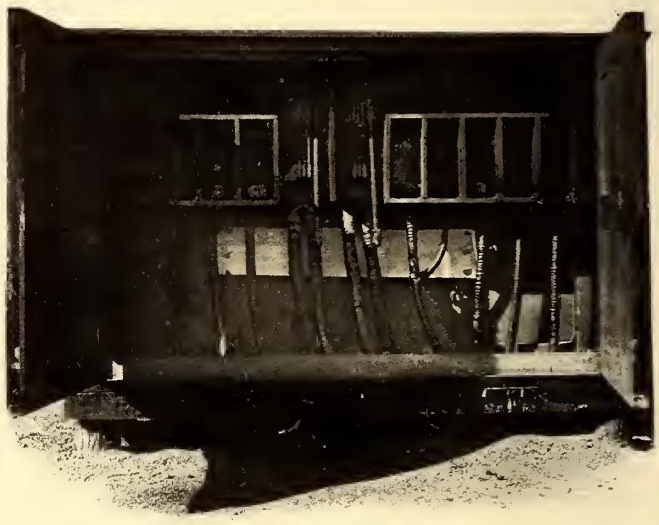


FIG. 35.—SWITCH AND FUSE HOUSE, CONTROLLING THIRD-RAIL SECTIONS IN YARD EAST OF JAMAICA

the line, which has no automatic block-signal system, however, soldered foot bonds, placed underneath the rail joints, were used.

A good deal of the bonding was done with laminated bonds of the soldered type, attached to the ends of each splice bar, requiring four bonds per joint. The bonds have a cross section of 486,000 circ. mils and are ¼ in. thick and 2 ins. wide, composed of successive layers of copper ribbon. In the tunnel sections cable bonds, 45 ins. long, spanning the splice bar, and with terminals compressed into the rail webs, were used. These are of 350,000-circ. mil cross section, and three are installed per joint, as the rail is of 100-lb. section. On the elevated portion of the line, and on Jamaica Bay trestle, the guard rails, which are 56 lbs. per yard, are bonded together and used as a part of the return circuit. The bonds used for these rails are also of the soldered type, built up of copper ribbon and fastened to the side of the rail head. They have a cross section of 560,000 circ. mils per joint.

The rail bonding was a difficult piece of work to execute, as much of the track was in constant use and the work had to be done during a severe winter, under the worst conditions. The spots where the bonds were applied on the rails and splice bars were cleaned by means of sand blasts operated by air compressors, driven by steam or oil engines. After a little practice, it was found that the soldered type of joint could, with the exercise of proper care, be made efficient and durable, but the vibration of the splice bars under

heavy traffic subjected them to unusual punishment, and on new work, where it was possible to control the cross section of the splice bars, they were especially designed to accommodate the protected type of bond between the running rail and the splice bars, and this type of bond was used.

Where the automatic block-signal system is used it is not possible to cross-bond the running rails, on account of the disturbance in the signal system which would thereby be occasioned. On other portions of the line two 350,000-circ. mil bonds of the plug terminal type were installed between the rails of the same track and between adjoining tracks at intervals of about 1500 ft. A special arrangement was devised for cross-bonding a portion of the line where the automatic block signal system is used. The cross connections only occur at the end of the signal blocks where the special inductive bonds are cut into each track rail. These inductive bonds serve to keep out signal current, but for the direct current act exactly the same as the ordinary bond, and maintain the continuity of the running rail. The cross-connections between the tracks are made at these points, the inductive bonds being used in both tracks, so that the signal system is not affected by the flow of current between them.

At the two drawbridges in the Jamaica Bay trestle the continuity of the return circuit is maintained by four 2,000,000-circ. mil, rubber-covered, armored cables at each crossing, similar to those used for the third-rail circuit, and connected up to the rails in like manner.

The feeder connections between the track rail and the negative bus-bar connections in the sub-stations are 2,000,000-circ. mil, bare tinned copper cable. In some cases these cables are buried directly in the ground without protection, while at others, they run in vitrified clay ducts.

CONCLUSION

The completed overhead line was first put in service on April 27, 1905, and the third rail was first put in service about May 13, 1905. Regular operation began July 26, 1905. The operation of the transmission line and the third rail have been remarkably free from interruption of whatever nature, and have demonstrated their efficiency as a substantial and reliable transmission system for a suburban railroad on whose regularity of operation thousands of people are daily dependent.

The design and construction of the foregoing transmission system was carried out by Westinghouse, Church, Kerr & Company, engineers for the Long Island Railroad Company, and the entire work was under the direction of George Gibbs, chief engineer of electric traction of the Long Island Railroad, subject to the approval of an electrical committee, consisting of the chief operating officials of the road, with the president as chairman.

RECOMMENDATIONS FOR NEW YORK SUBWAY CARS MADE BY CHIEF ENGINEER RICE

As a result of the collision and fire in the New York Subway on June 1, mentioned in the last issue of this paper, George S. Rice, chief engineer of the Rapid Transit Commission, has made the following recommendations to the board.

1. No parts of cars used in subway service should be constructed of inflammable material.

2. An adequate fire-line service should be installed throughout the whole subway, so that water could be had at interior points.

3. Means should be provided for quickly removing the smoke from the subway in such emergencies.

BLOOMINGTON, PONTIAC & JOLIET SINGLE-PHASE LINE

BY JOHN R. HEWETT

In the STREET RAILWAY JOURNAL for May 6, 1905, an account was published of the Bloomington, Pontiac & Joliet single-phase line, and it will be remembered that at that date the line extended from Pontiac to Odell, a distance of 10.4 miles. The line has now been extended, and is at present in operation to Dwight, making a total of nineteen miles in service.

By reference to the illustrations in the former article, it will be noticed that a double trolley was originally used, two parallel wires being spaced a distance of 10 ins. Cars running in one direction used the one, and those going in the reverse direction the other. Both were used as feeders. This

FIG. 1.—OVERHEAD CONSTRUCTION ON STRAIGHT TRACK

type of construction is only now used within the city limits of Pontiac. One of the trolleys having been moved further along the arm, serves as a feeder only. Fig. 1 illustrates the present form of overhead construction. The feeder, messenger cable and trolley are tied together at intervals of approximately a mile, a piece of No. 00 trolley wire being used for this purpose. There are no sub-stations on the line and no apparent drop of voltage is noticeable at the Dwight end of the line, which is remote from the power-house.

The trolley voltage is 3300 and no trouble has been experienced with operating at this pressure. In fact the results have been so satisfactory that there is every likelihood of this pressure being doubled in the near future. Fig. 2 shows the overhead construction at a single-track curve near Dwight, and Fig. 3 the span construction where the line enters Dwight.

By the courtesy of Mr. Corothers and Mr. Lucas, respectively the president and general manager of the line, the writer has been given every opportunity for going into the maintenance and operating expenses for the first nine and one-half months, from March 15 to Dec. 31, 1905, inclusive.

Table I. gives the details of maintenance expenses.

TABLE I.

Maintenance		Per car-mile in cents
1 Track and roadway	$152.76	.31
2 Electric line	43.32	.09
5 Electric plant (power plant)	.50	.001
6 Cars	95.31	.195
7 Electric equipment of cars	341.83	.7
9 Miscellaneous shop expense	8.00	.016
Total maintenance	$642.72	1.312

The figures for maintenance are undoubtedly satisfactory when taking the local conditions into consideration. The track needed a considerable amount of ballasting after the line was opened for traffic, and no doubt this figure (.31 per car mile) would have been higher, but for the fact that the company owned a large shale pile just outside Pontiac on its own right of way. A large amount of the ballast was hauled on flat cars drawn by the passenger cars when running on ordinary schedules.

As all the power is purchased from the Pontiac Power & Light Company, the maintenance of power plant may, for all practical purposes, be considered as not entering into these accounts.

The most interesting item of all is that for maintenance of the electrical equipment of cars. During the earlier months covered by this period of operation, the cars were equipped with GE A-604 single-phase motors, which were lent by the General Electric Company until the present GE A-605 equipments were shipped from Schenectady. The figures given above include everything, with the exception of changing the equipments. Of interest is the fact that not a single armature or field coil has been burned out on either equipment, not only during the period under consideration, but also from the time that the road was started up to the present date, which is considerably over a year's operation. The commutation of these motors has proved most satisfactory, the car Dwight having run for over 25,000 miles without any work having been expended on the commutator. It is further of interest to note that the brushes are giving no trouble, as some apprehension was felt on this score with the a. c. motor. The life of a brush varies from 10,000 to 12,000 miles, and is usually nearer the latter figure. The only trouble experienced with the present equipments has been some slight and easily remedied trouble with the brush holder studs. This figure, 7 cents per car mile, for maintenance of electrical equipment of cars, would have been lower had better facilities been provided in the car house; and further it should be noted that the bill for fuses, etc., may always be expected to be heavier when starting up a new road with motormen unaccustomed to their work. The life of a trolley wheel is about 3000 miles.

FIG. 2.—OVERHEAD CONSTRUCTION AT A CURVE

FIG. 3.—SPAN CONSTRUCTION WHERE BLOOMINGTON & PONTIAC LINE ENTERS DWIGHT

Table II. gives the charges against transportation.

TABLE II.

Transportation		Per car-mile in cents
11 For power	$2,751.56	5.625
17 Wages of conductors and motormen	1,825.70	3.73
19 Wages or other car service employees	315.21	.645
20 Wages of car house employees	65.26	.135
21 Car service supplies	325.60	.67
22 Miscellaneous car service expense	341.54	.705
22a Bus transfers	375.00	.775
Total	$5,999.89	12.285

The last item on Table II. refers to the expense incurred in providing for free busses from Pontiac to the city limits before the right of way across the steam line track was secured in the law courts, enabling the cars to run into Pontiac itself.

Table III. gives the miscellaneous expenses in detail.

TABLE III.

Miscellaneous		Per car-mile in cents
23 Storeroom	$19.25	.039
26 Salaries of clerks	442.50	.905
27 Printing and stationery	179.45	.366
28 Miscellaneous office expenses	117.92	.24
30 Stable expenses	10.50	.021
31 Advertising and attractions	109.27	.224
32 Miscellaneous general expenses	66.28	.135
33 Damages	12.30	.025
38 Insurance	190.96	.39
Total	$1,148.43	2.345

Table IV. is a resume of the three previous tables.

TABLE IV.

	Cents
Maintenance per car-mile	1.312
Transportation per car-mile	12.285
Miscellaneous expenses per car-mile	2.345
Total cost of operation per car-mile	15.94

Table V. gives further particulars of operation.

TABLE V.

Average mileage per car per day	167.2
Average watt-hours per car-mile	2100.
Average watt-hours per ton-mile	65.6
Earnings per car-mile (cents)	23.1
Operating ratio	68.8
Weight of cars each (tons)	32
Schedule speed (m. p. h.)	21
Maximum speed (m. p. h.)	42 to 44

Table VI. gives the names of the different villages and townships on the line, with their population.

TABLE VI.

Name	Population
Pontiac	5000
Owega	400
Esmen	400
Odell Township	792
Cayuga	78
Odell	1050
Total	7720

During the nine and one-half months to which the foregoing data relates, there were only 10.4 miles of track in operation. On an average each person in the community used the road 11.08 times, and the average earnings of the road per capita of population amounted to $1.47.

THE SITUATION IN SAN FRANCISCO

The legal holidays in San Francisco which were declared from day to day since the fire of April 18 have ceased, and in order to prevent any question being raised as to the legality of their acts during the holiday period, the Board of Supervisors on June 4 readopted all the resolutions it had passed since April 18, and once more passed to print all the ordinances enacted in the same period. Among the ordinances re-enacted was that permitting the United Railroads to change its former cable roads to electric trolley lines.

The United Railroads is progressing as rapidly as conditions will permit in its work of restoring the old electric railway service and changing the cable lines for electrical operation. The work is being retarded somewhat, however, by delay in receiving shipments of materials from the East, the principal trouble being caused by the lack of trolley wire and poles. Every effort is being made toward placing the Sutter Street line in operation, as there is at present no car service north of O'Farrell Street, although all other sections of the city have service. It is hoped that the work of changing this line from cable to trolley will be completed so that it can be operated by June 20 from Fillmore Street to the ferry. The necessary Y at Sutter and Market Streets has already been placed. Eventually the line will be run out to the Cliff House, through the Richmond district, connecting with the Presidio.

The Hayes Street line is also to receive early attention. The old route of this line is to be considerably changed, the cars starting on Masonic Avenue, going down Page to Fillmore, along Fillmore Street to Hayes, down Hayes to Market, and thence to the ferry. The cars will return by the same route, with the exception that the return trip will be made along Oak Street instead of Page Street. This line is now ready, with the exception of the wires and poles, and will be in operation a few days after the materials arrive.

Work is progressing on the Folsom Street line, and cars will be running along this street from Sixteenth Street to the ferry within a few days. Both the Folsom Street and the Kearny and North Beach lines will be in operation before the Sutter Street and Hayes Street lines. The Kearny Street line will run from Third and Townsend along Kearny Street to North Beach, and, returning, will run via Broadway to the ferry. This line will also be in operation by June 15, as practically all of the materials necessary are now on the ground and there is little clearing to do.

Workmen are engaged in taking down the 125-ft. brick stack of the Geary Street railroad power house, which was badly cracked during the recent earthquake. The brickwork will be removed by means of an inner scaffolding to a point about midway the height of the stack, below which the construction is solid. As crude oil has recently been used in the boilers of the power house, requiring less draft than coal, it has been decided not to rebuild the chimney to its former height. As soon as the chimney-repair work is completed the plant will be ready to resume operations, as the machinery was not injured. Whether the road will be placed in operation again as a cable road has not been decided, but it is asserted by A. D. Shepard, vice-president and secretary of the company, that the system could be put in shape to operate in ten days. The slot rails are warped in places, but the conduit is believed not to be injured. The road ran its cable for an hour after the earthquake on April 18, which shows that it suffered no material damage from the shock. One or two cars reached the down-town section and were subsequently burned.

William Muir, who made a similar application once before, has filed a paper with the city recorder, applying for the right to tunnel under the Bay of San Francisco for mining, domestic and transportation purposes, which he claims by right of location. His scheme includes a tunnel which is to extend under the Bay of San Francisco and across to Alameda. The tunnel is to begin at the Alameda Pier, 144 ft. below low-water mark; to run 10,500 ft. to the deepest part of the bay, and then to the west shore of the bay, terminating at Townsend and Second Streets, with branches to distributing points on the present railroad levels. The tunnel is to have a double track, standard gage, for the operation of electric cars. The upper half of the tunnel is to be equipped with roadways for teams, automobiles, bicycles, and pedestrians. The roadway is to terminate on Brannan Street, upon a level with that street. The tunnel is also to carry water for domestic purposes.

ROLLED STEEL WHEELS FOR INTERURBAN SERVICE

BY H. S. NEWTON,
General Manager, Hartford & Springfield Street Railway Company

The fitness of the forged and rolled steel wheel, which has been receiving so much advertising in the past year or two, to the class of interurban roads which is found in New England, has apparently been questioned by some of the railroad fraternity who have been solicited to purchase. It is entirely possible that the production of these wheels up to date has included some which were not well suited by design and physical characteristics to the service which they were intended to perform. Some specimens have been rolled which were undoubtedly too low in carbon, others have been poorly matched in diameters when pressed on the axles, and still further difficulties have developed, perhaps, which have influenced results. Yet, after an experience with these wheels of about two years, under conditions which could hardly be more severe, the writer has concluded that they deserve the serious consideration of every electric railroad management which is looking for economy in that very important item of operating expense, wheel wear.

As is well known, comparatively few New England interurban roads are built to any great extent on private right of way. The Hartford & Springfield Street Railway, upon whose lines the rolled steel wheel has been in use during a period of two years, is no exception to the rule, and when the route taken by the cars is not through the streets of the two cities, which are largely paved, it is confined largely to public highways and streets of the villages between, where, as the rail is laid flush with the surface of the road, the factor of sand and grit from the road material becomes a very important one. Attention is called to this characteristic of the route, since it is in marked contrast to the conditions existing on most of the interurban roads in the Central and Western States where the country rail is largely exposed.

It is not the purpose in this article to attempt an expert scientific demonstration of the inherent virtues of steel as applied to the manufacture of car wheels, nor does the writer care to make any formal comparison between the solid steel car wheel and the cast-iron or cast-steel wheel with a steel tire. Although past service on this road appears to demonstrate satisfactorily the superior advantages of the former, it is considered sufficient to limit all comparisons to the record of the rolled-steel wheel versus the chilled-iron article. Naturally that comparison, in terms of dollars and cents, forms a most important detail in the discussion, but it is also hoped to set forth in a form which will appeal to those financially responsible for operating expenses, some other points of interest in connection with rolled-steel wheels which, although often touched on before, have not to the writer's knowledge been brought out with any too great clearness and exactness from sources not allied with the manufacturers.

The record made by the wheel in the service of the Hartford & Springfield road can be best illustrated by the facts which have been developed in connection with it from a careful observation which has been made of the wheels under one car, selected at random, and with no special characteristics in design or in chemical analysis. The car weighs 21 tons, was employed only in winter service, and the wheels ran through the winter of 1904-5 and part of the winter of 1905-6. The facts may be set down under four headings.

(1) The amount and character of the wear, as shown by templates taken when the wheels were new, and again after they had run 50,880 miles.

(2) The apparent relation of the chemical composition, especially the carbon component, to the life of the wheel.

(3) The re-shaped wheel and the shop methods adopted for the re-shaping.

(4) A comparison from the standpoint of electric railway economics of the rolled-steel wheel, with its chilled-iron competitor.

Before preparing to ascertain by test the accuracy of the claims made for the rolled-steel wheel, the writer investigated carefully the conditions of track and road bed which would naturally affect the life and wear. It was found that the ideal arrangement for flange wear, viz., a condition of comparatively narrow gage between the wheels on axle was not possible, owing to the design of much of the rail used in Hartford and in Springfield. This is of the so-called Trilby section, laid in part at correct gage and in part to a gage somewhat wider than the standard 4 ft. 8½ in. A uniform wheel gage for all cars was, therefore, adopted of 4 ft. 8¼ ins. between centers of fillets, which, while it seemed sufficiently narrow to avoid cramping between rails of the track, was at the same time not so narrow as to cause the flanges of the wheels to ride on the inside of the grooved tram of the city rail, while the original thickness of those flanges remained.

The results shown by wear, and corroborated by chemical analysis, suggest that the wheels selected for special observation may differ somewhat from one or two previous sets purchased, in the amount of the carbon component. On this set the mileage shown before the first turning is probably somewhat larger than that obtained from some of the original wheels. It seems probable, however, that it will agree with the records which may be expected from all the later purchases. The relation between amounts of tread and flange wear, so far as can be seen from inspection of other wheels and comparison with these, is apparently normal, and indicates that the objection which has been so often urged against steel tires and wheels, viz., that the flanges wear excessively and the treads hardly at all, is not borne out. Thin flanges develop, but they are inevitably accompanied by heavy wear in the treads.

THE AMOUNT AND CHARACTER OF WEAR

The amount and character of wear obtained on this test set of wheels is shown in the accompanying sketches. They represent graphically the effects of 50,880 miles of service, and the general conclusions indicated are as follows:

(a) That the rolled-steel wheel, having a carbon component of 0.70 per cent, or thereabouts, may be reasonably expected to show in city service an average mileage of 10,000 for each 1-16 of an inch wear.

(b) That the density and resistance to wear of the wheel tread and flange is, to all intents and purposes, the same at all parts of the circumference. In no case did these wheels appear after service to be more than the merest trifle out of round.

(c) That on nearly every axle one wheel is found which has worn more or less thin in the flange, whereas the flange of its mate shows comparatively slight wear. In each of the four pairs observed, it is significant that the former shows a smaller diameter. The one wheel is apparently softer or of a texture more susceptible to wear; both tread and flange on this wheel have yielded more rapidly than they have on its mate, and, as the reduction has taken place, the flange has been crowded more and more against the rail, and the wear intensified by the tendency of the other wheel to advance farther in each rotation.

No evidence has developed to show that with brake-shoes of equal hardness and abrasive power this difference in wear may be attributed consistently to other causes. The car under which the wear took place is operated from both ends, there was no excessive play in the journals and the truck, of

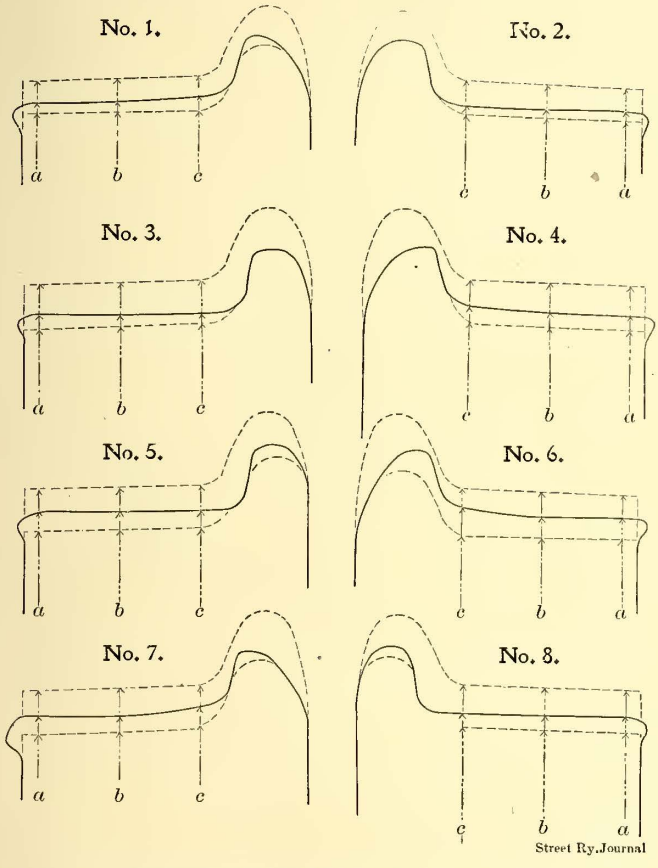
TABLE I.

SHOWING DIAMETERS AT THREE POINTS ON TREAD OF NEW, WORN AND RESHAPED WHEELS

Diameter	New Wheel			Worn Wheel			Reshaped Wheel		
	a	b	c	a′	b′	c′	a″	b″	c″
Wheel No. 1	33.9375	33.96875	34″	33.362	33.38	33.54	33.104	33.164	33.204
" 2	"	"	"	33.392	33.402	33.462	33.124	33.184	33.222
" 3	"	"	"	33.164	33.164	33.234	32.846	32.904	32.964
" 4	"	"	"	33.156	33.252	33.442	32.826	32.896	32.924
" 5	"	"	"	33.330	33.338	33.422	32.884	32.944	33.004
" 6	"	"	"	33.330	33.372	33.596	32.864	32.904	32.944
" 7	"	"	"	33.294	33.322	33.522	32.856	32.916	32.966
" 8	"	"	"	33.262	33.262	33.342	32.876	32.934	32.994

the M. C. B. general type, shows no indication of being out of true. It seems, further, so reasonable to expect difference in wear from wheels of different hardness and density, and when this wear occurs, to look for thin flanges on the soft wheels, that it appears unnecessary to cast around for other and what are apparently more remote causes.

(d) That homogeneous brake-shoes, having equal coeffi-



PROFILES SHOWING THE GRADUAL WEAR OF A SET OF ROLLED STEEL WHEELS UP TO 50,880 MILES

cients of friction, as far as possible, should be used in all wheels. It is not beyond belief that the wear of wheels may be somewhat influenced thereby.

(e) That there are no observable effects produced by the heat generated by braking. Measurements taken between inside faces of wheels reveal no distortion of web or rim.

THE CARBON COMPONENT

It is fair to presume that with uniform density in all cases the carbon component should be the determining factor in the grade of steel used for the manufacture of the rolled wheel. The presence of manganese, phosphorus and other elements, although modifying undoubtedly the characteristics of the metal, are, it seems probable, of decidedly secondary importance. To the percentage of carbon and the density of material is chiefly due the resistance to wear and the life of the wheel.

When it was decided to ascertain what the wheels under discussion had done under the test of 50,880 miles, and to estimate, if possible, what other wheels could be expected to do, a necessary part of the investigation was to determine by analysis this carbon component. Chips taken from the treads were furnished Prof. N. W. Lord, of the chair of metallurgy and mineralogy at the Ohio State University, and an analysis made. The results of this analysis are given in Table II.

TABLE II.

SHOWING CARBON COMPONENT AND WEAR OF THE EIGHT WHEELS

No. of Wheel	Mileage made in Service	Carbon Component	Total Average Reduction by Wear	Miles per 1-16″ wear	Stock Removed in Lathe	Total Reduction by Wear and Tool
1	50,880	.79	.2550″	12,717	.135″	.39″
2	"	.71	.2594″	12,257	.1213″	.3807″
3	"	.725	.37505″	8,479	.1417″	.51675″
4	"	.701	.32709″	9,724	.2007″	.52775″
5	"	.71	.28705″	11,082	.2097″	.49675″
6	"	.75	.25245″	12,595	.2643″	.51675″
7	"	.71	.27905″	11,396	.2334″	.51245″
8	"	.69	.32442″	9,802	.14255″	.50175″

While the wheels were purchased as .72 carbon, the analysis shows an even better percentage in some of them, and only one is below the .70-carbon mark. An ability to obtain uniform results at the mills is revealed also, which is creditable when it is remembered that the rolled-steel wheel is still somewhat of an innovation.

It will be seen, however, by examination of the diagrams, that the carbon component has not apparently been the determining factor in the wear of different wheels on the same axle. In one case (Nos. 1 and 2), a wheel with a high percentage shows a hardly appreciable better wear than its mate, which is .08 per cent lower carbon. In another case (Nos. 3 and 4), the wheel of lower carbon shows a decidedly better resistance than its higher carbon mate. On the other two pairs the wear is as might be expected, the lower carbon wheel in both cases showing the less resistance. In view of these anomalous results, the conclusion is suggested that there is quite a difference in the density of material making up the rims, and this conclusion is strengthened by the inequalities which appear in wheels on separate axles. A microscopical examination of etched sections of these wheels would probably show how much this theory has basis in fact. Naturally, however, such a determination by section examination was not possible in this case, since the wheels were desired for further service.

SHOP METHODS

It is probable that the lack of shop facilities for turning and grinding have stood in the way of the adoption of steel-tired and steel wheels by many roads which otherwise would have fallen in line at once. If these facilities are not at hand, the cost for freight, hauling and outside shop work is a great handicap. A modern lathe, suitable for turning car wheels, can be purchased for little short of $2,000. This sum is often more than a hard-fisted board on a small road feels like appropriating for what they are sometimes prone to believe is an experiment of doubtful success, and the old chilled wheels, requiring no turning, quickly available and, when worn out, having a considerable money value for scrap, remain the standard.

The record of large sections broken out of six different chilled wheels during the winter of 1903 and 1904, however, made a change on the Hartford & Springfield road imperative. In the absence of a large lathe, arrangements were made with one of the neighboring companies, possessed of a first-class machine shop, to do the necessary work of re-turning the wheels and putting them in shape for further service when the occasion required. Fortunately, however, the good offices of this company were never required, since be-

fore the first set of wheels were ready for turning, a tool was found on the bargain counter which was thought sufficient for all needs, and which was promptly set up in the shop, where it performs the work, with the aid of an auxiliary device, in a very satisfactory manner.

On a lathe of proper design and adequate weight of parts, it is undoubtedly practicable to dress with cutting tools rolled-steel and steel-tired wheels without serious difficulty. Such a lathe was not secured, however, by the Hartford & Springfield road, and it was early found that the qualities characteristic of a wheel tread after it had seen service were such as to make the turning down of the wheel with recourse to no tool but the lathe tool tedious, difficult and long drawn out. With these difficulties in evidence, the ingenuity of the master mechanic was called into play, and the result was the construction of a swing frame, holding a carborundum wheel for grinding, supported on the lathe countershaft, and of such a design as to allow the grinder being advanced to and from the wheel, as the axle holding it rests on centers in the lathe.

The principal difficulty in cutting the tread of either the steel-tired or the rolled-steel wheel is in getting below the hard spots, which have been formed from skidding of the wheels in service. These spots seem to be in the nature of chilled spaces, having the same ear marks as the chilled-iron castings, viz., the minute and almost microscopic chill checks which, in the form of wavering lines, cover the surface. The cutting tool on a light lathe will invariably jump and pass over these spots, and the inference is that not only must the frame work of a lathe be exceedingly stiff and unyielding, but the wheels themselves must be supported by a very rigid rest between centers before much progress can be made in turning off these spots. An attempt to mount first an emery and then a carborundum wheel on the tool rest, and to grind the entire surface of the wheel, resulted in the expenditure of a great deal of time to very little effect.

The swing frame holding a carborundum wheel is highly satisfactory. The hard spots only, and not the balance of the tread, are ground, and this work of grinding forms naturally the first process after the wheels are placed between centers. The turning, which follows, is done with tools of the very highest grade of self-hardening steel which can be procured. At the start an effort was made still farther to harden this steel by heating to a white heat and then plunging it in oil. This seems to give the material a crumbling tendency, however, and the practice has recently been discontinued.

The nature of the re-shaping of the tread and flange on the wheel after they have been worn is a subject which has been given a good deal of study. With a flange considerably worn, like some of those shown in the diagrams, it is clearly unnecessary to attempt to obtain a new flange of the full size secured on the wheel in its original shape, provided measures can be taken to prevent the worn flange from receiving a like amount of wear when the wheel is again put into service. The practice so far has been not to attempt to get full flanges again where they have worn thin, but to leave them when returned to the car with the profile of the flange and tread, as shown in the diagrams. It will be noticed in these cases that parts of new fillets have been turned up, which end rather abruptly when they infringe on the old ones, which have resulted from the continuous grinding of the flange against the rail. To prevent this new fillet being ground out and the wear coming again on the old flange, the practice is to turn the thin-flanged wheel to a diameter slightly larger than that of its mate. In this way it is hoped that the tendency to greater wear shown by the wheel having the thinner flange will be offset, and the wear thrown on the other wheel by the increase in diameter of the first. To what extent this scheme will succeed has not yet been developed. On no wheels which have been turned up in this way does a casual examination show signs of abnormal new wear in the old flange.

The work of turning and grinding must be done under the general supervision of a skilled mechanic. The lathe hand himself need have no more than apprentice's skill, as the tool must necessarily run slowly, and a large part of the attendant's time will be spent in watching the cut or in holding the grinding wheel against the tread.

Any old heavy duty lathe, which can be built up 6 ins. or less, so as to get a 36-in. swing, can be pressed into service provided the grinding frame suggested before is made a part of the tool. A turning speed of 10 ft. a minute has been found to be as high as is permissible when roughing off the worn tread and flange and naturally the heavier the bed, headstock and other parts, the less chatter and more rapid the results. In some shops it is apparently not considered necessary to taper the treads of wheels when re-shaping, but in the Hartford & Springfield Company's shop the taper is considered a most essential detail in the preparation of the wheel, and a good sharp one is considered conducive to less flange wear.

In the estimate of ultimate mileage of the rims on steel wheels it is calculated that a somewhat longer service will be obtained after the last turning than after the others. The reason for this expectation will be obvious when it is remembered that the intention is to use the old centers for new tires. It will not be necessary to take wheels out of service so quickly on account of thin flanges after they have been reshape for the last time, since there will be no objection to the latter running until the limit of flange safety is reached. The intention now is to fit the new tires either with the Gibson retaining ring or by simply shrinking them on against a shoulder. It is probable that the former method will be adopted, in view of the risk involved of tires getting loose when worn thin and held on only by the shrink .

ROLLED-STEEL VERSUS CHILLED-IRON WHEELS

As a substitute for the chilled wheel the record of the eight rolled wheels tested shows them to be a success. A really noticeable flat has never been developed either on these or on any other wheels of the rolled-steel variety in the two years during which they have been in service on the Hartford & Springfield road, and the trifling flats, occasioned by careless braking, have invariably worn off in forty-eight hours of service. The centers and rims are naturally both unbreakable, a chipped flange impossible and a broken one incredible. In the light of past experience under severe winter conditions even the cast-iron center wheel with a steel tire seems undesirable. Uniformity in production is something which few of the cast-iron wheel manufacturers seem to have attained, and a brittle center may be nearly, if not fully, as dangerous as a brittle wheel. The rolled wheel is safe.

A consideration of the estimate given below will indicate from the standpoint of dollars and cents what may be expected in medium-speed interurban service from the use of the two kinds of wheels. A life of 37,500 miles is allowed the chilled wheels, and is considered a liberal average through the year under the present conditions of track and special work. It is possible that were the conditions more favorable a greater mileage might be expected, especially if the climate were less severe. As it is, however, only a minor percentage of the chilled wheels which have been employed on this road in winter service have made good records for wear. The majority have either prematurely developed chipped flanges or soft spots, or have succumbed and become flat under the too earnest application of the air brakes. For summer or open cars the chilled wheel still remains the standard, and is mak-

ing a record sufficiently good to warrant serious consideration before it is definitely superseded.

A very natural question which arises in connection with the adoption of steel wheels on this road, and the proposed plan of equipping the centers with tires when the original rims are worn out is, why not adopt steel-tired wheels in the first place?

The wheel records here demonstrate that the steel tires will not show a greater mileage per unit wear than was shown by the rims on the rolled wheels under test. Therefore, as the solid rims may be worn down deeper than the tires, they are the more economical. The centers for tired wheels, which are furnished for duty similar to that performed here by the rolled wheels, are usually cast iron, which is not safe, or cast steel, which is expensive and, in a measure, also undesirable. The rolled centered, tired wheel has not been offered to the trade, so far as the writer knows.

Everything being taken into account, economy would seem to indicate the purchase in the first place of the rolled-steel wheel with the tire and center one piece. When the time for renewal comes a tire at an outside cost for material and labor of $14 is apparently more reasonable than the expenditure of $27 for a new wheel. The amount to be realized from the return of rolled centers as scrap to the mill is small, and would be largely eaten up probably by return freight charges and other incidentals.

In the compiling of the data used in the preparation of this record, much assistance was received from William F. McCoy, master mechanic of the Hartford & Springfield Street Railway Company.

TABLE III.
SHOWING COST OF 150,000 MILES SERVICE FOR ROLLED STEEL VS. CHILLED IRON WHEELS

ROLLED STEEL WHEELS

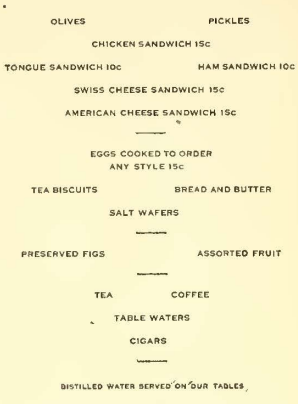
One pair of 34-in. diameter rolled steel wheels, 2½-in. thickness of rim, 2½-in. tread, ⅞-in. flange, at $27.00 per wheel, pressed on axles and delivered at freight station, Warehouse Point	$54.00	
Haulage from station	.50	
Cost of labor, substituting same for discarded wheels under car	1.25	
Cost of labor, taking out and replacing same under car twice, at $1.25	2.50	
Cost of labor, re-shaping treads and flanges twice, at $2.87	5.74	
	$63.99	
Less value of center to be used for re-tiring.	17.00	
		$46.99
Operating cost per 1000 miles		$ .3133

CHILLED-IRON WHEELS

One pair 33-in. diameter chilled iron wheels, 2½-in. tread, ⅞-in. flange, pressed on axle and delivered f. o. b. at freight station, Warehouse Point	$20.60	
Haulage from station	.50	
Cost of labor, substituting same for worn-out wheels	1.25	
Cost of three renewals, f. o. b., Warehouse Point, credit being allowed for old wheels returned as scrap, at $15.75	47.25	
Hauling old wheels to station three times	1.50	
Hauling new wheels from station three times	1.50	
Cost of labor, taking out and replacing with new wheels three times	3.75	
Cost of removing last pair when worn out	.625	
	$76.975	
Less value of old wheels as scrap at car house	4.35	
		$72.625
Operating cost per 1000 miles		$ .4842

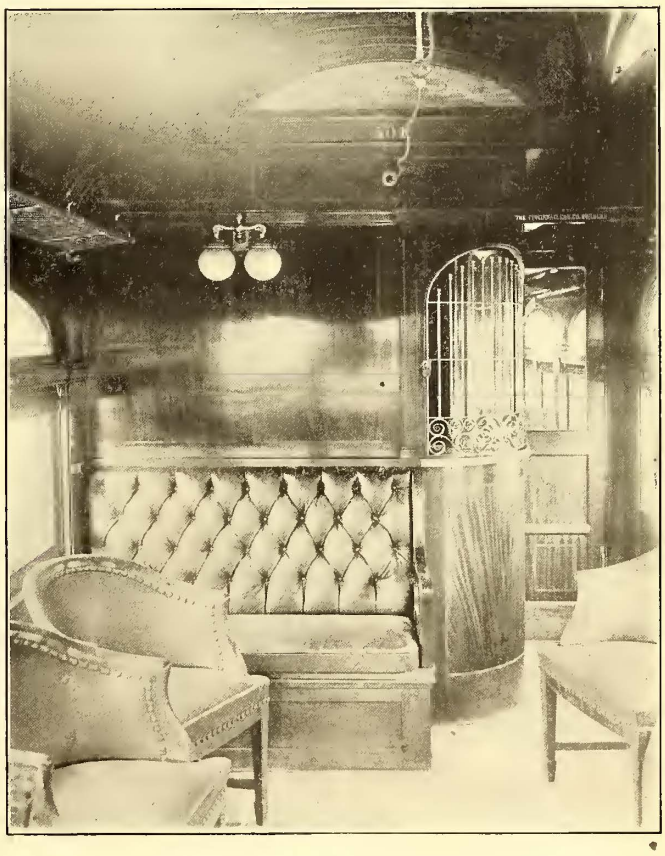
BUFFET AND LIMITED SERVICE INSTITUTED BETWEEN INDIANAPOLIS AND FT. WAYNE BY THE FT. WAYNE & WABASH VALLEY TRACTION COMPANY

Quite a distinct departure in the way of high-speed limited service has been instituted by the Ft. Wayne & Wabash Valley Traction Company and the Indiana Union Traction Company on the route between Ft. Wayne and Indianapolis. The service was instituted May 1 with a reception, given at the Traction Terminal station at Indianapolis. Two thousand invitations were issued and a number of traction officials from Ohio and Indiana attended. Two of the new cars for the service were on exhibition at the station, and light refreshments were served to guests.



REPRODUCTION OF MENU ON BUFFET CAR

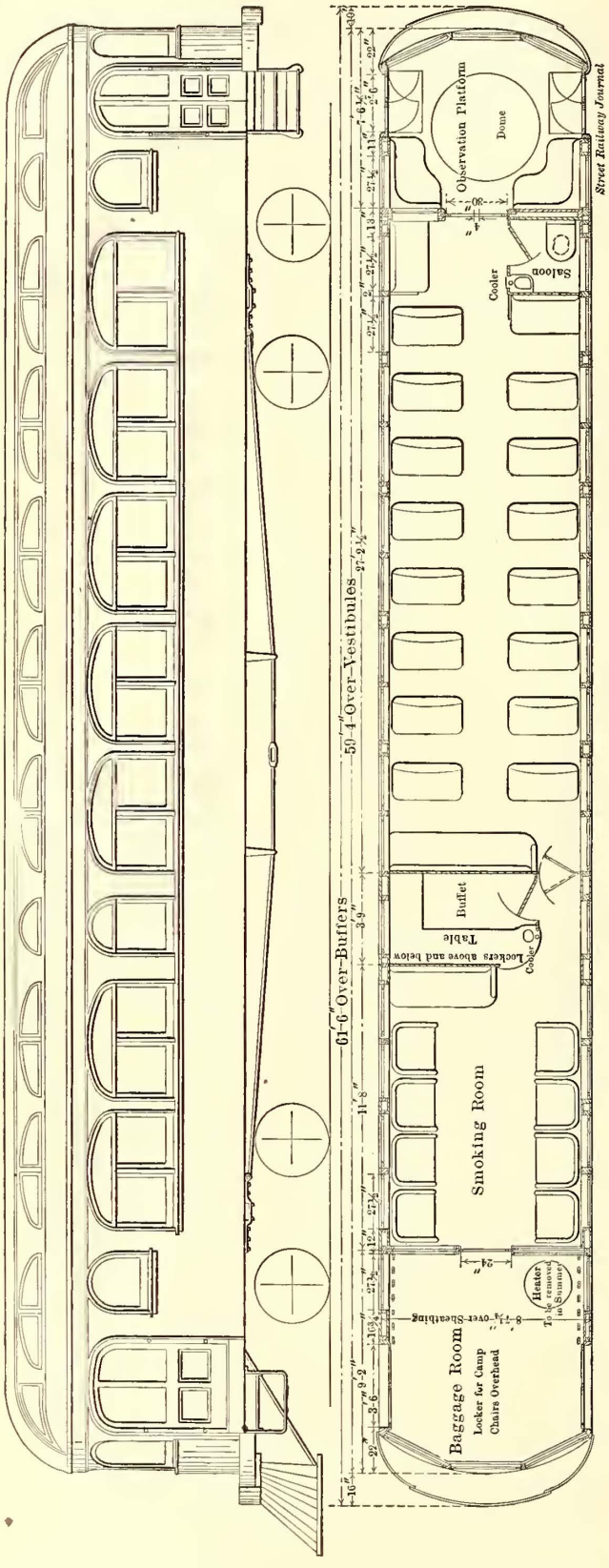
The length of this run is 138 miles, and the time is 4 hours, 40 minutes. Sixteen scheduled stops are made, the route being by way of Noblesville, Tipton, Kokomo, Peru, Wabash and Huntington. There are four trips a day in each direction . The fare on the trains between Indianapolis and Ft. Wayne is $2.45 one way, and $4.40 for the round trip, if



BUFFET AND SMOKING COMPARTMENT OF CAR FOR SERVICE BETWEEN FORT WAYNE AND INDIANAPOLIS

tickets are purchased. One hundred and fifty pounds of baggage will be checked free on each full fare ticket, which is a departure from the practice heretofore in vogue on the majority of the roads in this district. The schedules are so arranged that they connect at Ft. Wayne with limited cars of the Ft. Wayne, Van Wert & Lima Traction Company for

Lima, Ohio, making possible the trip of 200 miles in 7 hours and 10 minutes. Connection is also made with the Clover Leaf (steam) trains for Toledo.



SEATING PLAN AND SIDE ELEVATION OF BUFFET CAR OPERATED BETWEEN FORT WAYNE AND INDIANAPOLIS

The new cars for this service are probably the longest and heaviest interurban cars ever built. They are 62 ft. over all and weigh 45 tons. Two of them, the "Kenilworth" and the "Peru," have just been placed in service, while several others are under construction by the Cincinnati Car Company. The arrangement of the interior is shown by the accompanying floor plan. Each car has three compartments. The forward compartment is for baggage. The smoking compartment is finished to correspond with the same accommodations given on the Chicago-New York trains of the Pennsylvania and Lake Shore railroads. A buffet is provided in the center of the car, accessible to both smoking and main compartments. Chairs are used in the smoking compartment, but to secure larger seating capacity the seats in the main passenger compartment are of the high back walk-over type, upholstered in figured plush, and there are reclining lounges at each end of the same material.

A novelty in the car is the observation rear end. The rear platform is 9 ft. long, and it is completely enclosed by heavy oval-shaped plate-glass windows. Cozy corners and portable leather seats are provided for this end of the car. The forward compartment has two sliding side doors. A permanent stool is supplied for the motorman, and he is protected from the baggage by a substantial pipe frame work. In this compartment are placed the hot-water heater, a Babcock fire extinguisher, emergency tools and telephone instruments.

The interior finish of the car is rich inlaid mahogany. The windows are double, and have leaded art glass in the upper portions. The cars are lighted by clusters of lamps, enclosed in inverted holophane globes. A toilet room is provided in the rear of the passenger compartment, with a drinking water tank recessed in its partition wall. The underframing of the cars is of very substantial and rigid construction, all sills being reinforced with heavy 6-in. I-beams. They are

REGULAR PASSENGER SECTION OF BUFFET CAR RUNNING BETWEEN FORT WAYNE AND INDIANAPOLIS

equipped with Westinghouse No. 85 and No. 121 motors, with the Westinghouse multiple-unit switch control for the operation in trains of two or more cars, and they are mounted on Baldwin M. C. B. heavy interurban trucks. The motors are geared for a miximum speed of 60 m. p. h

A NEW AUTOMATIC COUNTING BLOCK SIGNAL

The United Electric Signal Company, of Providence, R. I., has just produced a new automatic counting block signal for use on single-track electric railways, which possesses some very novel features of construction, the most striking of which is its extreme simplicity. The signal mechanism consists of two powerful magnets provided with gravity-controlled armatures, a ratchet wheel mounted between the magnets designed to be rotated forward and backward by the movement of the armatures, a single-tooth wheel mounted upon the same shaft with the ratchet wheel and rotated therewith; an arm carrying a transparent red target mounted directly over the single-tooth wheel and having its lower end forming a segment to be engaged by the single-tooth wheel.

There are two openings in the signal casing, the larger of

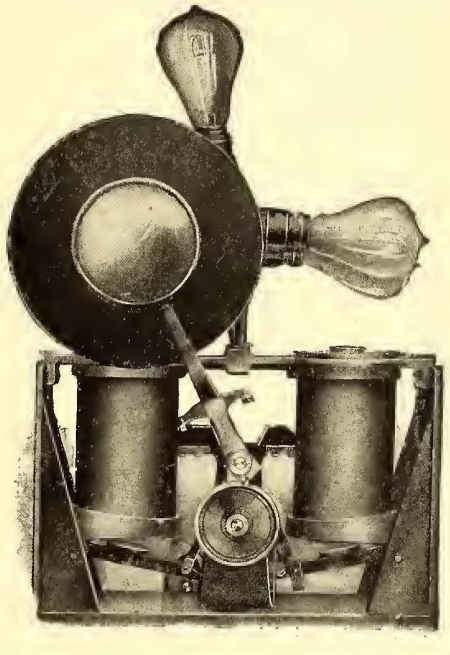
SIGNAL LANTERN

which is protected by a white glass and the smaller by a green bull's-eye. Both openings are illuminated by an incandescent lamp, and each opening also contains a reserve, or spare lamp, designed to be automatically cut in should the first lamp burn out. The large white opening is the one behind which the red transparent target falls when in danger position, and the green bull's-eye is the "answer back" or tell-tale signal, the illumination of which in the near signal is a positive indication that the danger target is set in the distant signal.

When the block is clear the larger opening will show a clear white light and the green bull's-eye will not be illuminated. As long as there is a car or cars within the block, the forward end of the block will display a red signal within the larger opening, and at the rear end the larger opening will show a white light, while the green bull's-eye will also be illuminated. The incandescent lamps do not form the main part of the system, but are only supplemental to the danger target.

As a car leaves a turn-out to enter a stretch of single track, a momentary impulse is sent to the operating magnet of the distant signal mechanism by means of an overhead device, which causes the armature thereto to rise, and by means of a pawl in engagement with the ratchet wheel to move the ratchet wheel one step forward. The single-tooth wheel, being mounted on the same shaft and traveling therewith, will also move one step forward and throw the target to danger position.

The falling of the target establishes a permanent circuit to the lamps behind the green bull's-eye of the near signal, giving a positive indication to the entering car that the danger signal has been set. Following cars that approach the block going in the same direction will see the green signal, indicating a car or cars in the block ahead. As the following cars enter the block with caution, each in turn operates the setting magnet, as above described, but gives no visible change at the danger end, though each car moves the ratchet wheel and the single-tooth wheel one step forward, all the while holding the danger target securely locked in danger position. The fact that each following car operates the setting mechanism is positively indicated at the point of entry by a flash upon the green bull's-eye, caused by the cir-



SIGNAL MECHANISM WITH COVER REMOVED

cuit being temporarily broken while the armature is in action. This is accomplished by a simple brush switch mounted upon the armature of the setting magnet.

As the cars leave the block each in turn, by means of the clearing magnet, rotates the ratchet wheel and also the single-tooth wheel one step backward, until the last car to leave the block brings the single tooth into engagement with the segment at the end of the target arm and throws the target back to safety position.

That the idea of extreme simplicity is well carried out is evidenced by the small number of parts, the entire absence of springs, and the general substantial construction. One of the most novel and ingenious features of the mechanism is the simple and positive device for locking the danger target in danger position. An extension of the target arm is formed into a segment with concave faces which bear upon the periphery of the single-tooth wheel and hold the target firmly in its assumed position until released by the single tooth in its rotation. A short auxiliary arm is also mounted loosely upon the target arm shaft, and is designed to take up lost motion,

so that the armature of the magnet can complete a part of its stroke before the real work of throwing the target commences.

This system requires three line wires. The magnets are of a special type, the upper half of the core being fixed to the coil, and the lower half of the solenoid type. Although in actual practice the coils receive but a momentary current at the usual 500 volts, they are wound to withstand a continuous current at a much higher voltage, and to operate at a much lower voltage than is required to move the cars. Furthermore, while the actual pressure needed to operate the target is but a quarter of a pound at the start, up to a pound and a half to complete the stroke, the initial pressure generated by these coils is over a pound and a half, with a maximum thirty-five pounds at its finish, thus allowing a very heavy margin for safety.

The entire wiring of the signal inside the case is brought to double binding posts set in a fiber block mounted upon the frame, and are permanently connected to one end of the binding posts; the line wires are brought into the casing from underneath and inserted into corresponding binding posts, and can be thus quickly disconnected when it is desired to remove the mechanism from the casing. The signal has been designed with such simplicity that should it become deranged it can be practically rebuilt at any machine shop, thus avoiding the necessity of being dependent upon the manufacturer for a new mechanism.

The overhead contact device is designed to be permanent, and needs no inspection. It consists of two short metal strips parallel to and on either side of the trolley wire, and designed to be short circuited by the trolley wheel, and will operate at any speed. The duration of the contact necessary to overcome the inertia of the magnets and operate the mechanism is maintained by an extremely simple device within the signal box, by which the current is maintained upon the coils until the mechanism has been operated. The overhead contact device is also differential, cars going in one direction operating the setting magnet and those going in the opposite direction operating the clearing magnet. The purpose of this system is to meet the needs of electric railroads desiring a simple and effective signal method at a small outlay and low maintenance cost.

ELECTRIFICATION PLANS OF THE ERIE RAILROAD

The contract for the electrification of the Rochester Division of the Erie Railroad between Mt. Morris and Rochester, N. Y., was awarded last week to Westinghouse, Church, Kerr & Company. This section is about 35 miles in length and extends south from Rochester to the junction of the Rochester branch with the Delaware, Lackawanna & Western Railroad. Work has already been commenced. The next section of the Erie Railroad in Western New York to be equipped is from Avon to Corning, a distance of about 70 miles. The single-phase system has been adopted and the operating voltage will probably be the same as that adopted by the New York, New Haven & Hartford Railroad, or 11,000 volts. In this case only one sub-station, located about the middle of the line, will be required. Power will probably be taken from the transmission lines of the Ontario Power Company, which cross the tracks of the Erie Railroad to be electrified. The cars to be used will be very similar to the standard Erie Railroad passenger coach, but slightly shorter and slightly heavier. It is proposed to run the cars in trains with the multiple-unit system, and part of each train will be composed of trailers. Later, electric locomotives may be used on some trains.

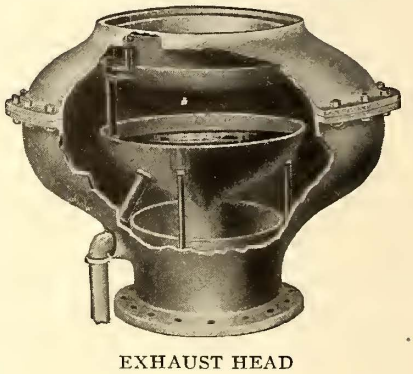
The electrical commission of the Erie Railroad has now practically completed its work of preparing estimates upon the cost of electrification of the Greenwood Lake and other suburban divisions of the Erie Railroad near New York by the various systems in most common use, and these estimates will be considered by the executive committee at an early date.

LONG DISTANCE EXCURSION BUSINESS IN OHIO

While the recent passage of a two-cent-per-mile rate law in Ohio will doubtless affect the long-distance one-way travel on interurban roads, the ruling of the steam-road people in refusing to grant low rates for conventions and special events places the electric lines in a position to secure a considerable portion of this business without materially reducing their established rates. The steam roads recently refused to grant reduced rates to the State G. A. R. encampment at Dayton this month, and the electric roads are offering through special cars and reduced rates from points as far distant as Columbus and Toledo. The indications are that the electric railways will get considerable of this business, as the veterans are inclined to be disgruntled at the withdrawal of the low rates heretofore made them by the steam roads

CAST-IRON EXHAUST HEAD

The Hoppes Manufacturing Company, of Springfield, Ohio, is placing on the market a new exhaust head which is made entirely of cast iron with the exception of the drain pipe. The apparatus, as will be noted from the accompanying illustration, is symmetrical in design and liberal in its proportions. The principles involved in the construction are those used in the company's well-known steam separators and oil eliminators. Intercepting troughs partly filled with water prevent the entrainment of water and oil in the exhaust pipe from passing through and falling on the roof of the building, while the cone in the center prevents excessive moisture in the steam from passing out without coming into contact with the inner surface of the head and having the moisture and oil removed. A special feature is an annular groove surrounding the outlet, which prevents condensation and oil from running over and down the outside of the head and pipe.



EXHAUST HEAD

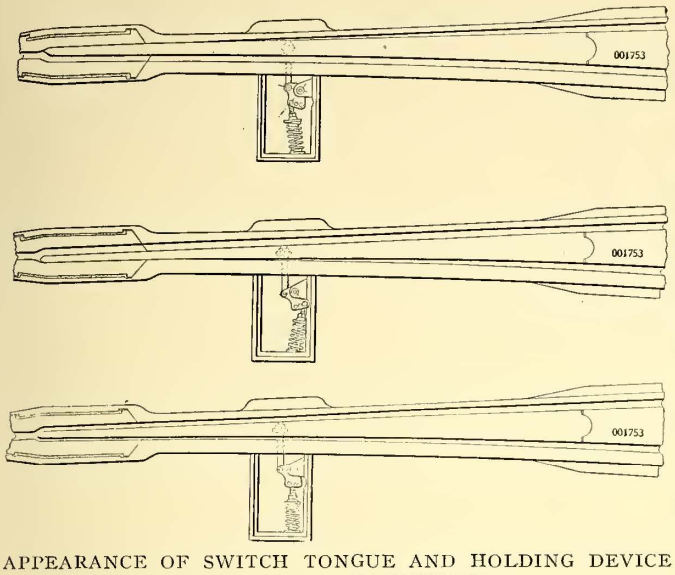
The exhaust head is made in sizes of pipe up to 48 ins. in diameter. Being constructed of cast iron, which is impervious to the action of the corrosive gases and atmosphere, it is free from the corrosive action to which sheet metal is subject.

INTERURBAN LINE NEAR DUNDEE, SCOTLAND

The Dundee, Broughty Ferry & District Railway, whose system was described in the issue of May 12, was financed and built throughout by J. G. White & Company, Ltd., of London, whose names were omitted in the previous article through an oversight. Although a comparatively short line, the system has attracted considerable attention in Great Britain on account of its interurban character.

HOLDING DEVICE FOR SWITCH TONGUES

The accompanying illustration shows an ingenious device recently put on the market by the Lorain Steel Company, for holding switch tongues in either a right or left-hand position or giving them an adjustment by which the tongue can be held in either direction as thrown. It is intended to prevent any possibility of a car doing what is known as straddling a switch.

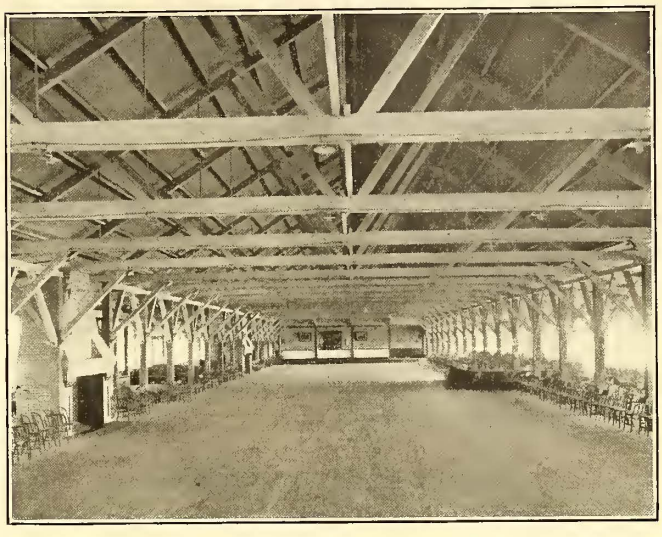


APPEARANCE OF SWITCH TONGUE AND HOLDING DEVICE FOR THE THREE POSITIONS

As will be seen, the tongue is connected by a lever to an irregularly-shaped plate or fulcrum, to which a spiral compression spring is connected. There are three holes in this disc, giving three adjustments, viz: for holding the tongue to the right-hand track, for holding it to the left-hand track, or for either direction, as shown in the lowest diagrams.

MORE SEMI-CONVERTIBLES FOR CHARLESTON, S. C.

The Charleston Consolidated Railroad was one of the last roads to be electrified in the South, so that its equipment is quite modern. Thirty miles of tracks are operated in the city through the principal business and residential sections, and reach the ferries, depots and places of amusement, as well as a number of parks. The Seashore division, 10 miles in length, is operated through and to three summer resorts, Mt. Pleasant, Sullivan's Island and the Isle of Palms, and the latter, which is shown in the engraving, is the leading seashore pleasure resort of this section of the South. This division of the Consolidated Railroad enjoys a large travel during the summer months. It also operates through Fort Moultrie, one of the largest military reservations of the Government and one of the harbor defenses. On the city lines are situated several pleasure parks, namely Battery Park, Hampton Park, where the recent exposition was held, and the South Atlantic Baseball Park. The suburban line passes through a very large and flourishing truck country, and handles the traffic of fifteen fertilizer and lumber mills employing 4500 to 5000 hands daily. This line also handles the traffic of the new Navy Yard now being constructed directly opposite the terminal of the street railroad.



INTERIOR OF PAVILION, ISLE OF PALMS, CHARLESTON, S. C.

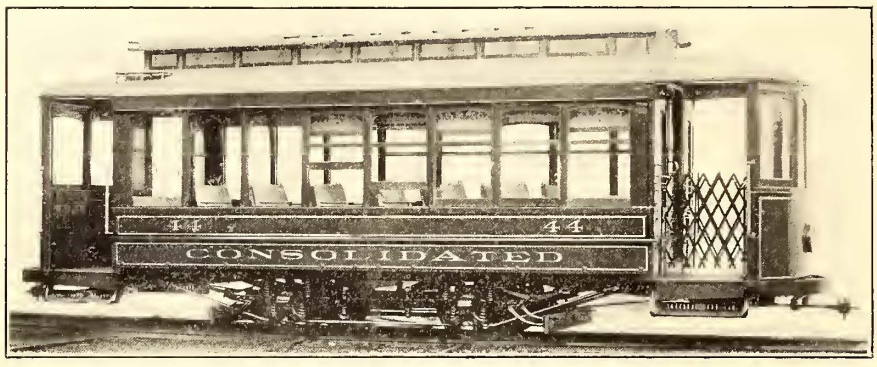
The present equipment of the road consists of twenty-five double truck cars, fifty-two single truck open and closed cars, two flat freight cars, two construction cars, two combination freight and passenger cars, and one box car. The city lines are equipped with 92½-lb. girder rail; the suburban and seashore lines with 60 and 50-lb. T rails. The climatic conditions of Charleston and vicinity are such that traffic is good during the entire twelve months. The winters, balmy and spring-like, make it popular as a tourist resort, and the exhilarating climate of this celebrated coast resort, the Isle of Palms, owned by the Consolidated Railroad, brings thousands to Charleston during the summer months.

The business of the company has grown to such an extent that an order has been placed with the J. G. Brill Company for a number of Brill grooveless-post, semi-convertible cars, this type now having been adopted as the company's standard. These cars, which are now being delivered, will be operated over the belt line of the street railway, which passes all the most prominent hotels and public buildings, steamship lines, ferries, union station, and also through the best residential section of Charleston. It is mainly due to the build-

HOTEL, FERRIS WHEEL AND PAVILION ON ISLE OF PALMS, NEAR CHARLESTON, S. C.

ing of the new union station, which will materially increase traffic on the belt line, that these new cars have been ordered. The company states that it has been operating single-truck cars of the same type for the past year with considerable success, and is satisfied that this type is the best for its conditions.

The dimensions of the cars are as follows: Length over the end panels, 20 ft. 8 ins.; length over the crown pieces and vestibules, 30 ft. 1 in.; width over the sills, 7 ft. 8½ ins.; width over the posts at belt, 8 ft.; sweep of posts, 1¾ ins.; centers of posts, 2 ft. 5 ins.; size of side sills, 3⅜ ins x 5 ins.; thickness of corner posts, 3⅝ ins.; thickness of side posts, 2¾ ins. The cars have a natural finish of cherry and the ceilings are of maple, decorated. The seats are upholstered with spring cane seats and back and fitted with corner grab handles. The Brill 21-E single truck on which the car is mounted has a wheel base of 7 ft. The wheels have a diameter of 33 ins., with 3¾ ins. axle diameter. Two motors of 40-hp capacity each are used per car.



SINGLE TRUCK, SEMI-CONVERTIBLE CAR FOR CHARLESTON, S. C.

HIGH-PRESSURE PUMPS FOR FIRE SERVICE

In taking care of an amusement ground, one of the principal points to look after is the protection of the buildings from fire. Park buildings are usually of very light construction, but even if intended for only one or two seasons the management should not neglect the possibility of fire, for one large conflagration may do irreparable injury to the park business. As many resorts of this kind are located far from municipal water mains, the high pressures required for effective fire-fighting must be obtained through special pumping machinery. For situations of this character and other places where the water pressure is too low, the Goulds Manufacturing Company, of Seneca Falls, N. Y., builds several types of fine pumps. Rather than go into any detailed description of their construction, it may be of more interest to describe at some length the characteristic high-pressure fire-protection plant installed by this company at Coney Island, New York.

Frequent fires made it necessary for the city officials to devise some means for better fire protection than could be given by the city fire department with the limited facilities at its command. It was therefore decided to construct a high-pressure water works system capable of delivering 4500 gallons of water per minute with a pressure at the pumps of 150 lbs. per sq. in., producing a pressure at the fire hydrant of at least 125 lbs. when the full capacity of the station is utilized. This project has been completed, and the city has now a fire system ready for any emergency.

The fire-fighting force located at the Island consists of two fire engines and one truck; forty minutes more are required to bring four additional steamers into service, and their supply of water was drawn from the domestic service pipe which supplied the island. This pipe was but 12 in. in diameter from a pumping station two miles distant, and the supply was barely sufficient for the ordinary daily demands of the service. As a fire started in this congested and highly inflammable district would spread with great rapidity, it was deemed necessary to provide for a large volume of water that could be concentrated at any point in the protected area. In view of the distance of Coney Island from the high-pressure city mains, a decision was reached to install a special pumping station. This is located on Coney Island Creek adjoining the sewerage disposal plant, about 1800 ft. from the main avenue of the protected area and about opposite the center of that area. The building is 37 ft. x 62 ft., one story, brick, built on heavy concrete base laid on a pile foundation, the floor level being about 4 ft above mean high tide. In this building are installed three Goulds triplex double-acting piston pumps, especially designed to resist the action of salt water, and provision is made for adding another pump in the future. Each pump is direct connected to and driven by a Nash vertical three-cylinder gas engine, and the combination is an independent unit not dependent upon any other. A special 16-in. high-pressure main leads from the pumping station to the main avenue of the protected area, and along this avenue in both directions to the limits of the district.

TEST OF HIGH-PRESSURE WATER SERVICE AT CONEY ISLAND, N. Y.

Several 12-in. branches are laid under the walks leading out toward the beach, and a number of private connections have

been made for fire protection only. The hydrants are located about 150 ft. apart in such positions that the full capacity of the system can be concentrated upon any one block of buildings.

Fresh water is supplied to the pumps from two practically distinct sources. The old city service 12-in. main is connected to a 12-in. service pipe which enters one end of the building extending its full length, just below the suction of each pump, to which it is connected. A new 20-in. city service pipe from a storage reservoir in the city is also connected to this 12-in. station main, and this station main is also connected to the discharge pipe from the pumps to keep the system at all times under full city pressure. In addition to these two sources of supply, suction connection is made with the pumps to draw water from Coney Island Creek, adjacent to the station building, so that salt water can be used in an emergency. A concrete pump well 6 ft. x 14½ ft. and 14 ft. deep is located just at the rear of the station building, this well being connected with a 24-in. intake main with a brick manhole, which in turn has an intake from the creek 9 ft. below mean high tide. The discharge from each pump is fitted with a water-relief valve that can be set for any pressure up to 200 lbs. When the pressure in the main exceeds that at which this valve is set, the valve opens and the pump discharges through suitable connections into the overflow pipe which ends in the salt-water well.

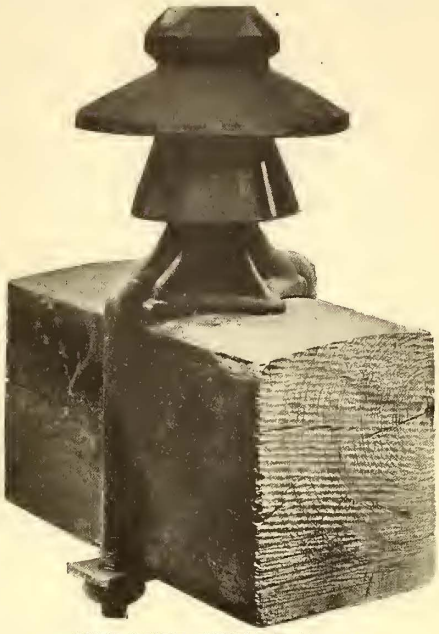
Each pump is also fitted with a by-pass connecting the discharge from pump with the overflow pipe. This by-pass is controlled by an electrically operated gate-valve. Each engine is started with the by-pass valve of its pump open, and when the engine has attained full speed this valve is gradually closed by an electric motor, which automatically stops when the valve is fully closed or opened; the pump then begins to deliver water to the mains.

A NEW INSULATOR PIN

In the description of the transmission line and third-rail system of the Long Island Railroad published in the June 9 issue, attention was called to the new type of iron insulator pin employed. This pin, which is a radical departure from previous practice in pin design, is the invention of W. N. Smith, of Westinghouse, Church, Kerr & Company, who has applied for a patent on the device. The design has been further improved, and arrangements are now being made for manufacturing and placing it on the market under the name ot the Smith-grip insulator pin.

It combines several important advantages, as follows: It does away with the necessity of boring holes in the cross-arms, thereby conserving the whole strength of the arm and lengthening its life; the metal composing it is distributed in the most effective manner possible, as its cross section is greatest next to the arm where the greatest resistance to bending is required. Finally, the shrinkage of the arm can more effectively be taken care of by the U-bolt and strap than by any of the other forms of pin fastening in common use, as there is no tendency to distort the bolt, and consequently there is no possibility of the pin standing crooked upon the arm after the shrinkage has been taken up. Furthermore, it is practically indestructible, and instead of being one of the weakest factors in line construction, this pin is expected to be the strongest.

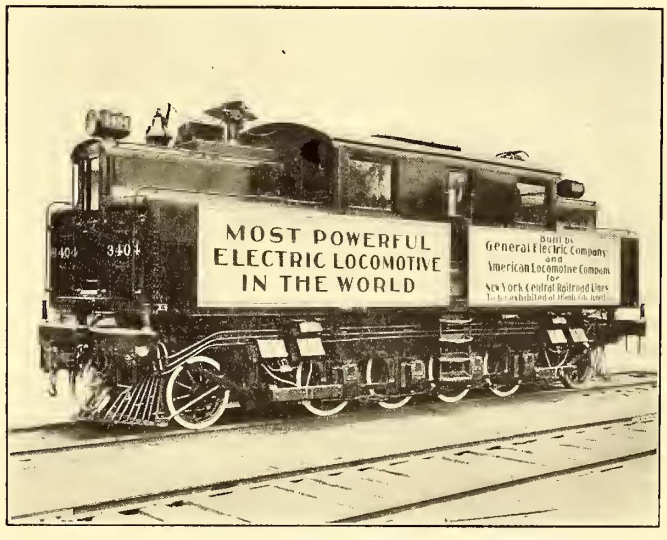
More than 8000 of the pins, as originally designed and shown in the accompanying illustration, were used in the transmission line construction of the Long Island Railroad, carrying 250,000 circ. mil cables in spans averaging 150 ft. in length, and no failures have yet been reported after over a year of service. A dozen or more standard sizes of the improved design are being worked up to fit several sizes of cross-arms and pole tops, and to carry insulators of varying sizes up to the highest voltages in practical use. The pins will be made of either cast or malleable iron. While it is designed particularly for use with wooden cross-arms, it can readily be adapted to steel cross-arms, and to such special fixtures as are often necessary in heavy transmission line construction.



GRIP TYPE INSULATOR PIN

ELECTRIC LOCOMOTIVE AT ATLANTIC CITY

One of the 100-ton electric locomotives which the General Electric Company and the American Locomotive Company are furnishing for the electrification of the New York Central lines in New York City arrived in Atlantic City June 8 from Schenectady, N. Y. During the attendance this month at various electrical and railroad conventions, prominent officials from all parts of the country will have an opportunity to inspect the locomotive. Its capacity under ordinary working conditions is 2200 hp, and it is said to be able to develop a speed of 80 m. p. m. when in regular operation. The locomotive is the same type as the famous "6000" which has many times distanced its steam competitor while working out on the test track on the New York Central road near Schenectady, but bears on its side the number 3404 and the inscription "New York Central Lines."



ELECTRIC LOCOMOTIVE EXHIBITED AT ATLANTIC CITY

The electric locomotiive is primarily on the ground to serve as an actual example of what many of the master mechanics will soon encounter in their daily work.

FINANCIAL INTELLIGENCE

Wall Street, June 13, 1906.

The Money Market

Increasing ease characterized the money market in all its branches during the past week. The heavy receipts of funds from San Francisco and the expected arrival of large amounts of money from other sources in the near future were reflected in a further material decline in interest charges for all maturities. Money on call, which loaned as high as 5 per cent in the preceding week, was obtainable in quantities during the current week at 3½ per cent and 3 per cent. Asking rates for time accommodations ruled fully ¼ per cent below those prevailing a week ago, and even at the reduced quotations borrowers were not inclined to enter the market upon a large scale. The demand for money was principally for over the year, which was supplied at 5 per cent. Lenders generally experienced considerable difficulty in placing short-time loans, this probably being due to the fact that contracts made for sixty and ninety days would carry the borrower well into crop moving season, when renewals would be difficult, except at materially higher rates. At the present time there is nothing in the situation calculated to cause any disturbance in the market. The demand for money for stock speculation is very light, while the banks continue to strengthen their resources by the influx of funds from all parts of the country. In addition, Government disbursements on account of pensions are expected to be larger during the balance of the month, and arrivals of gold from the Klondike will soon materially increase the supply of funds at this center. The latter movement has already begun, and it is estimated that between $30,000,000 and $35,000,000 gold will come from the Klondike and Alaska this summer. It is expected that final arrangements for floating the $50,000,000 Pennsylvania loan in Paris will be completed in a few days, and this will divert a strain to which the local money market would otherwise have been subjected. Foreign exchange has ruled decidedly strong, owing to the extremely light supply of commercial bills and other classes of remittances. The European markets have ruled easy, but without important changes in discount rates. The bank statement, published on last Saturday, was rather disappointing. Loans were $7,619,400 larger than in the preceding week, while deposits increased $10,384,300. The gain in cash was $2,942,100, but as the expansion in deposits caused an increase of $2,596,075 in the reserve required, the surplus was increased by only $346,025. The surplus reserve now stands at $7,162,050, as against $6,816,025 in the previous week, $9,827,500 in the corresponding week of last year, and $35,562,400 in 1904.

The Stock Market

The stock market during the past week has been very irregular, and the price movement has reflected the conflicting opinions regarding the ultimate outcome. Throughout the week the market has been influenced almost entirely by crop reports. For a time there was considerable apprehension that the Government crop report would be unfavorable, but the publication of this on Monday last showed the condition of winter wheat to be 83 per cent, as against 91 per cent on May 1, 86 per cent on June 1 of last year, 78 per cent on June 1, 1904, and 78 per cent as a ten years' average. The publication of the report was followed by a higher range of values, but toward the close of the week there was heavy selling of stocks by Western houses which caused sharp reactions. This selling was based largely upon the belief that both the wheat and corn crops have suffered since the compilation of the Government figures. This belief was also shared by the grain trade, prices for both wheat and corn advancing sharply at the close. A noteworthy feature of the week was the pronounced strength in St. Paul, which was accompanied by reports that the company will issue stock or bonds to finance the Pacific Coast extension, and that this issue will carry important rights to the stockholders. General conditions continued encouraging. Railroad earnings show gratifying increases over those for the corresponding period of last year, and the great activity in the iron and steel trades continues unabated. Money is cheap and in plentiful supply, and apart from a flurry in rates at the close of the month, as a result of the July 1 interest and dividend disbursement, there is nothing in the monetary situation to carry any material change in the rates for either call or time loans. The general market was dull, however, and failed to respond to these influences. Taking the situation as a whole there is no good ground for pessimism. The banking interests are indifferent, and operations are confined largely to the speculative element.

The local traction stocks ruled quiet but firm, especially Brooklyn Rapid Transit, which advanced on increased earnings and reports of a dividend on the stock in the near future. The other traction issues also displayed moderate strength on reports of larger earnings.

Philadelphia

Greater activity developed in the traction issues during the past week, but the dealings were accompanied by generally lower prices. Philadelphia Rapid Transit was again the leader of the group, about 2500 shares changing hands at from 25½ to 25. Philadelphia Company's issues displayed some strength early in the week, the common rising to 52, but toward the close there was a reaction to 50½, a net loss of ½ for the week. The preferred held steady, several hundred shares selling at 49⅞ and 49¼. A meeting of the stockholders of the company has been called for August 14, to ratify an increase in the capital stock from $36,000,000 to $42,000,000, by issuing 120,000 shares of the par value of $50 each. The proceeds of the new stock will be used for improvements, etc. The company has declared the usual quarterly dividend of 1½ per cent on the common stock, payable on Aug. 1. Fairmount Park Transportation sold at 17½, and small amounts of Consolidated Traction brought 82. Philadelphia Traction held firm at 98¾; Union Traction displayed decided strength. Early transactions were made at from 63¼ to 63¾. Later transactions were at 62½ and 63, ex. the dividend of $1 per share, which is equivalent to an advance of ½ point. American Railways also displayed considerable firmness, the price rising to 52¾ and closing at 52½, a net gain of 1⅛ points. Other sales included United Railway Investment of San Francisco at 65⅞, Railways General at 6¾, and United Traction of Pittsburg preferred at 51.

Chicago

Interest in the Chicago market centered largely in the elevated issues, nearly all of which advanced sharply on a somewhat larger volume of business. Metropolitan common rose 3 points to 30 on the purchase of 600 shares, while the preferred stock advanced 2 points to 72, on the exchange of nearly 1000 shares. South Side Elevated ruled 1½ higher at 98. Northwestern common jumped up 2 points to 28, and the preferred stock ended the week with a gain of 3 points. Chicago & Oak Park common brought prices ranging from 6¼ to 6⅞, while the preferred advanced from 22 to 24. The shares of the surface lines were extremely quiet, but prices held firm. North Chicago rose from 47¾ to 49, but reacted a point at the close. West Chicago was practically unchanged, with sales at 37 and 37¼, but Union Traction was firmer with transactions at 5½ and 5⅛.

Other Traction Securities

In the Baltimore market United Railway incomes furnished the leading feature of the trading, upwards of $235,000 changing hands at from 72½ to 73⅝, a net gain of more than a point. It was reported that a plan was being considered by banking houses by which sufficient money could be raised to pay off the accrued interest on the income bonds, which now amounts to about $1,400,000, and also to provide for a sufficient sum to put the property in good physical condition. The income bond certificates were also stronger, $70,000 changing hands at prices ranging from 71¼ to 72⅛. The 4 per cent bonds were quiet and steady, $40,000 selling at 92¼ and 92½. United Railway free stock sold at 16⅛ for 200 shares, and 400 shares of the pooled stock brought 16⅛ and 16⅜. Other transactions included Norfolk Railway & Light 5s at 99, Charleston Consolidated Electric at 95½, and Macon Street Railway & Light 5s at 101.

Apart from the unusual activity and pronounced strength in

the Massachusetts Electric shares, the Boston market was devoid of noteworthy feature. Massachusetts Electric common opened at 20¾, and on purchases of about 6000 shares the price rose to 23, while the preferred stock moved from 70½ to 73, on the exchange of more than 4000 shares. Otherwise the trading was quiet. Boston & Suburban common moved between 21½ and 22¾, and the preferred sold at 70 and 70½. Boston & Worcester common sold at 35 and 37 for odd lots, and the preferred brought 87½ and 88. Boston Elevated was steady at 153. West End common sold at 97½, and the preferred at 112.

Cincinnati, Newport & Covington Traction continues to be the active feature of the Cincinnati market. About 600 shares changed hands at practically stationary figures, 73½. Cincinnati Street Railway sold at 144, a fractional advance. Cincinnati, Dayton & Toledo declined a quarter to 26¼. Toledo Railways & Light was stationary at 34.

There was comparatively little activity in tractions in Cleveland. Aurora, Elgin & Chicago was the most active issue, the common selling at 35 and the preferred around 79½. These figures are in keeping with the past sales. Northern Ohio Traction & Light was a shade off in spite of the dividend announcement of last week. Several lots sold at 30, a decline of 2 points. Cleveland Electric continues quiet, selling at 79 to 79½. Lake Shore Electric sold at 16 for several lots of a fractional decline.

Toledo & Western was quite active in Toledo on the announcement that Mathew Slush had been unable to buy control of the stock at 15. It advanced steadily from 15½ to 18, and closed the week at 19 bid and 20 asked. The 5 per cent bonds of this company sold at 89½.

Security Quotations

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

	June 6	June 13
American Railways	51½	52½
Boston Elevated	153	151
Brooklyn Rapid Transit	84	84⅛
Chicago City	170	170
Chicago Union Traction (common)	4½	4⅞
Chicago Union Traction (preferred)	13	13
Cleveland Electric	81	80
Consolidated Traction of New Jersey	81½	81½
Detroit United	94	95
Interborough-Metropolitan Co. (common)	50¼	51
Interborough-Metropolitan Co. (preferred)	84	85
Interborough-Metropolitan Co. 4½s	—	—
International Traction (common)	59	58
International Traction (preferred), 4s	80	80
Manhattan Railway	152	151
Massachusetts Elec. Cos. (common)	20⅝	22⅜
Massachusetts Elec. Cos. (preferred)	70⅜	73⅜
Metropolitan Elevated, Chicago (common)	27½	29
Metropolitan Elevated, Chicago (preferred)	69½	70
Metropolitan Street	a114	112
Metropolitan Securities	—	—
New Orleans Railways (common)	32	32½
New Orleans Railways (preferred)	80	82
New Orleans Railways, 4½s	88¾	89¼
North American	98	97
North Jersey Street Railway	27	27
Philadelphia Company (common)	51	51
Philadelphia Rapid Transit	25½	24¾
Philadelphia Traction	98½	99
Public Service Corporation 5 per cent notes	95¼	95½
Public Service Corporation certificates	69	69
South Side Elevated (Chicago)	96½	98
Third Avenue	129¾	128
Twin City, Minneapolis (common)	115¼	114⅛
Union Traction (Philadelphia)	63	*63
West End (common)	—	—
West End (preferred)	—	—

a Asked. * Ex-dividend.

Metals

The "Iron Age" says that so far as stocks of iron are concerned, it may be stated, with the reserve which the absence of official statistics from the East and Central West imposes, that accumulations are very light. Consumption is keeping wonderfully close to an enormous production. Some wild reports of large sales of Bessemer pig for forward delivery have come from Pittsburg, which prove to be incorrect, at least so far as the United States Steel Corporation is concerned. That interest has not purchased more than trifling quantities for the third quarter. Only a moderate business for forward delivery is being done in foundry iron. The markets for structural material are rather quiet.

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

ENTERTAINMENT PROGRAMME FOR NEW YORK STATE CONVENTION

In connection with the annual convention of the Street Railway Association of the State of New York, to be held at Saratoga on Tuesday, June 26, and Wednesday, June 27, the association has decided upon the following entertainment programme.

On Tuesday afternoon there will be a carriage drive in and near Saratoga for the ladies, and on the evening of that day the banquest will be held. There will be a trolley ride and luncheon on Wednesday morning, and a dancing party in the ball room of the Grand Union Hotel on Wednesday evening. For Thursday an excursion has been planned to the General Electric Works for such of the delegates and guests who desire to remain for the same. Luncheon will be served at the General Electric Company's works.

IMPORTANT JERSEY DECISIONS

The Supreme Court at Trenton, N. J., held June 11, that the suit of Jersey City against the North Jersey Traction Company should not be pressed, because the company's charter is plainly not void. The city said the charter was void. The court holds an act extending the charter legal, and also that even if this were not the case the company could legally operate under the traction act. The city has several other actions pending by which it expects to regain the franchises granted thirty and forty years ago.

The Supreme Court also gave a decision holding that a person or corporation liable to a franchise tax for the use of the public streets under the act of 1900 is not liable to a property tax on the same property. Jersey City claimed the right to tax the properties of the Public Service Corporation. The company, under the act of 1900, pays a license tax for the right to use the highways. The city claimed the further right to tax the real value of the tracks and rolling stock. This, the court holds, cannot be done.

HIGH-VOLTAGE DIRECT-CURRENT LINES ON THE CONTINENT

In view of the experiments now being made in this country with direct-current motors using potentials above the present standard, it is interesting to note that in Germany and other countries, the Siemens-Schuckert Works have completed, or have under construction, a number of lines of this character. At the present time they are building several lines exclusive of the 1000-volt Cologne-Bonn Railway, which was described in this paper recently, and the Berlin elevated and subway lines, which use 800 volts.

One contract covers various branches of the Cologne suburban lines, which are to employ 700-800 volts direct current. On the Castellamare de Stabia-Sorrento (Italy) line, an operating current of 825 volts will be used, and also one of 750 volts at the center of the line. This system will be 19.4 km (12 miles) long, have a 950-mm (3 ft. 1½ ins.) gage, and with a maximum grade of 6.2 per cent and a minimum curve of 15 m (49 ft.). The highest speed at which cars will be run will be 30 km (18.6 miles) per hour. Current will be taken through trolley bows. At present there are twelve cars in operation, carrying 50-hp motors. Another line under construction is the Moselhütte Freight Railway (Maizieres-St. Marie). It will be 14.5 km (9 miles) long, and will use 2000 volts direct current. A freight railway is also being built for the Anhalt Coal Works, Reppist, near Senftenberg. This is to be a 900-volt line, 6.5 km (4 miles) long, 1435 mm (4 ft. 8½ ins.) gage with a grade of 1 per cent.

NEW ORDINANCE DRAFTED FOR THE SETTLEMENT OF THE CHICAGO TRACTION PROBLEM

Walter L. Fisher, special counsel on traction matters, has drafted an ordinance which embodies a plan for bringing about a settlement between the city and the street railway companies, and which has met with the approval of Milton J. Foreman and other prominent Aldermen. Mr. Fisher's plan is for the city to deal directly with the Chicago City Railway Company, and another termed in the draft of the ordinance the Unified Street Railway Company, which is to take over the properties of the Union Traction Company and its underlying companies. The proposed ordinance provides that the two companies shall proceed at once to reconstruct the tracks and roadbeds and put the entire systems in first-class condition. As long as they operate the systems, the companies are to expend certain amounts in renewals and repairs, and if the amounts specified are not expended in repairs, the balances are to be deposited with a trust company. The city has reserved the right to purchase and take over the properties of the systems on the first day of January, or the first day of July, upon giving at least six months' previous notice of its intention to do so. The plan provides for the immediate determination of the value of the physical properties, and also of the value of the franchises and rights, and these figures together with the costs of reconstruction and re-equipment of the lines are to be used in determining the purchase prices to be paid by the city for the lines. All the work of reconstruction and re-equipment is to be supervised and directed by a board of supervising engineers. The city also reserves the right to designate any person, firm or corporation as its licensee to purchase the systems at the expiration of twenty years upon the same terms that the city could purchase them. Of the gross receipts the railway companies shall first pay the costs of operation, maintenance and extensions and of the balances a certain per cent of the value of the present tangible properties is to be retained by the company. The remainders of the gross receipts are to be divided between the city and the companies in proportions to be decided upon.

At a meeting of the various Chicago traction interests in New York, an agreement was reached and formal action taken which will help materially to unravel the traction situation. Interests identified with the Chicago Union Traction Company and the North and West Chicago Street Railway Companies purchased and turned over to two trustees the stock of the Chicago Railways Company, which will be the parent company in the new scheme. Frederick H. Rawson, president of the North and West Chicago Street Railway Companies, was elected president of this parent company, while Henry H. Blair, receiver of the North and West Companies, was elected its vice-president. The Chicago Railways Company was organized some little time ago with a nominal capital of $10,000 for the purpose of holding the securities of the other companies and operating these companies. Under an agreement reached on May 25 last, between the various parties at interest, including the banking house of H. B. Hollins & Company, of New York, and representatives of the North and West Chicago Street Railway Companies, the stock of the Chicago Railways Company will be held in trust by George W. Wickersham, representing the New York interests, and L. C. Krauthoff, the representative of the Chicago traction interests. The present nominal capital of $10,000 of the Chicago Railway Company will be increased to whatever extent may be subsequently deemed necessary when full details are worked out in connection with the reorganization and the exchange of securities of this company for those of the Chicago Union Traction and the North and West Chicago Street Railway Companies. It has been agreed that the trustees shall formulate and promulgate a plan for this reorganization and financing, which, when formulated, shall be operative and binding. If the trustees themselves fail to agree upon such a plan, the Circuit Court of the United States for the Northern district of Illinois is to become practically the arbiter in the situation. The final plan for the distribution of any allotment of stock or securities to stockholders of the North and West Chicago Street Railway Companies or the Chicago Union Traction Company is to be submitted to Hollins & Company, and Henry H. Blair, Frederick H. Rawson, and George E. Adams, and upon its acceptance by them is to become binding. In the case of any dissent the final allotment may ultimately be determined by the decree of the Circuit Court of the United States for the Northern district of Illinois, as in the case of the reorganization plan itself. While all the negotiations regarding ordinances, under which the new company will operate the present traction systems, are to be conducted primarily by President Rawson, of the new Chicago Railways Company, and Vice-President Blair, the trustees of the Chicago Railways Company stock, Messrs. Wickersham and Krauthoff, will be represented in these negotiations by their counsel, W. W. Gulliver.

AN IMPORTANT JERSEY PROJECT

In accordance with the recent law passed by the State Legislature, a public hearing was given at the meeting of the Common Council of Summit, N. J., on June 5, to the Morris County Traction Company, which is applying for a forty-year franchise. The company wishes a feasible route to pass through Summit in order to get to Morristown and Dover, and so form connecting links between Dover, Morristown, Summit, Newark and Elizabeth. The line is completed and cars are in operation between Summit, Springfield and Union, the tracks having been laid about a mile in Summit's territory on a private right of way. At the conclusion of the hearing a motion was adopted referring the matter to the trolley committee of the Council, to report the necessary ordinance at the next meeting of Council.

F. H. Alleman, superintendent of the company, says he expects to have a full schedule running between Summit and Elizabeth within four months' time. When the entire line is completed there will be 104 miles of tracks, made up in sections as follows:

Dover division, Tabor to Stanhope, 20 miles; Morristown division, Tabor to Summit, 18 miles; Paterson division, Denville to Singac, 17 miles; Elizabeth division, Summit to Elizabeth, 9 miles; Newark and Westfield division, Springfield to Newark and Springfield to Westfield, 10 miles. The line will connect with the Easton Railroad at Stanhope, and with the Public Service Corporation at Elizabeth and at Paterson. At Maplewood it will connect with the Orange and Newark branch of the Public Service, and at Westfield with the Plainfield branch of the Public Service and with the Jersey Central Railroad. Private right of way has been secured wherever possible, and up to date the franchises obtained have been perpetual. The officers of the company are: Robert D. Foote, of Morristown, president; D. P. Skellenger, of Morristown, vice-president; D. L. Kay, of Morristown, treasurer; F. H. Alleman, of Summit, secretary and general manager; former Judge W. W. Cutler, of Morristown, counsel.

NEW YORK TRANSIT COMMISSION CONSIDERS BROOKLYN PROSPECTS

At the meeting of the Rapid Transit Commission of New York on Thursday, June 7, matters were considered that are largely of interest to Brooklyn. The first subject discussed was the question of the probable time of the completion of the Brooklyn tunnel. Mayor McClellan expressed concern as to the finishing of this work, because of the recent accident, to which reference has been made before in these columns. Mr. Rice, the chief engineer of the Commission, said most emphatically that in his opinion work would be completed by Jan. 1. The board then proceeded with other business. It formally approved of the loop terminal for the Coney Island subway. This will now be returned to the Board of Estimate, where it will be approved. Albert B. Boardman reported that, on June 18, the courts would confirm the reports of the commissioners on the Brooklyn routes. If all were well with the Manhattan routes, this would remove the last obstacle in the way of putting up the routes for bidders, but the opposition to the line through William Street, which is really the key to the Brooklyn system, is quite as active as ever, and on this account a further delay of the Brooklyn lines is not unlikely.

F. H. Behr, promoter of the Behr monorail system, appeared before the commission and explained the merits which he claims for his system. Mr. Behr said his proposition was to construct an elevated line from Flatbush and Atlantic Avenues to Coney Island. He said he had the money pledged for this line, and would not ask the city to put up a cent. The running time between these points, he said, would be substantially 8 minutes, the cars running at a speed of 60 miles an hour. Alternate cars will stop at alternate stations, so the service at way stations will be on an 8-minute headway, while cars will leave Flatbush Avenue every 2 minutes. Mr. Behr said he would build a loop line tapping Coney Island and going over the Williamsburg Bridge in less than one year. He offered in evidence letters written by William Barclay Parsons, late chief engineer of the Rapid Transit Commission; Gustave Lindenthal, late Bridge Commissioner, and Joseph Ramsey, Jr., the well known railroad engineer, all indorsing the plan.

DEAL COMPLETED FOR LINE FROM PITTSBURG TO WHEELING

Announcement has been made of the consummation by W. Caryl Ely, of Buffalo, and his associates, as the Ohio Valley Finance Company, of the plan to secure a through electric railway line in the Ohio Valley from Pittsburg to Steubenville and eventually to Wheeling. According to the statement issued the merger has been perfected connecting up the lines from Steubenville to Beaver, Pa. Connection from Beaver will be made via the Pittsburg Railways Company, which is now building a double track line to the former point. The plans were all completed some time since and the work of construction is now well under way on the double-track lines that will, eventually, by means of the proposed extension of the Pittsburg Railways company, mean trolley service from Wheeling to Pittsburg. The East Liverpool Traction & Light Company, the Ohio River Passenger Railway Company, with a Pennsylvania charter, to build 11.17 miles of track, and the Steubenville & East Liverpool Railway & Light Company, to build 8 miles of track to connect with the lines of the Steubenville Traction & Light Company at Toronto, are the companies closing up the gaps. All told, the companies, of which the officers are identical, control and will operate 66 miles of river front electric railway with easy curves and low grades, the maximum being not over 1½ per cent. The lines will serve a population of about 225,000 people. The capital interested has purchased the East Liverpool Traction & Light Company, owning the street railway lines in East Liverpool and Wellsville, Ohio, and Chester, W. Va., with the bridge over the Ohio River, and the summer resort of Rock Springs Park, W. Va., the entire system being about 12 miles in length. These lines will connect at the State line with the lines of the Ohio River Passenger Railway, now being built, a distance of 11.17 miles, passing through the new town site of Midland to Beaver, where connection will be made with the lines of the Beaver Valley Traction Company. Steubenville is now the terminus of another line connecting on the West Virginia side of the river with Wheeling, W. Va., and there is being constructed on the Ohio side a line connecting Steubenville with Wheeling, which when completed will make a double-track line from Steubenville to Wheeling. It is expected that all these connections and improvements will be completed by next year, when continuous trolley service will be inaugurated between Wheeling and Beaver. The syndicate also owns the right of way for a line from East Liverpool to Lisbon, Ohio, where connections are made with the Youngstown & Ohio River Railway Company's lines and through them with the interurban lines in Ohio and Indiana, and the great trunk lines running between Buffalo and Cleveland and other towns along the lake shore, both east and west.

ELEVATED RAILROAD RECOMMENDATIONS FROM THE RAILROAD COMMISSIONERS

The State Railroad Commissioners of New York have made a number of important recommendations regarding improvements to the elevated lines of the Interborough Rapid Transit Company. Most important among them are those that call for additional tracks. The recommendations are these:

1. That the Interborough Rapid Transit Company, operating the Manhattan Railway, extend the spur of the elevated structure now ending near the junction of Willis Avenue and 145th Street through Willis Avenue to Bergen Avenue to Westchester Avenue, there connecting with the tracks of the elevated extension of the subway system.

2. That a third track be placed on the Second and Third Avenue lines from the Harlem River as far south as practicable.

3. That additional track or tracks be constructed from 129th Street north to Bedford Park.

4. That when the above-mentioned tracks are constructed an express service shall be installed on the Second and Third Avenue lines, which shall be operated during the entire day, a portion of which trains shall be run to and from West Farms.

The Board suggests to the Interborough Rapid Transit Company that it institute an express service to be operated all day between West Farms and the City Hall via the subway.

While this communication, with its findings, suggestions and recommendations, is primarily intended for the Interborough Rapid Transit Company, a copy is forwarded to the Board of Rapid Transit Commissioners, with the respectful suggestion that such action as is necessary to make these recommendations effective be taken by the Rapid Transit Commission.

'BUS LINE FOR PHILADELPHIA

A bill authorizing the Department of Public Works of Philadelphia, to issue licenses to the People's Vehicle Company for operating an automobile 'bus line in the city has been approved by Councils' highway committee. According to the bill, the rate of fare will be 5 cents, six tickets to be sold for 25 cents and twenty-five for $1. Public school children will be carried for a 2-cent fare on Saturdays, between 8 a. m. and 4 p. m., on all vehicles running to and from Fairmount Park. They will also be carried for the same fare on other days between 9 a. m. and 3 p. m., when accompanied by their teachers. The company agrees to pay a license fee of $100 for a vehicle having a seating capacity of twenty passengers, $150 for a thirty and $200 for a forty-passenger omnibus. A thirty-year franchise is desired, with the understanding that the city may at the termination of that period renew the franchise for a like time or acquire the stock of the concern at its appraised value. The bill provides for the installation of auto-omnibuses on the following streets:

Broad Street, from League Island to the city line and return.

Market Street, from Broad to the Delaware River and return.

Delaware Avenue, from Callowhill to Dock, Dock to Third, Third to Market, both ways.

Diamond Street, from Front to Ridge Avenue, to Dauphin, to Park entrance and return.

Hunting Park Avenue, from Broad Street to Hunting Park and return.

The Parkway, from Twenty-Sixth Street to Broad, to Locust Street, to Fourth, to Walnut, to Delaware Avenue; return on Walnut to Broad, to Parkway, to Twenty-Sixth Street.

Aspen Street, from Haverford Avenue to Lancaster Avenue, to Hamilton, to Thirty-Second, to Spring Garden, to Broad, to South Penn Square; return to Spring Garden, to Lancaster Avenue, to Aspen, to Haverford Avenue.

Forty-First Street, from Parkside Avenue to Lancaster Avenue, to Thirty-ninth, to Walnut, to Broad, to Filbert; return to Walnut, to Fortieth, to Parkside Avenue, to Forty-First Street, with the privilege of using such other streets as are necesary to reach barn or garage.

PLAN TO ELECTRIFY MARYLAND & PENNSYLVANIA

It is reported in Baltimore that the General Electric Company has been engaged by the Maryland & Pennsylvania Railroad to report regarding the electrification of the company's line, which extends from Baltimore to York, Pa., a distance of 79 miles. Gen. Brown, of the company, is quoted as stating that at present perhaps the line may be electrified only as far as Belair, a distance of about 25 miles.

GRATUITY FOR MANILA EMPLOYEES

On April 1, 1906, the Manila Electric Railway & Light Company set aside a certain sum of money for the purpose of rewarding faithful, efficient and continuous service on the part of the motormen and conductors. The circular announcing the gratuity, which was posted conspicuously, says: Every regular motorman and regular conductor in the employ of the company on April 2, 1906, and who shall remain in the employ of the same for six months continuously thereafter, rendering faithful and efficient service, shall receive as a gratuity a sum equal to one and one-half centavos per hour for each hour of service rendered during the months of April, May and June of the same year; and every three months thereafter shall receive a like gratuity while so employed, provided he shall continue to render efficient service.

Regular motormen and conductors are those who have a car assigned to them daily, and extra motormen and conductors are those who take the places of regular motormen and conductors when absent. Regular motormen and conductors only are eligible to receive this.

On the first day of each month, after April 1, every motorman and conductor who shall have become a regular motorman or regular conductor during the preceding month, shall be eligible to receive the gratuity after six months' continuous service.

This gratuity will not be presented to any employee who shall have been discharged, or who voluntarily leaves the service.

In the event of the death or the permanent disability of motorman or conductor the gratuity will be presented to his estate or himself, as the case may be.

CANADIAN ASSOCIATION MEETS

The semi-annual meeting of the Canadian Street Railway Association was held at Chateau Frontenac, Quebec, last week. W. G. Ross, Montreal, presided, and these companies were represented: London Street Railway Company, Southwestern Traction Company of London, Niagara, Toronto & St. Catherines Railway Company, Toronto Railway Company, Toronto & York Radial Company, Toronto Suburban Railway Company, Montreal Street Railway Company, Quebec Street Railway Company, Halifax Street Railway Company, St. John (N. B.) Street Railway Company. Among the papers read was that by Mr. Neilson, Toronto, on track construction and maintenance of way, and the one on gasoline-operated motor cars.

REFERENCE BOOKS FOR ELECTRICAL ENGINEERS

The electrical engineering department of Sibley College has recently issued a bulletin giving a list of reference books for electrical engineers, which have been selected in conference with the leading teachers of electrical engineering and with a number of prominent practicing engineers. Each book represents the judgment of a number of persons, and the list is arranged in order of the number of votes cast. The list has been condensed so as to include only those books which are deemed most useful to a young engineer leaving a technical school. It is proposed to issue this list annually for the benefit of each senior class.

Electric Lighting—"Electric Lighting," F. B. Crocker, two volumes, $6.00; "The Art of Illumination," Louis Bell, $2.50.

Electric Railways—"Electric Railways," Ashe & Keiley, $2.50; "Electric Railway Economics," W. C. Gotshall, $2.00; "Power Distribution for Electric Railways," Louis Bell, $2.00; "Practical Electric Railway Handbook," A. B. Herrick, $3.00; "Engineering Preliminaries for Interurban Electric Railways," E. Gonzenbach, $1.00; "Report of the Electric Railway Test Commission," $6.00.

Telephony—"Telephony," A. V. Abbott, six volumes, $6.00; "American Telephone Practice," K. B. Miller, $4.00.

Power Generation and Transmission—"Electric Power Transmission," Louis Bell, $4.00; "Electric Transmission of Energy," A. V. Abbott, $5.00; "Storage Battery Engineering," Lamar Lyndon, $3.00; "Electrical Conductors," F. A. C. Perrine, $3.50; "High-Tension Power Transmission, A. I. E. E. and International Electrical Congress Papers," two volumes, $5.50.

Design and Construction of Electrical Machinery—"Design of Dynamos," S. P. Thompson, $3.50; "Electric Motors," H. M. Hobart, $5.00; "Induction Motors," B. A. Behrend, $1.50; "Alternating Currents," Alfred Hay, $2.50; "Practical Calculations of Dynamo Machines," A. E. Wiener, $3.00; "Armature Windings of Direct-Current Dynamos," E. Arnold, $2.00; "Induction Motors," B. de la Tour, translated by C. O. Mailloux, $2.50.

Measurements—"Testing of Electro-Magnetic Machinery," Swenson and Frankenfield, $3.00. "Electrical Engineering Measuring Instruments," G. D. A. Parr, $3.50; "Electrical Instruments," Carhart and Patterson, $2.00.

General Practical Works—"Electrical Engineers' Pocketbook," H. A. Foster, $5.00; "Mechanical Engineers' Pocketbook," Wm. Kent, $5.00; "Standard Polyphase Apparatus and Systems," M. A. Oudin, $3.00; "Mechanical Engineers' Reference Book, P. B. Supplee, indexed $5.50, not indexed, $5.00; "Steam Power Plants," H. C. Meyer, $2.00; "Practical Management of Dynamos and Motors," Crocker & Wheeler, $1.00; "Laboratory and Factory Tests in Electrical Engineering," Sever and Townsend, $2.50; "Electrical Engineering," E. Rosenberg, $1.50; "Central Electrical Stations," C. H. Wordingham, $7.50.

General Theoretical Works—"Theoretical Elements of Electrical Engineering," C. P. Steinmetz, $2.50; "Alternating Current Phenomena," C. P. Steinmetz, $4.00; "Alternating Currents," Bedell and Crehore, $2.50; "Alternating Current Engineering," E. B. Raymond, $2.50; "Elementary Lessons in Electricity and Magnetism," S. P. Thompson, $1.40; "Cyclopedia of Applied Electricity," American School of Correspondence; "Dynamo Electric Machinery," S. P. Thompson, $7.50; "Elementary Book on Electricity and Magnetism," D. C. and J. P. Jackson, net $1.40.

The most valuable reference books are the volumes of transactions of the engineering societies. It is suggested that students in electrical engineering join the A. I. E. E. either as students or associates. The value of the engineering periodicals also should not be overlooked.

THE RIGHT TO CHARGE EXCESS FARE ON LIMITEDS TO BE TESTED

The rights of interurban companies to charge excess fare on limited cars are to be tested in Indiana. N. A. Ward recently purchased a ticket at New Castle for Indianapolis over the Indianapolis & Eastern Company's line, which was stamped "not good for stopovers." After riding over the spur from New Castle to Dunreith he was required to change cars, and the first car that came on the main line was a limited, on which Mr. Ward took passage. The conductor, however, refused to accept the ticket unless 15 cents excess fare was paid. Mr. Ward refused to pay and was ejected. It is expected that this case will result in the handing down of a decision that will finally settle the question.

PECULIAR RULING BY OHIO ROAD COMMISSION

Traction companies in Ohio are likely to experience some difficulty in the future in securing right of way along the highways through the country districts of that State by reason of a ruling made by the State Highway Commissioner. The Commissioner has just rejected a number of applications for funds for road improvements, because portions of the highway are occupied by traction lines, and he says he will adhere to this policy of not allowing improved roads where the people have shown that they care more for trolley lines than for good roads. He claims that where trolley lines are located in such a manner as not to permit a ditch between the two, thus making them independent, it is impossible to maintain a satisfactory highway; that traction lines are usually built and repaired without due reference to the grades of the highway, and believes it inexpedient to improve such highways under State aid. He cites that New York, New Jersey, Massachusetts and Maryland have improved no roads where trolley lines are located on the traveled way, and when on the side of the road a trolley line must be so located that the two are independent of each other.

Fortunately for all concerned, the majority of new traction lines in Ohio have been built on private right of way, and in a great many cases the old roads are throwing their lines off from the highway to private right of way at the side of the road.

SOME EXCELLENT TRAFFIC CIRCULARS

There are three folders in this year's issue of pleasure pamphlets issued by the Boston & Northern and Old Colony Street Railway Companies, through their passenger department, for distribution among the patrons of the road. One of the folders is devoted expressly to the many parks and groves and beautiful recreation points along the lines of the two divisions of the road. The other two, which comprise within their pages schedules and time-tables as well as descriptive articles and rustic scenes, are devoted, one to the Boston & Northern division and one to the Old Colony division. The pamphlet descriptive of parks and groves is appropriately named "Parks and Groves." This folder contains instructive information and beautiful views. On the cover is a sketch showing a family, father, mother and little child, entering the gates of a park. The Old Colony folder is named "Old Colony Trolley Trips." Naturally the first thing to attract the attention is the beautiful cover. Standing high up on a great rock is shown the famous Indian chief immortalized by the poet Whittier, whose tribe, the Massasoits, once roamed and hunted the region now covered by the network of the modern trolley system. In full regalia he stands, overlooking silently the hills and great valleys and meadows of the South Shore. At his feet sweeps a beautiful lake. The folder, called "Trips by Trolley," is, from an external viewpoint at least, a complete contrast to the former. Portrayed on the cover is a typical modern mill city on the Merrimac. Standing a little apart on a rise of land, hat in hand and gun on shoulder, is an old-time colonist. Near him, among great trees stands his log cabin, and he gazes out, wonderingly, upon the city. Both of these folders are filled with descriptions of the many beautiful rides on the old South Shore and the rugged North Shore.

Still another circular, less elaborate than the others, describes a trip from Boston to New York by trolley and boat at a fare of $1.75. Through trolley cars are run between Boston and Fall River, where connections are made with the boats of the Enterprise Transportation Company. This service was begun June 11. The run from Boston to Fall River is made in 3 hours.

CONTRACT LET FOR BUILDING THE CLEVELAND, ASHLAND & MANSFIELD COMPANY'S LINE

The Cleveland Construction Company, of Cleveland, has been awarded the entire contract for building and equipping the line of the Cleveland, Ashland & Mansfield Traction Company. This road will be an extension of the Cleveland & Southwestern Traction Company system branching off from the southern division of that road at Seville and extending to Ashland and Mansfield. The new line to be constructed will be about 46 miles in length. It will be built entirely on private right of way except through villages. The Cleveland Construction Company is to commence work within sixty days, and will close contracts for construction work and material immediately. Track will be laid with 70-lb. T-rail, 60-ft. length in the country and 74-lb. 7-in. T-rail on paved streets. There will be approximately 362,450 yds. of excavating, and about 122,000 ties. Some 8050 soldered bonds will be required for the track work. Six inches of gravel or crushed stone ballast will be laid. The right of way will be fenced and vitrified, clay cattle guards will be used. There will be nine timber bridges of from 98 to 136 ft, and three girder spans 60 to 80 ft. long. The trolley wire will be two 000 figure 8, with bronze ears. Direct-current feeders will be 300,000 cm., and the high-tension lines No. 2 and No. 4. There will be approximately 87 miles of trolley wire, 12 miles direct-current feeders, 48 miles No. 2 and 126 miles No. 4 wire.

No power station will be built, and high-tension current will be sent from the Elyria power station of the Cleveland & Southwestern Traction Company over two circuits. There will be a cross-country line from the Wellington branch of the system to Polk on the new line, a distance of 16 miles, while another feeder will connect with the southern division of the Cleveland & Southwestern at Seville. The lines will be designed for 33,000 volts transmission, but 20,000 volts will be used at first. There will be five sub-stations, one of them a portable station, while the others are to be located in buildings at Leroy, West Salem, Nankin and Ashland. These buildings will include freight and passenger stations, residence for the attendant and machinery room. The buildings will be fireproof, built of concrete and steel with expanded metal roofs. There will also be switching stations at Wellington and Polk for operating the cross-country high-tension lines. These buildings are to be of concrete and will contain waiting room, freight room and ticket office. There will also be ten small waiting rooms built of concrete and expanded metal. The sub-stations will be equipped with one 300-kw rotary convertor, two 100-kw transformers, switchboard, lightning arresters, etc. The stations will be of sufficient size to permit of doubling the capacity later.

A car house and repair shop, 41 ft. x 184 ft., with a wing 10 ft. x 71 ft. will be erected near Mansfield. This building will be either of reinforced concrete or brick. It will be equipped with steel rooling doors, a crane and chain hoist of 3 tons capacity, two concrete pits, one of them fitted with four pneumatic car hoists. The building will be equipped with an automatic sprinkler system after specifications of the Traction Mutual Fire Insurance Company, and water supply will be furnished by a centrifugal pump with a capacity of 100 gals. per minute and a 300,000-gal. reservoir. There will also be a fireproof oil house adjoining the car house. At Seville there will be a brick car house 27 ft. x 126 ft., capable of holding four cars.

The rolling stock is not provided for in the present contract, but will be purchased a little later. It will include eight passenger cars, one express car and a portable sub-station. The passenger cars will be 51 ft. over all, having baggage, smoker and general compartments, and will be equipped with four 75-hp motors, air brakes, extra heavy trucks, fitted with 36-inch steel tired wheels. The express car will be 50 ft. long and will be equipped for double end control. The entire specifications were prepared by the Roberts & Abbott Company, of Cleveland.

Practically all of the underwriting of $1,000,000 of 5 per cent bonds and stock of the same amount has been subscribed, a greater portion of it being taken by the Pomeroy-Mandelbaum interests of Cleveland. The road will be operated by the Cleveland & Southwestern Company, and through cars will be run from Cleveland to Mansfield. The 82 miles will be covered by limited cars in 3 hours. Connection will be made at Mansfield with the line of the Ohio Central Traction Company, which is owned by the same interest, and eventually this will form the through route to Columbus.

DATE SET FOR CONVENTION OF THE COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION

The next convention of the Colorado Electric Light, Power and Railway Association will be held in Denver, Sept. 18, 19 and 20, 1906. The details of the programme have not yet been arranged.

ALLIS-CHALMERS COMPANY TO BUILD AIR BRAKES

Allis-Chalmers Company, of Milwaukee, has purchased the right to manufacture and sell the Christensen air brakes and air compressors, and has also secured the service of N. A. Christensen, who invented them. The immediate result of this new acquisition is that one of the Allis-Chalmers Company's shops is being fitted with a mechanical plant of original design for the construction of the Christensen air brake and compressors, and the next few months will witness the employment of 800 or 900 additional mechanics in this branch of the immense business.

Mr. Christensen, who is well known in the electric railway field, is not yet forty-one years old, and the air brake, his greatest achievement, was perfected when he was only twenty-seven, although not put into practical use until three years later. Its immediate success led to the formation of the Christensen Engineering Company, which was subsequently merged in the National Electric Company. He was born Aug. 16, 1865, at Toerring, a village in Denmark, and studied engineering at the Polytechnic Institute of Copenhagen. While in Copenhagen he made the first quick-firing Maxim gun built outside of England and America. It was constructed according to designs of Hiram S. Maxim, modified and improved by Mr. Christensen, and the Danish Government adopted it quite largely. In 1888 he moved to England and was engaged in engineering and engine design, first in London and later in Liverpool and Darwen, Lancashire. In 1891 he came to the United States and entered the employ of the Fraser-Chalmers Company, of Chicago. While inspecting the then new electric railway, known as the "Cicero & Proviso" system, at Oak Park, a Chicago suburb, an accident occurred resulting in the killing of two people and the injury of many others, due to the inefficiency of the hand brake. The young mechanic made up his mind that a power brake was needed and set to work upon the problem. He therefore developed the Christensen scheme of applying air brakes to such cars, and subsequently protected it by patents in this and all the European countries. Owing to the panic of 1893, the commercial development of this brake was delayed for several years.

The Christensen Engineering Company was organized in Milwaukee, in early part of the year 1897, and from small beginnings grew rapidly. At the outset Mr. Christensen did practically all the work of designing, selling, installing and collecting, but before the close of the first year the business had grown so that he demanded more assistance, and F. C. Randall (now district manager of the Allis-Chalmers Company at New York) was induced to associate himself with the company as chief of the sales department, and, with his active and successful management, the business grew so rapidly that the sales of air brakes in 1904 aggregated nearly $1,300,000. In the fall of 1902, against the judgment of Mr. Christensen, who was not himself a stockholder in the company, it was decided to broaden the scope of the business and include general electrical manufactures. This step led to the retirement of Mr. Christensen as general superintendent, and the Christensen Engineering Company was later merged in a new corporation known as the National Electric Company. Mr. Christensen engaged in the business of constructing air compressors and others of his patented articles, leaving to the company the construction of air brakes for electric cars under his patents, he receiving a royalty for their use. The National Electric Company went into the hands of a receiver in the spring of 1905. The company was recently sold at auction to interests, some of whom are identified with the Westinghouse Air Brake Company, and surrendered its rights to the Christensen patented devices to Mr. Christensen.

Since this settlement, negotiations have been brought to a successful issue with Mr. Christensen for the consolidation of the Christensen air brake and compressor business with that of the Allis-Chalmers Company, Mr. Christensen himself going to this institution as consulting engineer. The immediate result of this will be to put the manufacture of the Christensen air brake for electric traction on a stable basis.

NEW PUBLICATIONS

Pocket Book of Mechanical Engineering. By Charles M. Sames. Published by the Author, Jersey City, N. J. 176 pages; leather. Price, $1.50.

This book is the result of an effort to compact the greater part of the reference information usually required by mechanical engineers into a volume whose dimensions permit of its being carried in the pocket without inconvenience. The chapters include materials, strength of materials, transmission of power, steam engine, hydraulic machinery, shop data and electro-technics. The choice of information to be presented has been carefully made, and the book should prove useful as a handy reference volume.

Illustrated Technical Dictionary in six languages, English, German, French, Spanish, Russian and Italian. Vol. I. Elements of Machinery and the Tools Most Frequently Used in Metal and Woodworking. By K. Deinhardt and A. Schlomann. Published at New York by McGraw Publishing Company. 403 pages. Price, $2.

This dictionary is brought out by six prominent publishing houses in as many different countries, and will, it is thought, supply a demand which has long existed. The most striking feature of the dictionary is the arrangement followed. Heretofore, works of this kind have been very broad in their scope, and the alphabetical order has almost always, if not entirely, been used. In the book under review the technical terms have been classified, and so far as possible each term is illustrated by a sketch or diagram so as more clearly to define its meaning. In addition, alphabetical indices are added of each word of the several languages contained. The book under review is the first of a series which is to appear. The next volume will contain electrical terms.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED JUNE 5, 1906

822,314. Railway Signaling System; Jacob B. Struble, New York, N. Y. App. filed July 13, 1904. Storage batteries connected to the track rails through Ruhmkorff coil, energize the rails to an alternating difference of potential. The storage batteries also have connections to direct-current magnets operating the semaphore signal. This circuit is closed by short circuiting the track rails.

822,474. Car Construction; Alamanza Porter, Scranton, Pa. App. filed July 3, 1905. An open car provided with side walls, having means for engaging tracks at the top and bottom and adapted to fold and be stored on the car platform when not in use. A door is provided in the walls opposite each seat.

822,508. Railway Traffic Controlling Apparatus; Clyde J. Colcman, New York, N. Y. App. filed Dec. 4, 1905. Details of a signal operated by short circuiting the track rail sections which are energized by an alternating current.

822,522. Car Brake; Owen M. Jones, Chicago, Ill. App. filed Oct. 19, 1903. The brake-chain is wound upon the axle of a ratchet wheel, which is operated through the medium of an oscillating lever pivoted beneath the platform and extending vertically through the platform of the car convenient for the motorman.

822,606. Tramway Line and Railway Line at Level Crossing; Walter J. Hollick, Manchester, England. App. filed Aug. 2, 1905. By a system of levers a filling block is caused by the approach of a train automatically to fill the space between adjacent ends of intersecting rails. The block again drops to normal inoperative position after the train has passed.

822,625. Railway Signal Apparatus; Emil L. Nolting, Elgin, Ill. App. filed Sept. 18, 1905. An audible signal in the cab of the locomotive, a third rail adjacent the track rails connected electrically with a battery through line wires, and an electrical knife-switch attached mechanically to the railway switch in such manner that the opening and closing of the railroad switch will cause a corresponding opening and closing of the knife-switch, the latter being in electrical connection with both the line wire and the main rails of the railroad, so that when the railway switch is open the electrical switch is closed, and vice versa.

822,626. Railway Signal Apparatus; Emil L. Nolting, Elgin, Ill. App. filed Feb. 16, 1906. Relates to modifications of the above.

822,703. Guard for Open Railway Cars; Etta W. Wheelock, East Milton, Mass. App. filed July 31, 1905. The guard rail is hung by means of cords provided with counterpoise-weights.

822,709. Trolley Stand; John Zielinski, Detroit, Mich. App. filed Oct. 22, 1903. Comprises a pivoted arm having a spring-impelled block sleeved thereon and link connections from said block whereby the spring action produces an angular movement of the pole.

822,845. Trolley Wheel; George W. Jobe, Indianapolis, Ind. App. filed June 23, 1905. The wheel has incorporated therein a plurality of radial fingers capable of movement in an axial direction. These fingers close over the trolley wire in passing.

PERSONAL MENTION

MR. HORACE E. ANDREWS, president of the Cleveland Electric Railway Company and an active figure in the New York Central Railroad Company's electric railway properties in New York, has returned to his home in Cleveland after a two months' tour to Europe.

MR. RICHARD T. LAFFIN, manager and vice-president of the Manila (P. I.) Electric Railway & Lighting Company, whose proposed visit to the United States was noted recently in the STREET RAILWAY JOURNAL, has arrived in this country. Mr. Laffin was formerly general manager of the Worcester Consolidated Street Railway, and before that was connected with the Boston elevated.

MR. GEORGE FLETT, managing director of Dick, Kerr & Company, the large British electric railway manufacturers and contractors, is making a visit in New York. Mr. Flett left London for India last January on a trip around the world, and will sail for England June 19. On his journey he spent considerable time in the Far East, where his company has built a number of tramway systems.

MR. FREDERICK L. COOLIDGE died at his home in Fitchburg (Mass.) June 8. Mr. Coolidge was well known in street railway circles through his position as president of the Gardner, Westminster & Fitchburg Street Railway and as director of the Northampton & Amherst and Turner's Falls & Connecticut Valley Companies. He was elected to Congress as a Democrat in a Republican district in 1890.

MR. S. B. FORTENBAUGH, formerly electrical engineer of the Underground Electric Railway Company, Ltd., of London, has joined the traction department of the General Electric Company at Schenectady. Prior to his connection with the Underground Electric Railway Company, Mr. Fortenbaugh was associated with the English Electric Manufacturing Company at Preston, England, and still previously with the Walker Company, of Cleveland.

MR. M. J. FORD, who retires from the position of master mechanic of the Wheeling Traction Company, of Wheeling, W. Va., to his home in Massachusetts, because of ill health, was surprised at his home in Wheeling a few days ago by the employees under him and the officials of the company, who presented Mr. Ford and his wife with a number of handsome tokens of their esteem. Among those present were Mr. and Mrs. J. G. Crawford, of Camden, N. Y. Mr. Crawford will succeed Mr. Ford at Wheeling.

MR. SAMUEL MARTIN has resigned as general foreman carpenter of car equipment of the subway division of the Interborough Rapid Transit Company, which position he has held since June, 1904. Before that time Mr. Martin was foreman of car repairs of the Manhattan Elevated Railway Company. At one time Mr. Martin was connected with the Brooklyn Rapid Transit Company as inspector of car construction. Mr. Martin has now accepted the position of foreman car builder of the Trajano de Madeiros Car Company, of Rio de Janeiro, Brazil.

MR. JOHN H. BICKFORD, consulting engineer, of Boston, recently presented to the railroad committee of the Massachusetts Legislature an extended argument in favor of granting electric railways the right of eminent domain. This address has been reprinted in pamphlet form, and is an interesting and able presentation of the case. Mr. Bickford is an electric railway engineer of about eighteen years' experience, and took an active part in the construction of many of the early electric railway lines in Massachusetts. He discontinued his consulting business some years ago on account of poor health, but has now regained his health and has opened an office at 110 State Street, Boston.