Street Railway Journal

Vol. XXVIII. NEW YORK, SATURDAY, NOVEMBER 10, 1906. No. 19.

Published Every Saturday by the

McGraw Publishing Company

Main Office:

NEW YORK, Engineering Building, 114 Liberty Street.

Branch Offices:

Chicago: Monadnock Block.

Philadelphia: Real Estate Trust Building.

Cleveland: Schofield Building.

London: Hastings House, Norfolk Street, Strand.

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

TERMS OF SUBSCRIPTION

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

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

To All Countries Other Than Those Mentioned Above:

Street Railway Journal (52 issues), postage prepaid.................... $6.00
25 shillings. 25 marks. 31 francs.
Single copies ....20 cents
Remittances for foreign subscriptions may be made through our European office.

NOTICE TO SUBSCRIBERS

REMITTANCES.—Remittances should be made by check, New York draft, or money order, in favor of the Street Railway Journal.

CHANGE OF ADDRESS.—The old address should be given, as well as the new, and notice should be received a week in advance of tbe desired change.

BACK COPIES.—No copies of issues prior to September, 1904, are kept on sale, except in bound volumes.

DATE ON WRAPPER shows the month at the end of which the subscription expires. The sending of remittances for renewal prior to that date will be much appreciated by the publishers.

CLUB RATE.—On five or more subscriptions from one company or its employees, a club rate of $2.50 each per annum is quoted.

NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal, 8000 copies are printed. Total circulation for 1906 to date, 369,900 copies, an average of 8222 copies per week.

The Smoking Car Question

One of the points mentioned in the report presented at the Columbus convention by the committee on promotion of traffic was the extent to which smoking is allowed on cars. Of course, with the open car this question is a simple one. The last two or more seats may be given up to smokers without incommoding anyone. The problem is quite different, however, in a closed car, unless a smoking compartment is used.

For long runs, there can be little question of the advisability of providing a smoking compartment, especially where the road has to meet steam competition. It separates the users of the weed from the non-smoking passengers, and gives them the comforts offered by the steam railroad. We do not think, however, that this is the only advantage of the smoking compartment. It also affords a portion of the car which can freely be used by laborers in their working clothes and others who might prove personally objectionable to the occupants in the other compartment. Moreover, it will often be selected by many men who do not care to smoke themselves, but will prefer the greater freedom and the ability to open windows, to which objection might be made by fussy people in the other compartment. It is no uncommon sight to see men standing in the smoking compartment of an interurban car when there are seats in the non-smoking portion of the car.

Where, however, the run is comparatively short and the car cannot practically be divided into compartments, the problem is more serious. Some managers see no great necessity for making any provision for tobacco users. This may prove to be entirely satisfactory in some cities, but we do not believe any hard and fast rule can be drawn. The table published in the traffic report mentioned shows that out of 84 companies using closed cars without compartments, 25 permitted the practice on the rear platform; 5 on the front platform, 11 on both platforms; 1 on the last three seats; 1 on the last seat and 1 on all the seats; while only 19, or 23 per cent of the total number reporting, allowed no smoking. It must always be a question as to which rule will offend the greater number.

Undoubtedly the question when closed cars are employed is very much simplified where a large rear platform, like the Detroit platform, or those of the Montreal pay-as-you-enter car is used, in both of which the smokers stand behind a rail. Moreover, as such passengers are always content to stand, an increase in the seating capacity of the car is practically secured in this way.

Flexibility in Power House Piping

The trend of recent practice in the design of power house piping has been so positive in the direction of simplicity that it is worth while to consider if flexibility of operation has not been at times needlessly sacrificed. Broadly speaking, the exact balance struck between flexibility and simplicity in any engineering project is always debatable if the conditions are not well defined, so that, in the matter of piping design, there is much to be said for and against duplication of any kind.

It is pretty well conceded now that double runs of pipe between boilers and engines are not the best practice, provided the joints are kept in first-class condition. Few engineers would install a complete duplicate outfit on the live steam end of a modern plant, and the use of highly superheated steam in turbine practice has had such a wholesome effect in raising the standards of pipe system construction and maintenance that the present practice of feeding generating units by sectionalized headers and segregated boiler batteries is for the most part thoroughly reliable. Superheated steam has a way which is all its own of finding out the weak spots of pipe lines, and if the leaks are properly handled, it is certainly wise to avoid the complication of doubled lines at any part of the high pressure system.

Cases arise, however, where some sort of insurance against paralysis of output is necessary; in the event of a rupture of an individual generating unit supply line, it is generally best to put the machine out of service by closing the valve at the header supply, but in case the header itself gives out in any section, an alternative boiler connection with all the generating units is likely to be worth a great deal on a large system. This may be accomplished with comparatively little expense if the power house layout permits the installation of a closed loop, costing a few hundred dollars at the outside, around the ends of the header. By valving the header at its ends, condensation losses in the emergency side of the loop can be reduced to zero, and the fixed charges on such a loop are insignificant in proportion to the insurance offered. It is an immense advantage to keep all the engines or turbines in service when an accident occurs in any part of the piping, although at times the damage done is too great to prevent a shut-down on account of the loss of steam and the inaccessibility of the header valves. Here is where the motor-operated valve steps in with every prospect of triumph. It is by no means improbable that all the important live and exhaust steam pipes of very large power houses will be electrically valved on the remote control principle, from the main switchboard, in the not distant future. The tendency is entirely in the direction of the control of power house energy from a single point, and at every important stage between the coal conveyer and the outgoing feeder.

In the supply of steam to feed pumps and other auxiliaries, the same scheme of looping the main line around the ends of the boiler header is worth thinking about. The cost of feeding the boilers by cold water under pressure from the city mains is worth escaping, when the reduced capacity of the boilers to supply steam for handling rush-hour traffic is considered. Exhaust piping naturally does not require the same flexibility that live steam lines do, but it is important in handling low pressure steam equipment to provide each separate piece of machinery with a by-pass connection.

We mention these points because the idea has come about in some quarters that any closed looping of pipes in a modern power plant is a relic of ancient days, whereas, as a matter of fact, this general scheme has been adopted in some of the latest and best power house installations; not necessarily for railway service, but in plants where continuous supply is an absolute necessity. In all the range of power house piping, from mains conveying steam at 150 or 200 lbs. pressure down to service water and oiling system lines, duplication is not the point at issue so much as alternative routes. Familiar as the piping question is, it is worth looking into in many plants with a view toward securing increased reliability without undue expense for simple extensions of the trunk supply lines.

Concrete Piles in Power House and Foundation Work

In the field of railway construction, nothing is more striking at the present time than the multiplied use of concrete, both plain and reinforced. There is scarcely a detail connected with the design of permanent and massive structures which has not been treated, at least tentatively, with this material. Engineers are designing foundations of all kinds with increased care to meet the requirements of larger traffic and heavier equipment, and it is coming to be widely appreciated that first-class construction in the field must follow every design worked out on the drafting table if the resulting structure is to be capable of giving reliable service.

The use of concrete piles is a comparatively recent development in the direction of improved construction. They have not been confined to any particular locality nor to any particular kind of soil, but in many cases they have brought about considerable economy in the cost of foundation work, regardless of whether the soil be dry sand, quicksand, clay, mud, silt or filled ground. The saving has resulted from the decreased number of concrete piles required to carry a given load, reduction in the amount of excavation and masonry required with wooden piles, and consequent economy of time and money. The cost of concrete piles is naturally considerably more per lineal foot in comparison with ordinary wooden piles, perhaps twice as much; but the concrete pile as usually applied has a much larger bearing surface and is therefore able to support a greatly increased load in proportion to its cost. Wooden piles ordinarily average about 12 ins. in diameter at the top, and have 113 sq. in. of surface, whereas a 20-in. concrete pile has 314 sq. in. of surface. The taper of a wooden pile is seldom more than 3 ins. or 4 ins. from top to bottom, while the taper of the concrete pile may easily be 10 ins. to 14 ins.

For most foundation work, it has been determined by careful experiment that large tapering piles are the best. The full bearing value of the soil is thus taken advantage of by a tapering pile, giving relatively poor soil a great sustaining value. By using large, tapering, concrete piles, 18 ins. or 20 ins. in diameter at the top and 6 ins. or 8 ins. in diameter at the point, a much less lineal quantity of piling is needed than if straight piles are used.

The reinforcement of concrete piles by steel rods is readily effected if the reinforcing material is put in at the time when the concrete is formed up, and the speed of driving concrete piles under favorable conditions is all that could be desired. Cases have occurred where a dozen or fifteen concrete piles have been driven in within two and one-half hours, and in moderately hard driving it is not uncommon for a single driver to put down thirty or thirty-five in a day. The loading on concrete piles may run anywhere from 25 or 30 tons to 50 or 60 tons, according to the conditions, and the cost may run as low as 65 or 70 cents per foot in favorable circumstances. The top of the pile can be finished off in any desired manner, to support the piers of the power house or machinery foundations, and it is not necessary to cut off the concrete pile at the water line to preserve it, as in the case with wooden piles. In building abutments, the excavating and refilling with concrete are saved on this account. By their use, work on the abutment foundations may be begun regardless of the height of the river or creek. Substantial trestles can be constructed by extending the concrete piles to the desired height, sway bracing the piles with a concrete-steel web, and bolting the wooden or concrete cap to the pile tops. The power house of the Union Electric Company, of Dubuque, Ia., rests upon 568 concrete piles, fifty piles also being used to support the chimney. Their main advantage in this place is that the piles are free from the decay to which wooden piles in that case would be liable.

In some cases, attempts to drive concrete piles after they have been built have met with but limited success. In sinking these piles it is customary to make use of a water jet or the employment of a driven shell which can be filled in with fresh concrete. If the shell is sufficiently tight, it furnishes good protection against the action of sea water on the concrete, a point of more or less uncertainty at the present time. The determination of whether to use a concrete or a wooden pile in any specific electric railway construction job is, of course, a matter of estimating the costs and materials, supplemented by knowledge of what has been done in similar instances by other roads or power house builders. The larger the job, the more likely it is that a substantial saving can be shown by the concrete piles. They have not been in use long enough as yet to enable accurate forecasts of depreciation to be made, but aside from the uncertain action of sea water on unprotected piles, the outlook would seem to be favorable to long life.

The Camden-Atlantic City Line

The electrification of this line, formerly known as the West Jersey and Seashore branch of the Pennsylvania Railroad, is in some respects the most notable example of change of motive power from steam to electricity. In the first place, it is the longest line yet electrified, and in the second place, it is one of the few large examples of such work in which the change was made quite irrespective of terminal requirements, and, so to speak, strictly upon its merits. Of the two Pennsylvania Railroad routes between the terminals, this was the longer one carrying the heavier local traffic, and it was electrified simply because the traffic could be better and more economically handled upon it by electricity than by steam. It is notable, too, in being worked throughout on the multiple-unit system, and stands as a completely developed electric road for fast and heavy passenger traffic. The equipment chosen is absolutely canonical in general character, with high voltage transmission from a single generating station, sub-stations with rotary converters distributed along the line and a complete third-rail equipment, save in a few short stretches where it runs through city streets at grade, and on an interurban section where the line is operated by overhead trolley.

It may be matter of wonderment why, with the single-phase system coming rapidly along and bringing with it the possibility of an enormously simplified distribution, the third-rail system with low voltage should have been chosen for this very important work. The question is not altogether easy to answer, except to say it is understood that the saving in time was the controlling consideration. Having decided upon the change, every day's delay in its completion becomes onerous, and the direct-current equipment was found to be much the more speedy to install. Again, the not unnatural feeling of conservatism in installing a new system as yet untried on a large scale, also probably exercised considerable influence in the matter. The choice made certainly left no doubt about the operative success, as the results already secured with electricity as compared with steam have proved. The only risk undertaken was the somewhat sentimental one of possibly being pilloried as the last of the low voltage systems—a chance somewhat relieved by the possibility of changing over to a high-voltage d. c. system or even to single phase at any time during the future without any very great sacrifice of investment. That is to say, the power station and transmission system, or the permanent part of the installation, will be equally serviceable with high-voltage d. c. or single phase, and the motors will always be available for use elsewhere, leaving only the third rail for possible change to overhead in case of the possible use of a. c. It is said that the initial cost of installation would have been about the same in either case.

At all events, the Pennsylvania Railroad can congratulate itself on having an exceedingly good job of electrification, and on having done it in pretty nearly record time. From start to finish it has been a thoroughly workmanlike performance. If devoid of startling novelty, it has the merit of representing the best of present standard practice. The power station is a perfectly typical 6000-kw plant of turbo-generators, beautifully designed for easy operation. We should expect power to be delivered from it at a very low figure, and hope that figures will later be available on this point, since exact data on power cost on large roads of this type have not yet appeared. Those which have been quoted are from systems involving either urban traffic or relatively moderate interurban conditions. The transmission system is for the conservative voltage of 33,000, well and solidly built with two circuits on a single pole line. The only feature which we should be disposed to criticise is the placing the bases of the three-phase triangles uppermost, which rather increases the chances of foreign bodies finding lodgment there. In a relatively open country, this factor may be of comparatively small importance. The factor of safety on the insulators strikes us as being a trifle low—this would have been none too much in a country where lightning is to be expected. The top conductor as a lightning guard has both friends and foes. Sometimes it has worked admirably, and sometimes badly, but the stranded cable is certainly the best form in which to use it, since it is sound mechanically, which a strand of barbed wire or plain galvanized wire is not.

The third-rail construction of standard 100-lb. section like the track rails is remarkably solid and the insulators are of exceptionally sound mechanical design. The rail is unguarded, but the right of way is thoroughly fenced in and protected by cattle guards. It is worth noting that, with the immense conductivity of the third rails and the frequency of the sub-stations, no special feeders are necessary for the third-rail sections of the road, thus leaving the conducting system reduced to its simplest possible terms. The trolley section is of the usual construction, with cross suspensions. The sub-stations are eight in number, each at present provided with two rotaries and the usual accessories, the rotaries being of 500 or 750 kw, as the conditions require. They are all arranged to start from the a. c. side, and the whole sub-station equipment is organized in the simplest practicable fashion. Altogether the system is one in which nothing has been spared to make it thoroughly representative of sound recent practice, easy to operate and slow to depreciate.

THE ELECTRICAL EQUIPMENT OF THE WEST JERSEY & SEASHORE BRANCH OF THE PENNSYLVANIA RAILROAD

The opening of the electrified section of the Pennsylvania Railroad between Camden and Atlantic City, known as the

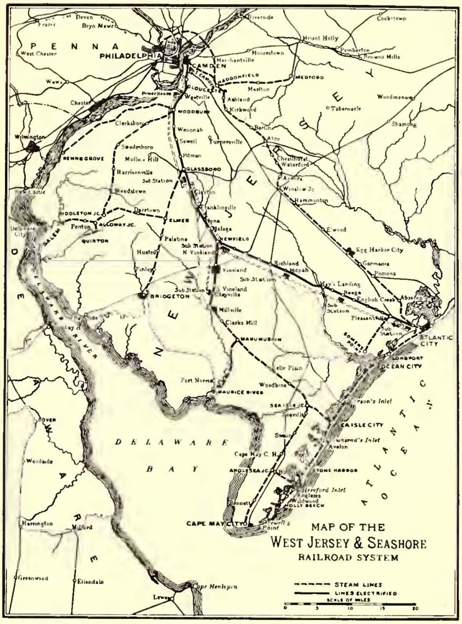


FIG. 1.—MAP OF THE WEST JERSEY & SEASHORE RAILROAD SYSTEM

West Jersey & Seashore Branch of the Pennsylvania Railroad, occurred Sept. 18, and involved the electrical equipment of a main line double-track steam road from terminal to terminal of a greater length than any electrified steam road in this country. It also included the construction of a power house of original design and built in record time. The site for this station was chosen on Jan. 17, 1906; the first pile was driven two days later, and on July 1 the first train to take current from the power house was run on the newly electrified tracks.

The line of the electrified system extends from Camden, N. J., via Newfield, to Atlantic City, a distance of 65 miles, and from Newfield to Millville, a distance of 10 miles. In addition to the erection of a power house, this work has called for the building of eight sub-stations, one of which is in the power house, the electrical equipment of approximately 150 miles of single track, the building of 71 miles of duplicate high-tension transmission line, and the construction and electrical equipment of sixty-eight cars. In addition, a great deal of other work always incident to extensive undertakings of this nature was done, as may be best appreciated from the following summary:

Track—	
Length of track relaid with new rails	48.1 miles
Length of new second track	36.6 "
Length of new third track	6.5 "
New rail laid	14,126 tons
Splices replaced by special splices for track bending	23,577 pairs
New third rail (100 lbs.)	10,198 tons
New long ties, for third rail insulators	83,857 "
Siding laid	13,400 ft.
New track, switch constructions	15 "
Signals—	
Length of track provided with automatic block signals	35.5 miles
Length of track provided with telegraph block signals	25 "
New automatic signals installed	86
New telegraph block signals installed	24
New signals at interlocking	201
New signal bridges	45
Fencing and Cattle Guards—	
Fencing	87.5 miles
Cattle guards installed	370

FIG. 2.—VIEW OF ATLANTIC CITY TERMINAL

Telephone and Telegraph—	
Thirty pair telephone cable	8.5 miles
Telegraph cables	6 "
Telephone wires	260 "
Telegraph line rebuilt	12 "
Telegraph wire changed	190 "
Bridges and Culverts—	
Twelve pile bridges, total length	1,150 ft.
One 30-ft. four-track concrete arch	2,800 cu. yds.
Center and rest piers for double-track drawbridge in Thoroughfare, Atlantic City,	
Trestle in Thoroughfare for drawbridge	500 ft.
Land trestle approach for drawbridge	600 "
Station Changes—	
Platforms moved back	16
Stations and freight houses moved back	10

Reading on an elevated structure, which includes nine concrete piers with steel superstructure, and enter the Atlantic City terminal on a descending grade. This terminal (Fig. 2) is new, and, like that at Camden, consists of a number of stub end tracks with concrete platforms between them, with steel umbrella shelters. It is located on the south of the present steam road terminal. From Camden to Atlantic City the road has been electrified with a third rail, with the exception of a stretch of track 4.4 miles in length between Haddon Avenue and South Gloucester. Here the tracks pass through the city streets at grade and are equipped with the overhead trolley.

In addition to this through route, the line from Newfield to Millville —10 miles—has been electrified. On this portion of the road the overhead trolley has been installed. New

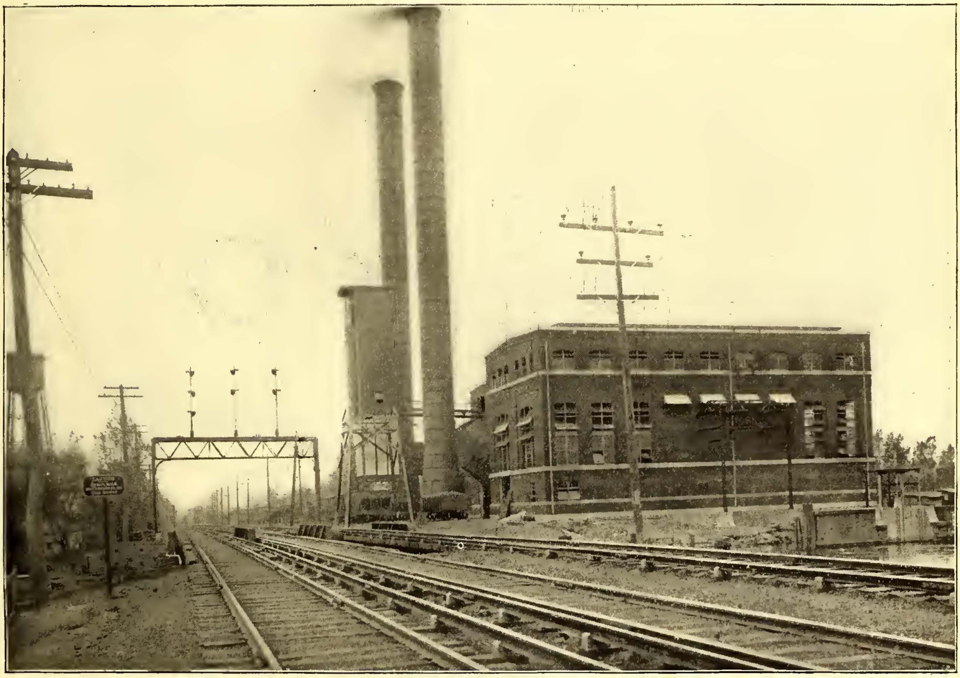


FIG. 3.—GENERAL VIEW OF WESTVILLE POWER STATION

The magnitude of the undertaking can best be appreciated by studying the map published in Fig. 1, together with the following description:

Beginning at the Camden end of the line, an entirely new terminal has been constructed which adjoins the present ferry terminal. The work at this point includes a number of stub end tracks with suitable sheltered platforms between them, and three-quarters of a mile of new elevated double-track trestle, with stone piers and steel superstructure at street intersections, which has been built to connect this terminal with the existing lines, at grade, at a point near Haddon Avenue.

From a point about 2 miles from Atlantic City a new right of way has been secured, and after crossing the Thoroughfare on the drawbridge on which the unfortunate accident of two weeks ago occurred, the tracks cross the Philadelphia & terminal facilities have been provided here, including 100 ft. of umbrella shelter sheds.

The line from Camden to Atlantic City is a double-track road throughout, and is a three-track road between Camden and Woodbury. From the Camden terminal to Newfield the road is laid with 100-lb. rails of the Pennsylvania Railroad standard cross-section, and from Newfield to Atlantic City it is laid with 85-lb. rails of the A. S. C. E. section. The line from Newfield to Millville is a single-track road and is laid with 100-lb. rails of standard Pennsylvania Railroad cross-section.

It will be noticed on the map that the Pennsylvania Railroad Company has two roads connecting Camden with Atlantic City, and it is the longer of these routes that has been electrified. This has been done because there is a large local traffic on the longer route that can be handled more economically and expeditiously by electric traction than is possible with steam haulage.

The importance of the undertaking is further emphasized by the density of the traffic on the electrified section of the road. The power house and sub-station equipment and the line are laid out with a view of supplying sufficient power for the operation of all the cars now provided, operating in an express service to Atlantic City, consisting of three-car trains running on a headway of fifteen minutes in each direction at a speed on straight level track of 60 m. p. h., and for local service of two-car trains between Camden and Millville on half-hour intervals, and single cars between Camden and Woodbury on ten-minute intervals. The initial schedule that has been put into service includes three-car express trains between Camden and Atlantic City on one-hour intervals, the running time being ninety minutes, and a local service of two, three and four-car trains run on a minimum interval of fifteen minutes during the rush hours between Camden and Glassboro, every fourth train going on to Millville. The motor baggage and mail cars are attached to the passenger trains as conditions require. As described elsewhere, provision is made in the power house and sub-stations for increasing the equipment to accommodate the heavier traffic which is expected to result from the improved service.

It should be mentioned that each car in the electric service is a motor car, no trailers being used.

GENERAL SCHEME OF ELECTRIFICATION

The contract for the entire electrification work was given to the General Electric Company and through it certain portions were sub-let. The electrical equipment throughout is of standard General Electric design.

The general scheme of electrification consists of generating a. c. power at a potential of 6600 volts at the power house, where it is stepped up to 33,000 volts. At this latter pressure it is transmitted over the high-tension transmission lines to the sub-stations, where it is reduced to a potential of 430 volts by means of step-down transformers, and then led to the rotaries and converted to direct current at 650 volts, at which pressure it is fed to the third rail for operating the cars.

THE POWER HOUSE

The power house (Fig. 3) is situated at Big Timber Creek, just to the north of Westville, N. J., at a point 5.6 miles from the Camden terminal, where there is an abundance of water for boiler feed and condensing purposes. The power house, boiler house and stacks are built on approximately 850 concrete piles. The foundations, which were started on March 15, are of reinforced concrete and are superimposed upon the piles in such a manner that the latter project about 1 ft. into the mass of concrete, making a thoroughly homogeneous foundation. The boiler foundations were completed by March 25, and those for the steam turbines by June 5. The erection of the steel work for the main building was begun on April 18. On March 5 the foundations for the stacks were started and these were completed by the 25th of the same month. The steel work for the stacks was started on April 11, and the first stack was erected, lined and ready for use by June 29. Other dates might be given, but the most significant of all is that on July 1, five and one-half months from the

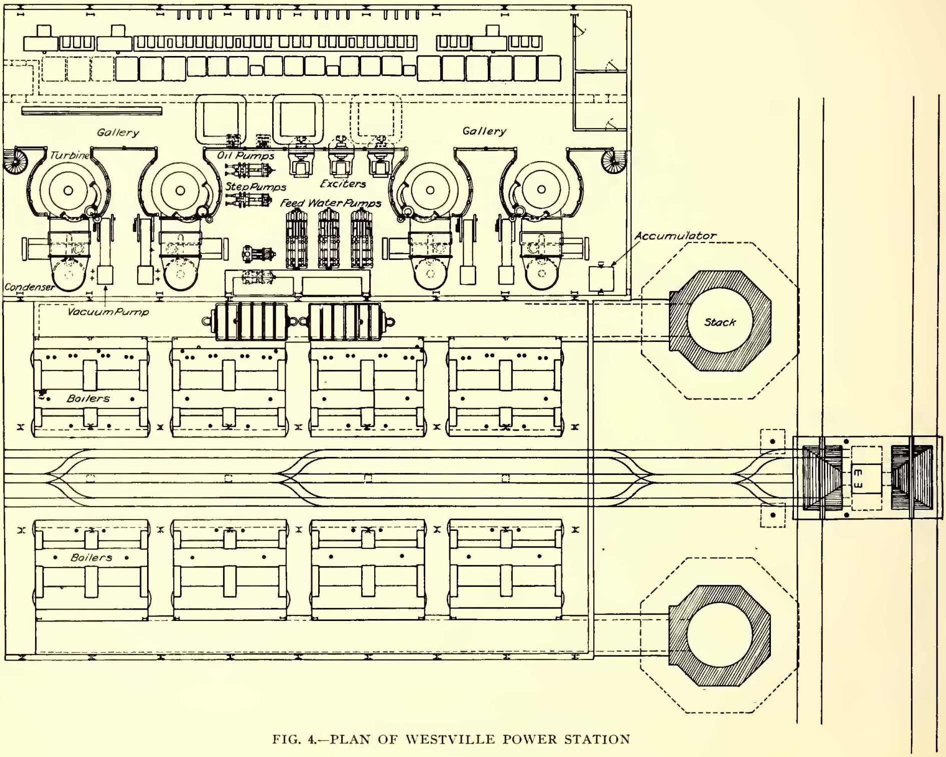


FIG. 4.—PLAN OF WESTVILLE POWER STATION

date upon which the first pile was driven, two boilers were under steam at working pressure, a turbine and all the necessary auxiliaries were running, the sub-station in the power house was in operation, and the first car to take current from the power house was run on the line.

For the sake of brevity, the main portion of the electrical equipment of the power house is given below in tabular form:

Three 2000-kw, 6600-volt, 25-cycle, three-phase Curtis turbo-generators.

Two 75-kw, 25-cycle air blast transformers.

Three blowers, capacity of each 20,000 cu. ft. per minute.

The switchboard consists of:

Three 3-phase generator panels.

Two exciter panels.

Three blower motor panels.

One synchronizing equipment.

Three 33,000-volt transformer panels.

Two sets lightning arresters and switches.

Six static potential indicators.

Two 33,000-volt outgoing line panels.

It will be seen from the above that the present normal capacity of the generating station is 6000 kw. However, there is sufficient room provided in the layout of the building for an additional 2000-kw turbo-generator set, together with the necessary auxiliaries. The foundation for the extra turbine is already built. In addition to this provision for extra power, one of the end walls of the station is of a temporary nature in order that increasing demands for power may be met with a minimum of expenditure in the future.

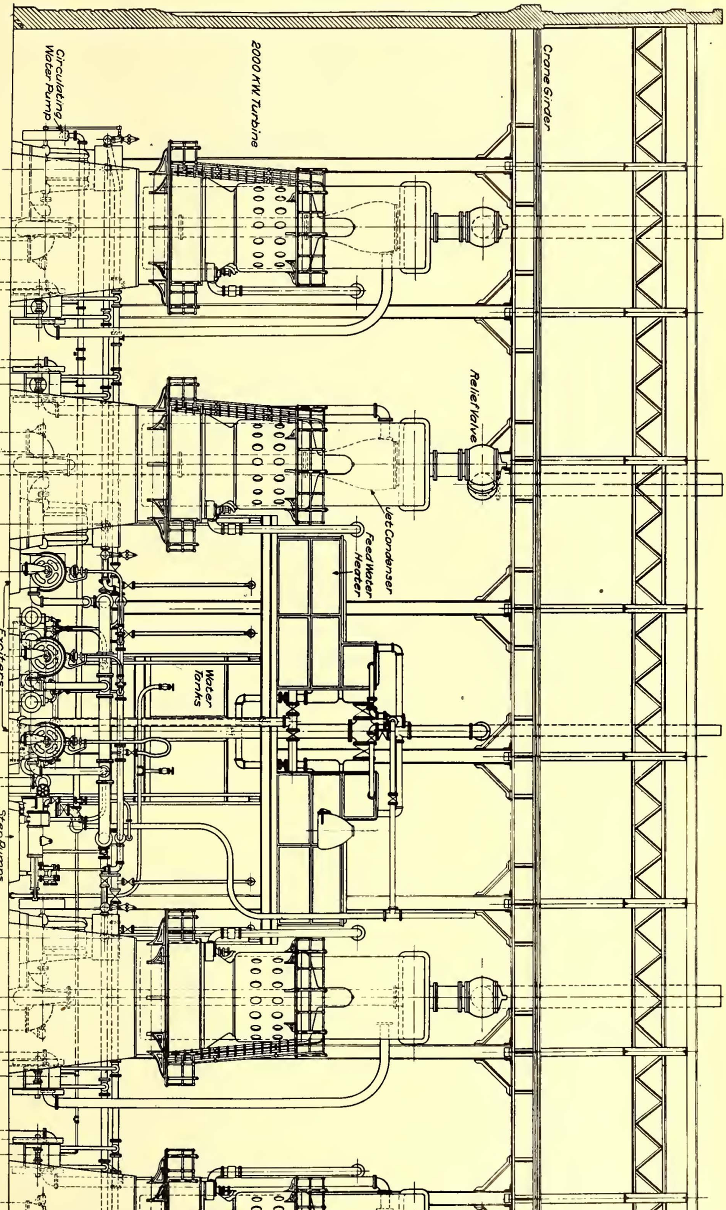


FIG. 5.—LONGITUDINAL SECTION THROUGH TURBINE ROOM OF WESTVILLE POWER STATION

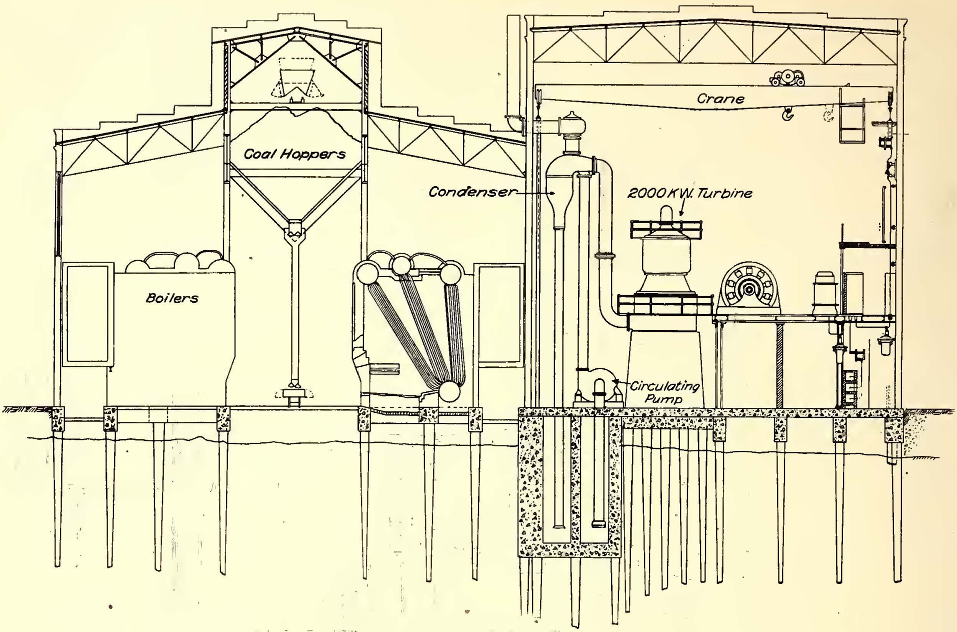


FIG. 6.—TRANSVERSE SECTION OF WESTVILLE POWER STATION

The most important items among the auxiliaries are as follows:

(a) Two exciter sets, consisting of horizontal Curtis steam turbines, coupled to 75-kw four-pole General Electric d. c. generators, running at 2400 r. p. m., and delivering 600 amps. each at 125 volts pressure. The turbines of these sets work non-condensing, as the exhaust is used for heating the feed water.
(b) Three barometric condensers, built by Williamson Bros., in connection with Crane & Company, of Philadelphia, who were also the sub-contractors for the circulating and air pumps. These condensers are capable of maintaining a vacuum of 28 ins., and are designed to condense 60,000 lbs. of steam per hour with circulating water at a temperature of 70 degs. F. The approximate ratio of condensing water to steam condensed is 75:1.
(c) Three dry air pumps, built by I. P. Morris & Company, of sufficient capacity to fulfil the guarantees given with the condensers.
(d) Three centrifugal circulating pumps, built by the I. P. Morris Company, and driven by Reeves engines. The piping for these engines is so arranged that the exhaust may be discharged to either the feed-water heater or to the third stage of the turbine, the latter arrangement only being used when the exhaust from the other auxiliaries exceeds that required for the feed-water heater.
(e) Two Cochrane feed-water heaters. Each heater has a capacity for heating 135,000 lbs. of water per hour, from 70 degs. F. to 212 degs. F.
(f) Two Worthington boiler feed pumps.
(g) Two Worthington make-up pumps.
(h) Two Worthington step-bearing pumps.
(i) Three Worthington step-bearing water return pumps.
(j) One accumulator for the step bearings with a capacity of 100 gals. of water at 800 lbs. pressure per square inch. This accumulator was supplied by R. D. Wood & Company, of Philadelphia, Pa.

The area of the power house is 17,069 sq. ft., and the cubic contents amounts to 829,113 cu. ft., thus giving 2.13 sq. ft. and 103.6 cu. ft. per kw as the unit output of the station, based on 8000 kw as the ultimate capacity of the present structure.

The layout of the steam piping in the power house is of a very neat design and allows ample operating space around all the machinery. W. K. Mitchell & Co., of Philadelphia, Pa., were the sub-contractors for this work, together with the steam valves, etc., and Keasby & Mattison furnished the pipe covering.

FIG. 7.—VIEW OF TURBINES, TRANSFORMERS AND LIGHTNING ARRESTERS AT WESTVILLE POWER STATION

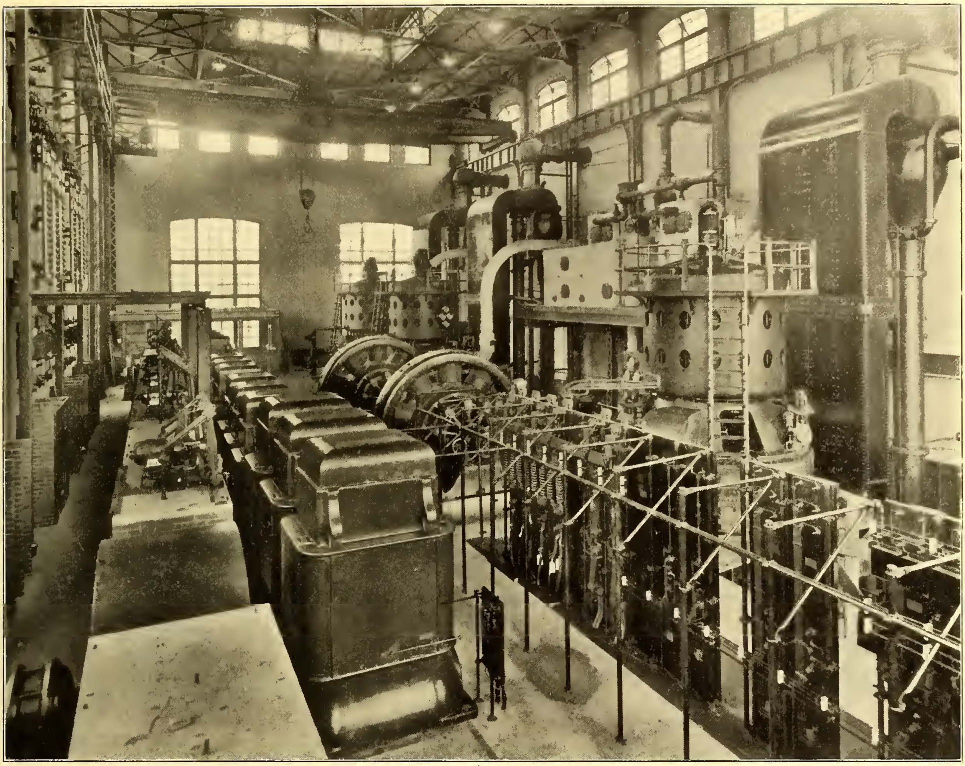


FIG. 8.—INTERIOR VIEW OF TURBINE ROOM AT WESTVILLE POWER STATION

BOILER HOUSE

The boiler house is furnished with twelve Stirling water-tube boilers arranged in pairs forming six batteries. Each boiler is rated at 358 hp and is furnished with a superheater capable of delivering steam at 175 lbs. pressure and at a temperature of 125 deg. F. in excess of that of saturated steam. The Stirling Boiler Company was sub-contractor for both the boilers and boiler settings.

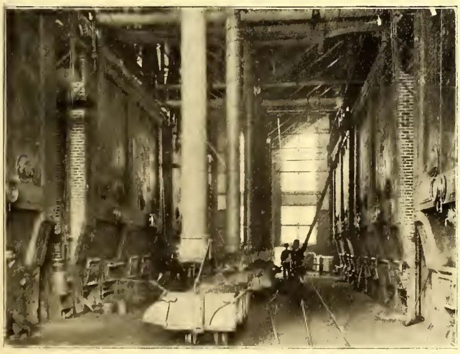


FIG. 9.—VIEW OF BOILER ROOM AT WESTVILLE POWER STATION

The coal and ash handling machinery is illustrated in Fig. 10. The coal is dumped from the railway cars into the receiving hopper over which the rails are laid, as shown in the plan. As will be seen, the receiving hopper has a slanting bottom to feed the coal by gravity through a valve which is only opened when the skip is in the correct position for loading. The loaded skip is raised by means of the hoisting engine till it reaches the level of the deflector, when it is automatically tipped into the crushing hopper, the smaller coal passing through the screen and the larger coal being broken in the crusher in transit. From this hopper the coal is fed into the gravity return car by means of the valve at the bottom, when it is conveyed by the automatic railway over the coal bunkers, into which it tipped. From these bunkers it is again fed to the coal cars on the tracks on the boiler room floor. The ashes are taken from the boiler house in cars and dumped into the receiving hopper, from where they are raised in a similar manner to the coal, but the deflector being thrown in the reverse direction from that shown in the illustration. The ashes are conveyed from the ash chute to the ash storage bin, from whence they are conveyed by means of a chute to cars on the railway track.

SUB-STATIONS

The high-tension three-phase current is reduced in pressure and converted to a direct current at 650 volts in eight sub-stations distributed along the line as follows:

One is located in the power house at Westville. There are three terminal sub-stations situated respectively at South

Camden, Clayville and Atlantic City, and four intermediate sub-stations, one at Glassboro, one at Newfield, one at Mizpah, and one at Reega.

The equipments in the several different sub-stations vary according to the requirements of the portion of the road they supply. Table I. shows the number and capacity of rotary converters installed in each sub-station, together with the extra capacity provided for, and Table II. gives a list of the switchboard panels.

The rotary converters are all of standard General Electric design, and are capable of running at 150 per cent full load for two hours with a temperature rise not exceeding 55 deg. The transformers are all supplied with taps giving one-third and two-thirds of the working voltage to enable converters

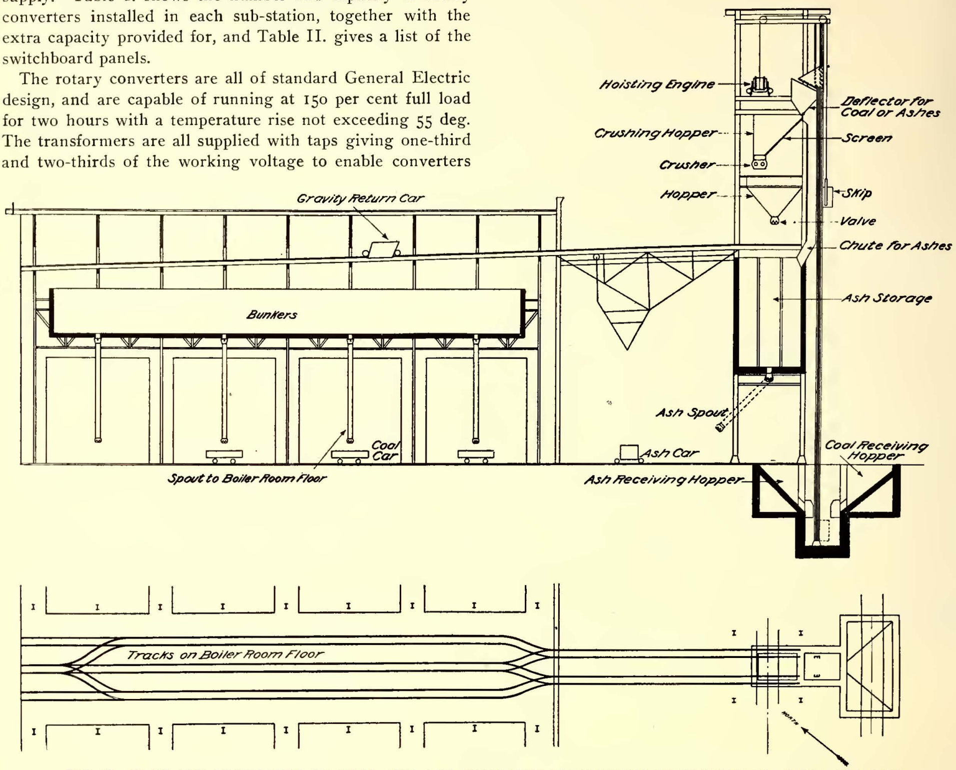


FIG. 10.—PLAN AND ELEVATION OF COAL AND ASH HANDLING MACHINERY AT WESTVILLE POWER STATION

to be started from the a. c. side. This method of starting needs no synchronizing, and should the d. c. polarity of the machine chance to come in the wrong direction it is readily changed by means of the field reversing switch provided for this purpose. By this method any of the rotary converters can be started, run up to full speed, and be delivering power to the line within a minute.

Three air-cooled transformers are provided for operation in conjunction with each rotary, and these are located in each case with a view to the further extension of the substation, and as they are all of standard design it is not necessary to go into details regarding their construction.

The disconnecting switches and lightning arresters in each sub-station are located in a separate room (Fig. 14); the high-tension circuits are of bare copper wires supported on insulators on a pipe framework, and each pole of the oil switches is enclosed in a separate brick compartment. In all cases the instruments and oil switches are of General Electric design.

For the purpose of illustration, the intermediate sub-stations with two 750-kw rotary converters are selected as being typical. Figs. 11, 12 and 13 are respectively the plan, longitudinal and transverse sections, and will give a clear conception of the arrangement of machinery in all. Fig. 15 shows the interior, and Figs. 16 and 17 the exterior of sub-stations. These illustrations render a detailed description unnecessary.

The sub-station buildings are of red brick, trimmed with Indiana limestone facings, and the floors are of concrete.

TABLE I.

NAME OF SUB-STATION.	Kw. Capacity of Rotary Converters Already Installed.	Kw. Capacity of Additional Rotary Converters Prov. For.
South Camden	2—500	1—750
Westville (in power house)	2—750	1—750
Glassboro	2—750	1—750
Newfield	2—750	1—750
Clayville	2—500	1—750
Mizpah	2—500	1—750
Reega	2—750	1—750
Atlantic City	2—750	2—1000

Table II. gives a list of the switchboard panels.

TABLE II.

PANELS.	In Power Station.	South Camden.	Glassboro, Mizpah and Reega.	Newfield.	Millville.	Atlantic City.
A. C. rotary converter panels	2	2	2	2	2	2
D. C. rotary converter panels	2	2	2	2	2	2
Starting panels	2	2	2	2	2	2
D. C. feeder panels	6	4	4	5	2	4
Blower motor panels	2	2	2	2	2	2
High potential incoming line panels	2	2	2	2	2	2
High potential outgoing line panels	2	2	4	..	..	..

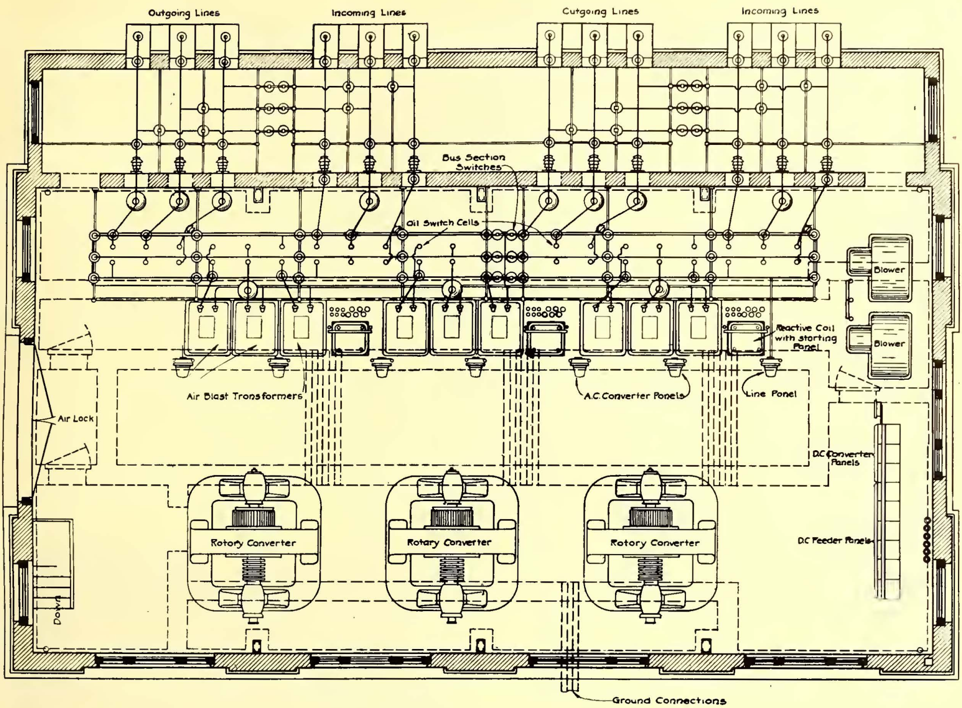


FIG. 11.—PLAN OF TYPICAL SUB-STATION

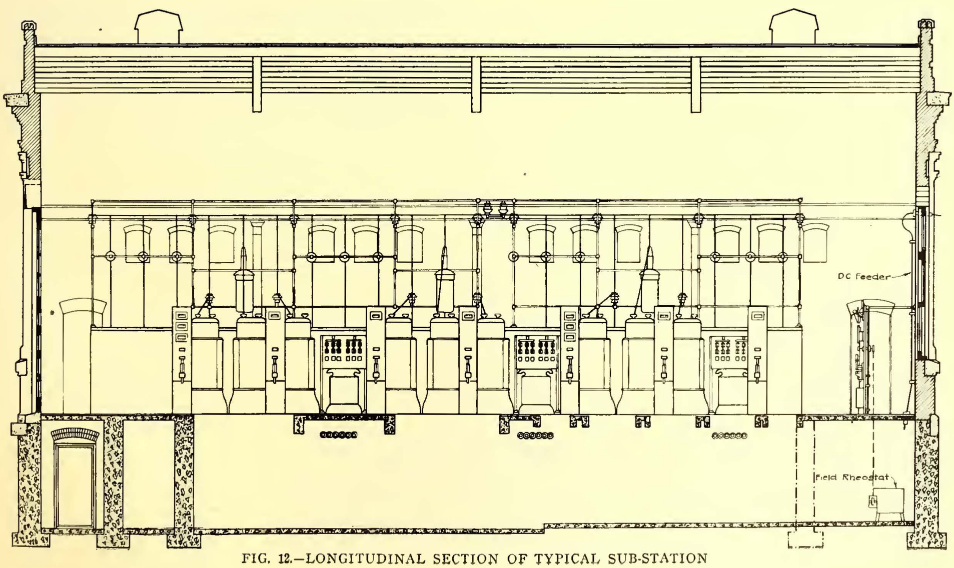


FIG. 12.—LONGITUDINAL SECTION OF TYPICAL SUB-STATION

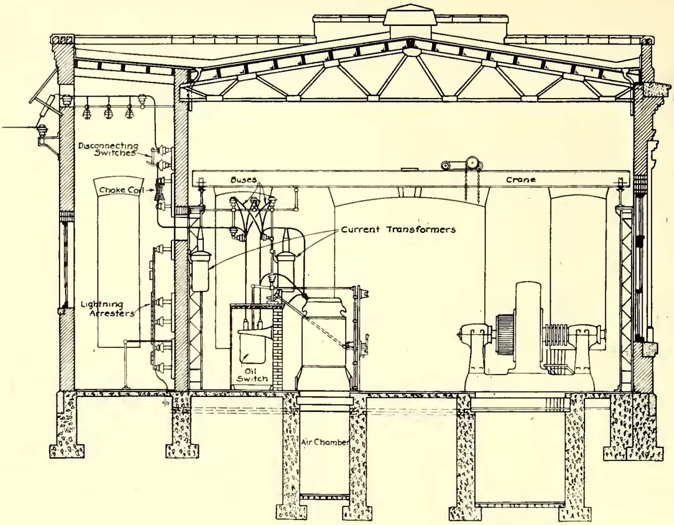


FIG. 13.—TRANSVERSE SECTION OF TYPICAL SUB-STATION

Each sub-station is furnished with a hand-operated crane, capable of handling any of the machinery installed.

It is a matter of interest that the sub-station buildings, including the foundations, were built in sixty working days, and that the installation of machinery was accomplished in thirty working days.

INSPECTION SHEDS

Inspection sheds have been built at the three terminals. The largest one is on the dock at Camden, just back of the new passenger terminal. This is a three-track shed 221 ft. long by 56 ft. wide, accommodating nine cars, with room for office, storeroom and small machine shop at the end opposite to the entrance. All tracks have pits provided with steam heating, electric lights and receptacles, and compressed air outlets for cleaning. The third rail is not carried into the shed, overhead trolley being used instead. The center track has overhead hand-operated crane, with runway extending into the machine shop. The building is of wood frame construction covered with corrugated galvanized iron, with four-ply slag roof, and is supplied with large windows and skylights. Kinnear steel rolling doors are used at the main entrance.

At Atlantic City the shed is of the same general arrangement, but smaller. It is a two-track shed 80 ft. x 42 ft., with doors at both ends, and so located that a train can be run through on either track and the cars inspected one at a time as they stand over the pits in the shed. This building is of wood frame covered on the outside with expanded metal plastered with cement. It is shown in Fig. 18.

The shed at Millville has one track and is of sufficient length for one car, with space to work around a truck when run out at one end. The construction is generally similar to the shed at Atlantic City.

In all of the sheds the track rail is carried on a stringer which makes the top of the rail 12 ins. above the floor level. All tracks in the sheds are provided with continuous pits 3 ft. 5 ins. deep from top of rail. This arrangement is laid out with special reference to the arrangement of control and brake apparatus on the under side of the car, and is very convenient for inspection.

FIG. 14.—VIEW OF LIGHTNING ARRESTER ROOM, NEWFIELD SUB-STATION

THE HIGH-TENSION TRANSMISSION LINES

The 33,000 - volt high-tension transmission line is in duplicate throughout. It is Y-connected with the neutral grounded, and consists of six No. 1 B. & S. hard-drawn solid copper wires mounted on porcelain insulators. The poles are of chestnut, their height being 45 ft., with extra long poles where special conditions require. They are spaced 125 ft., but at street crossings the spacings are reduced

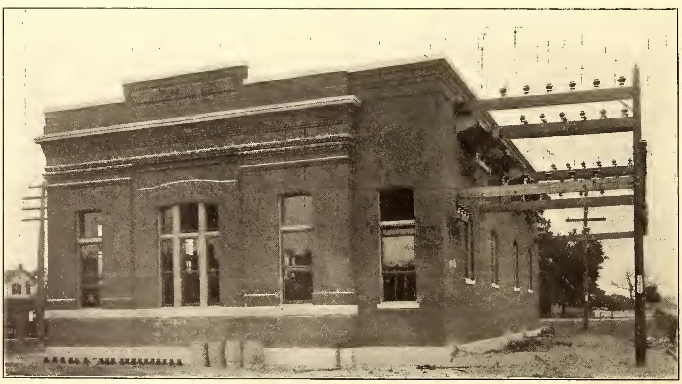


FIG. 16.—EXTERIOR OF GLASSBORO SUB-STATION

to 100 ft. Head guys are used at distances of approximately one-quarter of a mile. There are two cross-arms, the top arm being 12 ft. in length, carrying four insulators, and the lower arm, which is 8 ft. 6 ins., carries two insulators. As will be seen on reference of Fig. 19, the six wires form two inverted equilateral triangles, and the insulators on each triangle are 42 ins. apart. These wires in each triangle are transposed by one complete spiral between each sub-station.

The cross-arms are bolted to the poles, and as an additional support they are stiffened with galvanized iron braces. Locke insulators are used, made in three parts and designed to stand double the working pressure. Each petticoat was tested separately, the top section to 45,000 volts. In each case these tests lasted four minutes, and following this the assembled insulator was subjected to 85,000 volts for ten minutes, and also a precipitation test was made at 52,500 volts. The insulators are mounted on iron pins.

A unique feature of the transmission line is the method of protection from lightning, which consists of a seven-strand galvanized steel cable, 5-16 in. in diameter, strung for the entire length of the line on top of the transmission poles, 4 ft. above the nearest active wire, and provided with ground connections at every fifth pole. This form of protection from lightning is believed to be an efficient supplementary adjunct to the arresters.

In all there are 71 miles of transmission line. This was erected at a speed of from one-half mile to 2 miles a day; the work including the digging of holes and pole erection, besides the stringing of six wires and tying them in position to their respective insulators.

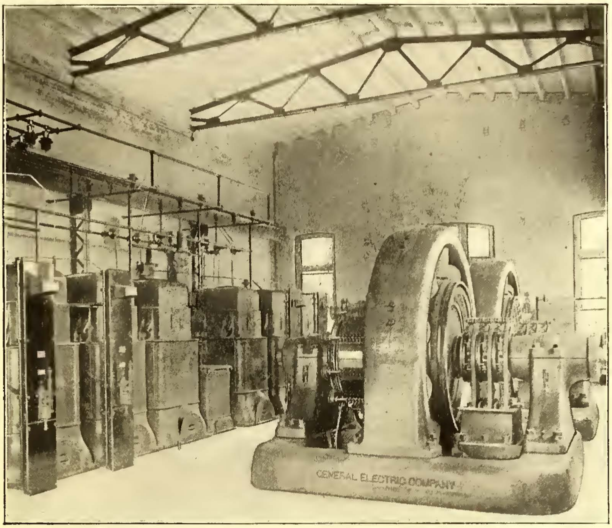


FIG. 15.—INTERIOR OF ATLANTIC CITY SUB-STATION

FIG. 17.—EXTERIOR OF NEWFIELD SUB-STATION

THE THIRD RAIL

The proposition of installing the third rail for the double-track road of this length in the prescribed time demanded a considerable amount of skill on the part of those organizing the work, and the fact that a large amount of steam traffic and double-tracking was going on at the same time materially added to the difficulties of the undertaking.

The Pennsylvania Railroad Company provided and installed all the necessary long ties on which the insulators are placed, and it also provided and distributed along the track all the third rail, third-rail splice bars and bolts. Typical views are shown herewith.

The rails used for this purpose are of the Pennsylvania Railroad standard cross-section and composition; they are in lengths of 33 ft., weigh 100 lbs. per yard, and have a conductivity about equal to that of a copper rod of 1,200,000 circ. mils. This type of third rail was used in order that it might be interchangeable with the track rails.

The insulators are of reconstructed granite, and are held in position by a metal centering cup which is secured to the long ties by means of a lag screw. The insulators are 10 ins. in length and 5½ ins. broad at the base, with an effective depth from the bottom of the rail to the tie of 3½ ins. The general form of these insulators may be seen in Figs. 20 and 21, which also show the method of retaining them in position. An advantage of this method of securing the position of the insulator is that on the ties being depressed by the passage of a train no tension strain is brought to bear on the insulators. The insulators are spaced about 8 ft. apart. The top of the third rail is 3½ ins. above the top of the track rails, and its gage 26 ins. distant from the gage line of the adjacent track rail, these dimensions constituting the standard of the Pennsylvania Railroad and the Long Island Railroad, and also make the shoe interchangeable with the Interborough Rapid Transit, of New York City.

The approaches of the third rail are made of cast iron of the shape shown in Figs. 21 and 22. The third rail is bonded with concealed ribbon bonds with solid copper terminals compressed into 1-in. drilled holes in the rail. There are two

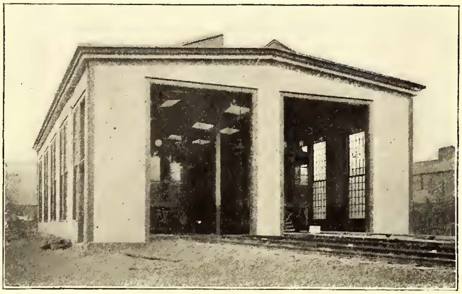


FIG. 18.—EXTERIOR OF INSPECTION SHED AT ATLANTIC CITY

bonds to a joint, and each has an area of 50,000 circ. mils, giving a total area of copper third-rail joint equal to 1,000,000 circ. mils. The work of bonding the third rail was accomplished at the rate of 660 bonds per day.

The third rail jumpers are of specially neat design. They are shown in Figs. 20 and 32-34. They are used at all grade crossings and wherever continuous third rail is impracticable. The cable is drawn into a black bituminized fiber tube, which is laid in a solid concrete protection. The diagram shows a double jumper. Terra cotta covers are employed to protect the cable terminals. Those for a single cable jumper are of the round form and those for double cable of an elliptical shape, as shown.

The third rail is anchored at intervals; this is accomplished by means of metal clamps secured to the under flange of the rail in such a position as to engage the insulator on either side. The third rails are arranged in such a manner that each track may be isolated from the other, but normally the third rails are electrically connected midway between the sub-stations through a combined switch and fuse box, thus obtaining the combined conductivity of the third rails. There are also section insulators opposite each sub-station, so that in the event of an accident on any part of the system only a short section of the third rail will be dead.

The company's right of way is fenced in, and at all crossings (Fig. 22) the fence meets Climax cattle guards at the edge of the crossing. In this way the public is prevented from reaching the third rail.

At all stations and in the Atlantic City and Camden yards, the third rail is protected by a wooden top and side guard. This consists of a 2-in. plank carried on castings attached to the top of maple posts, which are secured to the third rail at intervals of about 6 ft. The top casting is of such form that, although it is provided with a web for strength, no part of it extends either above or below the protection plank. This is also shown in Fig. 38.

Opposite all platforms the rail is further protected by a plank fastened to the side of the rail. Wherever possible, the rail is kept between the tracks, and is therefore on the side of the track farthest from the station platform, and inter-track fences are provided to prevent crossing the tracks. To prevent passengers or others on the platforms from touching the contact shoes on the platform side of the car, there is a protection plank similar to the third rail protecting plank but carried on castings fastened to the ties. The shoes are at all times under this plank and therefore protected. This is used at all stations, even where the third rail gives way to the trolley, although there is a switch on the car switchboard which enables the contact shoes to be cut out when operating from the trolley.

A point of great interest is to be found in the fact that the third rail system has been adopted at both terminal stations

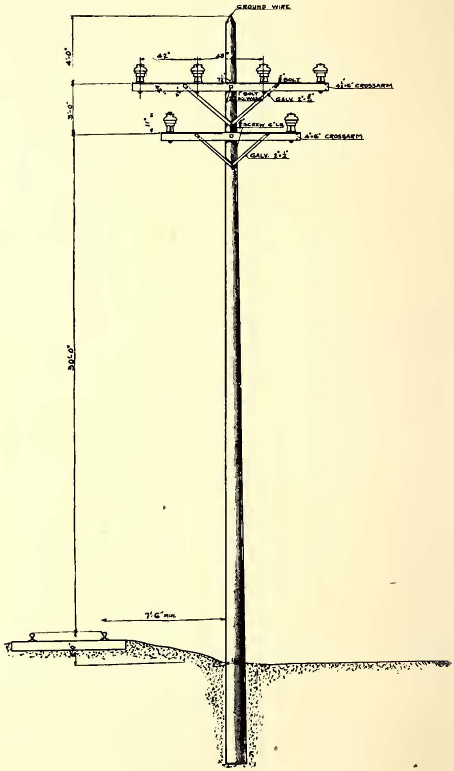


FIG. 19.—HIGH-TENSION LINE POLE

where there are a number of platforms, and it will be interesting to engineers to learn that this system was adopted on the score of less difficulties being encountered in its installation than would have been the case had an overhead trolley been erected.

BONDING OF MAIN TRACKS

The bonding of the main track between Camden and Atlantic City was a work of great magnitude, which will be appreciated when it is remembered that a heavy steam traffic was in progress during the whole period. It is a matter of interest to know that all the holes were drilled by hand, and also that the bond terminals were expanded by means of screw compressors. Two bonds of the "concealed" type were used per joint, each with a capacity of 400,000 circ. mils, and on account of the large size of bonds special angle plates had to be provided. As the road is double track throughout on the main line, the rebonding required the drilling of a prodigious number of 1-in. holes.

This work was performed almost entirely with untrained labor under skilled foremen. The men were given a royalty of 5 cents on each hole drilled above thirty per day, and some reached as high a maximum as eighty in a day's work. The railroad company required that one splice bar should always be kept in place against the rail to provide for the safe operation of the passing trains.

TROLLEY LINE

The trolley construction between Newfield and Millville and on the stretch of track between Haddon Avenue and South Gloucester is of the span type, with poles spaced at distances of 100 ft., and where practicable the high-tension transmission poles have been used for supporting the span wires. Through Camden the greater part of the trolley construction is on tubular steel poles. The trolley is suspended 22 ft. above the top of the track rails.

There are no copper feeders used on the third rail, but those for the trolley lines are as follows:

Two 750,000-circ. mil feeders from South Camden to Haddon Avenue.
One 750,00-circ. mil feeder, running from South Camdtn to Brown's Crossing.

Both of these form a conjunction with the third rail. The copper feeder between Newfield and Millville is 500,000 circ. mils in section.

The length of the line between Newfield and Millville is approximately 10 miles. The trolley wire is of No. 0000 grooved section, and the bonding is exactly similar to that already described on other portions of the road. The span wires are of standard galvanized steel 3/8 ins. in diameter. The lightning arresters are installed at approximately 1000 ft.

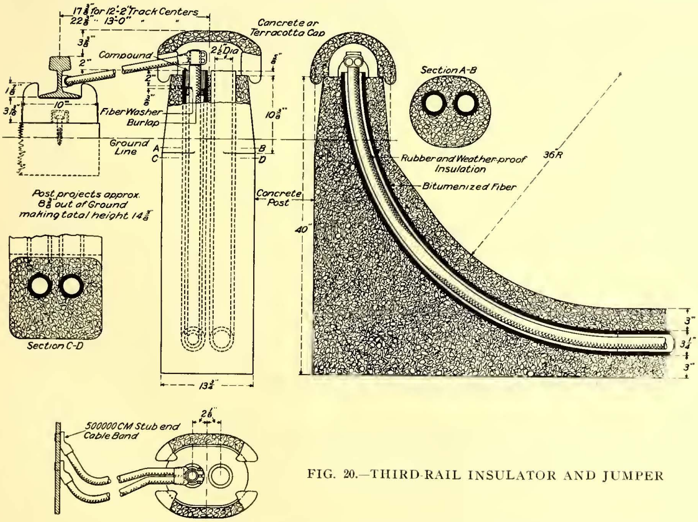


FIG. 20.—THIRD-RAIL INSULATOR AND JUMPER

apart. All pull-offs, strain ears, feeder ears and splicing sleeves are of bronze, and as these items, together with all other line material, such as frogs, etc., are of standard pattern, a further description would be superfluous.

CARS

For initial service sixty-two passenger cars and six combination baggage and mail cars have been provided. All of the cars are motor cars, the motor and control equipment being the same on all.

In preparing the design of these cars, the engineers of the railroad followed the general design of the standard Pennsylvania Railroad coaches, except that the height is less than the

FIG. 21.—THIRD RAIL AND TRANSMISSION LINE

standard to decrease the weight, the shape of the roof is changed, and the interior finish is of mahogany instead of oak. These cars also differ in some other details, such as coloring of the seats, the basket racks, sash fixtures and lighting fixtures. Figs. 25, 26 and 27 show interior and exterior of passenger cars, and Fig. 28 shows the exterior of a baggage and mail car.

The seating capacity is fifty-eight passengers, and the seats are of the Pennsylvania Railroad standard type, made by the Hale & Kilburn Manufacturing Company. Both ends of the cars are provided with vestibules and have the standard arrangement of steps, trap doors and vestibule side doors, with standard equipment of bronze hardware and grab handles. The vestibule center door is so arranged that when it opens it slides over and encloses the control apparatus.

The bottom framing consists of 5-in. x 8 11-16-in. yellow pine side sills and 7-in. I-beams for center and intermediate sills. The center and intermediate sills are continuous from end to end of the car. The floor bridging is of yellow pine fitted into the intermediate sills and into the side sills with blocking between center sills and between the intermediate and center sills, and is secured transversely by tie rods. Double diagonally laid flooring is used, both layers being tongued and grooved, and between the layers there is 1/8-in. asbestos. The top flooring is of maple. The entire under side of the car is protected by 1/4-in. transite, and above the motor truck steel plate over asbestos fire felt is used. The needle beams are 6-in. I-beams, and are supported at the ends in pockets which are provided with cast-steel truss rod struts. The body truss rods are of 1 1/4-in. round iron, upset at the ends. The body bolsters are of the steel truss type, two being used at the motor end and one at the trailer end. The body bracing is of the "W" form with short diagonal bracing and cripple posts.

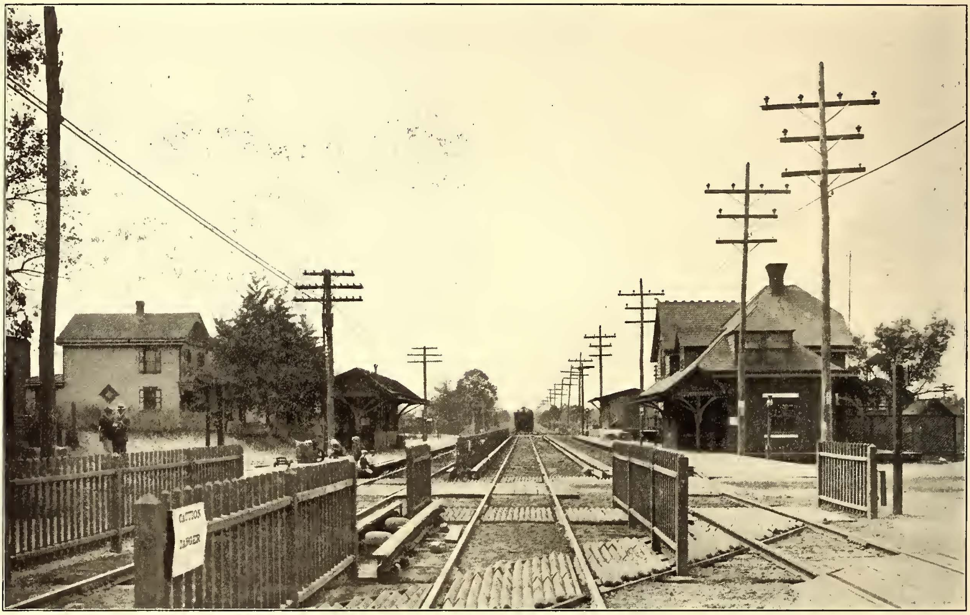


FIG. 22.—CATTLE GUARDS, JUMPERS, APPROACH BLOCKS AND THIRD-RAIL COVERING AT WESTVILLE

The general dimensions of the cars are as follows:

Length over buffers, 55 ft. 5 1/2 ins.
Length over body and sills, 46 ft. 6 ins.
Center to center of needle beams, 10 ft. 6 ins.
Truck centers, 33 ft.
Width over side sills, 9 ft 8 3/4 ins.
Width over sheathing, 9 ft. 10 ins.
Width over window sills, 10 ft.
Width over eaves, 10 ft. 1 1/4 ins.
Height from under-side of center sill to top of roof, 9 ft. 8 1/2 ins.
Height from under-side of center sill to top of rail (car-light), 3 ft. 7 5/16 ins.
Height from top of rail to top of roof (car-light), 13 ft. 3 13/16 ins.
Height from top of rail to top of trolley wheel when hooked down on roof, 14 ft. 8 1/2 ins.
Total weight of car, fully equipped on track, 89,000 lbs.

The combination baggage and mail cars are of the same general dimensions as the passenger cars and have similar vestibules. The mail compartment is 20 ft. long inside and the baggage compartment is 29 ft. 9 1/4 ins. long inside. The arrangement of the baggage compartment is similar to the standard Pennsylvania Railroad combination car, and the fittings and arrangements in the mail compartment are in accordance with the standard requirements of the Post Office Department.

All cars are provided with a 50-cp incandescent electric headlight and two electric markers or route lamps on the hood at each end. These were manufactured by the Dressel Railway Lamp Works, of New York. In the interior of the car there are five 5-light clusters, and in the saloon there is a single lamp. There are two lights in each vestibule, one being over each trap door, arranged in reflectors so that the lamp does not come below the vestibule ceiling. All wiring for lights is done in galvanized iron conduit on the roof of the car so that it is at all times accessible. Where the conduit goes through the roof to the fixtures, special roof plates are used, laid in lead so as to be water-tight. On the roof, in the center of the car, there is an illuminated numeral panel which permits the car number to be read from either side. The lamps in this panel are in the headlight circuit so that they are only lighted on the leading car of the train.

Each car has two trolleys, each with a retriever, and on the roof between the trolley bases there is a box containing the lightning arrester, trolley cut-out switch and trolley fuse. Steps are provided on the vestibule corner posts, and there are grab irons and roof platforms to permit of easy access to the roof.

The cars are heated by Gold cylindrical heaters, one being under each seat and a total of twenty-eight heaters per car. There are two coils in each heater, thus providing three degrees of heat.

In the vestibule, at the saloon end of the car, on the motorman's side, there is a switchboard on which are mounted the headlight and air compressor switches and fuses, the switch for cutting out the contact shoes when operating on trolley, the trolley cut-out switch and current limit relay. This switchboard is provided with double steel doors lined with asbestos, and is accessible from the vestibule. This switchboard, as well as all conduit wiring and fixtures for heating and lighting, was installed by the General Electric Company.

The American Car & Foundry Company, of Wilmington, Del., built twenty-two of the passenger cars, and the J. G. Brill Company, of Philadelphia., Pa., built eighteen and the Wason Manufacturing Company twenty-two passenger and six combination baggage and mail cars.

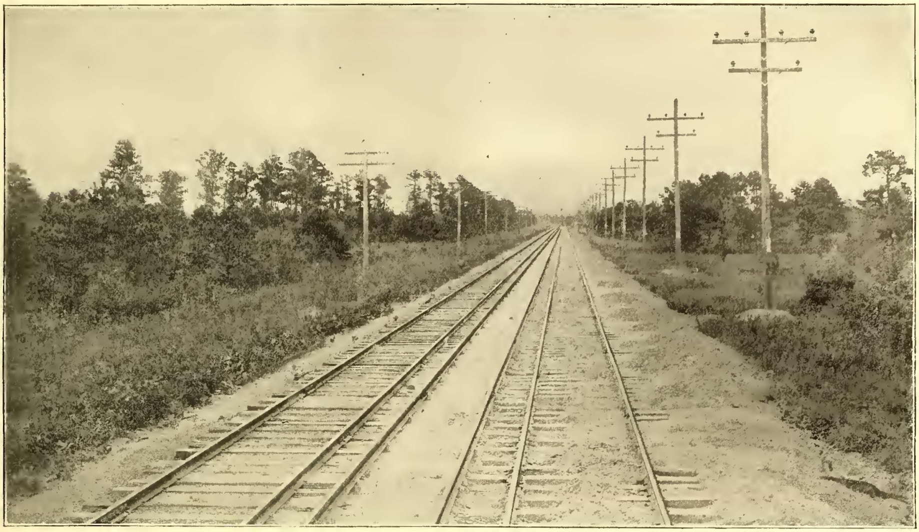


FIG. 23.—SECTION OF TRACK NEAR MIZPAH, N. J., SHOWING THIRD RAIL AND TRANSMISSION LINE

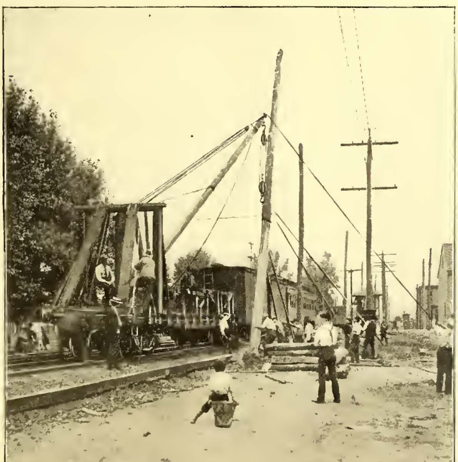


FIG. 24.—RAISING POLE WITH DERRICK CAR

TRUCKS

The motor and trailer trucks are of the M. C. B. double side-bar equalized type, somewhat similar to those used on the cars of the Interborough Rapid Transit Company and the Long Island Railroad, but with greater wheel base. The general dimensions of the trucks are as follows:

Gage of track, 4 ft. 8½ ins.
Distance between backs of wheel flanges, 4 ft. 5⅜ ins.
Wheel base, 7 ft.
Weight of motor truck complete without motors, 14,934 lbs.
Weight of trailer truck complete, 9,653 lbs.
Weight on center plate (carbody light) motor truck, 25,384 lbs.
Weight on center plate (carbody light) trailer truck, 26,065 lbs.

The truck bolster and truck center plates are steel castings machined to the proper dimensions. The side frames are of wrought iron machined on four sides. All bolt holes in the side frames are accurately drilled.

The pedestals are forgings lipped over the side frames and machined on all surfaces where they have a bearing. The motor truck transom consists of rolled-steel channels resting on the side frame castings provided with joining bolts of wrought iron. The trailer truck transom is of forged wrought iron with machined lips where it is bolted to the side frames. All equalizer bars are machined on the top edges for spring seats and on the bearing surface over the journal box.

The swing hangers are forgings supported on the transom by accurately fitted turned pins to carry the bolster spring seats. The side bearings are of cast steel provided with liners for adjustment of height and wear. On the motor trucks the bolster springs are elliptic and on the trailer truck they are triple elliptic. The equalizer springs are double coil of open-hearth steel. The spring plank on the motor truck is of rolled steel channel, and on the trailer truck is of 2½-in. white oak in one piece. The brake-hangers, rods and levers are of forged iron, and the pins throughout the brake rigging are accurately turned to dimensions.

On the motor truck the transoms are reinforced at the center by a steel casting bolted to the web and fitted around the top flange of the channel so as to be flush. Bolted to the top flange and partly supported by this steel casting is a chafing plate on which the nose of the motor rests. These same bolts hold a ⅞-in. x 2-in. strap over the motor nose.

The wheels of the motor truck are steel-tired with separate cast-steel spoke centers. They are 26 ins. in diamater with M. C. B. standard tread. The tires are 3 ins. thick, shrunk and bolted to the steel center. The hub of one wheel on each axle of the motor truck is extended and to this hub the forged-steel gear is shrunk after the wheel has been pressed on the

FIG. 25.—INTERIOR VIEW OF MOTOR CAR

axle. The axles are of open-hearth steel and conform to the test requirements of the Pennsylvania standard specifications. The journals are 5 ins. x 9 ins., the diameter of the axle at the wheel fit is 8 ins., and the diameter between wheels is 7 ins. finished all over.

Schoen solid rolled steel wheels, 33 ins. in diameter, are hung. On the motor truck the brakes are hung from cast brackets riveted to the transom. The connection between the live lever and the crescent bar is by means of links straddling the wheels. On the trailer truck the brakes are hung from angles thrown across from the truck side frames, and the Davis brake-beam is used.

The contact shoes are carried on maple beams which are supported from the notched face of the extended equalizer spring seats, allowing for adjustment in height.

The motor and trailer trucks for sixty-five cars were built by the Baldwin Locomotive Works, of Philadelphia, and for three cars by the J. G. Brill Company, of Philadelphia.

BRAKES

The cars are equipped with hand brakes and with Westinghouse quick-service automatic air brakes, Schedule "AMT". This brake schedule includes the brake valve, brake cylinder, triple valve, feed valve for reducing main reservoir pressure to 70 lbs., the brake pipe for train line, switches, gages, reservoirs, etc., together with what is known as the control line. This line extends through the train, and besides insuring uniform pump labor on all cars, provides, in connection with other apparatus, for the graduated release. The motorman is able to divide the process of release into as many steps as may be desired, securing the same flexibility as with straight air.

The quick recharge feature automatically maintains the auxiliary reservoir pressure through three separate feed ports so that any number of brake applications can be made in quick succession without depleting the system. It also includes a quick-service feature, so that in service applications communication is established between the brake cylinder and brake pipe pressure, which materially assists the auxiliary

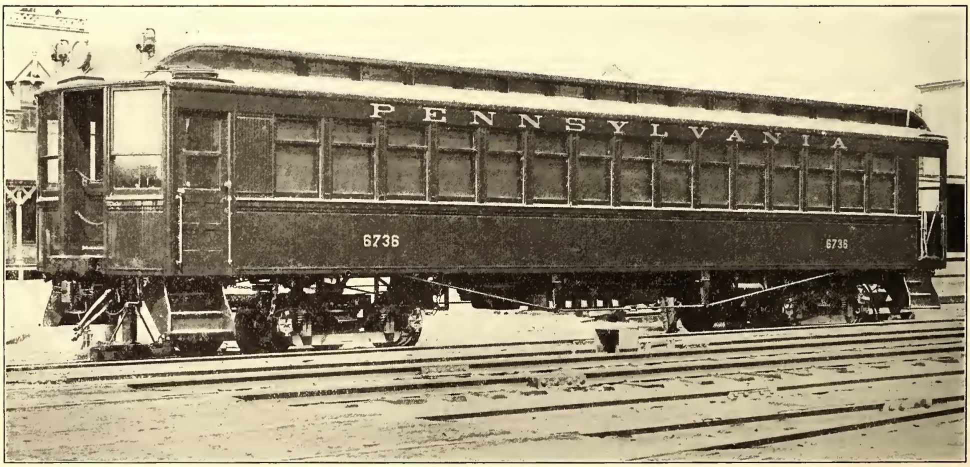


FIG. 26.—EXTERIOR VIEW OF STANDARD PASSENGER MOTOR CAR

used on the trailer truck. The trailer truck axles have 4¼-in. x 8-in. journals, are 5¾ ins. in diameter at the wheel fit, and tapered to 4¾-in. diameter at the center.

The journal boxes are of the Symington M. C. B. type with bronze journal bearings as in the locomotive practice, and with wearing surfaces and the journal seat planed to template.

The brakes on both motor and trailer trucks are inside-

reservoir to build up brake cylinder pressure in the ordinary manner.

The motor-driven air compressor, with its governor and whistle, are of the General Electric Company's manufacture. The compressors are mounted on two oak planks, supported by a cradle of wrought-iron bars. The cradle is suspended beneath the car near the motor and permanently bolted to the sills. The compressor consists of a duplex single-acting air pump, driven by a herring-bone gear and pinion from a railway type motor. All parts of the pump and motor are easily accessible and are designed so as not to be damaged by the severe conditions met with in this class of service. The motor is of the entirely enclosed type, and requires no additional housings or protection of any kind. The governor is a combination of diaphragm, piston, springs and operating levers connected to a single pole switch of a type similar to the contactors used in the motor circuits. The working parts are protected by a hinged cover which can readily be dropped for inspection.

The General Electric Company installed all the brake apparatus, including piping, but not the foundation brake rigging, which was furnished by the car builders.

MOTOR AND CONTROL EQUIPMENT

The electrical equipments were furnished and installed by the General Electric Company. There are two GE-69 motors which are 200-hp units on each car, while the control system is of the Sprague-General Electric automatic multiple-unit type. The controllers are so arranged that current is cut off from the motors throughout the train and the brakes are applied automatically should the motorman release his hold of the controller handle.

A large portion of the electrical apparatus was installed on the car bodies during their construction at the works of the three car builders. All the cables for the electrical conduits are run in grounded loricated conduits, the outlets of which are provided with rubber bushed bell-mouths.

On account of the short time at the disposal of the contractors it was not possible to follow the usual cut-and-try methods in installing the brake and control apparatus and piping, and carefully-made detailed drawings of all conduit work and hangers were prepared in advance and the equipments were installed simultaneously at the three car shops in accordance with these plans as soon as the body framing was sufficiently advanced to permit it, thus securing uniform and interchangeable work. The greatest care and attention was given to all details of the conduit and wiring, and all circuits were tested with high potential alternating current after completion. It is safe to say that a more carefully thought-out and installed piece of car wiring has never been done. For the sake of brevity, these equipments will not be entered into in detail, as they are of standard design. With the exception that each car is provided with a trolley and third rail shoe, the control system is similar to that of the twenty-four equipments supplied to the Boston Elevated road some eighteen months ago.

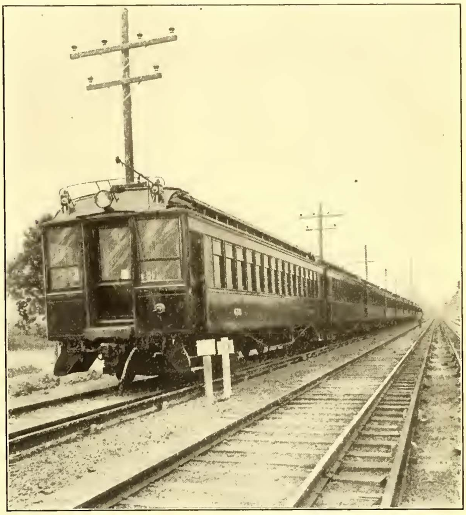


FIG. 27.—MOTOR CAR TRAIN

BLOCK-SIGNAL SYSTEM

The line is equipped with the a. c. block signal system of the Union Switch & Signal Company, similar to that used in the East Boston tunnel of the Boston Elevated Railway Company and on the Long Island Railroad. As is well known, the track in this system is sectionalized by inductive bonds, which permit the use of both rails for the direct-current return but confine the alternating current to the block. The inductive bonds have a resistance equivalent per block to about 40 ft. of 100-lb. rail, which makes the increase in ohmic resistance of return circuit about 1 per cent.

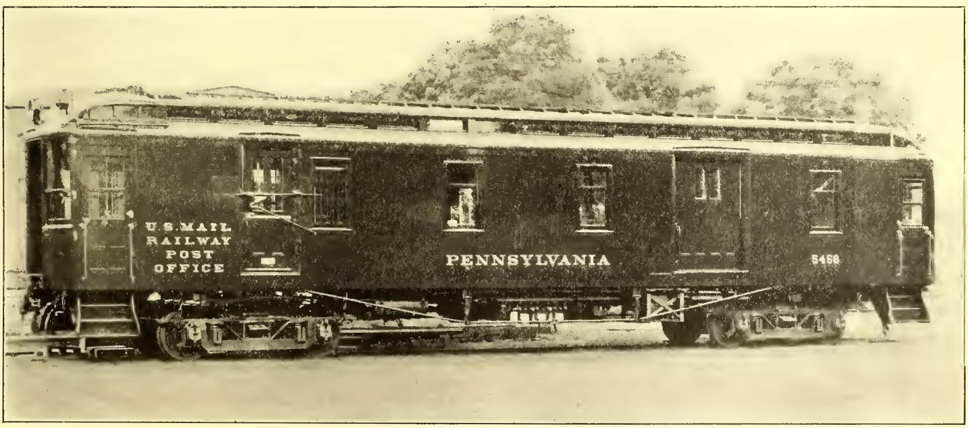


FIG. 28.—EXTERIOR VIEW OF BAGGAGE AND MAIL CAR

The inductive bonds at the end of the block are arranged in a cross-connection between the service rails of each track, as shown in Fig. 30. The block is supplied with alternating current at its center through transformers connected with 110-volt, 25-cycle signal mains running from the sub-stations. The semaphore relays are of the motor type with fields supplied with alternating current taken from the entering end of the block and with the armature supplied with current taken from the leaving end of the block. A view of these transformers is shown in Fig. 29.

From Camden to Newfield, a distance of 30 miles, the block signals are automatic, electro-pneumatic, with 120 block sections of the kind described; from Newfield to Pleasantville the telegraphic block system is used, with blocks about 2 miles in length; from Pleasantville to Atlantic City, 5.5

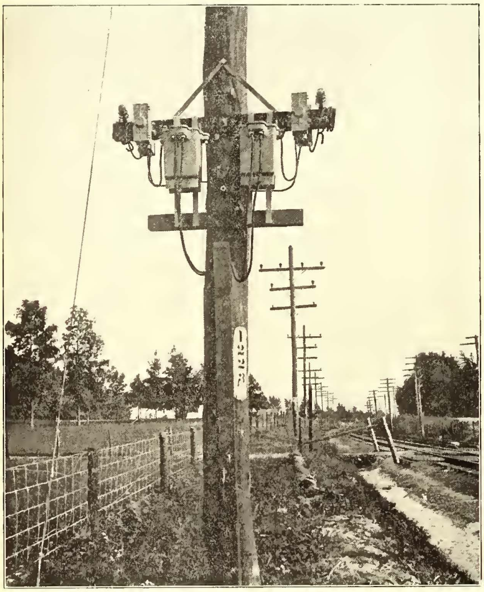


FIG. 29.—POLE SHOWING TRANSFORMERS FOR OPERATING SIGNAL SYSTEM

miles, automatic signals similar to those used between Camden and Newfield are employed.

SECTIONALIZING THE THIRD RAIL

To obtain the combined conductivity of the two third rails they are connected electrically, but at the same time provisions are made to insure only a short piece of single track becoming dead in the event of an accident. These desirable results, securing the collective conductivity and the sectionalization of the third rail, are obtained by the insertion of a combined switch and fuse box at points midway between each sub-station, as shown in Figs. 35 and 36. The gaps in the third rails at these points are filled with pieces of wood flush with the surface of the rail.

The sketch shown in Fig. 37 will give a clear idea of the electrical connections and arrangement of switches and fuses. The sections of rail marked *A* and *B* with the gap between them represent one third rail and *C* and *D* the other. When a short circuit occurs on any one section the circuit breaker will be thrown in the nearest sub-station and the fuse electrically nearest that section of the rail will be blown out, owing to the rush of current.

The following will show the conditions for a short on each section.

Short on *A* blows fuse No. 1. Fuse No. 1 takes total current from all sub-stations, while 2, 3 and 4 each take one-third.

Short on *B* blows fuse No. 4. Fuse No. 4 takes total cur-

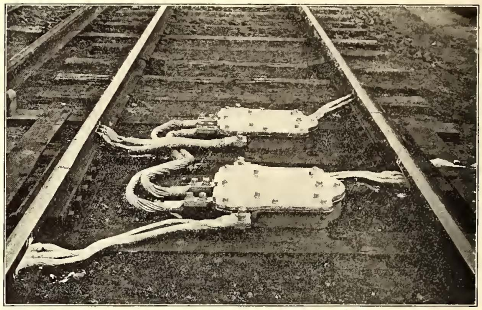


FIG. 30.—TWO INDUCTION BONDS CONNECTED BETWEEN RAILS

rent from all sub-stations, while 1, 2 and 3 each take one-third.

Short on *C* blows fuse No. 2. Fuse No. 2 takes total current from all sub-stations, while 1, 3 and 4 each take one-third.

Short on *D* blows fuse No. 3. Fuse No. 3 takes total current from all sub-stations, while 1, 2 and 4 each take one-third.

From the above it is apparent that a short circuit on any section of the third rail will incapacitate that section alone,

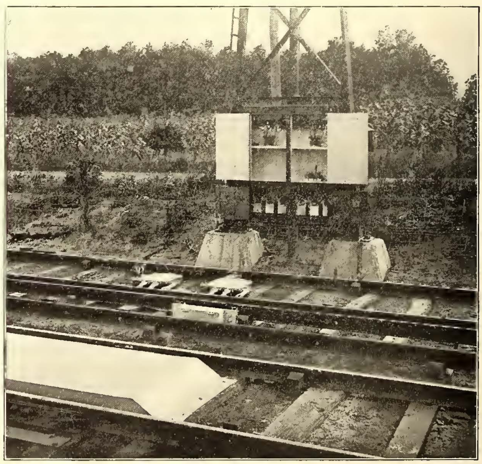


FIG. 31.—FOOT OF SIGNAL TOWER, SHOWING STORAGE BATTERIES AND INDUCTION BONDS IN TRACK

and that it will again be operative immediately the circuit breaker in the sub-station is closed, although it will draw no current from the other sections until its fuse has been replaced. The combined switch and fuse boxes are located between the two tracks and each contains four switches and four fuses.

SCHEDULES

It is interesting to note that the entire system of schedules and headway have been changed on the West Jersey & Sea-

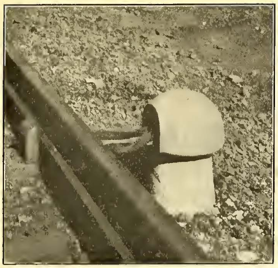
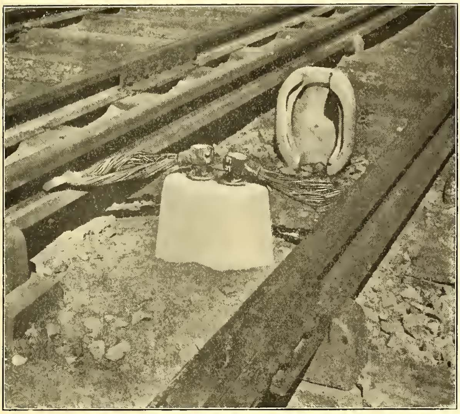


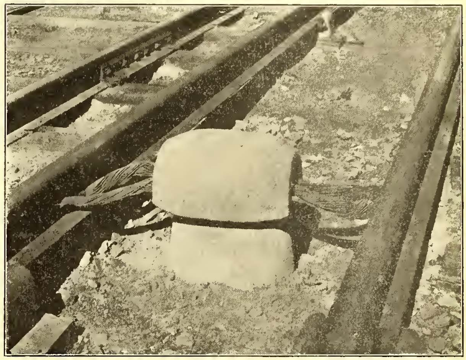
FIG. 32.—SINGLE THIRD-RAIL JUMPER

shore Railway with the motive power. In other words, the opportunity which electrical equipment affords of short trains at frequent intervals, as compared with the steam railroad plan of long trains at infrequent intervals, has been utilized to its fullest extent. The schedules now in force are similar to those on an interurban electric railway with express trains running every hour and locals at frequent intervals. Altogether there are fifty-one electric trains on the week-day schedule which now leave the station at Camden between 5:35 a. m. and 12:05 a. m. Of this number fourteen trains leave Camden between 4 p. m. and 6:20 p. m., or an average of ten minutes apart. Thirty-one of these trains are made

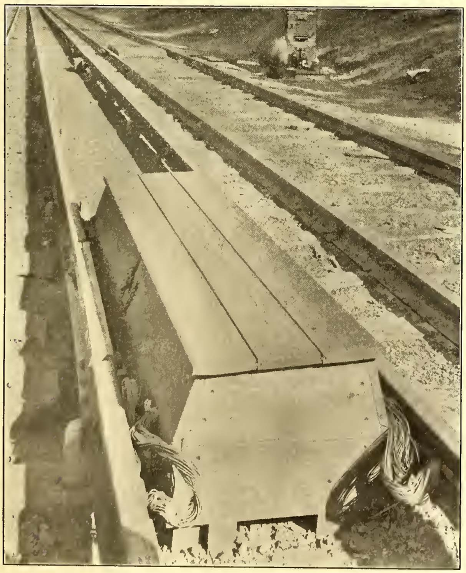
TABLE III.—SHOWING TRAINS LEAVING CAMDEN FOR POINTS ON CAPE MAY AND ATLANTIC CITY DIVISIONS

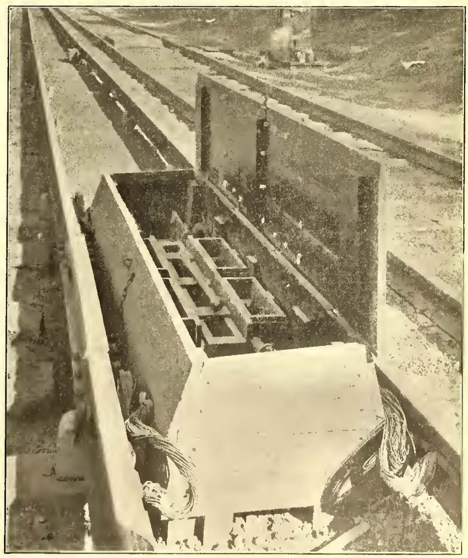
	1906		1905
	Electric	Steam	Steam
Camden to Newfield or beyond	14	..	8
Glasboro to Newfield or beyond	..	..	1
Camden to Glasboro	22	2	12
Camden to Clayton	1	..	1
Camden to Wenonah	..	..	1
Camden to Atlantic City (express)	14	..	..
Newfield to Atlantic City (local)	3	..	2
Total	54	2	25





FIGS. 33 AND 34.—DOUBLE THIRD-RAIL JUMPER WITH COVER REMOVED AND IN POSITION





FIGS. 35 AND 36.—THIRD-RAIL SECTION SWITCH AND FUSE BOX, OPEN AND CLOSED

up normally of two cars each; nineteen of the trains are made up of three cars each, and one train is made up of four cars each. Baggage cars are run at frequent intervals. Table III. shows a comparison between the October schedule this year with electric equipment and last year with steam power. This table gives the number of trains running east and south from Camden to Newfield or beyond.

It will be remembered that this schedule shows the traffic after the Atlantic City season proper has terminated. Actual statistics of travel are not available, but it may be said that there has been a large increase in passengers during the short time in which the line has been in operation. In fact the additional traffic has been so large that the company is already planning to increase its equipment by the addition of another turbine. Next summer, when the season at Atlantic City begins, a still larger increase in passengers is anticipated.

ORGANIZATION

The conversion of the lines of the West Jersey & Seashore Railroad above described from steam to electric traction was carried out by the following organizations:

The construction of the terminals, inspection sheds, double tracking, changes in existing tracks, grading, new bridges, changes in telegraph lines, and installation of a special telephone system were carried out by the regular engineering and maintenance of way departments of the Pennsylvania Railroad Company.

The installation of the interlocking plants and automatic block signaling was carried out by the Union Switch & Signal Company in accordance with plans of the signal department of the Pennsylvania Railroad Company.

The new cars and trucks required for the electric service were designed by the motive power department of the Pennsylvania Railroad Company.

The entire contract for the electrical equipment, including the construction of the power house, sub-stations and the

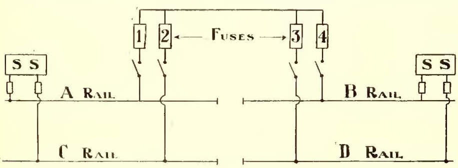


FIG. 37.—DIAGRAM SHOWING CONNECTIONS, ARRANGEMENT OF SWITCHES AND FUSES BETWEEN SECTIONS OF THIRD RAIL

electrical equipment on the cars, was awarded to the General Electric Company, and in accordance with the plans under the supervision of George Gibbs, chief engineer of electric traction, in consultation with the officers of the railroad company. Stern & Silverman, of Philadelphia, were appointed by the General Electric Company as its general sub-contractors, and the Scofield Company, also of Philadelphia, acted as general engineers for the power house and sub-contractors for the piling and foundations.

The whole of the electrical work was under the personal supervision of W. B. Potter, engineer, railway engineering department General Electric Company, directly assisted by J. Elliot Hewes, C. E. Eveleth and W. H. Clapp.

GROUNDING A TEST MOTOR

In most shops overhauled motors are given a spin before hanging them on a truck, to test the armature bearings. On ground return systems this test will show up any existing

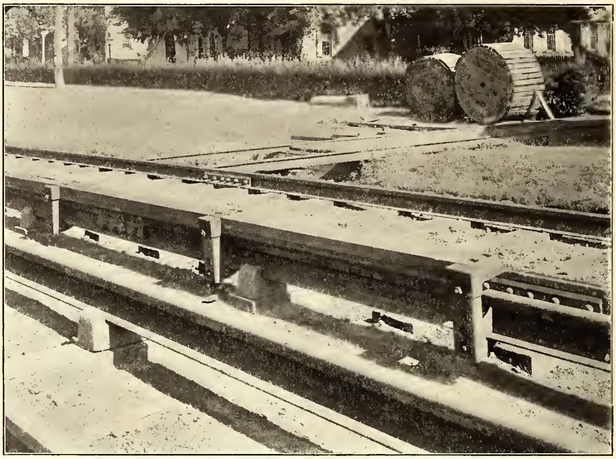


FIG. 38.—THIRD-RAIL PROTECTION BOLTED TO THIRD RAIL, AT WOODBURY

fault ground in the motor winding, provided the motor frame rests on a grounded part, because the motor frame then represents one side of the circuit everywhere exposed to the copper representing the other side of the circuit but separated from it by insulation. Bad insulation anywhere will permit the two sides of the circuit to get together and there is at once a demonstration indicative of the cause and location of the fault.

When the motor under test rests on a cement floor or a wooden platform, either the motor frame must be connected to the track rail or to some copper part of the motor, otherwise the existence of a single ground to frame will not be indicated. In such tests also the field should be connected to trolley and the armature to ground, then the rotation can be reversed by reversing either the field or the armature. If the armature is made trolley and the field ground and reversal is effected by reversing the armature, the motor may get through the test without showing up an existing grounded field coil, because the maximum difference of potential between the + side of the field and the frame may not exceed two or three volts, which is insufficient either to break down weak insulation or to cause burning through an actual short circuit, although in the case of a perfect short circuit the motor might refuse to start or might run at very high speed according to the number of coils cut out. Failure to observe this precaution accounts for grounded fields getting through even a test conducted with the motor mounted on the truck. On a metallic return system, the copper circuit must be connected to the motor frame and first one end of the motor must be made + then the other, otherwise the potential difference acting through the fault will be insufficient to cause noticeable demonstration unless the by-path formed by the frame ground and fault cuts out two or more field coils. In all cases in event of a ground on the armature, owing to that member rotating, the symptom will be plain whether the armature is connected to + or —.

TABLES OF CAR POSITIONS ON CURVES

BY GEO. L. FOWLER

The first two tables reproduced herewith show the angles subtended by cars of different lengths on curves of different radii, together with the angles between the truck and body bolsters when the former stands radially to the track. A practical application of these tables is made in a few others showing the allowances that must be made for the distances between side sills whose bottoms are at a height of 2 ft. 3 ins. above the rails and are used with wheels of 33-in. diameter and 3-in. width of tread, combined with trucks varying in wheel base from 4 ft. to 5 ft.

While these tables do not cover a very wide range of car and truck construction and combination, they are sufficiently comprehensive to give the designer of a car an idea of approximately what he will have to provide for. For sills at a greater distance above the rails or for smaller wheels the distances between the former to allow for clearance can be less, while the reverse holds if the sill bottoms are lower or the wheels larger. Where wheel treads of greater or less width than 3 ins. are used an addition or subtraction of twice the difference in the width will give the clearance, or rather the distance, between the sills at which the edges of the rims will touch. As noted, the proper clearance allowances, as well as that needed to compensate for the play of the journals, must be added to the figures of the tables.

ANGLE SUBTENDED BY CAR-BODY ON CURVES OF VARIOUS RADII AND DISTANCES BETWEEN BOLSTER CENTERS

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	42° 12′	44° 40′	47° 10′	49° 40′	52° 12′	54° 46′	57° 22′	60° 0′	62° 40′	65° 22′	68° 6′	70° 54′	73° 44′
30 "	34° 54′	36° 56′	38° 56′	40° 58′	43° 2′	45° 4′	47° 10′	49° 14′	51° 22′	53° 30′	55° 38′	57° 48′	60° 0′
35 "	29° 48′	31° 30′	33° 12′	34° 54′	36° 38′	38° 22′	40° 6′	41° 50′	43° 36′	45° 22′	47° 10′	48° 56′	50° 46′
40 "	26° 0′	27° 28′	28° 58′	30° 26′	31° 56′	33° 26′	34° 54′	36° 26′	37° 56′	39° 26′	40° 58′	42° 30′	44° 2′
45 "	23° 4′	24° 22′	25° 40′	27° 0′	28° 18′	29° 34′	30° 56′	32° 16′	33° 34′	34° 54′	36° 16′	37° 36′	38° 48′
50 "	20° 44′	21° 54′	23° 4′	24° 14′	25° 26′	26° 36′	27° 46′	28° 58′	30° 8′	31° 20′	32° 32′	33° 42′	34° 54′
55 "	18° 50′	19° 54′	20° 58′	21° 54′	23° 4′	24° 8′	25° 12′	26° 16′	27° 20′	28° 26′	29° 30′	30° 34′	31° 40′
60 "	17° 16′	18° 14′	19° 12′	20° 10′	21° 8′	22° 4′	23° 4′	24° 2′	25° 2′	26° 0′	27° 0′	27° 58′	28° 58′
65 "	15° 56′	16° 48′	17° 42′	18° 36′	19° 30′	20° 22′	21° 16′	22° 10′	23° 4′	24° 0′	24° 52′	25° 46′	26° 42′
70 "	14° 46′	15° 36′	16° 26′	17° 16′	18° 8′	18° 56′	19° 44′	20° 34′	21° 24′	22° 14′	23° 4′	23° 54′	24° 44′
75 "	13° 48′	14° 34′	15° 20′	16° 6′	16° 52′	17° 38′	18° 24′	19° 12′	19° 58′	20° 44′	21° 30′	22° 18′	23° 4′

ANGLE BETWEEN CAR-BODY AND TRUCK BOLSTERS ON CURVES OF VARIOUS RADII AND DISTANCES BETWEEN BOLSTER CENTERS

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	21° 6′	22° 20′	23° 35′	24° 50′	26° 6′	27° 23′	28° 41′	30° 0′	31° 20′	32° 41′	34° 3′	35° 27′	36° 52′
30 "	17° 27′	18° 28′	19° 28′	20° 29′	21° 31′	22° 32′	23° 35′	24° 37′	25° 41′	26° 45′	27° 49′	28° 54′	30° 0′
35 "	14° 54′	15° 45′	16° 36′	17° 27′	18° 19′	19° 11′	20° 3′	20° 55′	21° 48′	22° 41′	23° 35′	24° 28′	25° 23′
40 "	13° 0′	13° 44′	14° 29′	15° 13′	15° 58′	16° 43′	17° 27′	18° 13′	18° 58′	19° 43′	20° 29′	21° 15′	22° 1′
45 "	11° 32′	12° 11′	12° 50′	13° 30′	14° 9′	14° 47′	15° 28′	16° 8′	16° 47′	17° 28′	18° 8′	18° 48′	19° 24′
50 "	10° 22′	10° 57′	11° 32′	12° 7′	12° 43′	13° 18′	13° 53′	14° 29′	15° 4′	15° 40′	16° 16′	16° 51′	17° 27′
55 "	9° 25′	9° 57′	10° 29′	10° 57′	11° 32′	12° 4′	12° 36′	13° 8′	13° 40′	14° 13′	14° 45′	15° 17′	15° 50′
60 "	8° 38′	9° 2′	9° 36′	10° 5′	10° 34′	11° 2′	11° 32′	12° 1′	12° 31′	13° 0′	13° 30′	13° 59′	14° 29′
65 "	7° 58′	8° 24′	8° 51′	9° 18′	9° 45′	10° 11′	10° 38′	11° 5′	11° 32′	12° 0′	12° 26′	12° 53′	13° 21′
70 "	7° 23′	7° 48′	8° 13′	8° 38′	9° 4′	9° 28′	9° 52′	10° 17′	10° 42′	11° 7′	11° 32′	11° 57′	12° 22′
75 "	6° 54′	7° 17′	7° 40′	8° 3′	8° 26′	8° 49′	9° 12′	9° 36′	9° 59′	10° 22′	10° 45′	11° 9′	11° 32′

TABLE OF NECESSARY DISTANCES BETWEEN INSIDE FACES OF SIDE SILLS TO ALLOW TRUCK WHEELS TO SWING
Conditions: 4-ft. Wheel-Base, 4-ft. 8½-in. Gage of Track, 33-in. Wheels, 3-in. Wheel-Tread, 2 ft. 3 ins. from Top of Rail to Under Side of Sill

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	7′-0¾″	7′-1¾″	7′-2⅝″	7′-3½″	7′-4⅜″	7′-5¼″	7′-6″	7′-6¾″	7′-7½″	7′-8¼″	7′-8⅞″	7′-9½″	7′-10″
30 "	6′-9⅝″	6′-10½″	6′-11⅜″	7′-0¼″	7′-1⅛″	7′-1⅞″	7′-2⅝″	7′-3⅜″	7′-4⅛″	7′-4⅞″	7′-5½″	7′-6¼″	7′-6¾″
35 "	6′-7¼″	6′-8⅛″	6′-8⅞″	6′-9⅝″	6′-10⅜″	6′-11⅛″	6′-11⅞″	7′-0⅝″	7′-1¼″	7′-2″	7′-2⅝″	7′-3¼″	7′-3⅞″
40 "	6′-5⅜″	6′-6⅛″	6′-6⅞″	6′-7⅝″	6′-8¼″	6′-9″	6′-9⅝″	6′-10⅜″	6′-11″	6′-11⅝″	7′-0¼″	7′-0⅞″	7′-1½″
45 "	6′-4″	6′-4⅝″	6′-5¼″	6′-5⅞″	6′-6½″	6′-7⅛″	6′-7⅞″	6′-8½″	6′-9″	6′-9⅝″	6′-10¼″	6′-10⅞″	6′-11⅜″
50 "	6′-2¾″	6′-3⅜″	6′-4″	6′-4½″	6′-5⅛″	6′-5¾″	6′-6⅜″	6′-6⅞″	6′-7½″	6′-8″	6′-8⅝″	6′-9⅛″	6′-9⅝″
55 "	6′-1¾″	6′-2¼″	6′-2⅞″	6′-3⅜″	6′-4″	6′-4½″	6′-5″	6′-5½″	6′-6⅛″	6′-6⅝″	6′-7⅛″	6′-7⅝″	6′-8⅛″
60 "	6′-0⅞″	6′-1⅜″	6′-1⅞″	6′-2⅜″	6′-2⅞″	6′-3½″	6′-4″	6′-4⅜″	6′-5″	6′-5⅜″	6′-5⅞″	6′-6⅜″	6′-6⅞″
65 "	6′-0⅛″	6′-0⅝″	6′-1⅛″	6′-1⅝″	6′-2″	6′-2½″	6′-3″	6′-3½″	6′-4″	6′-4⅜″	6′-4⅞″	6′-5¼″	6′-5¾″
70 "	5′-11½″	5′-11⅞″	6′-0⅜″	6′-0⅞″	6′-1¼″	6′-1¾″	6′-2⅛″	6′-2⅝″	6′-3″	6′-3½″	6′-4″	6′-4⅜″	6′-4¾″
75 "	5′-10⅞″	5′-11⅜″	5′-11¾″	6′-0¼″	6′-0⅝″	6′-1″	6′-1½″	6′-1⅞″	6′-2¼″	6′-2¾″	6′-3⅛″	6′-3½″	6′-4″

TABLES OF NECESSARY DISTANCES BETWEEN INSIDE FACES OF SIDE SILLS TO ALLOW TRUCK WHEELS TO SWING. PROPER CLEARANCE ALLOWANCE MUST BE ADDED TO THESE FIGURES

Conditions: 4-ft. 1-in. Wheel-Base, 4-ft. 8½-in. Gage of Track, 33-in. Wheels, 3-in. Wheel-Tread, 2 ft. 3 ins. from Top of Rail to Under Side of Sill

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	7'-1 1/8"	7'-2 1/8"	7'-3"	7'-4"	7'-4 7/8"	7'-5 3/4"	7'-6 1/2"	7'-7 1/4"	7'-8"	7'-8 3/4"	7'-9 3/8"	7'-10"	7'-10 5/8"
30 "	6'-10"	6'-10 7/8"	6'-11 3/4"	7'-0 5/8"	7'-1 3/8"	7'-2 1/4"	7'-3"	7'-3 3/4"	7'-4 1/2"	7'-5 1/4"	7'-6"	7'-6 5/8"	7'-7 1/4"
35 "	6'-7 1/2"	6'-8 3/8"	6'-9 1/8"	6'-10"	6'-10 3/4"	6'-11 1/2"	7'-0 1/4"	7'-1"	7'-1 5/8"	7'-2 3/8"	7'-3"	7'-3 3/4"	7'-4 3/8"
40 "	6'-5 5/8"	6'-6 3/8"	6'-7 1/8"	6'-7 7/8"	6'-8 5/8"	6'-9 1/4"	6'-10"	6'-10 5/8"	6'-11 1/4"	6'-11 7/8"	7'-0 5/8"	7'-1 1/4"	7'-1 7/8"
45 "	6'-4 1/8"	6'-4 7/8"	6'-5 1/2"	6'-6 1/8"	6'-6 3/4"	6'-7 3/8"	6'-8 1/8"	6'-8 3/4"	6'-9 3/8"	6'-10"	6'-10 1/2"	6'-11 1/8"	6'-11 5/8"
50 "	6'-2 7/8"	6'-3 1/2"	6'-4 1/8"	6'-4 3/4"	6'-5 3/8"	6'-6"	6'-6 1/2"	6'-7 1/8"	6'-7 3/4"	6'-8 1/4"	6'-8 7/8"	6'-9 3/8"	6'-10"
55 "	6'-1 7/8"	6'-2 1/2"	6'-3"	6'-3 1/2"	6'-4 1/8"	6'-4 3/4"	6'-5 1/4"	6'-5 3/4"	6'-6 3/8"	6'-6 7/8"	6'-7 3/8"	6'-7 7/8"	6'-8 1/2"
60 "	6'-1"	6'-1 1/2"	6'-2"	6'-2 5/8"	6'-3 1/8"	6'-3 5/8"	6'-4 1/8"	6'-4 5/8"	6'-5 1/8"	6'-5 5/8"	6'-6 1/8"	6'-6 5/8"	6'-7 1/8"
65 "	6'-0 1/4"	6'-0 3/4"	6'-1 1/4"	6'-1 3/4"	6'-2 1/4"	6'-2 3/4"	6'-3 1/8"	6'-3 5/8"	6'-4 1/8"	6'-4 5/8"	6'-5 1/8"	6'-5 1/2"	6'-6"
70 "	5'-11 5/8"	6'-0"	6'-0 1/2"	6'-1"	6'-1 1/2"	6'-1 7/8"	6'-2 3/8"	6'-2 3/4"	6'-3 1/4"	6'-3 3/4"	6'-4 1/8"	6'-4 5/8"	6'-5"
75 "	5'-11"	5'-11 1/2"	5'-11 7/8"	6'-0 3/8"	6'-0 3/4"	6'-1 1/4"	6'-1 5/8"	6'-2"	6'-2 1/2"	6'-2 7/8"	6'-3 1/4"	6'-3 3/4"	6'-4 1/8"

Conditions: 4-ft. 6-in. Wheel-Base, 4-ft. 8½-in. Gage of Track, 33-in. Wheels, 3-in. Wheel-Tread, 2 ft. 3 ins. from Top of Rail to Under Side of Sill

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	7'-2 5/8"	7'-3 3/4"	7'-4 3/4"	7'-5 3/4"	7'-6 3/4"	7'-7 3/4"	7'-8 5/8"	7'-9 1/2"	7'-10 1/4"	7'-11 1/4"	8'-0"	8'-5/8"	8'-1 3/8"
30 "	6'-11 1/8"	7'-1/4"	7'-1 1/8"	7'-2 1/8"	7'-3"	7'-3 7/8"	7'-4 3/4"	7'-5 5/8"	7'-6 1/2"	7'-7 1/4"	7'-8"	7'-8 3/4"	7'-9 1/2"
35 "	6'-8 1/2"	6'-9 1/2"	6'-10 3/8"	6'-11 1/8"	7'-0"	7'-7/8"	7'-1 5/8"	7'-2 1/2"	7'-3 1/4"	7'-4"	7'-4 3/4"	7'-5 1/2"	7'-6 1/8"
40 "	6'-6 1/2"	6'-7 3/8"	6'-8 1/8"	6'-8 7/8"	6'-9 5/8"	6'-10 1/2"	6'-11 1/8"	6'-11 7/8"	7'-5/8"	7'-1 3/8"	7'-2 1/8"	7'-2 3/4"	7'-3 1/2"
45 "	6'-4 7/8"	6'-5 5/8"	6'-6 3/4"	6'-7 1/8"	6'-7 3/4"	6'-8 1/2"	6'-9 1/8"	6'-9 7/8"	6'-10 1/2"	6'-11 1/8"	6'-11 7/8"	7'-1/2"	7'-1"
50 "	6'-3 1/2"	6'-4 1/4"	6'-4 7/8"	6'-5 1/2"	6'-6 1/4"	6'-6 7/8"	6'-7 1/2"	6'-8 1/8"	6'-8 3/4"	6'-9 3/8"	6'-10"	6'-10 5/8"	6'-11 1/8"
55 "	6'-2 3/8"	6'-3"	6'-3 5/8"	6'-4 1/4"	6'-4 7/8"	6'-5 1/2"	6'-6"	6'-6 5/8"	6'-7 1/4"	6'-7 7/8"	6'-8 3/8"	6'-9"	6'-9 1/2"
60 "	6'-1 1/2"	6'-2 1/8"	6'-2 5/8"	6'-3 1/4"	6'-3 3/4"	6'-4 3/8"	6'-4 7/8"	6'-5 3/8"	6'-6"	6'-6 1/2"	6'-7 1/8"	6'-7 5/8"	6'-8 1/8"
65 "	6'-0 7/8"	6'-1 1/4"	6'-1 3/4"	6'-2 1/4"	6'-2 3/4"	6'-3 3/8"	6'-3 7/8"	6'-4 3/8"	6'-4 7/8"	6'-5 3/8"	6'-5 7/8"	6'-6 3/8"	6'-6 7/8"
70 "	6'-0"	6'-0 1/2"	6'-1"	6'-1 1/2"	6'-2"	6'-2 1/2"	6'-2 7/8"	6'-3 3/8"	6'-3 7/8"	6'-4 3/8"	6'-4 7/8"	6'-5 3/8"	6'-5 3/4"
75 "	5'-11 3/8"	5'-11 7/8"	6'-1/4"	6'-3/4"	6'-1 1/4"	6'-1 5/8"	6'-2 1/8"	6'-2 5/8"	6'-3 1/8"	6'-3 1/2"	6'-4"	6'-4 3/8"	6'-4 7/8"

Conditions: 4-ft. 10-in. Wheel-Base, 4-ft. 8½-in. Gage of Track, 33-in. Wheels, 3-in. Wheel-Tread, 2 ft. 3 ins. from Top of Rail to Under Side of Sill

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	7'-4 1/8"	7'-5 1/4"	7'-6 3/8"	7'-7 1/2"	7'-8 5/8"	7'-9 5/8"	7'-10 5/8"	7'-11 5/8"	8'-1/2"	8'-1 3/8"	8'-2 1/4"	8'-3"	8'-3 3/4"
30 "	7'-3/8"	7'-1 1/2"	7'-2 1/2"	7'-3 1/2"	7'-4 1/2"	7'-5 1/2"	7'-6 3/8"	7'-7 3/8"	7'-8 1/4"	7'-9 1/4"	7'-10"	7'-10 3/4"	7'-11 5/8"
35 "	6'-9 5/8"	6'-10 5/8"	6'-11 1/2"	7'-3/8"	7'-1 1/4"	7'-2 1/4"	7'-3 1/8"	7'-3 7/8"	7'-4 3/4"	7'-5 5/8"	7'-6 3/8"	7'-7 1/4"	7'-8"
40 "	6'-7 1/2"	6'-8 1/4"	6'-9 1/8"	6'-10"	6'-10 3/4"	6'-11 5/8"	7'-3/8"	7'-1 1/8"	7'-2"	7'-2 3/4"	7'-3 1/2"	7'-4 1/4"	7'-5"
45 "	6'-5 5/8"	6'-6 1/2"	6'-7 1/4"	6'-8"	6'-8 3/4"	6'-9 1/2"	6'-10 1/4"	6'-11"	6'-11 5/8"	7'-3/8"	7'-1 1/8"	7'-1 3/4"	7'-2 1/2"
50 "	6'-4 1/4"	6'-5"	6'-5 5/8"	6'-6 3/8"	6'-7 1/8"	6'-7 3/4"	6'-8 1/2"	6'-9 1/8"	6'-9 3/4"	6'-10 1/2"	6'-11 1/8"	6'-11 3/4"	7'-3/8"
55 "	6'-3 1/8"	6'-3 3/4"	6'-4 3/8"	6'-5"	6'-5 5/8"	6'-6 3/8"	6'-7"	6'-7 5/8"	6'-8 1/4"	6'-8 7/8"	6'-9 3/8"	6'-10"	6'-10 5/8"
60 "	6'-2 1/8"	6'-2 3/4"	6'-3 3/8"	6'-3 7/8"	6'-4 1/2"	6'-5 1/8"	6'-5 5/8"	6'-6 1/4"	6'-6 7/8"	6'-7 1/2"	6'-8"	6'-8 5/8"	6'-9 1/8"
65 "	6'-1 1/4"	6'-1 3/4"	6'-2 3/8"	6'-3"	6'-3 1/2"	6'-4"	6'-4 5/8"	6'-5 1/8"	6'-5 5/8"	6'-6 1/4"	6'-6 3/4"	6'-7 1/4"	6'-7 5/8"
70 "	6'-0 1/2"	6'-1"	6'-1 1/2"	6'-2 1/8"	6'-2 5/8"	6'-3 1/8"	6'-3 5/8"	6'-4 1/8"	6'-4 5/8"	6'-5 1/4"	6'-5 5/8"	6'-6 1/4"	6'-6 5/8"
75 "	6'-0"	6'-1/2"	6'-7/8"	6'-1 3/8"	6'-1 7/8"	6'-2 3/8"	6'-2 3/4"	6'-3 1/4"	6'-3 3/4"	6'-4 1/4"	6'-4 3/4"	6'-5 1/8"	6'-5 5/8"

Conditions: 5-ft. Wheel-Base, 4-ft. 8½-in. Gage of Track, 33-in. Wheels, 3-in. Wheel-Tread, 2 ft. 3 ins. from Top of Rail to Under Side of Sill

RADII OF CURVES	DISTANCE BETWEEN BOLSTER CENTERS IN FEET												
	18	19	20	21	22	23	24	25	26	27	28	29	30
25 FEET	7'-4 7/8"	7'-6"	7'-7 1/4"	7'-8 3/8"	7'-9 1/2"	7'-10 1/2"	7'-11 5/8"	8'-5/8"	8'-1 5/8"	8'-2 1/2"	8'-3 3/8"	8'-4 1/4"	8'-5"
30 "	7'-1"	7'-2 1/8"	7'-3 1/8"	7'-4 1/4"	7'-5 1/4"	7'-6 1/4"	7'-7 1/4"	7'-8 1/8"	7'-9 1/8"	7'-10"	7'-10 7/8"	7'-11 3/4"	8'-5/8"
35 "	6'-10 1/8"	6'-11 1/8"	7'-0"	7'-1"	7'-2"	7'-2 7/8"	7'-3 3/4"	7'-4 5/8"	7'-5 1/2"	7'-6 3/8"	7'-7 1/4"	7'-8"	7'-8 7/8"
40 "	6'-7 7/8"	6'-8 3/4"	6'-9 5/8"	6'-10 1/2"	6'-11 3/8"	7'-1/4"	7'-1"	7'-1 7/8"	7'-2 5/8"	7'-3 3/8"	7'-4 1/4"	7'-5"	7'-5 3/4"
45 "	6'-6 1/8"	6'-6 7/8"	6'-7 5/8"	6'-8 1/2"	6'-9 1/4"	6'-10"	6'-10 3/4"	6'-11 1/2"	7'-1/4"	7'-1"	7'-1 3/4"	7'-2 1/2"	7'-3 1/8"
50 "	6'-4 5/8"	6'-5 3/8"	6'-6 1/8"	6'-6 3/4"	6'-7 1/2"	6'-8 1/4"	6'-8 7/8"	6'-9 5/8"	6'-10 3/4"	6'-11"	6-11 3/4"	7'-3/8"	7'-2"
55 "	6'-3 3/8"	6'-4 1/8"	6'-4 3/4"	6'-5 1/2"	6'-6 1/8"	6'-6 3/4"	6'-7 3/8"	6'-8"	6'-8 5/8"	6'-9 3/8"	6'-10"	6'-10 1/2"	6'-11 1/4"
60 "	6'-2 3/8"	6'-3"	6'-3 5/8"	6'-4 1/4"	6'-4 7/8"	6'-5 1/2"	6'-6 1/8"	6'-6 5/8"	6'-7 1/4"	6'-7 7/8"	6'-8 1/2"	6'-9"	6'-9 5/8"
65 "	6'-1 1/2"	6'-2 1/8"	6'-2 5/8"	6'-3 1/4"	6'-3 7/8"	6'-4 3/8"	6'-5"	6'-5 1/2"	6'-6 1/8"	6'-6 5/8"	6'-7 1/4"	6'-7 3/4"	6'-8 1/4"
70 "	6'-3/4"	6'-1 1/4"	6'-1 7/8"	6'-2 3/8"	6'-3"	6'-3 1/2"	6'-4"	6'-4 1/2"	6'-5"	6'-5 5/8"	6'-6 1/8"	6'-6 5/8"	6'-7 1/2"
75 "	6'-1/8"	6'-5/8"	6'-1 1/8"	6'-1 5/8"	6'-2 1/8"	6'-2 5/8"	6'-3 1/8"	6'-3 5/8"	6'-4 1/8"	6'-4 5/8"	6'-5 1/8"	6'-5 5/8"	6'-6 1/8"

These tables are based upon the assumption that the truck bolsters and center plate are midway between the wheels, so that they do not apply to maximum-traction trucks where the pivotal point is set at unequal distances from the axles. It is also assumed that when a car is on a curve the truck bolster stands radial to the same.

CORRESPONDENCE

ACKNOWLEDGMENTS FROM THE COLUMBUS BOARD OF TRADE

Columbus, Ohio, Oct. 30, 1906.

Editors Street Railway Journal:

We are in receipt of a large number of letters of thanks and congratulations for the manner in which the Convention committee of the Board of Trade and the citizens of Columbus applied themselves to the task of making the recent Convention of the American Street and Interurban Railway Association in Columbus a memorable and enjoyable event. It would be an immense task to answer all of these letters, personally, and I am therefore about to ask you to publish this letter, or an excerpt therefrom, stating, in behalf of our Convention committee of the Board of Trade, and the combined citizenship of Columbus, that we keenly felt not only the responsibility but the honor that was conferred upon our city by its selection for the place of meeting of the American Street and Interurban Railway Association. Whatever has been done by us was the outgrowth of the officials with whom we came in contact prior to the convention dates, and who enthused and stimulated us to the activity and hospitality that was bestowed, yet I cannot refrain from a little boasting, by stating that our citizens are ever keen and alert to respond to the wants and tastes of the "stranger within their confines."

We, in turn, desire to express our appreciation to all of the officers and executive committees of this grand organization, and extend to them our sincerest thanks for having placed faith enough in our city in choosing it for their convention, and assure you again that we are quite proud of the achievement which you so generally intimate has been accomplished.

Henry C. Pirrung,
Chairman Convention Committee.

THE EVERYBODY BUSY PRINCIPLE

Oct. 18, 1906.

Editors Street Railway Journal:

I do not agree with the master mechanic who said in your issue of Sept. 18 that everybody can be busy when the manager is around, and that there are lots of things that would escape the observation of the manager's eye. A master mechanic should not allow anything to be done in his shop that he wouldn't tell his manager and superintendent about. It is the duty of the master mechanic to show the manager all of the crippled cars on hand and explain to him the cause. Don't show him simply the good ones and let him go back to the office in content. In a few days he will call you up and ask you: "What is the trouble with No. 601, or 66; I thought you told me the other day that you had all of your cars in good shape." Then the master mechanic will reply: "Why, so and so told me that those cars were o. k." Reports like that put hardships on the man who does the work. If the master mechanic makes a daily and monthly report of his cars and balances these reports each month, he is in a position to talk to the manager. A master mechanic should know the name and size of every piece of material that is on a car. He should know how to adjust the electrical equipment. He cannot do all of this work by himself, but he can pay good wages and get good sober men and show them what he wants done.

In our shop the boys are always busy whether the manager is there or not. I have been in the street railway business for twelve years, and have served my time in all of the working departments of construction and repair work of street railway work. I would like to see every man that is assigned to any part of the street railway work, let it be in the pit or have the superintendent's job, get busy and try to improve his work to such a degree as to be promoted to something better. I would like to see the merit system put in use, and then everybody would get busy sure enough. One would watch the other and the master mechanic would get busy too.

Shopman.

A LOW VOLTAGE SHOP CIRCUIT

Detroit, Mich., Oct. 24, 1906.

Editors Street Railway Journal:

It seems to the writer that the following is a very good method of obtaining the low voltage for shop trolley circuits spoken of in your editorial of Sept. 22. It is applicable

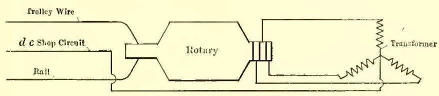


FIG. 1.—CONNECTION WITH UNSTABLE VOLTAGE POINT

under certain conditions only, to roads using high-tension transmission and rotary converter sub-stations.

Connect the shop trolley wire to the neutral point of the low-tension a. c. system. This will give one-half of the normal d. c. voltage between the low voltage trolley and the rail. Care must be exercised to make sure that the neutral point to which connection is made is not an "unstable" one, as would be the case if three separate single-phase transformers are used with star connection. If a polyphase transformer is used, the neutral point will be nearly stable, but the best results are secured when a six-phase converter is employed. The accompanying diagrams will make my meaning clear. Fig. 1 illustrates the three single-phase transformers which have an unstable neutral point. Fig. 2 illustrates the connection when three single-phase transformers are used with a six-phase converter. In this case the neutral point is stable because the current in coil A balances that in Coil A', B balances B', and C balances C'. In either case there will be a d. c. voltage on the shop circuit, and in the case of Fig. 2 this will be a constant voltage with a value one-half that of the d. c. end of the rotary.

In some cases it is the practice in converter sub-stations to

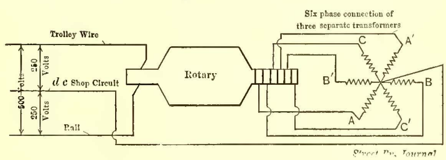


FIG. 2.—CONNECTION WITH STABLE VOLTAGE POINT

ground the neutral point of the high-potential primary circuit. This would not interfere with the plan proposed, but of course the neutral point of the secondary circuit should not be grounded.

F. K. B.

REPORT OF THE SWISS GOVERNMENT RAILROAD COMMISSION

In May, 1904, the Swiss government appointed a commission to report on the advisability of equipping the State railroads of that country with electric power. The commission has made an exhaustive study of this subject during which its secretary, Dr. W. Wyssling, with Charles Wirth, Engineer of Swiss State Railways, visited this country about a year ago. The preliminary report of the commission has just been published by Dr. Wyssling.

The first question considered by the commission was the amount of energy required to move all of the steam trains in Switzerland. Section I. of the Swiss State Railways was selected and the energy requirements were worked out for each class of traffic and reduced to a ton-km basis. The tractive resistance was found to vary for different types of trains. In express service from 5 to 8.6 kg per metric ton was taken, in passenger service 4.5 to 5 kg per ton, and in freight service from 3 to 3.2 per ton. Owing to the curvature on the Gotthard line and the less favorable conditions existing in regular service than during tests, an average figure of 6 kg per ton was adopted for the standard-gage roads and 10 kg per ton for the narrow-gage lines. To the theoretical energy required for starting at stations and for running, 30 per cent was also added for passenger and freight trains, and 110 per cent for express trains, to allow for changes in speed during running and for starting after signal stops, slow-downs, etc.

The average train loads during the winter in Switzerland ranged from 70 to 80 per cent of the passenger business during August and of the freight business during October, and the power requirements were calculated for both summer and winter traffic. Allowance was made for electric heating on the basis of .156 kw per seat during the winter, and for lighting 2 cp, or .031 hp, per seat. Recuperation of energy on down grades is considered possible but not particularly practicable under most conditions. The following table gives the total amount of energy in horse-power-hours for an average day needed at the driving wheels by all of the roads in Switzerland:

POWER REQUIREMENTS OF SWISS RAILWAYS, IN HP-HOURS

RAILWAY.	Tonnage.	For Operation.	Recuperation Possible.	Starting.	Total.	Heating and Lighting.	Grand Total.
Swiss State Ry...	18030000	476500	(82400)	189500	666000	27300	693300
Switching service	....	27000	....	18000	45000	......	45000
Gatthard Ry....	3460000	121000	(43200)	13500	134500	3700	138200
Other Standard Gage Rys.....	1061400	38145	(14785)	11780	49935	3540	53475
Total Standard Gage Rys.....	22551400	662655	(140385)	232780	895435	34540	929975
Narrow Gage Ry..........	526710	30755	(11030)	2860	33615	2175	35790
Grand Total..	23078110	693410	(151415)	235640	929050	36715	965765

Taking up now the subject of energy available, a total efficiency of 40 per cent is assumed between turbine shaft and driving wheels. The maximum daily demand for power in summer is about 1,200,000 hp-hours, which at 40 per cent efficiency would mean 3,000,000 hp-hours, or a continuous supply of 125,000 hp for twenty-four hours per day. Of the 1,200,000 hp-hours, 200,000 hp-hours, or one-sixth, might be recuperated. Recuperation is not of equal importance on all lines. On some roads it would amount to one-third of the total work, but on others not over one-thirtieth.

The average daily power consumption throughout the year as shown in the table is 966,000 hp-hours at the driving wheels, or, at 40 per cent efficiency, 2,400,000 hp-hours would be required at the turbine shaft. This is equal to twenty-four hour daily output of 100,000 hp.

The report then considers the ratio between maximum and average loads, which in some cases is quite large, and discusses the relative advantages of storage batteries and water storage. The latter is considered more practicable. To supply the 100,000 hp average demand would require a power station capacity of 500,000 hp in turbines, which the author considers ample for present conditions.

NEW ENGLAND STREET RAILWAY CLUB

The first fall meeting of the New England Street Railway Club was held in the electrical engineering lecture room of the Massachusetts Institute of Technology, at Boston, on the evening, Oct. 25. An illustrated lecture upon "Modern Illuminants" was the subject of the meeting, the speaker being Prof. H. E. Clifford, of the Institute.

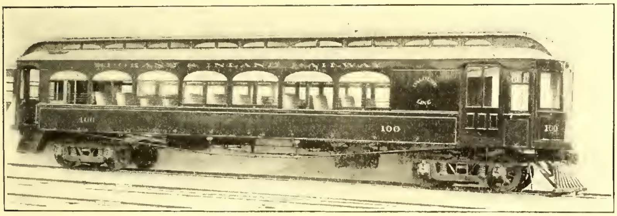
Prof. Clifford gave a brief sketch of the history of the arc lamp in beginning his address, outlining the developments from the early forms of open arc lamps to the latest types of enclosed and impregnated carbon lamps in use to-day. He projected the direct-current arc upon a screen and showed the changing characteristics of the alternating arc by means of a stroboscopic disc driven by an induction motor. Passing to the enclosed arc, the salient features of increased life and better distribution of light were emphasized, though the point was brought out that these are obtained at a sacrifice of efficiency. The speaker then discussed the characteristics of the magnetite arc lamp, in which the arc rather than the terminals is luminous, and the life is about the same as that of the enclosed lamp.

Both magnetite and flaming arcs were shown in operation, two styles of the latter being exhibited. One was equipped with carbons impregnated with barium salts, giving a yellowish light, while the other gave an intense white light on account of calcium salts in the carbons. These lamps burn two in series on 114 volts, and although the efficiency approaches 0.2 watts per candle-power, the cost of maintenance is high on account of the short life of the carbons. The downward distribution adapts the lamp to large areas, but its lack of steadiness precludes its successful application to interior lighting.

The last portion of the lecture was devoted to incandescent lamps. The carbon filament's slight progress for about twenty-five years was touched upon, and the late designs of 2.5-watt metallized filament lamps were discussed. The tantalum lamp was shown in operation, and the point was mentioned that its chief disadvantages seem to be its length of filament—about 20 ins., with numerous supports—and the extremely short life of the filament on alternating-current circuits. The street railway man should be interested in the metallized filament lamp of even 2.9 watts per candle-power efficiency, which is a notable improvement over the ordinary four-watt lamp. A tungsten lamp of 1.5-watts efficiency was shown in operation. The principal difficulty with this lamp seems to be the brittleness of the aggregated filament. A Cooper-Hewitt mercury vapor lamp was exhibited in operation. Its efficiency being one-third watt per candle-power, Prof. Clifford concluded with a plea for intelligent appreciation of these modern illuminants, emphasizing the importance of using engineering principles in a common-sense manner in installing high-efficiency lamps.

ROLLING STOCK FOR THE NEW PALOUSE—SPOKANE LINE, WASHINGTON

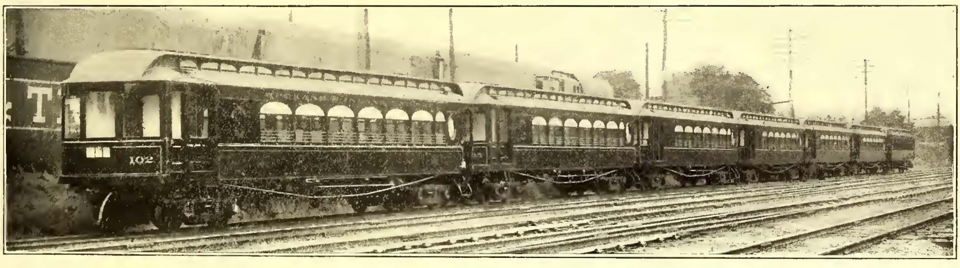
The latest road to build out of Spokane, which is an important interurban railway center, is the Spokane & Inland Railway. Some particulars of this road were published in the Street Railway Journal for Aug. 25, and the construction has now progressed as far as Waverly, 34 miles distant from Spokane. At Spring Valley Junction a branch has been built in a southerly and westerly direction to Palouse City and thence to Moscow, while the main line continues south to Colfax. When the line is completed the length of the two branches will aggregate 114 miles. An imposing terminal station has been built at Spokane, and is shared by the different divisions of the Inland Empire Railway, of which the Spokane & Inland Railway and the Coeur d'Alene & Spokane Railway form a part. The photograph of this station reproduced on page 952 was taken on July 4 last, when forty-two train loads were dispatched each way over the lines of the Coeur d'Alene & Spokane Railway. This road had then 34 miles of track, and no train was over an hour and twenty minutes in making the run. Over ten thousand passengers were carried. The cars for both of these lines were built by the J. G. Brill Company and the American Car Company, and include passenger and combination cars, trailers and express cars.



COMBINATION CAR ON THE PALOUSE LINE OF THE SPOKANE & INLAND RAILWAY

The passenger motor cars and passenger trail cars of the Inland Railway, illustrated herewith, are the same in style and dimensions with the exception that the trailer cars have an observation platform at the rear end. These observation platforms are 6 ft. 10 3/8 ins. long—this makes the trailer cars measure 2 ft. 2 3/8 ins. longer than the motor cars, whose platforms measure 4 ft. 8 ins. The straight passenger cars, both motor and trailer types, have a seating capacity of sixty-two; the combination cars seat fifty-six passengers. In addition to the latter, accommodation is provided for seating ten passengers on folding seats in the baggage compartment. The cars are all finished in the same style—quartered oak—with semi-empire domes. The seats in the straight passenger compartment are upholstered in figured plush and those in the combination cars in spring cane; the seats are 38 ins. long and have metal arm rests and adjustable foot rests; the backs are of the push-over type and are 24 ins. high. An interesting window arrangement is used in all of the cars, and consists of an adaptation of the Brill semi-convertible systems which enables lower sashes to be raised their full height. For this purpose pockets are formed in the space between the letterboard and the wide molding at the post heads; the upper sashes are stationary and are glazed with art glass; the same kind of glass is used in the ventilator sashes. Four-bar window guards are placed between each pair of posts; continuous basket racks are used in the passenger compartment in all cars; the vestibules are arranged with end doors to permit passing from one car to another. In addition to the usual signal cord, the conductor may communicate with the motorman by means of a metal speaking tube which connects both platforms.

The bottom framing is alike in the three types of cars, and consists of four 6-in. I-beams with pine fillers which constitute the center and intermediate sills, and 15-in. x 3/8-in. steel sill plates sandwiched between double side sills, the outer of which is 4 ins. x 8 3/4 ins. and the inner 2 ins. x 6 ins. The cross-members are 3 3/4 ins. x 6 ins., with 7/8-in. I-beam needle pieces with double-trussed 7-in. needle beams. The under trusses are 1 1/2 ins. in diameter, anchored at the body bolsters. The flooring is double and the interspace filled with mineral wool. The height from rail to top of floor is 4 ft. 2 1/2 ins., and height from rail to under side of side sill is 3 ft. 7 3/8 ins. The trucks have a wheel base of 6 ft. 5 ins. and diameter of wheel of 36 ins.



A TRAIN OF CARS LEAVING FOR THE PACIFIC COAST ON THEIR OWN TRUCKS

The construction of the baggage cars is unusually substantial. The side sills are 5 5/8-in. x 8 7/8-in. long-leaf yellow pine with 8-in. x 5/8-in. sill plates on the inside. The center sills are 4 3/4 ins. x 8 3/4 ins., and the intermediate sills 4 3/4 ins. x 6 3/4 ins. Besides cross-bars of 3 1/2 ins. x 6 3/4 ins., additional transverse strength is obtained by long diagonal cross-bracing composed of 2 1/4-in. x 4 1/2-in. pieces. The 1 1/2-in. undertrusses are anchored close to the body bolsters; the needle-beams are composed of 8-in. I-beams, double-trussed. Short inside truss rods of 2 1/2-in. x 1/2-in. flat iron support the ends of the car. These truss rods are carried over the side windows 6 ft. 3 3/4 ins. from the top of the floor to the under side of the rod. The side posts are 2 ft. 1/2 ins. from center to center, except at the windows, where they are 2 ft. 5¼ ins. Four sliding doors—two at each side—have 4-ft. 6-in. open-

INTERIOR OF SPOKANE & INLAND CAR

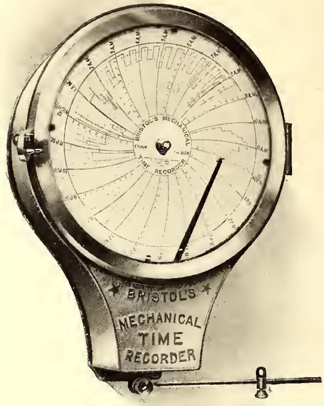
ings; doors at diagonal opposite corners are arranged to swing outwardly. Standard steam-car couplers are used on both passenger and baggage cars.

MECHANICAL TIME RECORDERS

To answer demands for an instrument which makes a graphic record of variations and time of such variations, of mechanical improvements, the Bristol Company, of Waterbury, Conn., has brought out the instrument illustrated herewith, which it calls a mechanical time recorder. A circular chart revolves by clockwork at uniform speed, while the pen moves over the chart an amount proportional to the motion to be recorded. The chart is 8 ins. in diameter, being the same size as on the well-known standard Bristol gages. Clock movements can be supplied for complete revolution of chart once in fifteen minutes, one hour, two hours, three hours, four hours, six hours, eight hours, ten hours, twelve hours, twenty-four hours, or seven days. Thus it will be seen that the speed may be selected to give best results under all commercial requirements.

The pen arm is rigidly attached at its lower end to a shaft which is turned by a short arm projecting through a slot in the bottom of the case. The lever shown in the cut, projecting to the right, is clamped to the short arm by a thumb nut. Special attention is called to the fact that the lever is adjustable and can be clamped to the arm at any convenient angle. The motion to be recorded after being properly reduced, if necessary, is imparted to the lever, which in turn transmits it to the pen. The total scale on the chart is usually taken proportional to the total motion to be recorded. Reduced motion, if necessary, can easily be arranged by the aid of pulleys, levers or other reducing devices.

Fine adjustments can readily be made by applying the motion at the proper point along the lever, and to facilitate this,



MECHANICAL TIME RECORDER

a metal attaching piece is provided which is adjustable on the lever arm and secured in any position by thumb nut. It will be seen that by the aid of the adjustable lever arm and the adjustable slide on the arm the instrument is most conveniently adapted to record motions of all amounts and directions. Total deflection of the pen is obtained by turning the lever through an angle of about 21 deg. or 5 sec. motion at its outer end.

This instrument can be used to record the rate of motion

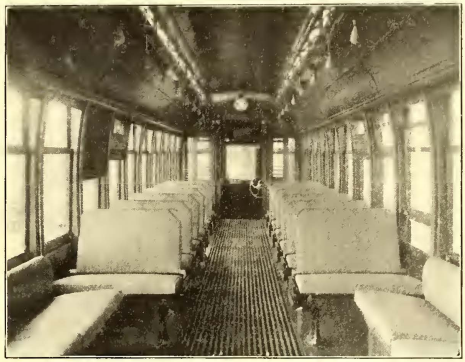
A FOURTH OF JULY CROWD AT THE SPOKANE TERMINAL STATION and position of sluice gates, turbine or engine governors, gate valves., etc. It is also adapted for recording the rise and fall of liquids in tanks, rivers, reservoirs and fore bay.

NEW CARS FOR CITY SERVICE IN KANSAS CITY

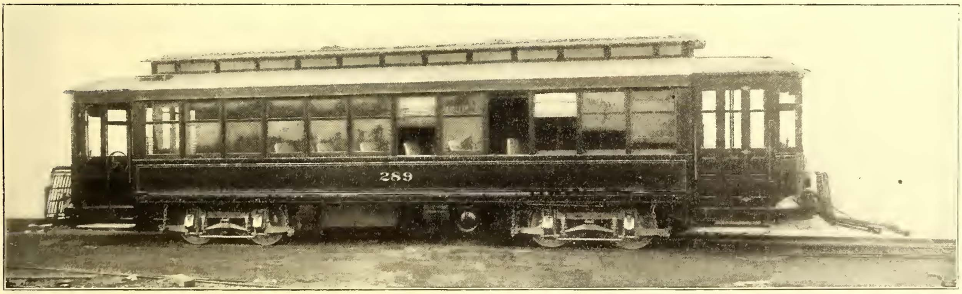
The latest type of car for city service, ordered by the Metropolitan Railway Company, of Kansas City, Mo., is shown in the accompanying engravings. It is of the semi-convertible type, built by the American Car Company, and presents a number of novel features. The car measures 33 ft. 4 ins. over the end panels and 45 ft. 4 ins. over the vestibules. The width over sills including sheathing is 8 ft. 6 ins., and the height from floor to ceiling is 8 ft. 5¼ ins. In the framing the usual ⅜-in. x 12-in. steel sill plate was employed, but reinforced at the bottom with 3½-in. x 6-in. x ⅜-in. angle-iron.

There is a striking similarity in the car illustrated to the cars supplied the Chicago City Railways by the same builders and the J. G. Brill Company. This is evidenced in the vestibules, at the entrance of which will be noted the dividing stanchion, which not only makes ingress and egress systematic, but forms a support for the large triple folding doors which close the vestibule opening. Another feature which recalls the Chicago cars is the destination sign placed midway down the car; also the angle-iron bumper filled with oak and covered with bumper shield. The flooring is double, interspaced with three-ply felt.

The seating arrangement is quite novel in that half the car is given up to cross seats and half to longitudinal seats. This is most clearly shown in the side view, in which the six cross seats can be seen through the sash in the center of the car. This plan was adopted to accommodate both the short-trippers, who will choose the longitudinal seats as being nearer the exit, and the long-distance riders, who will prefer the transverse seats. Another advantage, of course, in the extra provision made for seats of the longitudinal type is the large amount of standing room that is possible. Push buttons are provided, and the interiors are attractively finished in quartered oak; the ceilings are of the same wood. The truck used is the No. 27-GE1, having a wheel base of 4 ft. 6 ins. Four motors of 40-hp capacity each are used on each car.



INTERIOR OF KANSAS CITY CAR WITH LONGITUDINAL END SEATS



SEMI-CONVERTIBLE CAR FOR KANSAS CITY

A DIFFERENTIAL VOLTMETER PLEA

The bar to accuracy in measuring resistance on a railway circuit is variation of line voltage, which makes it extremely tedious to get corresponding voltmeter and ammeter readings or comparative voltmeter readings at the same current value. The resistances most commonly to be measured in shop work are those of starting coils, fields and armatures. Bridge methods, except in skilled hands, give poor results when applied to very low resistances, and are actually misleading when applied to starting coils composed of a series of joints or contacts. A differential voltmeter has two sets of connecting posts to which internally connect two separate deflecting coils. With equal voltages applied to the posts according to the polarity marked on the posts, the deflecting coils have equal but opposite tendencies to deflect the needle from zero, which is at the center of the scale. If unequal voltages are applied to the posts, then the needle will move to one side of or to the other an amount depending on their difference. In measuring car resistances absolute resistance is not so much a matter of custom as that they shall be within certain safe limits of variation. At an approximately given current the differential voltmeter is an excellent instrument for comparing the exactly simultaneous drops across an unknown resistance and a known resistance to be used as a source of standard drop. For example, in testing a set of motor fields in the motor, they are connected in series with a similar set outside; one pair of meter posts is connected to the test fields and the other pair to the standards. On closing the circuit, passing a safe current and pressing both meter keys, if the opposing resistances, hence drops, are the same, the needle will not flicker, but a difference in resistance will cause a differential deflection, the interpretation of which, in the case of motor fields, will be given later.

FINANCIAL INTELLIGENCE

Wall Street, Nov. 7, 1906.

The Money Market

There has been no material change in the local money market during the past week. The demand for money from stock commission houses has not been urgent, owing to the inactivity in the securities market, but the heavy interest and dividend disbursements on Nov. 1, and the continued heavy shipments of money to the interior cities for crop moving and general business purposes have served to maintain rates for both call and time loans at last week's high level. Money on call has ranged between 3 and 9 per cent, averaging about 6 per cent, while sixty-day money commanded 6 per cent and a commission, bringing the total charge to the borrower up to 7 per cent. Three and four months' accommodations were obtainable at 6½ per cent, but five and six months' maturities were rather liberally offered at 6 per cent. The relative ease in the rates for long periods was due to the fact that contracts made for six months would mature in March, a period when money is generally in plentiful supply. The outward flow of funds to the West and South during the week have been rather heavy, the net cash loss by the banks amounting to $7,342,400, and resulting in a further heavy reduction in the surplus reserve of the clearing house institutions to a comparatively low point. At the close of the week, however, there were signs of a relaxation in the demand for money at the Western cities, especially at Chicago, where New York exchange sold at par, as against 15 cents discount, the rate prevailing earlier in the week. In banking circles this is taken to indicate an early return movement of money in this direction, which will probably be stimulated by the high rates for money prevailing at this center.

The monetary situation abroad, and especially at London, continues to attract considerable attention. During the week open market discounts at the center rose to 6¼ per cent, or ¼ per cent above the official rate. The Bank of England has not been very successful in replenishing its gold reserve, and the governors of that institution may find it necessary to make a further advance in the minimum rate at their meeting this week. The shipments of gold to Egypt to finance the cotton crop continues, and private cable advices are to the effect that the Bank of France has released $2,000,000 gold for that purpose. The situation abroad resulted in an advance of ½ cent in sterling exchange in the local market, but it is not expected that the rate for sterling will reach a point that will necessitate the exportation of gold from this side. Cotton bills are now appearing on the market in large quantities, owing to the decline in the price of the staple, and it is the belief that from now on the shipments of cotton and grain from this country will create enough exchange to keep the rates below the gold export figure. The bank statement, published on last Saturday, was rather better than expected. Loans decreased $9,542,300. Cash decreased $7,342,400, but as the reserve required was $4,718,500 less than in the preceding week, the surplus reserve was decreased by $3,819.075. The surplus now stands at $7,765,250, as against $11,504,325 in the preceding week, $2,345,475 in the corresponding week a year ago, and $10,112,400 in 1904.

The Stock Market

The stock market, while still under the influence of election uncertainty, displayed considerable strength during the week, and with the election now out of the way the speculation will be governed by developments in the railroad field and in the money market. The latter is still very unsatisfactory, and may yet prove to be a disturbing factor. The clearing house banks lost heavily in cash last week, and the surplus reserve is now down to a point which does not admit of any loan expansion to further speculative operations in securities. The Bank of England is slow in increasing its reserve, and it is not improbable that the governors of that institution will increase the discount rate to 7 per cent in the near future. Such action would cause further liquidation of stocks in our market. We have also to consider the fact that a large amount of securities have been returned from abroad, and payment for these will probably be made this week and may result in an unfavorable bank statement on Saturday. In some quarters there is a disposition to consider the probability of gold exports in the near future, but the heavy exports of cotton are making a large amount of exchange, and gold cannot be withdrawn from here with money ruling at prevailing high rates. As it will be some weeks before money will begin to return in volume from the crop sections, there is reason to expect a continued firm money market during the balance of the year. The important development of the week was the increase in the dividend on Pennsylvania stock from 6 to 7 per cent per annum. This action has been criticized as unfavorable, on the ground that the company has added very largely to its capital obligations for improvements and extensions which will not be productive of income for a considerable time, and also for the reason that the railroad employees of the country are now demanding increased wages to meet the higher cost of living. On the other hand, the earnings of the Pennsylvania have increased to an extent that justifies a larger return to the stockholders, and the income account of the company has been enlarged by the proceeds from the sale of Baltimore & Ohio and Norfolk & Western stocks. The quarterly statement of the United States Steel Corporation reflected the great prosperity in the iron and steel trades, and if the earnings continue at the present rate the corporation should be able to provide for all improvements and to place the common on a 4 per cent basis, and still have a surplus sufficient to cover the cost of construction of the new plant at Gary, Ind. The weakness in New York Central attracted some attention and appeared to be the result of liquidation.

The local traction shares were favorably affected by the defeat of the Democratic candidate for Governor and the belief that such defeat would remove a menace to all public utility properties. The market as a whole has been almost entirely professional, and the so-called big interests occupy a waiting position. Every attempt to run up prices brings out long stocks, and it appears to be the policy to hold speculation in check until the monetary outlook is brighter. Stocks are in strong hands, but the public have gone into mining stocks and pay little attention to railroads and industrials.

Philadelphia

The dullness prevailing in the general securities market during the past week was reflected to a very large extent in the market for the local traction shares. The demand for these shares was not large, but in the absence of any pressure to sell prices generally ruled firm. In some instances strength was displayed, but the net changes for the week were unimportant. Philadelphia Rapid Transit was the only stock to display any signs of activity, the total transactions in the stock aggregating about 9000 shares at from 27½ to 28⅛. At the close, however, a heavy selling movement developed on the calling of another $5 assessment, making a total of $10 a share call on this stock this year. The final sale of the stock was at 26. Otherwise the trading was in small lots. Union Traction fluctuated between 64½ and 64¼, on transactions of a few hundred shares, and odd lots of Philadelphia Traction sold at 97⅜ and 97½. Other sales included American Railways at 52, Fairmount Park Transportation at 14½, Lehigh Valley Transportation preferred at 20, and Philadelphia Company preferred at 48½. The gross earnings of the Philadelphia Company for the nine months ended Sept. 30 were the largest in the history of the company, the earnings available on the common stock being equal to 7.26 per cent on the authorized issue of $36,000,000.

Baltimore

Extreme dullness prevailed in the Baltimore market for traction issues. The demand was confined almost entirely to the securities of the United Railway Company, and such transactions as were recorded were at fractionally higher prices. The 4 per cent bonds brought 88⅞ and 89 for about $20,000, and the funding 5s sold at 89¼ and 89⅜ for about $20,000.

Other Traction Securities

Trading in the Boston market was unusually light, but prices generally held firm. Boston Elevated, after an early advance from 154 to 154¾, lost all of the improvement. Boston & Worcester common rose from 28⅜ to 28¾, on purchases of 450 shares, and a small lot of the preferred brought 80. Massachusetts Electric common brought 18 for several hundred shares, while the preferred moved up from 67¼ to 68. West End common sold at 74, and the preferred at 109. In the Chicago market trading was practically at a standstill. North Chicago sold at 44 and 44¾ for fifty shares. South Side Elevated brought 91 for 100 shares, and 200 Northwestern Elevated preferred brought 62.

Cleveland Electric reached low mark of 63 last week, but advanced to 67 the early part of this week on indication of a favorable Supreme Court decision on an important point. Buyers are watching the stock with a great deal of interest as it is certain to move up many points in case of a favorable decision. Lake Shore Electric securities have been showing some decline through sales of insiders who apparently are attempting to realize on these securities. The common stock sold down to 15¾, the old preferred at 66½ and the new preferred at 60 the early part of this week. Northern Ohio traction is down to 27½ for apparently the same reason. Aurora, Elgin & Chicago preferred has been very active at around 77 and the common at 32½ to 33. Cleveland & Southwestern Traction preferred moved up to 66. A small lot of Western Ohio receipts sold at 12½.

Cincinnati, Newport & Covington advanced to a high figure of 84 on the strength of the reported leasing deal to the Columbia Company. This was a gain of about 5 points within a week. The preferred was inactive at 86½. Cincinnati Street Railway sold at 140, a decline of one point from recent figures. Detroit United sold at 90, also a decline from recent quotations. Toledo Railways & Light sold at 32.

Security Quotations

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

	Oct. 31	Nov. 7
American Railways	52	52
Boston Elevated	154	155
Brooklyn Rapid Transit	77½	80⅜
Chicago City	140	160
Chicago Union Traction (common)	4⅜	4½
Chicago Union Traction (preferred)	14½	14
Cleveland Electric	65½	—
Consolidated Traction of New Jersey	76	77
Detroit United	88	88¾
Interborough-Metropolitan, W. I.	35⅝	38
Interborough-Metropolitan (preferred), W. I.	75	79
International Traction (common)	60	66
International Traction (preferred), 4s	79	88
Manhattan Railway	142	144
Massachusetts Electric Cos. (common)	18	17½
Massachusetts Electric Cos. (preferred)	67	67½
Metropolitan Elevated, Chicago (common)	24	23
Metropolitan Elevated, Chicago (preferred)	65	64
Metropolitan Street	105	106
North American	88	88¾
North Jersey Street Railway	27	28
Philadelphia Company (common)	49	48½
Philadelphia Rapid Transit	27½	26
Philadelphia Traction	97⅜	97⅜
Public Service Corporation certificates	65½	65
Public Service Corporation 5 per cent notes	94¾	95
South Side Elevated (Chicago)	90½	90½
Third Avenue	123	123
Twin City, Minneapolis (common)	*109⅞	111
Union Traction (Philadelphia)	64	64¼

* Ex-dividend.

Metals

Advices to the "Iron Age" from Cleveland, show that some of the ore interests have opened their order books for the coming season and have entered a very considerable tonnage at advanced prices. The pig iron markets continue in an unsettled condition, with little doing in the Central West, where there is little available. The steel plants are being driven to top-notch speed. With the exception of structural steel, the volume of business keeps up at a tremendous rate and runs in excess of current capacity, great as that is.

Copper metal continues strong, at unchanged prices. Lake is quoted at 21¾ to 22½c.; electrolytic at 21½ to 22c.; castings at 21¼ to 21¾c.

INTERNATIONAL STREET RAILWAY ASSOCIATION ELECTS OFFICERS

The official proceedings of the Milan Convention of the International Street Railway Association closed with the election of officers on Sept. 21. F. Nonnenberg, director of the Compagnie Generale des Chemis de Fer Secondaires (General Interurban Railway Company), Brussels, retired from the executive committee in favor of C. de Burlet, of Brussels. At the suggestion of the president, the German representation was increased so that the executive committee is now constituted as follows: President, Leon Janssen, general director of Tramways Bruxellois (Brussels Tramways); vice-president, Gustav Koehler, director of the "Grosser Berliner Strassenbahn" (Great Berlin Street Railway); E. A. Ziffer, president of the managing committee Bukowiner Local Railways, Vienna, and C. deBurlet, general director of the Société Nationale des Chemins de Fer Vicinaux de Belgique (National Belgian Railway Company), Brussels; members of executive committee, officers and Messrs. Broca, director of the Compagnie des Tramways de Paris et du Department de la Seine (Paris & Seine Department Tramways Company), Paris; Geron, manager Kölnischen Strassenbahn Gesellschaft (Cologne Street Railway, now in liquidation), Brussels; Gessels, director of the Société Generale de Chemins de Fer Economique (General Economical Railway Company), Brussels; Lavalard, director of the Compagnie Generale des Omnibus (General Omnibus Company), Paris; von Pirch, director Barmen-Elberfield Electric Railway, and Poetz, manager of the Strassenlisenbahn Gesellschaft (Street Railway Company) of Hamburg.

The last order of business was the selection of a city for the 1908 meeting. An especially cordial invitation was received from Munich where the year named will be celebrated with a world's fair in honor of the 750th anniversary of the city's founding. An invitation was also received from the Hungarian Government to hold the meeting in Buda Pest. The final decision on this question was left to the executive committee.

ELEVATED TRAFFIC IN CHICAGO

The Metropolitan elevated for the month of October broke all records in the matter of traffic. The daily average was 142,671 passengers, being an increase of 10,681 over the corresponding month last year. The increase was partly attributable to the baseball business, the championship series falling within the month. The Northwestern Elevated also made a record for the month. The South Side elevated made a relatively better exhibit than for September. In the latter month a decrease was shown, while for October there was a small gain, .87 per cent. The figures follow:

METROPOLITAN ELEVATED

	1906	1905	Increase	Per Cent
January	129,730	116,013	13,717	11.82
February	135,570	121,177	14,393	11.90
March	138,169	124,853	13,316	10.63
April	137,477	124,946	12,481	9.93
May	136,735	125,164	11,571	9.24
June	133,974	124,569	9,415	7.55
July	123,370	113,578	9,792	8.69
August	123,512	116,395	7,117	6.11
September	126,975	124,427	2,548	2.05
October	142,671	131,990	10,681	8.09

SOUTH SIDE ELEVATED

	1906	1905	Increase	Per Cent
January	92,406	84,659	7,747	9.03
February	95,077	88,173	6,904	7.83
March	95,466	91,384	4,082	4.46
April	95,756	91,901	3,855	4.19
May	97,159	89,971	7,188	7.99
June	101,770	93,941	7,829	8.33
July	92,976	85,272	7,704	9.03
August	88,539	85,288	3,251	3.81
September	89,749	89,022	*727	*0.81
October	93,577	92,824	753	.07

NORTHWESTERN ELEVATED

	1906	1905	Increase	Per Cent
January	81,191	73,728	7,463	10.12
February	83,572	78,773	4,799	6.09
March	85,154	80,500	4,654	5.78
April	84,224	79,779	4,465	4.93
May	81,748	77,863	3,885	4.98
June	80,165	75,837	4,328	5.70
July	73,308	67,488	5,820	8.62
August	73,176	68,938	4,238	6.14
September	77,508	74,307	3,201	4.30
October	88,384	80,642	7,702	9.55

* Decrease.

ANOTHER STEP FORWARD IN CHICAGO MATTERS

After a series of conferences Oct. 29, the city officials and representatives of the street car companies reached a compromise on the terms under which the city will be permitted to take over the properties through the instrumentality of a private company. It was agreed that the law should protect the companies from being deprived of their properties by "financial pirates," while at the same time a company behind which the city honestly stands may acquire the lines for the purpose of operation until the city assumes direct control. The compromise on the conditions under which municipal ownership and operation may be brought about was reached at a meeting of the Council committee on local transportation. As the ordinance was presented to the committee by the companies there was no provision for the city acquiring possession of the lines through a license, as suggested in the Werno letter. Mr. Gurley explained that this provision had been stricken out at the request of the New York interests which will finance the rehabilitation of the lines.

LOW-FARE LINE OPENED IN CLEVELAND—OTHER MATTERS

The Forest City Railway Company commenced the operation of two cars over 9 miles of track on the west side of the city last week. Owing to the granting of a temporary injunction the cars are unable to reach the Public Square, and the nearest they come to the center of the city is about 2 miles. At present they are operating on Fulton Road from Detroit Street to Denison Avenue and on Denison Avenue from Pearl Street to Lorain Street. The opening of the new line was attended with a celebration. Mayor Tom L. Johnson handled the controller on the first car, which carried city officials and officers of the new company. Mayor Dunne came over from Chicago a day or so later and inspected the new line.

Last week Mayor Johnson took advantage of the city's contention that the franchise on East Ninth Street and Central Avenue had expired and the police stopped the cars of the Cleveland Electric for a stretch of ¼ of a mile on East Ninth Street. This was done without any warning whatever and it seriously embarrassed not only the Cleveland Electric, but the Electric Package Company, operating interurban express cars, as they were unable to reach the union freight station on East Ninth Street. One car loaded with perishable freight was held up for two days and was unable to get out of the station. The Mayor undertook to require the company owning the car to make a reduction on its rate to a suburban town before he would allow the car to depart. The company, which is in the hands of the United States Court, took the case into court and obtained a release. The business of the Electric Package Company was very seriously interfered with and its cars had to load and unload in the streets in various parts of the city. The action was believed to have been largely a retaliatory step against the Electric Package Company because of its refusal to give consents for a three-cent fare line in front of its property. For five days the Cleveland Electric was unable to use one of its most important loops and each evening there were serious blockades during rush hours. There was much unfavorable comment from the public against the Mayor's arbitrary action. The question of a franchise on the streets mentioned was in the hands of the United States Supreme Court, and on application of the Cleveland Electric Railway that court issued an order restraining the Mayor from interfering with the traffic on these streets until the case could be heard. Accordingly the case will be advanced.

The Forest City Railway Company is now building on East Fourteenth Street to enable its cars to reach Central Avenue if it can hold this franchise, and is building on Bridge Street on the West Side to enable its cars to reach free territory on West Fourteenth Street, thereby reaching the center of the city without the use of the enjoined track on Detroit Street.

Judge Phillips of the Common Pleas Court has made a tentative suggestion that three of the judges of this court sit en-blanc to hear all of the injunction suits now pending in the Common Pleas Court between the Cleveland Electric and the Forest City Railway Company. There are some twenty of these cases.

The Cleveland Electric was unable to carry its point of securing a referendum vote on the street propositions at the election last week, it being held that a vote on this question was illegal. A plan is now being offered to the City Council for a masked vote on some other proposition, the result to determine the question under discussion.

WISCONSIN ELECTRIC AND INTERURBAN RAILWAY ASSOCIATION

Pursuant to a call issued by F. W. Montgomery, president Madison & Interurban Traction Company; Ernest Gonzenbach, treasurer and general manager Sheboygan Railway & Light Company, and N. C. Draper, vice-president and general manager Eastern Wisconsin Railway & Light Company, a meeting was held at the Hotel Pfister, Milwaukee, on Monday, Oct. 29, for the purpose of considering the forming of a Wisconsin street and interurban railway association. There were present: Herbert Warren, general manager Duluth-Superior Street Railway Company; Thomas Higgins, president Manitowoc & Northern Traction Company; Irving P. Lord, general manager Waupaca Electric Light & Railway Company; H. F. Whitcomb, of Eastern Wisconsin Railway & Light Company; George W. Knox, general manager Green Bay Traction Company; F. W. Walker, vice-president Milwaukee Northern Railway Company; Ernest Gonzenbach, president Sheboygan Railway & Light Company, and Clement C. Smith, president Columbia Construction Company. The roll of all the street railways in Wisconsin being called it was found that out of twenty-two companies eight were represented personally, and assurances of interest and support had been received from five others, among them the Milwaukee Electric Railway & Light Company. After a general discussion of the purposes and benefits of the organization and possibility of securing one that would be effective, it was unanimously voted to take the preliminary steps for such organization.

In accordance with this plan a meeting was held at the Pfister, in Milwaukee, on Saturday Nov. 3, 1906. Thomas Higgins, temporary chairman, presided, and Clement C. Smith, temporary secretary, acted as secretary. There were present: H. D. Smith, secretary and treasurer Wisconsin Traction, Light, Heat & Power Company; Thomas Higgins, president Manitowoc & Northern Traction Company; B. E. Edwards, president La Crosse City Railway Company; Dudley Montgomery, vice-president Madison & Interurban Traction Company; Irving P. Lord, secretary and general manager Waupaca Electric Light & Railway Company; Ernest Gonzenbach, vice-president and general manager Sheboygan Light, Power & Railway Company; N. C. Draper, vice-president and general manager Eastern Wisconsin Railway & Light Company; Edward B. Kirk, vice-president and general manager Winnebago Traction Company; Neal Brown, president Wausau Street Railway Company; Frederick W. Walker, vice-president Milwaukee Northern Railway Company; Clement C. Smith, president Columbia Construction Company. Letters of regret were received from John I. Beggs, president Milwaukee Electric Railway & Light Company; George W. Knox, vice-president and general manager Green Bay Traction Company; George B. Wheeler, general manager Chippewa Valley Electric Railroad Company; Herbert Warren, General Manager Duluth Street Railway Company, and E. S. King, secretary Merrill Railway Company. Mr. Wheeler requested the secretary to enter the name of his company as a member of the association, and Mr. King gave the organization his approval and stated his company would co-operate in the work. The following companies which were not represented at the first meeting signed the articles of association as charter members: Wisconsin Traction, Light, Heat & Power Company; Winnebago Traction Company; Madison & Interurban Traction Company; Wausau Street Railway Company; La Crosse City Railway Company; Chippewa Valley Electric Railroad Company. It was unanimously voted to suspend the rules and instruct the secretary to cast the ballot of the association for the ticket reported by the committee on nominations, which was as follows: Henry D. Smith, of Appleton, president; Thomas Higgins, of Manitowoc, vice-president; F. W. Montgomery, of Madison, second vice-president; Herbert Warren, of Duluth, third vice-president; Clement C. Smith, of Milwaukee, secretary-treasurer. The above named officers were thereupon declared elected to serve until the date of the next annual meeting and until the election and qualification of their respective successors.

Meetings of the association will be held annually, the date selected being the second Tuesday in November. In order to join the association an admission fee of $10 will be exacted, in addition to which there will be annual dues. The latter will be levied only in accordance with the requirements of the association by the executive committee, and will consist of a uniform percentage of the gross receipts of each member from railway and from electric light during the previous year. The total amount so levied will not, however, exceed one-tenth of one per cent of such earnings.

IMPORTANT COURT DECISION IN OHIO

The Supreme Court of Ohio has decided in the case of the Interurban Railway & Terminal Company against the city of Cincinnati that the plaintiff will not have to recognize the transfers of the Cincinnati Traction Company. The question of the rate of fare was not raised in the case decided, but it is claimed that the same ruling would hold that interurbans are not obliged to charge the regular rates of the municipality upon their cars. The court held in substance the control of an interurban line entering the city over the tracks of a local line is entirely a matter of contract between the two corporations. It is claimed that if this contract does not provide that the cars shall be operated as local cars at the same rates of fare and with the same transfer privileges as the local cars, they cannot be compelled to so operate.

The court held that neither Section 2505-c. R. S. nor Section 3443-11 R. S. makes the power it confers upon urban and interurban railroads to agree as to the use of the tracks of the latter of so much of the tracks and other property of the former as may be necessary or desirable to enable it to enter or pass through the municipality, conditional upon the exchange of transfers. The sections mentioned refer to the rights of interurban roads to condemn the use of city tracks, and the sense of the decision is that, having these rights the interurban companies cannot be compelled to hold to the restrictions imposed upon city companies. This is a most important decision to the interurban roads and it is one which is likely greatly to improve the conditions under which they operate over the tracks of city companies in the city.

MEETING OF THE EXECUTIVE COMMITTEE OF THE A. S. I. R. A.

A meeting of the executive committee of the American Street and Interurban Railway Association was held on Friday, Oct. 19, immediately after the close of the convention. Those present were President Beggs, Vice-President Shaw, C. L. S. Tingley, H. H. Adams, and the secretary, B. V. Swenson. Among the subjects discussed was the location of the 1907 convention. The secretary reported that invitations had been received from a number of places, including Chicago, Boston, Atlantic City, Put-in-Bay, and the Jamestown Exposition Company. Action on accepting any of these invitations was deferred for further consideration. The committee reappointed B. V. Swenson secretary and treasurer for the year 1906-07. The question of additional office assistants and office room, and also the question of moving the main office from 60 Wall Street to the United Engineering Building, now being erected on Thirty-Ninth Street, New York, were considered and the matter was referred to the president and secretary for report. There was also some discussion as to the form of the published reports of the association and the publication of the report of the committee on municipal ownership. After some discussion it was decided that the publication of the report of this committee and that on public relations, either in whole or in part, should be decided later after all of the members of the committee had had a chance to study the reports carefully.

REPORT OF CONSOLIDATED RAILWAY—CONNECTICUT RAILWAY LIGHTING DEAL

The negotiations for the purchase of the Connecticut Railway & Lighting Company by the New York, New Haven & Hartford Railroad are said to have been completed, and the announcement is made in Waterbury, Conn., that the transaction will be finally effected Dec. 1. The Connecticut Railway & Lighting Company controls a number of electric properties in Connecticut, including 186 miles of city and interurban railway lines. The New Haven & Hartford, within the past few weeks, sold all its holdings in Massachusetts street railway properties, turning the stock over to the New England Investment & Security Company. This was done because of the opposition in Massachusetts to the control of the electric lines by the railroad company. The Connecticut Company has outstanding $9,191,000 common and $5,809,000 preferred stock. Outside of the Consolidated Railway Company, which was the New Haven's holding company for its Massachusetts electric roads, the Connecticut Railway & Lighting Company is the largest combination of electric railway lines in New England.

ESTIMATES FOR EQUIPMENT WANTED

The Meyersdale & Salisbury Street Railway Company is about to complete the construction on its line from Garrett to Salisbury, Pa., running through Meyersdale and Boynton, a distance of 13½ miles, the cost of which will approximate $300,000. The bonds have been underwritten at 80 per cent, and work will start within fifteen days. The company would be pleased to receive estimates for equipment of four-motor 50-hp d. c. interurban cars, one freight and express car combined, and also the overhead construction for 13½ miles and a power house complete with boilers, steam engines, two generators of 300 kw each, pumps, accumulators, storage batteries, switchboard and all other paraphernalia necessary to such power house. Among the underwriters are: Henry Cohen & Company, New York City; L. B. McNeill, of Morgantown, W. Va.; Frank L. Ober, of Pittsburg; J. B. Baughman, of Blairsville, Pa., and others. The officers of the company are: Orran W. Kennedy, of Uniontown, Pa., president; H. G. Kimick, of Pittsburg, secretary; Judge J. Norman Martin, of New Castle, Pa., vice-president. The managers of the writing syndicate are Henry Cohen & Company. All further information can be obtained from W. W. Staub, of the Pittsburg & Allegheny Valley Company, 612 Keystone Building, Pittsburg, Pa.

STONE & WEBSTER DISTRICT OFFICE IN TEXAS

Messrs Stone & Webster, of Boston, have established a district office in Dallas, Tex., and M. M. Phinney has been placed in charge of this office as district manager, to represent them in connection with the management of their railway and lighting properties in Texas.

MEETING OF THE RAPID TRANSIT COMMISSION

At a meeting of the Rapid Transit Commission held last week, it was voted to ask the Board of Estimate and Apportionment for an appropriation of $675,000 to build an extension to the Broadway subway from 230th Street to Van Cortlandt Park. The application of the allied Bronx civic associations to the board to reconsider its action in refusing a franchise to the Interborough Rapid Transit Company for a third track on the Second and Third Avenue elevated lines was referred to the committee on plan and contracts for action. It is understood that the Interborougr is now willing to apply for a limited franchise for these privileges on terms to be fixed at a later date.

THE CAUSE OF THE ATLANTIC CITY DISASTER NOT DISCOVERED

After a thorough investigation the Pennsylvania Railroad officials have found no explanation of the accident on the electric division of the South Jersey & Sea Shore Railroad, between Camden and Atlantic City, at the Thoroughfare bridge Sunday, Oct. 27. All possible theories were traced to the bottom, but the cause of the derailment of the electric train is no better known than it was at first. In an official statement the company says:

"It was hoped that the trucks of the cars when raised out of the water would afford some clue, but they did not. They were carefully examined by officials of the company, including General Manager Atterbury, General Superintendent of Motive Power A. W. Gibbs, Chief Electrical Engineer George Gibbs, and Assistant Chief Engineer Temple. The trucks were intact and there was nothing about either the wheels or the other parts to show any light on the matter.

"Thorough examination of the bridge and the mechanism used in moving the draw show that these were in perfect shape. All evidence shows that the rails were exactly in place. Aside from the fact that the interlocking signal could not have shown a clear track otherwise the bridge-tender is positive that the rails on the draw and those on the stationary part of the bridge fitted precisely. When the train approached he was standing within 3 or 4 feet of the point where the rails join, and he looked at the track to see if it was all right.

"The officials examined the bridge structure with particular care to see if anything about it would furnish an explanation of the accident. They found it strong and absolutely safe. The bridge is of new material and of the most approved modern type."

B. J. ARNOLD TALKS ON NEW YORK CENTRAL ELECTRIFICATION IN CHICAGO

At the first meeting of the year of the Chicago branch of the American Institute of Electrical Engineers, Nov. 2, Bion J. Arnold gave an illustrated talk on the electrification of the New York terminal of the New York Central Railroad. He first discussed briefly the high-tension line, the sub-stations and the third-rail system, and then proceeded to the noteworthy features of the cars and of the electric locomotives. Considerable time was spent in describing the new terminal in New York City.

At the conclusion of the talk, in replying to questions, Mr. Arnold brought out some interesting points with regard to some advantage of a. c. and of d. c. operation for heavy duty, and also with regard to relative advantages of high and low frequency d. c. systems. The a. c. motor, he said, weighed considerably more than the d. c. motor.

Manufacturers offered to supply a. c. motors with a weight of 20 per cent greater than d. c. motors. The greater original investment in the d. c. system and the extra amount of labor required to operate such a system, however, offset some of the disadvantages of the heavier a. c. motor. Mr. Arnold added that he was not a strong advocate of the third rail. He thinks the conductor should preferably be overhead.

He said that with low frequencies the weight of the single-phase motor per horse-power is reduced, and more power per axle can be obtained. With a 15-cycle system, for instance, the weight of the motors was less than for a 25-cycle system, but the increased weight of the low-frequency transformers brought the total weight of the car equipment back to about what it was for a 25-cycle system. However, the 15-cycle system had the advantage that with it the motors for a given power could be put on four axles where sometimes six axles would be necessary with the 25-cycle system.

SCHOEPF SYNDICATE MILEAGE BOOK

The Schoepf syndicate, operating in Ohio and Indiana, has announced a new interchangeable mileage book to be sold for $15, covering 1000 miles and good for bearer and parties of more than one, making it practically wide open. The book will be good on all the syndicate lines in Ohio and Indiana which include the following: Indiana, Columbus & Eastern, Lima & Toledo, Indianapolis & Eastern, Cincinnati Northern, Indianapolis & Martinsville, Indianapolis & Northwestern, Indianapolis & Western, Indiana Union Traction Company, Ft. Wayne & Wabash Valley and the Indiana Coal Traction Company. The Schoepf properties have abandoned the sale of the interchangeable coupon books of the Central Electric Railway Association, but the various roads will continue to accept these coupons for transportation. Several of the independent Ohio roads which will continue to sell the Central Electric coupon book have entered into an arrangement with the Schoepf syndicate to accept its mileage books as transportation. Other roads are unwilling to do so because it makes a lower rate than the interchangeable coupon book and is wide open to anyone, whereas the coupon book is good only for purchaser.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED OCTOBER 23, 1906

833,765. Signal System for Railways; Maxmillian G. Voightlander, Harrison, Ohio. App. filed Nov. 14, 1904. Contact plates are provided alongside the track rails which are adapted to be electrified or not according to the position of the switch point. The car trucks have a depending shoe which contacts with these plates to establish signal on the train.

833,863. Switch Operating Mechanism; Henry J. Auger, Spokane, Wash. App. filed July 11, 1906. The switch throwing mechanism comprises a lever disposed at one side and in line with the switch-tongue, means for connecting the lever with the tongue, and means for actuating the lever comprising a pair of members located one on each side of the rail, guiding devices for guiding the members in a direction longitudinal of the rail, and an oscillatory device between the members and the lever.

833,921. Apparatus for Public Amusement; Baldwin De Martz, New York, N. Y. App. filed Dec. 27, 1904. An inclined plane having obstacles thereon, down which a passenger is adapted to slide in a chair or car.

833,946. Car Fender; Herman Thiele, Milwaukee, Wis. App. filed Feb. 23, 1906. Details of construction.

834,071. Valve; William K. Omick, Detroit, Mich. App. filed May 28, 1906. Consists of a valve body having three ports therein, two diametrically opposite to one another, leading, respectively, to the supply pipe and the atmosphere, and one at right angles thereto, leading to the outlet pipe, the first two ports being controlled by two valve discs secured to a common stem and engaging seats outside the valve body.

834,100. Overhead Trolley System; Charles E. Barry, Schenectary, N. Y. App. filed May 1, 1905. Conductors supported at the sides of the roadway and an underrunning collector carried by the car adapted to be automatically shifted from the conductor on one side of the roadway to the conductor on the opposite side.

834,107. Power-Operated Brake; Frank E. Case, Schenectady, N. Y. App. filed June 9, 1904. Comprises a powerful spring tending to apply the brakes and power-operated means for compressing the spring to release the brake.

834,108. Track Sander; Fred B. Corey, Schenectady, N. Y. App. filed Feb. 15, 1904. Comprises a casing having sand supply and delivery openings, a cap having its outer edge terminating in close proximity to the tray, and means for supplying compressed air to the space between the cap and tray.

834,118. Fare Register; Charles E. Gierding, Newark, N. J. App. filed Jan. 13, 1906. Includes, among other improvements, means indicating whether or not the register has been reset to zero at the end of a trip.

834,120. Fare Register Bell Mechanism; Charles E. Gierding, Newark, N. J. App. filed June 21, 1906. Details of construction.

834,129. Block Signal System; Laurence A. Hawkins, Schenectady, N. Y. App. filed April 7, 1906. Designed to overcome the defect of present railway signal system where the rails are cross-tied together. In the present system a breakage of a rail is not indicated by the signals. This invention comprehends means for insuring operation of signals when one rail is broken, although they are cross-connected or tied.

834,134. Trolley Base; Henry Holland, Cleveland, Ohio. App. filed Aug. 5, 1905. The base connected to the car by a ball-bearing and the pole is provided with a spiral spring which compresses a sliding block against a pair of pins so as to swing the pole upward against the wire in either direction. Means are provided for rendering this spring inoperative when desired.

PERSONAL MENTION

MR. F. A. BOUTELLE, for the past three years superintendent of transportation of the Columbus, Newark & Zanesville Traction Company, has resigned to become superintendent of transportation for the Puget Sound Electric Railway Company and the Tacoma Railway & Power Company, with headquarters at Tacoma, Wash. Mr. Boutelle went to Newark from Albany, N. Y.

MR. H. E. FARRINGTON, superintendent of car repairs Boston & Northern Street Railway Company, has resigned his position to become identified with the United Railroads of San Francisco, San Francisco, Cal., as master mechanic. Mr. Farrington has been identified with the Lynn & Boston and Boston & Northern Street Railway Companies for twenty-six years, and is one of the best-known street railway men in New England. Mr. Farrington is past president of the New England Street Railway Club, and has been actively identified with the club since it was organized.

SEVERAL CHANGES HAVE BEEN ANNOUNCED in the operating force of the Canton-Akron Railway system, which was recently absorbed by the Northern Ohio Traction & Light Company. Mr. J. R. Harrigan has resigned as general manager to go with Tucker-Anthony Company, of Boston, and the office of general manager has been abolished. The operating force will in the future report directly to Mr. Charles Currie, general manager of the Northern Ohio Traction & Light Company. Mr. George E. Barber becomes division superintendent of the Canton-Akron division. Mr. John Freeman, of Akron, succeeds Mr. W. J. Goldthwait as superintendent of the Tuscarawas division, and Mr. Goldthwait becomes superintendent of the electric lines at Manchester, N. H. Mr. Daniel A. Scanlon remains as superintendent of the Canton city lines.