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Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905 *to date,* 424,350 *copies, an average of* 8161 *copies per week.*

The Westinghouse Correspondence

The letters hastily inserted in our last issue form the most notable as well as the spiciest contribution to the polemics of engineering that we have had the pleasure of publishing for many a year. They are flavored with the fine odium theologicum of the early days to which Mr. Westinghouse feelingly alludes, and if some interesting rejoinders are not soon in evidence we shall be greatly surprised. We note with some satisfaction the frank endorsement by Mr. Westinghouse of the position which we took at the time of the New York Central decision, i. e., that under the existing circumstances, and without prejudice to the alternating-current system, the choice of continuous-current equipments was a logical conclusion. By the action of the New York, New Haven & Hartford Railroad, the question has now been reopened in its largest aspect, and must be considered again upon its merits, whatever they may be. There is much to be said on both sides of the question. As we have again and again reiterated, the larger railway work depends on the successful use of high voltage upon the working conductors. To go to such voltages as are desirable, most probably means the abandonment of the third rail, which we have repeatedly characterized as a dubious blessing, however valuable it may be under favorable circumstances. These judgments have no necessary bearing on the particular form of alternating equipment advocated by Mr. Westinghouse. They stand in favor of any system capable of successfully utilizing some thousands of volts on the working conductor, and do not in the least reflect upon d. c. traction, save as the experience of the past tends to discourage high-voltage direct-current equipment.

The possibility of the use of high voltage direct current has recently received the powerful advocacy of Mr. Sprague, who, as our readers are aware, has put himself on record as believing that d. c. traction can be carried up to 1500 volts or higher. We have already expressed our great pleasure at this announcement, although until some of the manufacturers agree to build and guarantee such equipments, they are not entirely free from the general objections not unjustly urged against non-standard apparatus. On the other hand, it is claimed that alternating-current series-motors have two intrinsic disadvantages: the intermittent delivery of energy, which affects the capacity of the motors, and cannot be gotten rid of, and the difficulty of commutation with alternating current, which is a question in which the magnitude of the unit plays a very important part. In other words, the complete success of a 50-hp motor does not insure against failure in a 500-hp motor, in the same way and for much the same reason that a 5000-volt arc machine may run beautifully, while no one has had the temerity to build a generator for the same voltage at 100 amps. or more. The possible success of the a. c. locomotive on a large scale is a matter not of theory, but of fact. Upon this point we should have data before long. So far as the steam railroads are concerned, their policy is one of readiness to adopt either system. Give them a successful high-voltage trolley system, and they care not what kind of current is chosen for operating it. Along the so-called "standard" lines of practice, large railway work is hopelessly handicapped outside of suburban service. It is merely a question as to what the forward step should be and how soon it may be taken.

Testing New Equipments

One of the most perplexing problems in electric railway work is the question as to how extensively new equipment should be tested before it is finally approved and accepted by the executive officers of the road concerned. Practice on different systems varies widely in this respect. Some roads make no tests whatever, other than the more or less conclusive one of putting the equipment into actual service, while others spend large sums of money annually in the effort to evaluate every physical characteristic of their apparatus which can be extracted by the ingenuity of the technical staff. Between these two extremes lies an economic medium which, in the great majority of cases, probably represents the trend of the best practice, judged by modern operating conditions.

Most electric railway managers agree, we believe, that apparatus involving untried or experimental features should be placed in commercial and multiplied service throughout a system only after searching tests have demonstrated its fitness for the work in hand. Certainly the acceptance of new equipment, often involving the payment of many thousands of dollars to the manufacturers, is rarely consummated on large systems without some pretty definite information in the management's hands as to the way in which the specifications have been fulfilled. Tests may have been made at the manufacturer's works for the reason that while service conditions can be duplicated on an experimental track, it is often impossible to carry out experimental work on an operating system without embarrassing the movement of paying traffic. The equipment may have been "tried out" by introducing one or two new units into regular service and noting their behavior under fire, so to speak; or tests by independent engineers and laboratories may have been made for the purpose of determining capacities, temperature rises under various conditions and other limiting characteristics. The essential point is the ability of the new equipment to perform the required service with reliability and economy. On small roads having moderate resources, all but the service test must often be dispensed with; but as a general proposition one cannot learn too much about the actual performance of a new type of equipment under the trying conditions of street railway service. Companies with ample financial strength may well spend money liberally upon the expert analysis of the behavior of their apparatus in seven-days-per-week operation, for the information thus gained is often of the utmost value, not only in reducing the cost of maintenance, but in furnishing a rational basis for new and more efficient designs of machinery at the manufacturers' hands. Even the small road can help itself and others in this work by keeping careful records of maintenance, although the services of testing experts can frequently be secured only in combination with other companies operating in the same general part of the country.

As for standard equipment—apparatus which the manufacturers have found worthy of confidence and which they stand ready to produce in any desired quantity on either a large or a small scale—it is difficult to know where to draw the experimental line. If a company has had experience with a given equipment there is often little object in subjecting it to exhaustive tests departing to any great extent from the service requirements, unless each individual piece of apparatus is exceedingly expensive in itself. A street railway buys, for example, twenty car equipments costing $3,000 each. These equipments are standard; similar ones are in the company's service operating satisfactorily upon long established routes. Certainly there is little advantage in subjecting each one of these equipments to elaborate tests. The main point is that they must perform the given service, whether on new routes or old, without undue temperature rise or excessive wear and tear. If the service has been accurately specified to the manufacturers it is not a very serious matter to make the few service tests necessary to establish the ability of the motors to fulfil the requirements. The regular staff of the road should be equal to such a problem without the necessity of specialized advice from outside. In some cases the specification of maintenance guarantees is worth thinking about.

Suppose, however, that the same company buys a 3000-kw turbo-alternator, costing in round numbers $100,000. In such a case as this the amount of money invested is so large, and the importance of the unit so great in the power supply of the system, that the most thorough tests are justified in order to make sure that the specifications have been met. If the machine falls short of the requirements the proper deduction to be made from the contract price will probably far exceed the cost of the test; but, although this condition is seldom presented with the scientific designing and manufacturing practiced to-day, it is of the greatest importance to know exactly what such a machine is capable of doing. Units of this and larger sizes supply power on the wholesale plan, and the possibility of bettering the guarantees by bringing service operation nearer test conditions carries with it a potential saving in the fuel account which is not to be scoffed at. The large system can afford to specify with greater detail than the small road, although in standard equipment the service requirements are the rub of the whole question, and a wise engineer will not pin the manufacturer too closely on constructional details.

The Abuse of Automatic Circuit Breakers on Interurban Cars

Interurban cars are often fitted with controllers which do not have the ability to break the current under all conditions without destructive arcing. To avoid this arcing and burning of the controller, the motormen are frequently forced to use the automatic circuit breaker for purposes other than those intended in its design. We refer to the habit of using the breaker as a starting switch. Such use of a circuit breaker soon destroys its value as a means of protecting the motors from overload. The frequent flying out under heavy load burns and blisters the contacts and loosens the adjustment and other parts so that the apparatus is not reliable as an automatic breaker. This is probably the chief cause of trouble with a considerable percentage of the circuit breakers on heavy interurban cars. If tests were made, no doubt the station switchboard breakers would often open before those on the cars.

The writer once had occasion to notice a test of the breakers on several interurban cars. These breakers were placed up over the motorman's head within easy reach, and were frequently used to start and stop the car. In following behind slow-speed city cars it was a common practice to let the controller remain on the first notch and keep the car running at a slow speed by closing and opening the circuit breaker at intervals. Of ten or fifteen cars tested, but one breaker was found that would automatically trip at a reasonable load. In several instances the power house breaker was blown without affecting the car breaker. When there are no fuses in the car circuits and the breakers are out of order, the result in case of a short circuit or grounded armature can readily be imagined. Instead of one or two armature coils being injured, the ex-

cessive current simply continues to flow until a considerable number of coils are so burned as to necessitate their removal.

A car should always be provided with a good reliable circuit breaker. If certain railway systems would give proper attention to this one piece of apparatus on their cars they would, at the end of the month or year, find account No. 7, or that of electrical repairs exceedingly low.

The suggestion seems rather out of the ordinary, but nevertheless it would, no doubt, be a good plan in many instances where hand-operated drum controllers are used on heavy cars, to put two circuit breakers in series in the line. One, automatic in action, might be placed somewhat out of reach of the motorman. The other need not have the automatic feature and should be located where the motorman could use it merely as a line switch and a means for protecting the controller from excessive burning of the segments and fingers. In such an instance the automatic breaker should be tested at intervals by connecting an ammeter in series, throwing on the brakes and then turning the controller to successive notches until the proper current for opening the breaker is obtained. Such a method would of course be hard on the resistance if the current were allowed to continue to flow for any length of time, and of course the operator must use care in this respect.

Where there are several cars to be tested, however, we believe it a good plan to rig up a permanent testing outfit, consisting of a water resistance and a means for readily connecting the circuit breaker of the car in the line.

Operating With "Roadmasters" in Toronto

In the fall of 1902 the Toronto Railway Company instituted a new grade of service among employees in its operating department, and to the positions created in this grade gave the title of "roadmasters." For some reason or other this innovation has never been given the attention outside of Toronto which it very justly merits. As outlined elsewhere in this issue, the system consists in promoting certain of the older motormen on each line to the positions of roadmasters and bestowing upon them considerable authority and responsibility with reference to operating details. The novelty of the scheme consists chiefly in the fact that although these men fill most of the duties of street inspectors they perform their duties while operating regular cars as regular motormen. It would appear that the maintenance of this arm of the service offers immense possibilities in the direction of effective organization. As the superintendent of the Toronto Railway expresses it: "These men enable us to keep our fingers on the pulse of our business and form an indispensable link between the management and the rank and file of the men"—a link, he might have added, that sometimes seems to be missing on some roads in the States. The idea is so simple it is surprising the possibilities have not received greater consideration in this country. The term "roadmaster" is not a good one in view of the duties of the positions, but the idea itself would appear, in the vernacular of the street, to be "all to the good."

In the first place, the roadmasters make the regular trips over their respective lines throughout the day, and are therefore in intimately close touch with all the little every-day details of the service. They know what of the company's rules are good and what are bad, and they know what rules are being broken, because they have the same temptation to break them as do the other men. They hear all the "gossip" and small talk of the business and have opportunities for getting sidelights on the internal workings of the organization. They mingle with the employees at the car houses and during the reliefs, and to all intents are regular motormen, and are therefore in a position to judge the service from the standpoint of an employee. On the other hand, the responsibility delegated to them makes them virtually officials, or at least semi-officials, of the company, and as such they are in a position to handle conditions from the standpoint of an official. They are not secret spotters, and are not so regarded either by the company or by their fellow employees. But they are men who by reason of long and faithful service have been advanced one step in the ladder and enjoy a somewhat closer confidence with the management for the good of the service. In attempting to carry out this phase of organization care would have to be exercised to avoid any feeling of "chestiness" on the part of the men advanced to the higher grade. This is prevented in Toronto by careful selection and by constant reiteration that the roadmasters are not given their position to domineer over or spy upon their fellow employees, but are aids or lieutenants of the management in the work of improving the service and securing the greatest good for all concerned.

The Toronto roadmasters are given a thorough training in the shops and are competent to make all manner of repairs to cars on the streets. And here comes in another advantageous element. It is manifestly more satisfactory to take a few picked men from the best of the rank and file on each line and give them a thorough schooling as to the mechanical details of the equipment than it is to attempt to pass all of the motormen, good and bad indiscriminately, through the shops in the endeavor to make mechanical men of them. An otherwise good motorman may make a poor mechanic, and it is but a waste of time to attempt to give him a mechanical training. In promoting a man to the position of roadmaster, his aptitude for mechanical training is taken into consideration. This works out in practice as follows: A motorman is having trouble with his car, due, perhaps, to some fault in the controller, or the car may be braking badly. Instead of attempting to remedy the trouble himself, he limps along as best he can until he meets the regular car in charge of his roadmaster. The two men immediately change cars and the motorman of the cripple works out the run of the roadmaster, while the roadmaster repairs the defect if possible or else runs the defective car into the car house. In other words, there is always a motorman running somewhere on each line who is competent to take charge of any situation or emergency that may arise.

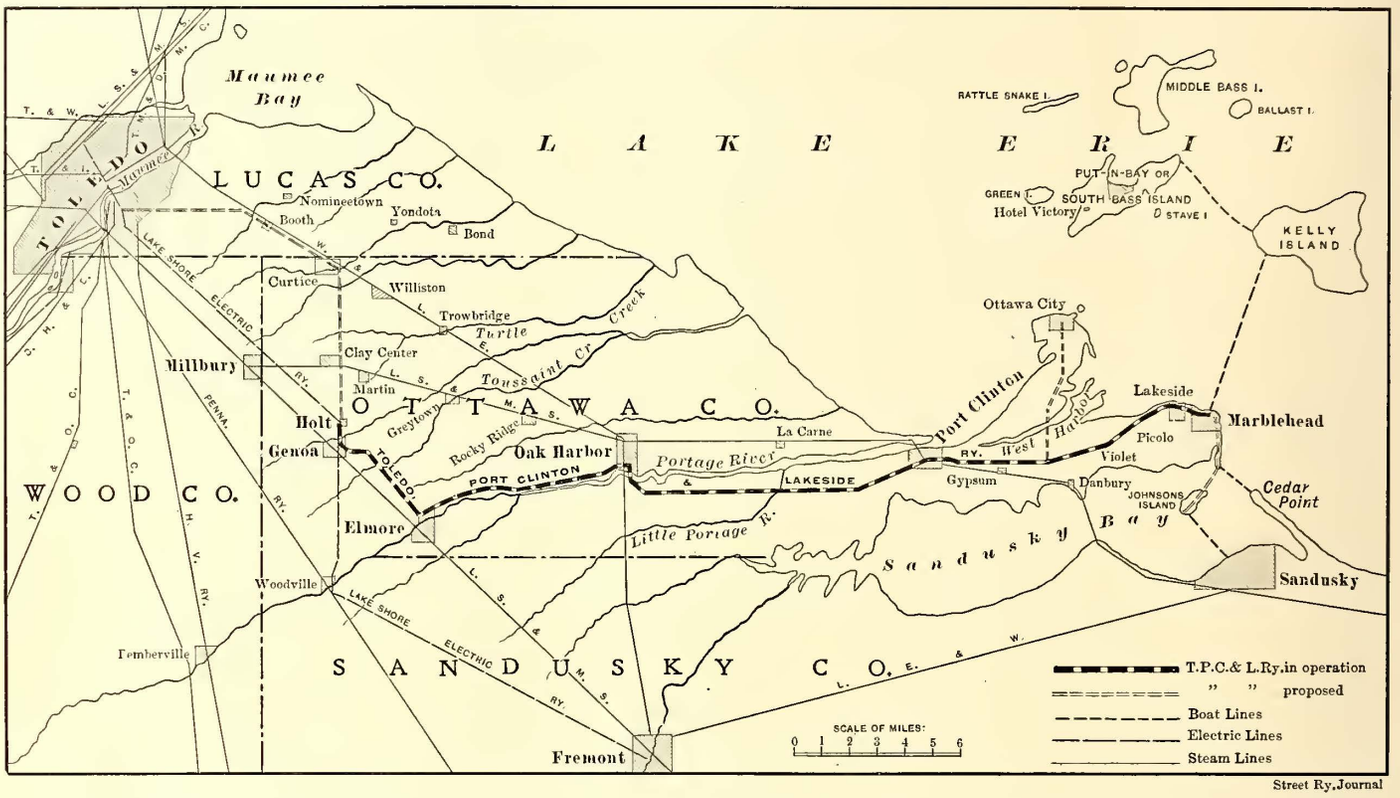
The transportation department also derives great assistance from the information received from the roadmasters regarding the volume of traffic at certain hours. These men are riding over the line at all hours of the day, and their reports as to whether too many or too few cars are being operated to accommodate the travel are of prime value in making and altering schedules.

Another of the moral benefits derived is the creation of several positions open to the rank and file of the men, which are in the nature of a step higher in promotion. The men in the ranks who feel they never could hope to rise to the position of street superintendent or inspector may very well aspire to a position as roadmaster with considerable promise of eventually getting and keeping the place.

As to the cost to the company of maintaining the "roadmaster" system, it may be said that the expense will be about the same as with a full complement of street superintendents or inspectors, for the reason that, although roadmasters are paid from a third to a half more than the regular motorman, each roadmaster while filling the duties of inspector is also earning his wages as a regular motorman of a regular car.

THE TOLEDO, PORT CLINTON & LAKE SIDE RAILWAY

The Toledo, Port Clinton & Lakeside Railway, recently completed in Northern Ohio, presents an interesting example of a line which has opened up territory heretofore handicapped by inadequate transportation facilities. It is also especially interesting from an engineering standpoint, being the first interurban road in the Central West to be equipped throughout with apparatus furnished by the Allis-Chalmers-Bullock combination of steam and electrical interests.



MAP OF THE TERRITORY SERVED BY THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY, BETWEEN TOLEDO AND LAKESIDE, OHIO

ROUTE AND TERRITORY

The company operates cars from Toledo to Marblehead, Ohio, 52 miles, the line extending the full length of the Marblehead Peninsula, a point 30 miles long, bounded on one side by Lake Erie and on the other by Sandusky Bay. Near the

VIEW SHOWING THE COUNTY COURT HOUSE IN PORT CLINTON, THE TEMPORARY WAITING ROOM OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY IS AT THE LEFT

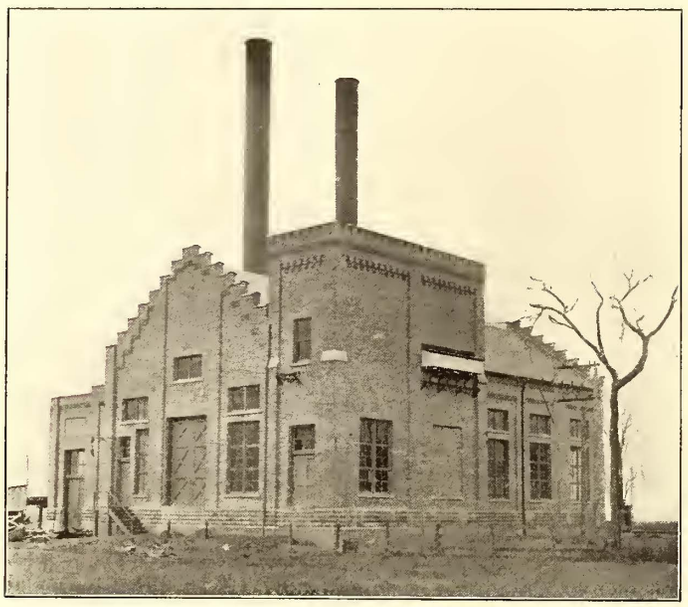
apex of this point is a large group of islands, chief among which are Kelly's Island, famous for its lime products, and Put-In-Bay Island, noted as the scene of Commodore Perry's victory against the British in 1812. This district is literally the garden spot of Northern Ohio, and features which go to make an interurban line successful are peculiarly combined here. Enormous quantities of fruit are raised on the islands and peninsula, shipments of grapes and peaches from the town of Port Clinton alone amounting to $750,000 annually. Wine is produced in great quantities and heavy shipments are made. The farmers all through this district are wealthy and progressive, and the road affords them a convenient method for handling their products. The islands and peninsula are of limestone formation, and there are several large establishments for the production of lime, cement and gypsum. The company has installed standard freight cars, and it will undoubtedly derive considerable tonnage from the products mentioned. Few roads have such excellent prospects for summer traffic. The summer population and excursion business at the islands are very large. The line passes directly through Lakeside, a summer encampment city, which is the headquarters of the Ohio Methodist Conference, and from 75,000 to 100,000 people spend their summer vacations or attend the meetings there.

CAR LEAVING THE MARBLEHEAD TERMINUS OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY. THE CONCRETE SUBSTATION AT THIS TERMINAL IS SHOWN AT THE RIGHT

VIEW OF SWING BRIDGE AND TRESTLE AT OAK HARBOR, SHOWING ALSO THE HIGH-TENSION TOWERS CROSSING THE STREAM

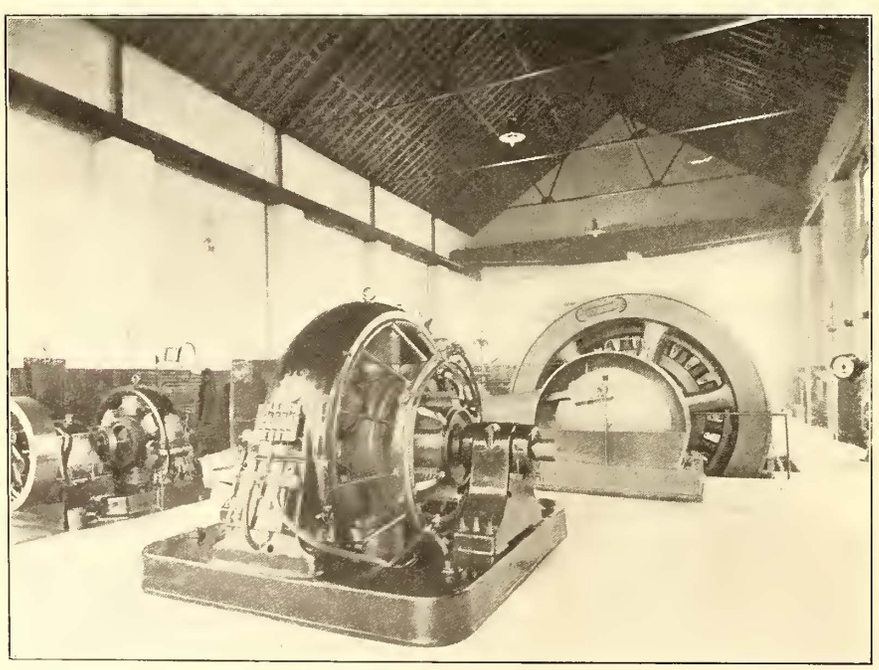
Cedar Point, opposite Marblehead, is a famous pleasure re-

sort, while Hotel Victory, on Put-In-Bay Island, is one of the largest summer hotels in the country. There is a tremendous flow of traffic between these points, and the company will operate steamers between its terminus at Marblehead and the various resorts mentioned. It is also planning to build an ex-



EXTERIOR VIEW OF THE POWER STATION OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY AT PORT CLINTON

tension around to the end of Marblehead Point bridge, across the shallow bay for a distance of about 1000 ft., and build on to Johnson's Island. This is another famous summering place and noted as the location of one of the Federal prisons during the Civil War. By operating a ferry from Johnson's Island to Sandusky and Cedar Point, the company believes it can secure a considerable portion of the through traffic between these points and Toledo. There is also a plan to build a spur line to Catawba Island, reaching Ottawa City, and providing a shorter route to Put-In-Bay. During the fall months the road derives much traffic from hunters. Duck and geese abound in the marshes surrounding the islands and bays, and there are numerous club reserves, so that the sport is protected.



INTERIOR VIEW OF PART OF THE ENGINE ROOM OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY

At present the company operates cars from the Toledo city limits to Genoa—10 miles—over the tracks of the Lake Shore Electric Railway, and it has its own traffic arrangement with the city company for entrance to Toledo and use of the terminal station. The arrangement with the Lake Shore Electric gives that company all the fares while the cars are on its tracks, the Lake Shore assuming the liability and paying the crews. It also pays a small rental per car-mile for the use of the cars. As the Lake Shore is a single-track line and has a heavy traffic of its own, the Port Clinton Company believes that its summer traffic will be handicapped, and is arranging for an independent entrance into Toledo, being confident that it will prove a profitable addition to its holdings. Accordingly, it has secured a private right of way from the present junction, north to the village of Curtice, thence to Booth, and into Toledo by way of a city line, which it is claimed will give a very short route to the center of the city. This line will be built early next spring, and it is claimed that it will open up a farming district and oil territory near the city which will make it a profitable line in itself.

The line was built to Elmore and Oak Harbor two years ago, and last summer it was extended to Port Clinton and Marblehead. The original portion was operated by a temporary power station at Genoa. The new power station at Port Clinton, which will operate the entire line and proposed extensions, was completed about Oct. 1 of this year.

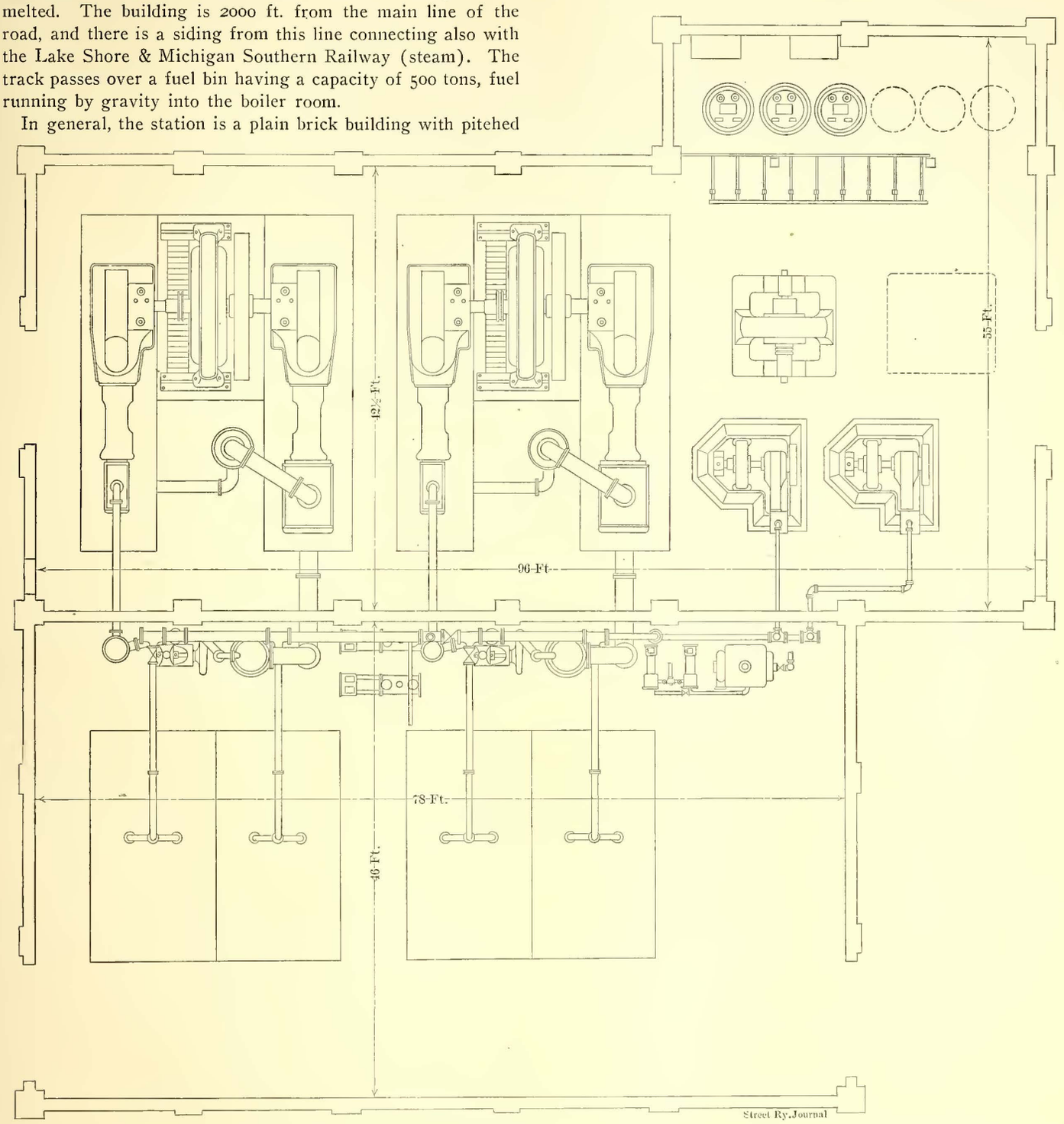
POWER STATION

The station is located on the lake front, so that a permanent water supply of the best quality is assured. The land is only a few feet above the lake level, and the lake is shallow at this point. Consequently a channel 600 ft. long and 7 ft. deep was dredged to within 200 ft. of the house. A 24-in. line conveys the water by gravity to an 8-ft. well, 12 ft. deep, adjoining the house. Next spring it is the intention to extend this pipe to 1000 ft. and build a crib with a bed of crushed stone for a filter. The condenser discharge can be emptied into the channel,

BOILER ROOM OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY

and gates are provided to keep it from contaminating the intake water. During severe weather, when needle iee is likely to accumulate in the intake, the supply can be taken from a point near this outlet, whieh has sufficient warmth to keep the iee melted. The building is 2000 ft. from the main line of the road, and there is a siding from this line connecting also with the Lake Shore & Michigan Southern Railway (steam). The track passes over a fuel bin having a capacity of 500 tons, fuel running by gravity into the boiler room.

In general, the station is a plain brick building with pitehed



PLAN VIEW SHOWING THE GENERAL ARRANGEMENT OF BOILERS, PIPING, GENERATING SETS, ETC., IN THE POWER PLANT OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY COMPANY

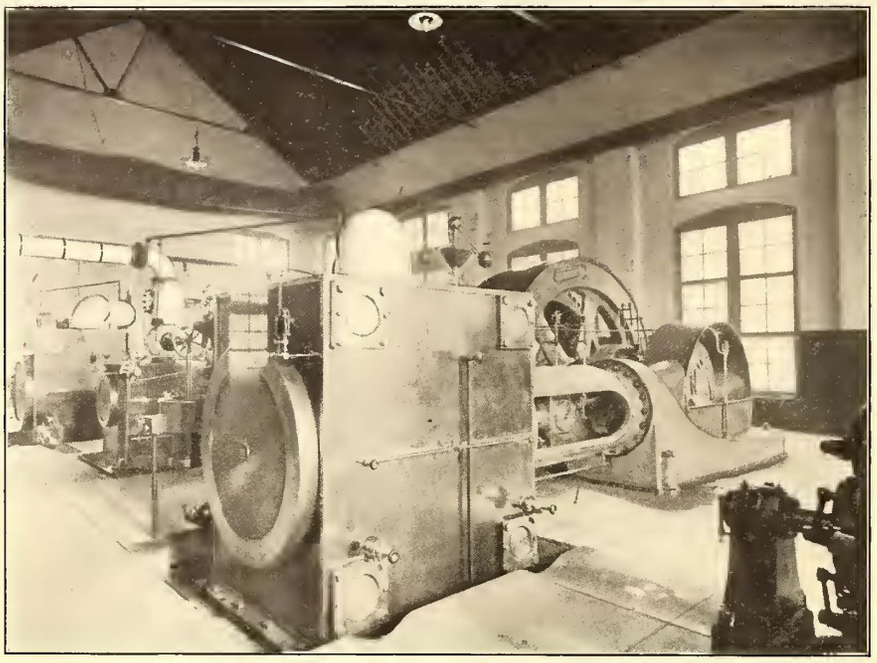
slate roof and steel trusses. At one corner is a two-story wing for the high-tension apparatus, while the boiler room is a one-story wing. The dimensions are shown in the aeeompanying plan. The building has a large area of glass surfaee, a seeond row of windows being placed sufficiently high to permit a large amount of ventilation. The engine room is eovered by a 15-ton hand-operated erane with a lift of 25 ft., which was furnished by the Northern Engineering Works. The floors are conerete and expanded metal. Great care was used to seeure solid foundations for the building and engines, and over 1000 tons of concrete were used in this work.

STEAM AND ELECTRICAL EQUIPMENT

The main units eonsist of two horizontal cross-compound condensing Allis-Chalmers engines direct connected to 800-kw Bullock revolving field, engine type, alternating-eurrent generators delivering current at 375 volts, three-phase, 25 eycles. The engines are designed for a normal load of 1280 hp when operating at 26 ins. vacuum and 150 lbs. pressure. The engines are of the standard Allis-Chalmers heavy-duty type. They have a gravity automatic oiling system, Allis-Chalmers safety stop valve, Reynolds-Corliss valve gear, special anti-friction metal on low-pressure piston, and operate at 125 r. p. m.

The boilers are four 400-hp Erie City water-tube boilers with plain hand-fired grates, and are designed for a working pressure of 150 lbs. They are arranged in two batteries, and

each battery has a 120-ft. steel stack, well braced and guyed. The pumps and auxiliaries are arranged back of the boilers. The feed-water pumps are two Fairbanks, 6 ins. x 5¾ ins. x 6 ins. These take either cold water from the cold well outside or hot water from a hot well, and pass it to a 1000-hp Cochrane feed-water heater. The boiler feed-pumps are two Fairbanks duplex, 8 ins. x 5 ins. x 10 ins. All drips from steam lines and auxiliaries discharge to the heater, which supplies water to the boilers at about 210 degs. The condensers are two 18-ft. Tomlinson barometric type, supplied with water by two 6-A Lawrence centrifugal pumping engines. The main steam header is mounted on brackets supplied with rollers, and it may be divided into three parts, making it possible for any boiler to supply any engine. The lines to the exciter engines are bypassed, and it is possible to cut off the separators and take steam for the auxiliaries through an auxiliary header. In case it is desired to cut out the condensers, the engines may exhaust through exhaust heads provided with Jenkins automatic relief and back-pressure valves.

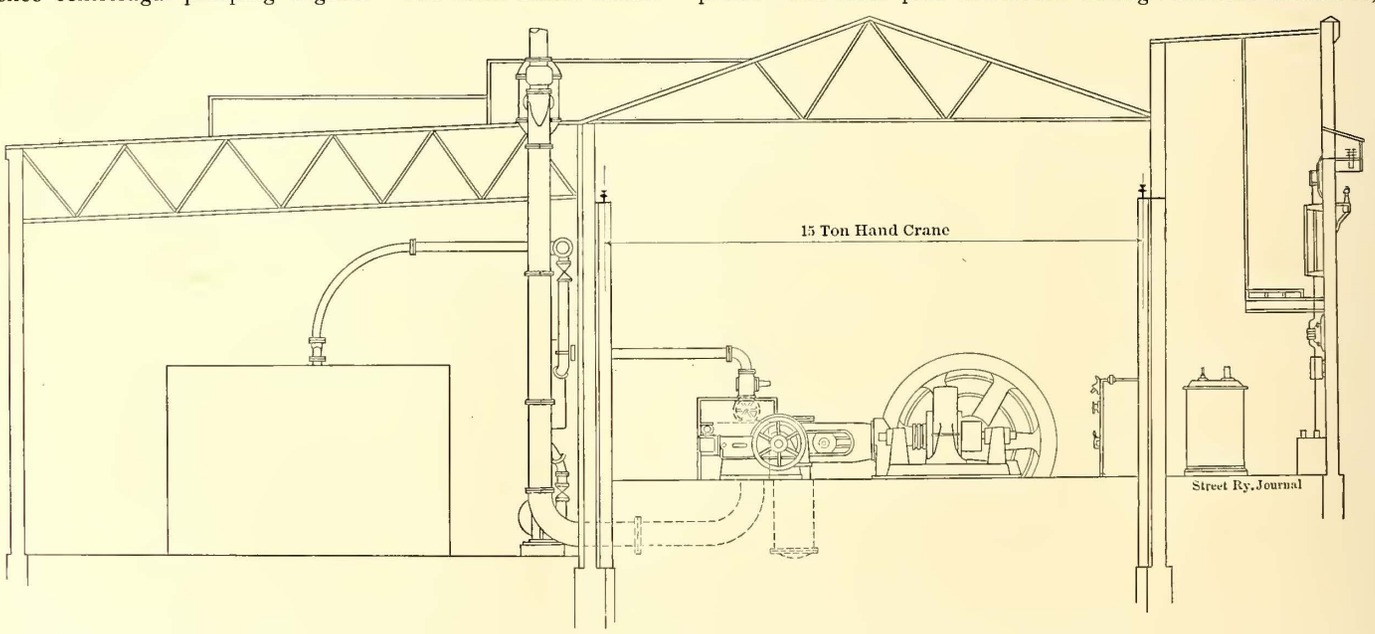


ANOTHER VIEW IN THE ENGINE ROOM, SHOWING THE ENGINE SIDE OF ONE OF THE HORIZONTAL DIRECT-CONNECTED GENERATING SETS

The exciter units consist of 10-in. x 10-in. Erie City engines connected to 50-kw, 120 volts, d. c. Bullock generators. Each is capable of supplying either or both the main generators, and in addition, taking care of the station lighting. The building is well illuminated by Adams-Bagnall 110-volt, d. c. arc lamps located back of the board and in the basements, as well as in the engine room and boiler room.

HIGH-TENSION EQUIPMENT

Current from each large generator is lead through six 1,000,000-circ. mil rubber-insulated cables, through the switchboard, to three 500-kw, 375-20,000-volt, oil-filled water-cooled Bullock transformers placed back of the switchboard. The transformers have smooth surfaces. Cold water is circulated by the heater pumps through coils in the transformers. It circulates at the rate of about 1 gal. per minute, and there is a tell-tale device in the discharge pipe at the side of the engine room which indicates that the water is circulating. The transformers are guaranteed not to heat above 30 degs. under full load, and there is a thermostatic alarm gong on each transformer. Westinghouse type E oil switches are provided between the high-tension sides of the transformers and the outgoing lines. They are hand-operated from the board and are provided with automatic trips. The outgoing lines are protected by suitable lightning arresters and choke coils, which are accessible from a balcony, consisting of a large slab of reinforced concrete. The outgoing lines pass through a hood extending outside the building about 2½ ft. and about 40 ft. from the ground; this hood is so constructed that it is thoroughly waterproof. The leads pass downward through suitable insulators, through the bottom of the floor of the hood, and to an anchorage 5 ft. below. This anchorage is fastened on the outside of the building wall and leads from it directly to the main pole line. The inside run of high-potential wiring is designed to be as short as possible, extending only about 25 ft. from the high-potential side of the transformer to the anchorage hood.



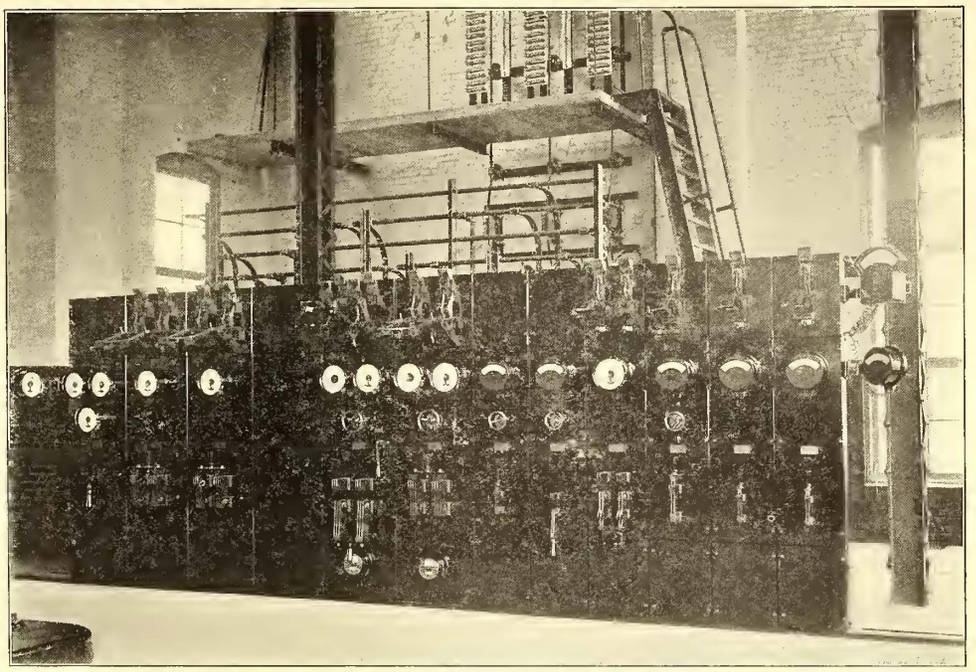
CROSS-SECTION OF POWER STATION, SHOWING THE TYPE OF ROOF CONSTRUCTION, PIPING FROM BOILER TO ENGINE, POSITION OF HIGH-TENSION APPARATUS, ETC.

Directly beneath the three transformers is a large metal tank of sufficient capacity to receive the entire quantity of oil re-

quired for the transformers and reactive coils, the latter being located in the basement. The large cables running from the rotaries, generators, exciters and transformers are run in the basement and are suitably mounted on porcelain metal rack insulators.

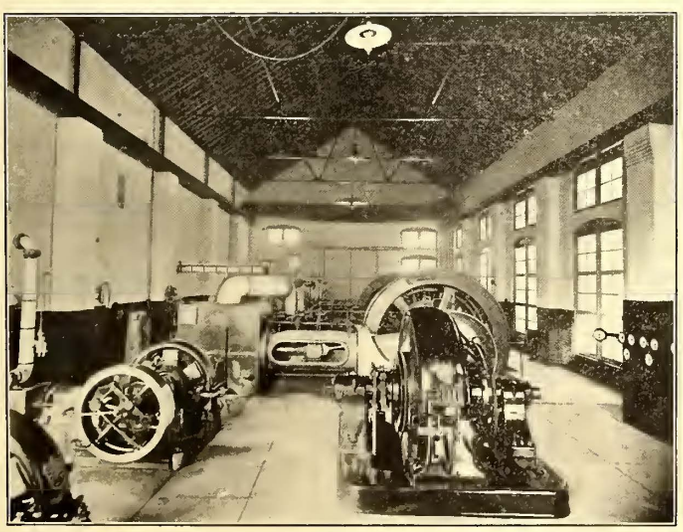
At present there is installed in the station a 400-kw rotary converter sub-station outfit, and provision is made for a second converter of the same rating. The rotary is provided with the Bullock electrical oscillator. Current applied to the converter is taken from the main generator bus-bar at 375 volts a. c., and delivers d. c. at 600 volts. The generator bus-bars, located back of the board, are solid rolled copper, wrapped with seine twine, covered with black insulation varnish.

The switchboard is black enameled slate, consisting of thirteen panels, on which all instruments are black. The switchboard equipment consists of the following panels: One high-tension panel, two transformer panels, two generator panels, two exciter panels, one a. c. rotary panel, one d. c. rotary panel and two feeder panels. The panels are equipped with Weston and Westinghouse instruments, and Cutter I-T-E circuit breakers are used on all panels except the high-tension and exciter panels. The board rests on insulated stringers, and the cable openings are slate-covered.

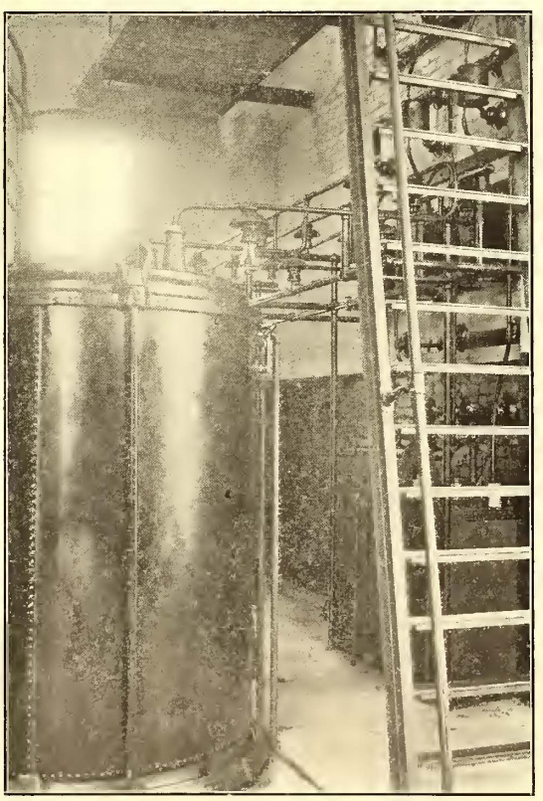


SWITCHBOARD, BUS-BARS AND CONCRETE LIGHTNING-ARRESTER GALLERY IN TOLEDO, PORT CLINTON & LAKESIDE RAILWAY COMPANY'S POWER STATION

At present there are sub-stations at Genoa, Oak Harbor, Port Clinton and Marblehead, and a fourth will be installed near Toledo, giving an average distance between stations of 13 miles. Each is equipped with a 400-kw rotary and suitable step-down transformers and boards. The Toledo sub-station will probably be installed in a car so that it may be used as a portable sub-station. The Marblehead station was placed at the extreme east end of the road, as it is the intention to supply several manufacturing establishments with current, and a second rotary may be installed there. The sub-station buildings are built of concrete block, and two of them contain waiting rooms and freight-handling facilities.



ENGINE-ROOM VIEW, WITH EXCITER AND ROTARY CONVERTER IN THE FOREGROUND

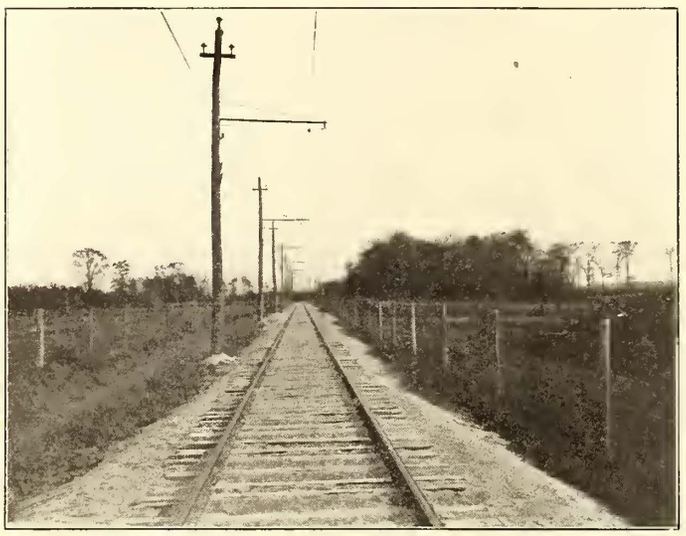


WATER-COOLED, OIL-INSULATED TRANSFORMERS AND OIL SWITCHES IN POWER STATION

TRACK AND OVERHEAD CONSTRUCTION

The district traversed by the line is fairly level. At Elmore the line strikes the Portage River and parallels it on the north side through Oak Harbor, where it crosses it, and continues along the south side of the river to Port Clinton. The first portion contains numerous curves, caused by the meanderings of the river, but the balance is fairly straight. The maximum curvature is 14 degs. and the maximum grade 2 per cent. There is a ruling grade of 1 ft. in 100 ft. and an average grade of .3 per cent. The track is 70-lb. T-rail, joined by four-bolt angle

bars with Ohio Brass Company's soldered bonds. The ballasting is rather out of the ordinary, advantage being taken of the limestone quarries in this district. Nine inches of broken stone is used under the ties, and it is then filled even with the tops of the ties and around the ends with limestone screenings, a fine grain material which, thoroughly soaked and operated over



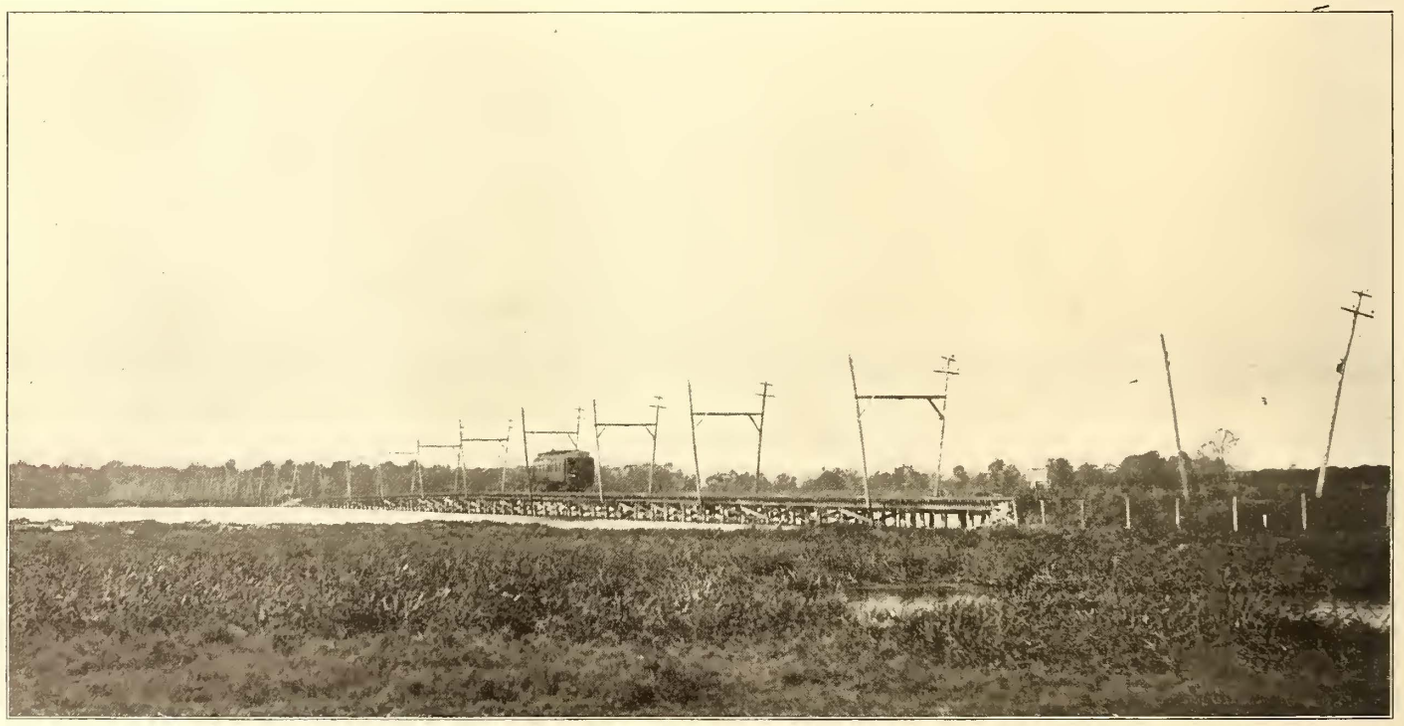
TYPE OF BRACKET SUSPENSION AND POLE FITTINGS USED ON THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY

for some months, packs down like concrete, giving a most substantial foundation for the track. Two-inch broken stone costs 50 cents on the tracks, and the screenings 35 cents per ton. Poles are 35 ft., with 7-in. tops. The first portion of the road was built with span construction and a double line of poles set with a decided rake. On the newer portion it was decided to adopt the side-arm construction, as the limestone formation necessitated drilling and blasting in setting poles. On portions of the line the cost averaged $4 per hole. The brackets are Ohio Brass Company's Richmond type, 9-ft. 2-in. pipe with flexible suspension. Garton lightning arresters are placed on poles, three to the mile, and grounded to a metal plate surrounded by charcoal. Two 0000 trolley wires are used, and a 0000 feeder extends the full length of the line. The three-phase transmission line is No. 4 and No. 6 B. & S. gage copper. There is a single cross-arm at the top of the pole, and 7-in. Locke insulators are mounted on Fletcher steel pins. The ridge pin is a Fletcher roof bracket extended several inches down the side of the pole, and secured to the sides and ridge by four lag screws.

Several rather extensive bridges were erected, crossing lowlands, streams and railroads. Over the Portage River at Oak Harbor it was necessary to erect a swing bridge, as the river is navigable beyond that point. The bridge, which is illustrated herewith, has two steel spans, the center one turning and operating by a motor. In order to get the high-tension lines above the masts of boats, three steel towers were erected on the bridge. The tower over the center span has a pole set on a revolving center, so that while the bridge revolves, the pole remains stationary. A pile trestle about 1200 ft. long is illustrated. It will be noted that on the trestles a double set of trolley poles are used and the trolley wire is suspended from a cross timber which is braced on either side, making a very strong structure. The overhead crossing near Port Clinton is S-shaped, with trestle approaches, with two spans, one a through truss 153 ft. long over the Lake Shore & Michigan Southern tracks and the other 66 ft. long over the company's power house track, a riveted half-deck truss.

ROLLING STOCK

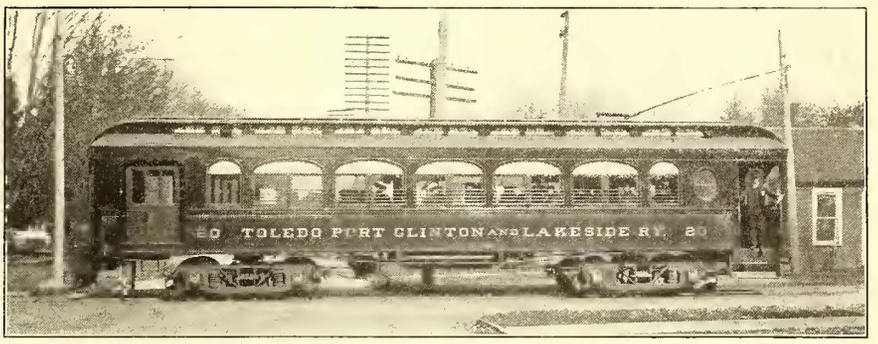
The original rolling stock consisted of four 50-ft. cars, containing passenger and smoking compartments, built by the Kuhlman Car Company. These were described and illustrated in this paper some months ago. They are unusually wide for an interurban car, and have wide, comfortable seats, but it is difficult for two of them to pass on city streets, so the new cars recently received from the Niles Car & Manufacturing Company were made narrower. There are four of these, 51 ft. long and 8 ft. 8 ins. wide over all. Two have passenger and smoking compartments, and the others are three-compartment cars, there being a 9-ft. baggage compartment continuous with the front vestibule. The cars are finished in quartered oak, have semi-Empire roof, leather seats in smoker and plush with high head rolls in the passenger compartment, continuous parcel racks and Pullman-shaped windows with art glass above. They are provided with quadruple motor equipments, Peckham



A LONG TRESTLE AND FILL ALONG THE LINE OF THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY

40-A trucks, Nichols-Lintern air sanders, Westinghouse individual compressor air equipments, and the Lintern system of markers and classification lights. On the rear end are marker lights over the rear vestibule windows, while on the front end on one side are classification lights with white and green lense. These lights are operated by separate switches and are controlled by the motorman.

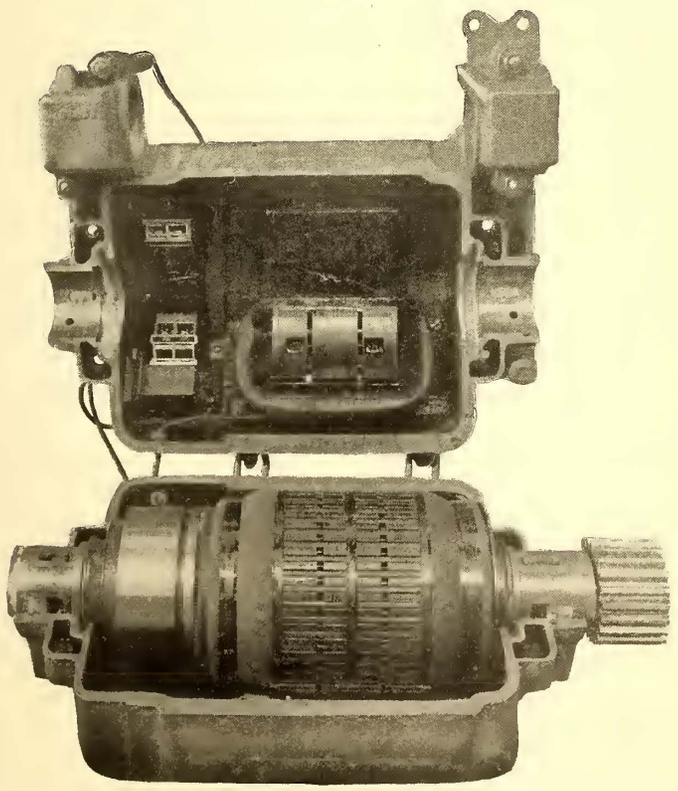
For express service there is a 45-ft. car with two large doors on either side. It has monitor deck and closely resembles the passenger cars. The company also owns one electrically-equipped work car for locomotive use and several standard box cars, flat cars, etc.



ONE OF THE COMBINATION PASSENGER AND BAGGAGE CARS OPERATED ON THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY

MOTORS AND CONTROLLERS

The motor and controller equipments are all of Bullock manufacture. The motor is known as R-50, and is of liberal design, with ample bearings. It is rated at 50 hp, but is claimed to be capable of a considerable overload without heating. It has a continuous capacity of 45 amps. at 500 volts, showing no more than 75 degs. C. rise in shop test. The field frame is of steel castings, divided horizontally through armature and axle bearings. A liberal center distance is allowed between these bearings so that a maximum axle of 6 ins. in diameter may be used. The pole pieces are of laminated iron secured to the frame with through bolts. There are four poles, each provided with a coil, which is securely held in place by the projecting tips of the pole pieces. The pole pieces are provided with ventilating



VIEW OF THE GENERAL INTERIOR ARRANGEMENT OF THE NEW 50-HP MOTOR USED ON THE TOLEDO, PORT CLINTON & LAKESIDE RAILWAY

ducts, which correspond with the ducts in the armature, allowing air to circulate through the pole piece and around the coil. The armature core is built up of soft steel laminations, annealed after punching. The coils are machine wound and thoroughly insulated. They fit accurately in the slots and are held down by band wires, which are well below the surface of the core. The commutator is 11½ ins. in diameter and 4½-in. face. It is built up of hard-drawn copper bars and insulated with the best mica. The commutator has a wearing depth of about ⅞ in. The brush holders are of cast brass secured to a specially treated wood block. This block is in turn bolted to the end of the upper field frame fitting an accurately babbitted seat. Each holder is secured to its block independently of the other, and carries two carbon brushes; an independent pressure finger is provided for each brush. The bearings are of cast iron with babbitt lining. The pinion end armature bearing is 3½ ins. in diameter and 9½ ins. long, and the commutator bearing is 3 ins. in diameter and 7¼ ins. long. The axle bearings are 5½ ins. in diameter and 9½ ins. long. Cast-steel cut gears of split pattern are used. They are of No. 3 teeth diametral pitch and 5-in. face. The pinions are of forged steel, fit the armature shaft on a taper seat, and are securely keyed to same. The gear ratio is 24 to 65. Lugs are provided on the top field frame for bolting to the suspension bar.

The controller used is of the series-parallel type. The main drum makes the rheostatic and motor combination for the four motors. The reverse drum is provided with contact for each motor and is interlocked with the main drum. A cut-out switch is provided for cutting the motors out of circuit. The cut-out switch can be thrown without removing the controller cover by using the reverse lever. A special main handle is used, requiring at least a short stop at each point when feeding it. There are seven points in series and five in multiple. A magnetic blow-out is used to protect the contacts. The arcing is also reduced at the open circuit position by inserting an extra section of resistance before breaking.

BUILDINGS

The company has neat frame stations in each town, containing ticket office, waiting room and baggage room. A temporary station of this character erected at Port Clinton is shown. This will be removed shortly to another town, as the company plans to erect a handsome two-story stone station on this site, the lower floor containing the usual passenger and freight facilities and the upper floor the general offices of the company. This is on the Public Square of the town, and the land was donated for the purpose by the city and county authorities. The building will be of stone to harmonize with the fine county court house recently erected. This illustrates the friendly feeling which the citizens of this district bear toward this company, which met with unusually liberal treatment in building the road.

THE COMPANY

The company is composed largely of wealthy local and Toledo people who have interests in this district. The road was built by the Toledo Interurban Construction Company, which was formed for the purpose by the leading stockholders of the company. T. R. Wickenden, chief engineer of the company, had entire charge of locating and building the line, purchasing the equipment and supervising the work. The entire contract for the equipping of the power station, sub-stations and cars was given to the Allis-Chalmers Company. The officers of the Toledo, Port Clinton & Lakeside Railway Company are:

Theodore Schmitt, president; A. E. Klauser, vice-president and general manager; H. R. Klauser, treasurer; H. T. Shunk, secretary; H. C. Warren, general superintendent; C. N. Hawley, auditor; T. R. Wickenden, chief engineer; C. Pollett, electrical engineer; O. R. Sterzinger, master mechanic.

PROPOSED ELECTRIC RAILWAY IN HAMBURG

The railways of Hamburg, like so many others in large cities, have to face the problem of handling a suburban traffic far beyond their normal capacity. After a rapid transit campaign extending over ten years, the City Senate, or Council, has been led to consider building five lines, which will be of mixed underground and elevated construction. The heaviest grades are not to exceed 2½ per cent and the curves are not to be sharper than 100 m (328 ft.) in radius.

There will be fifty cars, each supplied with three 120-hp, 750-volt, 25-cycle, single-phase motors. The trolley wire will be supplied with current at 6600 volts, a car transformer being used to reduce the voltage for the motors. The latter are four-pole machines running at a normal speed of 600 r. p. m. Each motor weighs 2700 kg (5940 lbs.) alone, or 3000 kg (6600 lbs.) complete with gears. The main car transformer weighs about 1000 kg (2200 lbs.) and the regulating transformers about 200 kg. (440 lbs.). The total weight of the electrical equipment will be about 16.5 tons per car, and the total weight of the double cars used will be, including the average load of forty to forty-five passengers, about 75 tons. The total seating capacity of each double car is 140 persons. Current will be taken through two trolleys of the bow type. The overhead line will be of the catenary construction, using a grooved conductor of 80 sq. mm in cross section and a single steel suspension wire 6 mm in dia. The conductor will be supported from the catenary at intervals of about 3.5 m. (11 ft. 5 ins.). The height of the conductor above the rail will be 5.5 m (18 ft.) normally and 4.8 m (15 ft. 9 ins.) under bridges. Each train will be made up of two or three double cars controlled by a multiple-unit system. The circuits to the motors are opened between adjacent running points. The schedule speed is to be 27 km (16.2 miles) per hour, with fifteen stops of 30 seconds each, approximately ½ mile apart.

It is intended to divide the contracts for the construction and equipment between the Siemens & Halske Company and the Allgemeine Company, both of Berlin. The total cost of building and equipping the lines is the sum of 41,143,600 marks (approximately $10,285,000). Two lines are to be built within five years, and the remaining three within the following five years. It is proposed to turn the system over to an operating company for forty years, the municipality receiving a definite percentage of the gross earnings and later a portion of the net profits. All changes in street piping required to permit the construction of these lines will be carried out by the city.

THE LIGHTING SYSTEM AND OVERHEAD CONSTRUCTION IN THE PHILADELPHIA SUBWAY

The opening of the new subway of the Philadelphia Rapid Transit Company was announced in the issue of the Street Railway Journal last week. At that time an account was given of the track construction, provisions for ventilation and the lighting system. Further particulars of the latter and of the overhead construction are presented in this issue.

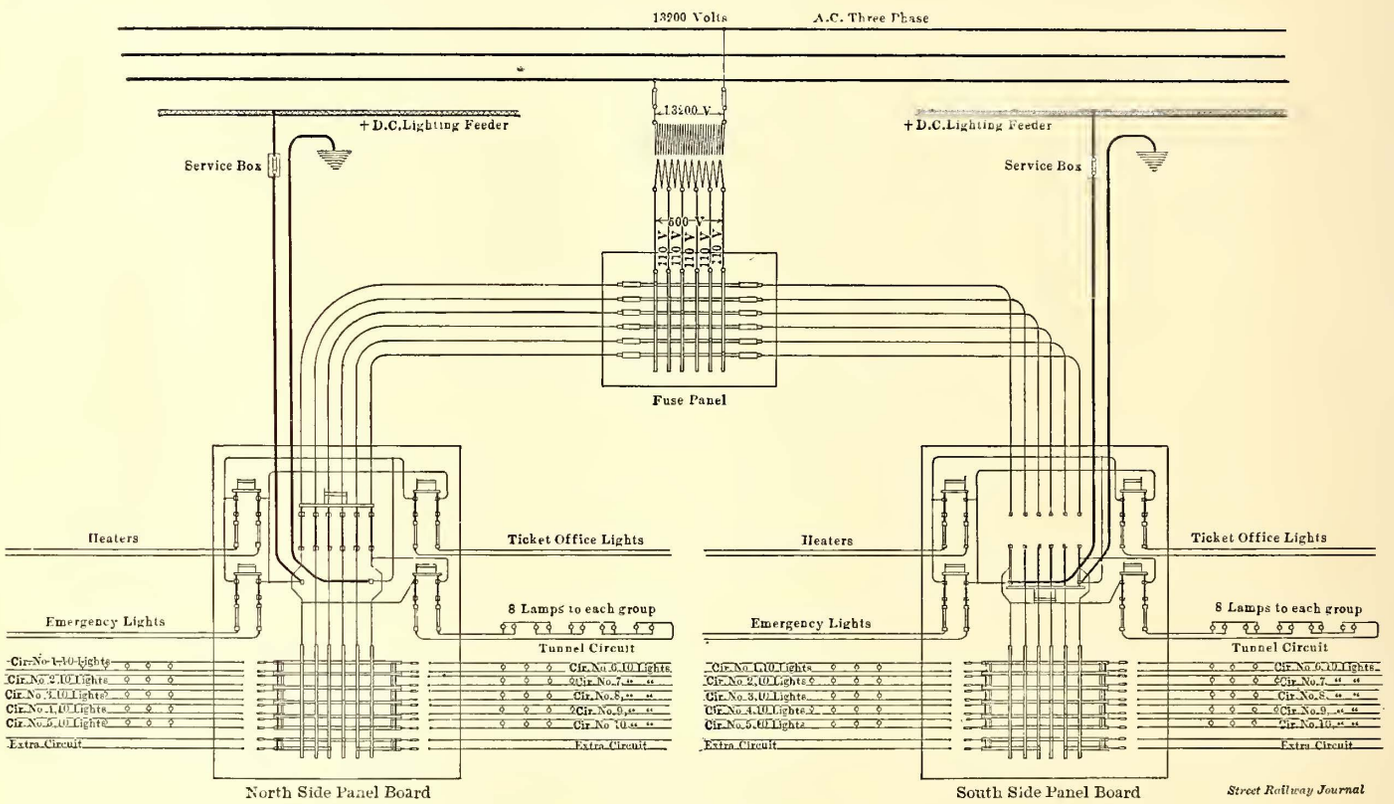


FIG. 1.—SCHEMATIC DIAGRAM OF LIGHTING SYSTEM AT EACH PASSENGER STATION

Fig. 1 shows the general scheme of light wiring. The distribution system is divided into as many lighting sections as there are stations and the lights in each station and in the section of subway adjoining it are controlled from a panel in the station. The system is arranged with two distinct methods of supply. The first is by a direct-current feeder from the nearest power house or sub-station which will supply 550 volts direct current. The other, which is the main source of supply, is by a three-phase cable supplying alternating current at 13,200 volts, 25 cycles, from an independent lighting generator installed in the main station. This cable connects to the transformers in the various subway stations.

One subway station is connected to the A and B phase, the next to the B and C phase, and the next to the A and C phase, so as to make the load as nearly balanced as possible. Fig. 1

shows the transformer connected to the A and C phase. Each transformer is wound for 13,200 volts on the high-tension side and gives 550 volts on the low-tension side, with taps at every 110 volts. These taps are connected to the fuse panel, from which the distributing cables connect to the panel boards of the north and south stations, respectively. Small switches on the panel board control an equal number of lights; in the Nineteenth Street station there are ten switches of ten lights each, making 100 lights for the south side of the Ninteenth Street station.

The six-pole switch, shown in the diagram, when thrown up, connects the transformer to the various circuits; when thrown down it disconnects the transformer entirely and connects the two outside circuits, one to the direct-current feeder and the other to the negative return. The plan of the company is that under ordinary conditions the six-pole switch will be in its

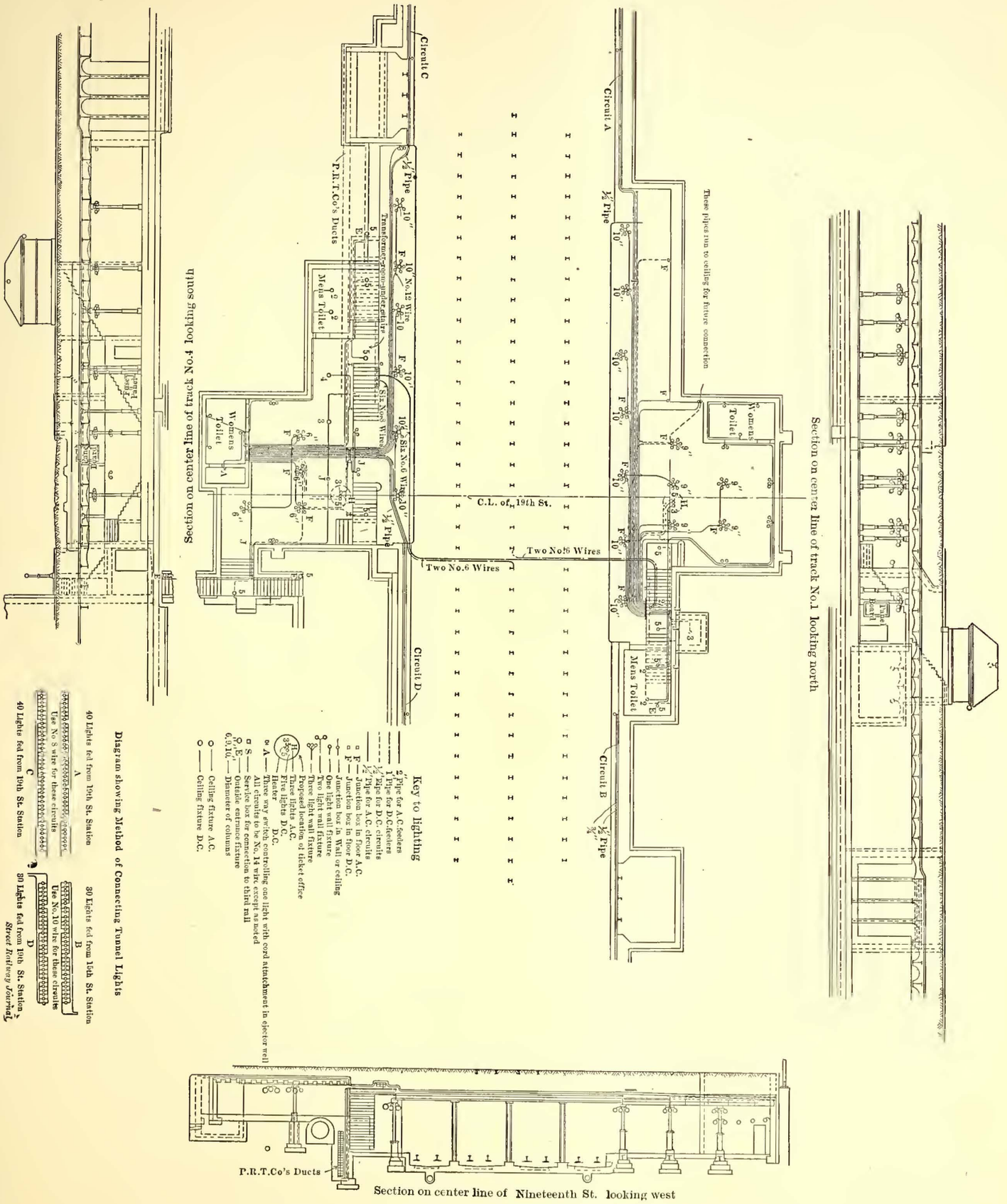


FIG. 2.—GENERAL LIGHTING SCHEME OF THE NINETEENTH STREET STATION

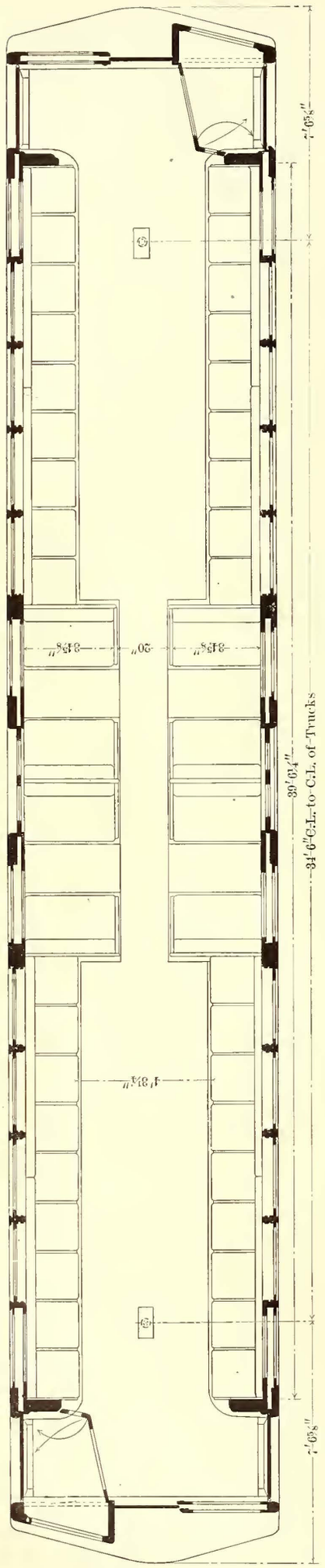


FIG. 3.—PLAN OF STEEL CAR TO BE USED IN EXPRESS TRAINS

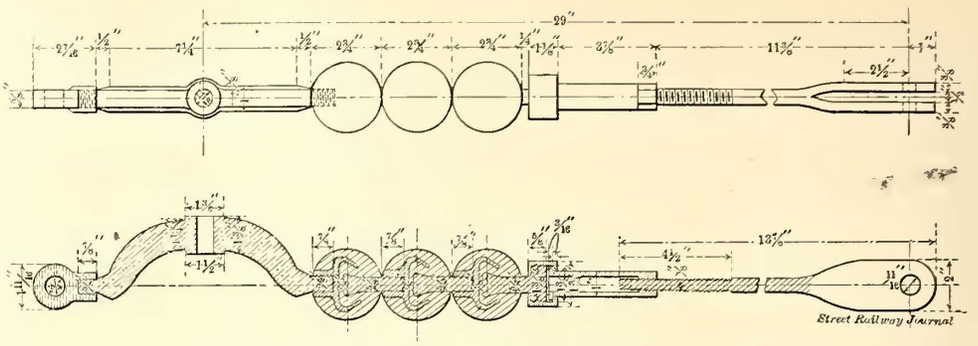


FIG. 4.—OVERHEAD CONSTRUCTION FOR SURFACE LINE UNDER ELEVATED STRUCTURE

"up" position. It is then possible to throw in any light circuit desired by closing any of the small double-pole switches. In the event of a burn-out of the transformer or of the supplying cable, however, the six-pole switch is thrown down. The lamps are then connected in two sets of five in series and ten in multiple, making it possible to burn all the lights from the 550-volt direct-current cable, or half the lights if so desired. In the latter case half the lights need not necessarily be those controlled by switches 1 to 5, or those controlled by switches 6 to 10, but can be any combination of five switches as long as no two switches are directly opposite; for instance, switches 1-7-3-9-5 may be thrown.

The tunnel lights are connected to the two outside bars on the panel board, and are connected in series multiple. Where there are four tracks there are two circuits of lights, one between the first and second tracks and the other between the third and fourth tracks. One of these circuits is fed from the panel board at one station and the other from the panel board at the next station.

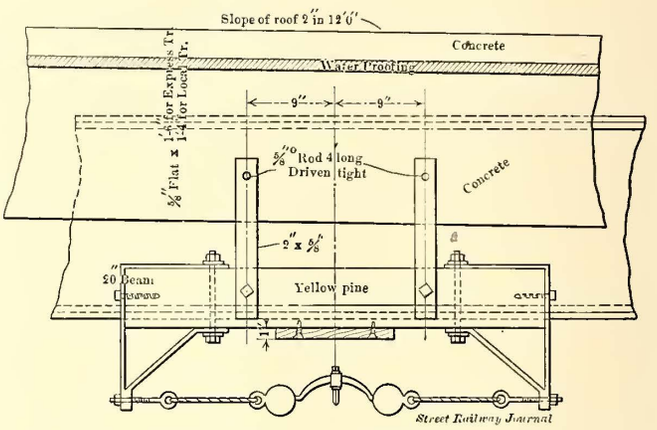


FIG. 5.—OVERHEAD CONSTRUCTION FOR SUBWAY LOCAL TRACKS

Fig. 2 shows the general lighting scheme of the Nineteenth Street station. The principal lights are arranged to be supplied from the lighting transformer, but on each platform and on every stairway there is one circuit more supplied from the direct-current lighting cable. The switches for these circuits, as will be noticed, are marked on the wiring diagram as "emergency lights." The purpose of putting these lamps on the power circuit was that if there was trouble in the lighting transformer or supply cable at night time, the station would not be left in complete darkness, but these lamps would give sufficient light for the station attendant to open the six-pole switch and throw it down, connecting the arc lights to the direct-current cable. Arthur B. Stizer, electrical engineer of the company, had charge of the design and installation of the lighting system of the subway.

Fig. 3 presents a plan of the pressed steel express car to be used in the subway and on the elevated railway system. As will be seen, the car is provided with side

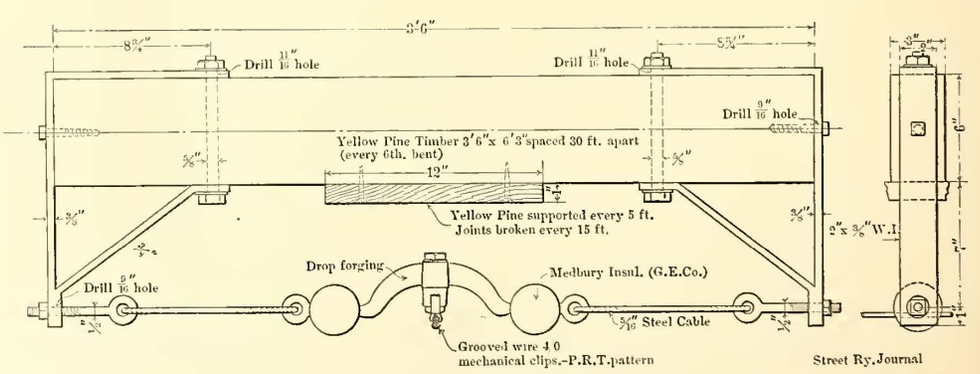


FIG. 6.—ENLARGED DIAGRAM SHOWING FLEXIBLE HANGER ON LOCAL TRACKS

doors in the center as well as end doors. These side doors will not be used at present, and the seats are located regardless of them. At a later date, if the traffic conditions of the subway require it, these seats can be removed.

The overhead construction used on the local tracks was described briefly in the issue of last week, but engravings, Figs. 5 and 6, showing the methods and apparatus employed, are presented herewith. As will be seen, the trolley wire is grooved, No. 0000 in size, and is held in a mechanical clip. The double pull-off has a drop forged yoke and two globe strain insulators and is supported from its two supporting brackets by a 5-16-in. cable with ½-in. bolts and nuts. The brackets supporting the span are attached to a yellow pine timber, 3 ft. 6 ins. x 6 ins. x 3 ins., spaced 30 ft. apart, or on every sixth bent. Directly above the span wire and a distance of 2½ ins. from the top of the hanger bolt is a yellow pine guard-board which is supported every 5 ft. The construction differs from that usually followed in cases of this kind in which the insulator is attached directly to the guard-board. It is thought that the construction adopted with a 3-ft. 6-in. span, will give all the flexibility required to produce smooth and noiseless operation.

Fig. 4 shows the method of suspending the trolley wire under the elevated structure.

THE "ROADMASTER" SYSTEM IN TORONTO

One feature of the operating organization of the Toronto Railway Company, of Toronto, Can., is deserving of special comment, and although the practice has been followed in Toronto since 1902, it will probably be new to most managers in the United States. The scheme consists of picking two of the best motormen on each line of the system and promoting them to positions known as "roadmasters." These roadmasters have their regular runs on the cars and fill all the duties of the regular motormen, but in addition they have delegated to them considerable authority over the other employees and over the various details of operation. They fill many of the duties which in the United States usually devolve upon officers known as street inspectors or street superintendents, but instead of watching the operation of the line from street corners or riding on an occasional car, the Toronto roadmasters fill these same duties while working as motormen on regular cars. These men are virtually working deputy superintendents.

Two roadmasters are appointed for each line, one as a regular and one as a relief, so that there is a responsible roadmaster somewhere on every line at every hour of the day while cars are in service. Primarily, the roadmasters are held accountable for the conditions on their respective lines with regard to regularity of service, obedience to rules, meeting emergencies and operation in general. For instance, if a car develops a defect while in service, the motorman of the crippled car either moves along as best he can or, if necessary, has the next car push him along, and in the meantime keeps a sharp lookout for the car upon which the roadmaster is running. The roadmasters have their regular runs, and all employees are required to know these runs. When the crippled car meets the roadmaster's car the roadmaster immediately takes charge of the situation. All of the roadmasters are given a thorough mechanical training and are competent to remedy ordinary faults. The roadmaster changes places with the motorman of the crippled car, this motorman going on with the roadmaster's regular run, while the roadmaster either repairs the defect or else orders the car to the car house. If a collision or other emergency happens on the line, the roadmaster takes steps to reach the scene as soon as possible and takes charge of the situation.

The roadmasters have considerable latitude in performing their duties. They are free to change cars with any motorman they may happen to meet, and they do this frequently so as to get back over the line at times when they are not always expected. They keep close watch on the travel and make recommendations as to whether the schedule in force is properly meeting the conditions of traffic, and if cars are running too full or too light they recommend suitable changes.

It is their duty to make to a head roadmaster daily reports in writing covering all the conditions on their lines and making any suggestions they may deem advisable. These daily reports give the management an insight into details on the property that can be obtained in no other way. Roadmasters have no authority to hire or discharge employees, but they are required to report any infraction of the rules or practices that are not conducive to good service.

Another important duty is the regulating of late runs. It has been found that crews on late runs are often tempted to run recklessly and frequently get into the car house 10 or 15 minutes earlier than the schedule calls for in order to get through their work a little sooner. This is avoided by giving the relief roadmaster the car that is due in at the car house the first of the night runs. This relief roadmaster after turning in his car in the evening stays at the car house and checks up all the other night cars as they arrive to see that the men are not coming in earlier than the schedule calls for. He stays on duty until the last car has been turned in.

Another advantage is in the handling of the sweepers during the winter. Each sweeper is placed in charge of a roadmaster, who is given a competent crew, and thus the sweepers are always in charge of a responsible official. It is believed that when the sweeper crews are picked from the regular men there is sometimes a temptation to shirk some of the duties, especially when the sweepers are out at the ends of the lines, and the crews find it more comfortable to take unscheduled layovers instead of keeping right up to the work. The roadmasters are all men who have been thoroughly trained and tested, and as they are virtually officials with considerable authority and responsibility, they are well fitted to take charge of the sweepers and handle the snow-fighting work. The roadmasters are always promoted from the ranks and are paid by the month instead of by the hour. They receive from $15 to $20 a month more than the full-time regular motormen on the same lines. As a badge of authority, each roadmaster wears a special cap with the word "Roadmaster" in gold braid on the band. The Toronto Railway is now operating eighteen separate lines of routes, and there are therefore about thirty-six roadmasters. They report to the head roadmaster, who is virtually the assistant superintendent of the road.

The roadmasters do not absolutely supplant street inspectors, as the company has about eight inspectors in addition to the roadmasters. The duties of these inspectors, however, are confined largely to checking the cars and looking after trouble when the roadmaster does not happen to be on the ground.

In its plans for the protection of its property, the Consolidated Railway Company, of New Haven, has erected on its lines a total of 2500 ft. of storm fence, which is planned to keep much of the snow off the tracks during the winter. These fences have been built in the open country on the East Haven, Branford and Woodmont lines, and it is planned to put out more of this sort of protection on the Mt. Carmel line, where the company suffers most during the heavy snow storms. On Curtiss Hill, on the East Haven line, a place where the wind has full sweep and drives the snow onto the trolley tracks, a long stretch of storm fence has been built. Another long stretch of track, an open section just this side of the trolley terminus at Branford, is similarly protected, and the same thing has been done near what is known as Chapel Street at Woodmont. These fences are 5 ft. high and of a special design for the purpose which they are to serve. They are situated about 25 ft. to 30 ft. from the tracks.

COST OF GENERATING ELECTRIC POWER

BY F. A. GIFFIN

The cost of power is dependent upon so many variable and uncertain factors that it is impossible to arrive at any theoretical results which will be strictly applicable to individual practical cases, but it is possible by making certain assumptions to calculate a series of cost curves which will approximately represent the cost of power per kw-hour under various conditions and whose relative values will be fairly reliable.

While some of the assumptions which have been made in reaching the final results of this paper may be erroneous and may not accurately represent average conditions, yet it is believed that any errors which may creep into one assumption may be offset by errors in the opposite direction in some other assumptions. This feature of the tendency of the errors made in one group of assumptions to counteract those made in another group is of considerable generality in engineering estimates, and may in many cases be laid down as a law. As a well-known illustration of the principle, may be cited the close agreement which usually obtains between estimates of the cost of an engineering project when made by independent engineers. It frequently happens that the estimated costs of component items differ as much as 100 per cent, yet the sum of the cost of all items will give a total cost frequently within a few per cent of the average of all estimates. Moreover, it is a frequent experience of engineers to find the actual cost of a project agreeing within a few per cent of the estimated cost, in spite of the fact that unforeseen extra expenses were involved.

The following formulæ and figures are intended to be applicable to a modern power station containing four 1000-kw units, and the following assumptions will be made regarding the manner in which the efficiency of each piece of apparatus varies with the load:

It is assumed that the transformers have a full load efficiency of 98 per cent, and that the maximum efficiency occurs at full load. It follows that 1 per cent of the full load rating of the transformers is a constant loss at all loads, and that 1 per cent varies as the square of the load.

The generators are assumed to have a full load efficiency of 95 per cent. Three per cent of the full load rating of the generators is assumed to represent the losses which are constant at all loads, the remaining 2 per cent varying as the square of the load. In other words, the maximum efficiency of the generators is assumed to occur at about 22.5 per cent overload.

The mechanical efficiency of the engines at full load is assumed to be 90 per cent, and it is also assumed that the mechanical losses, which amount to 10 per cent of the full load rating of the engines, are constant at all loads. It is also assumed that 10 per cent of the steam supplied to the engines at full load is lost by condensation, and that this condensation is a constant quantity, independent of the load.

It is assumed that the piping has a full load efficiency of 95 per cent. Since the minimum loss in steam piping occurs when the loss due to friction is one-fifth of the loss due to radiation, it is assumed that one-sixth of 5 per cent of the full load losses varies as the square of the steam velocity—that is, as the square of the load, and that five-sixths of the full load losses, namely, that due to radiation, is constant at all loads.

It is assumed that 20 per cent of the steam input in the main piping is consumed at full load by the auxiliaries; that one-quarter of this steam is constant at all loads, and the remaining half varies directly with the load.

It is assumed that the boilers consume a minimum amount of coal per pound of water evaporated at full load. It is also assumed that at one-half load and at 50 per cent overload the efficiency of the boilers is 90 per cent of the full load efficiency, and the efficiency at other loads may be obtained by passing a circle through the three points above mentioned. If P denote the load expressed as a fraction of full load, then the ratio of the efficiency of the boilers at load P to their efficiency at full load will be given by the expression:

$$\sqrt{.69 + 2P - P^2} - 0.3.$$

Since the efficiency of boilers differs greatly in individual cases, the above assumption is probably the most questionable of all that have been made, but is believed to represent a fair average of what experience has shown. In general, the falling off of boiler efficiency at light loads is due to radiation losses, and the falling off at overloads is due to the imperfect combustion of the fuel when the boilers are forced.

Summing up all the above losses, it is found that for the 4000-kw station 2028 kw represent the losses which are independent of the load; 296 kw represent the losses which vary directly with the load, and 176 kw represent the losses which vary directly with the square of the load.

By using these figures the coal consumption per kw-hour expressed as a decimal fraction of the consumption at full load has been computed, and the results have been found to conform closely to the following empirical formula, in which P represents the average station output expressed as a decimal fraction of rated output:

Cost of fuel per kw-hour expressed as a decimal fraction of cost at full load $= .3435 \dfrac{P^2 + 2.32}{P + 0.14}$

The following table may be considered as representative of the average distribution of the several items going to make up the total cost of power when bituminous coal may be had at about $2.25 per ton:

	Per Cent
Coal	50
Wages	33
Repairs	10
Supplies	5
Water	2
Total	100

Since the water consumption is proportional to the coal consumption, 52 per cent of the cost of generating power will vary according to the above empirical formula. It will be assumed that wages are a quantity independent of the load, also that 40 per cent of the cost of supplies will be a constant quantity independent of the load. The remaining percentage is assumed to vary directly with the load.

The following table is a reclassification of cost of power according to the manner in which the various items vary with the load:

52	per cent varies according to fuel formula.
39	per cent constant.
9	per cent proportional to load.
Total, 100	per cent.

The 39 per cent which is constant will be divided by the average output of the station to obtain the cost per kw-hour due to this item.

There are thus two kinds of load which must be distinguished in discussing the cost of power per kw-hour, namely, P, the average load upon the machines in use, which determines the efficiency of the machinery; and F, the average output from the station expressed as a decimal fraction of the rated capacity of the station, which has a direct bearing upon the labor item.

Collecting all these results, and letting C represent the cost of fuel in dollars per ton, the cost of power per kw-hour may be expressed by an empirical constant times:

$$\left[.0763\,(C + 0.09)\frac{P^2 + 2.32}{P + 0.14} + \frac{0.39}{F} + 0.09\right]$$

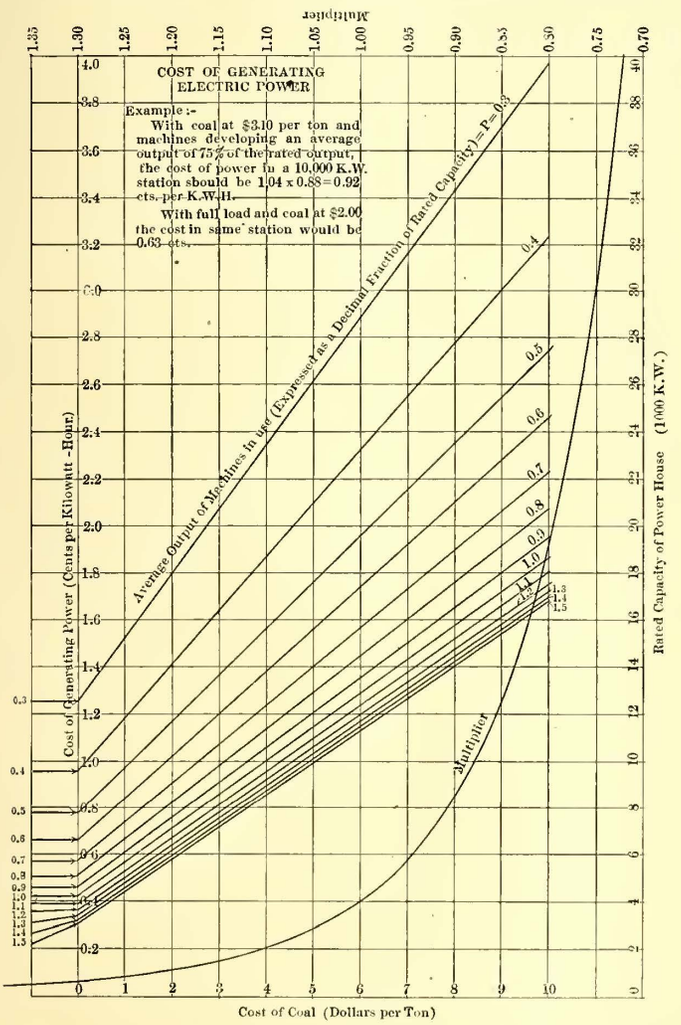
This empirical constant must be so chosen that the formula will express the correct cost of power as determined by past experience.

If the actual time each machine is in use is known, F may evidently be expressed in terms of P. In calculating the following curves, F has been taken equal to 71.6 per cent of P, this representing about average conditions with a railway or lighting load.

Making this substitution and representing the empirical constant by a proper value, the formula for the cost of power per kw-hour finally becomes:

$$\text{Cost} = 0.05 \frac{(P^2 + 2.3)\ C + 0.1P^2 + 1.2P + 7.36 + 1/P}{P + 0.14}$$

This formula applies only to a modern generating station with a rated capacity of 4000 kw and within the limits indi-



cated on the curve sheet, namely, between P equals 0.3 and P equals 1.5. To make the curves plotted from this formula of general use, the results must be multiplied by a correction factor where the rated capacity of the station is other than 4000 kw. The vertical curve intersecting the straight lines on the curve sheet below is believed to give approximately true values for this correction factor for stations ranging in capacity from 400 kw to 40,000 kw, since the results obtained from its use have been checked by a large amount of published data upon the cost of generating power under widely varying conditions.

While the reader may not find that the actual values derived from these curves conform to his own experience, it is hoped that the relative values are fairly reliable, so that he may multiply any value obtained from these sheets by a constant correction factor to make the results agree with his own experience:

APPLICATION

Since the assumptions underlying the foregoing results have been stated, by exercising a reasonable amount of judgment the curves may be used in solving quite a variety of economic problems which are constantly occurring in engineering practice.

Probably the most important factor in the cost of generating power is the personal equation of the operators so that a skilled power house staff may be able to turn out power at two-thirds or less of the cost obtained by an unexperienced staff. The cost of power expressed by the above curves is intended to represent the cost which can be obtained commercially in a well-designed station with a reasonably efficient operating staff.

The use of the curves may be illustrated by solving an example. Let it be required to find the cost of generating power in a station whose rated capacity is 10,000 kw, the average load on machines in use being 75 per cent of their rated output and bituminous coal costing $3.10 per ton. Following up from the lower horizontal scale to a point about midway between the straight line marked 0.7 and the one marked 0.8 over the point corresponding to $3.10 per ton, the figure 1.04 is found on the left-hand vertical scale. Following to the left from the right-hand vertical scale along the 10,000-kw line to its intersection with the curve marked "multiplier," the figure 0.88 is read upon the upper horizontal scale. The product of the two figures thus obtained, 1.04 times 0.88, gives 0.915 cent per kw-hour as the probable cost of power.

If the average output of the machines in use is equal to their rated capacity, and coal can be had at $2 per ton, the cost of power would be only 0.63 cent per kw-hour.

GAS ENGINES

If anthracite coal or any other fuel is burned instead of bituminous coal, the cost of power may be obtained from the curves by reducing the cost of the fuel used to its equivalent in dollars per ton of bituminous coal, the reduction being accomplished by considering the relative number of heat units in the respective fuels and any difference which may exist in the furnace efficiencies. As an example of this principle, let it be required to find the cost of power where gas engines are the prime movers, under the supposition that the coal consumed by a gas engine per unit of power generated, is one-half of that consumed by a steam engine and that coal costs $2 per ton. Under this assumption coal at $2 per ton for a steam engine is equivalent to coal at $1 per ton for the gas engine, so that a 10,000-kw plant with the machines in use running at rated capacity should generate power at a cost of 0.5 cent per kw-hour, as against a cost of 0.63 cent per kw-hour for a similar plant using steam engines as the motive power.

If the average load on the station during 18 hours of operation per day is 71.6 per cent of its rated capacity, the total output per day would be 128,880 kw-hours, which with the saving effected by the gas engine over the steam engine at 0.13 cent per kw-hour would amount to $167.54 per day, or about $61,000 per year. Assuming interest and depreciation on both plants at 10 per cent per annum, this is equivalent to $610,000 extra capitalization, or $61 per kw, which it would be economical to pay as an extra price per kw-capacity for the gas engine installation.

WATER POWER

Assuming roughly that the labor in the boiler room of a steam plant is about the same as the extra labor in maintaining the intake and piping system of a water-power plant, the cost of generating power by water can be found from the above curves by assuming that coal costs nothing. In other words, the cost of generating power in a water-power station of 10,000-kw capacity when the machines in use are running at their rated capacity would be about 0.35 cent per kw-hour.

CONSIDERATIONS DETERMINING THE LOCATION OF ELECTRIC RAILWAY SUB-STATIONS*

BY C. W. RICKER

To show more clearly the method of treating the problem of sub-station location suggested in the original paper, a simple problem will be discussed by means of it. A typical interurban railway consisting of one long line has been selected, because it suffices to exhibit the method without an excessive amount of labor.

No attempt has been made to determine the quantities used exactly, but only to make them consistent, as in any particular problem they must be determined for the particular conditions encountered.

Assuming the following data, there is required the number of sub-stations to obtain the best operating economy.

Distribution, a.c.-d.c.

Length of line, 60 miles.

Service, hourly in both directions, 20 hours per day.

Schedule speed, 30 miles per hour.

Stops per single trip, 10.

Cars on the line, 4 for 18 hours, 2 for 2 hours.

Car-hours per day, 76.

Weight per car (approximate) 30 tons.

Mean amperes per car, 135.

Mean square amperes per car, 35,000.

Running current, multiple, per car, 200 amperes.

Starting current, multiple, per car, 400 amperes.

Track, single, 80 rails.

Track resistance per mile, .0313 ohm.

Sub-station power factor, 1.

Resistance of copper per mil-mile, 54,750 ohms.

Weight of copper per mil-mile, .016 lbs.

Price of copper per lb., $0.15.

Rate of interest, 5 per cent.

Annual fixed charges on sub-station buildings and land, 7 per cent.

Annual fixed charges on sub-station equipment, 15 per cent.

Cost of energy at sub-station a. c. bus, $0.0125.

The secondary copper is assumed continuous and of uniform section from end to end of the line.

The sub-stations are arranged so that the drop in the secondary copper and track is the same at points midway between sub-stations and at the ends of the line, the end sections being three-fourths the length of the intermediate sections.

Assuming this line fed through different numbers of sub-stations, it is desired to draw the following curves, with the number of sub-stations as abcissæ and the total annual cost in dollars, as ordinate.

Annual charges on sub-station buildings and land.

Annual charges on sub-station equipments.

Annual charges on secondary conductors.

Annual cost of sub-station attendance.

Annual cost of sub-station losses.

Annual cost of losses in secondary conductors and track.

*A paper supplementary to a paper by the same author, presented at a meeting of the American Institute of Electrical Engineers, Dec. 15, 1905, and published in the Street Railway Journal for Dec. 23, 1905.

The cost and loss in the primary distribution are assumed to be nearly enough constant so that they may be neglected in a primary discussion, but if desired curves representing them may be added to those enumerated.

These quantities have been computed and the curves drawn, for the number and arrangement of sub-stations shown in the following table.

Sub-Station Capacity.—With the service outlined, the maximum load of any sub-station will be that due to the starting of two cars at once, 800 amperes, lasting for a few seconds. With the largest number of sub-stations, the capacity of each has been made equal to one-half of this, allowing a momentary overload of 100 per cent in case the whole load falls upon one sub-station. With the smallest number of sub-stations, the capacity of each has been made equal to the maximum load. In the intermediate arrangements, the capacity of each is graded between these limits in the proportion of the combined line and track resistance between adjacent sub-stations, which is very nearly proportional to the distance between the same.

TABLE I.—SECONDARY COPPER BY KELVIN'S LAW

Sub-Stations					Daily Total Input Kw-H.	All Day Efficiency	Cost Kw-H. D.C. Bus.	Annual Charges on			Annual Cost of			Totals
No.	Distance	Capacity	Computed Capacity	Total Capacity				Real Estate	Sub-Stat'n Equipm'ts	Secondary Copper	Sub-Stat'n Attend.	Sub-Stat'n Losses	Secondary Copper Loss	
6	10.9	260	250	1,560	8,500	77.6	1.61	840	8,550	4,480	8,640	8,730	4,530	35,770
5	13.3	281	300	1,400	8,410	79.3	1.58	700	7,780	4,550	7,200	7,960	5,450	33,640
4	17.1	315	300	1,260	8,185	81.7	1.53	560	6,225	5,480	5,760	6,920	6,110	31,055
3	24.	377	400	1,131	8,070	82.7	1.51	420	5,220	6,450	4,320	6,400	7,625	30,435
2	40.	520	500	1,040	7,926	84.3	1.48	280	3,900	8,690	2,880	5,750	10,420	31,920

Sub-Station Losses and Secondary Copper.—The mean all-day efficiency of the sub-stations of each arrangement was obtained by dividing the total output of the sub-stations by the total input. The total output was assumed constant at 6.669 kw-hour. The efficiency of each sub-station at the mean load of one car and at the mean load of two cars, was computed from typical efficiency curves of rotary converters and transformers, allowing 6 per cent for losses when running idle, From these the mean rates of input and the total input were computed. From the all-day efficiency the cost of energy at the direct-current bus was computed, for use in proportioning the secondary conductors by Kelvin's law.

The exact computation of the losses in the secondary conductors is very laborious, so to approximate the same, the load was assumed to be fixed at its mean distance from the sub-station, one quarter section, and the resistance of the secondary copper multiplied by the car hours per section and the mean square current per car.

TABLE II.—SECONDARY COPPER BY LIMITING DROP

No. of Sub-Station	Annual Charges Secondary Copper	Annual Cost of Secondary Copper Loss	Totals
6	4,460	4,560	35,780
5	5,850	4,560	34,050
4	8,380	4,560	32,405
3	15,120	4,560	36,040
2	76,400	4,560	93,770

The annual cost of the secondary copper was taken at 6 per cent to cover interest and cost of reclaiming.

The secondary copper was proportioned by Kelvin's law, for each arrangement of sub-stations as follows:

$$\frac{35{,}000 \times \text{car hrs. per year} \times \text{Res. per mile copper} \times \text{length section} \times \text{cost kw-hour}}{4000} = \frac{\text{wgt. mil-mile} \times \text{Res. mil-mile} \times \text{length section} \times 15 \times 6}{\text{Res per mile copper} \times 10{,}000}$$

$$\text{Res. per mile copper} = \frac{.95}{\sqrt{\text{Car hrs. per year} \times \text{cost kw-hour}}}$$

The annual loss in the secondary conductors and tracks was computed in the same way. The annual loss in the sub-sta-

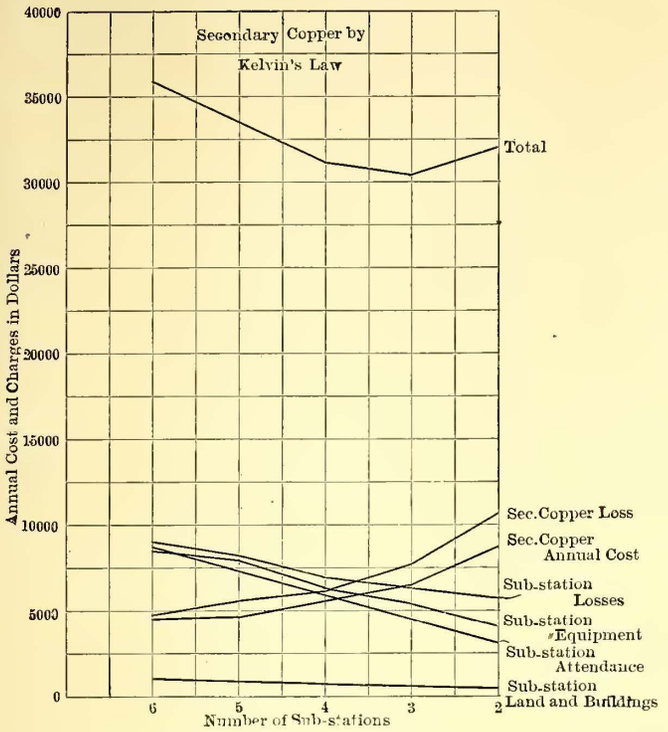


FIG. 1.—CURVE SHOWING RESULTS OF COMPUTING SECONDARY COPPER BY KELVIN'S LAW

tions' apparatus is given by the difference between the total input and output. In computing the cost of these losses the

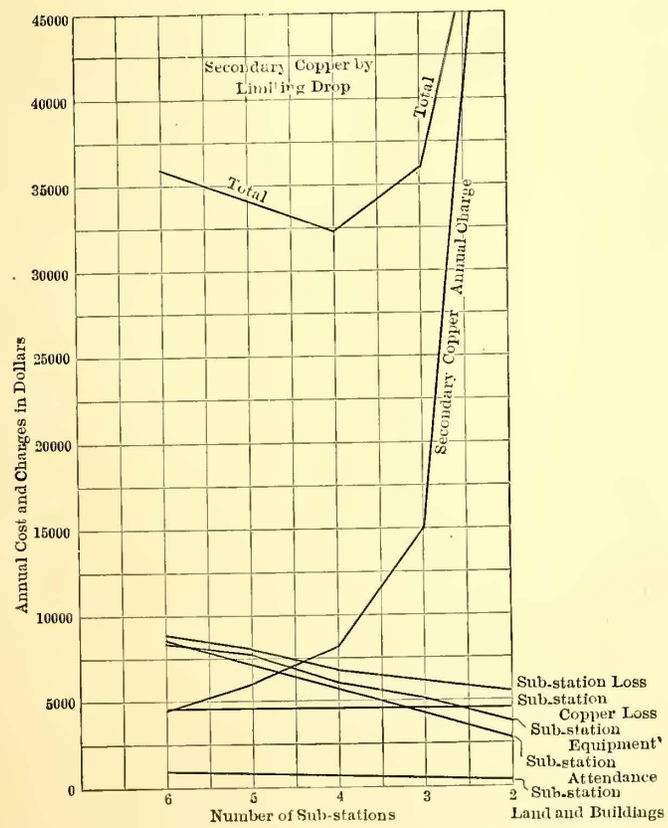


FIG. 2.—CURVE SHOWING RESULTS OF COMPUTING SAME PROBLEM BY LIMITING DROP METHOD

cost of power at the sub-station alternating-current bus should be used.

Cost of Sub-Stations.—The cost of sub-station buildings and land was taken at $2,000 each. Switchboards and wiring were estimated at $2,500 per sub-station. The nearest commercial sizes of rotaries and transformers were used in estimating the cost of sub-station equipments at prices varying from $21 per kw. for 500 kw. to $38 per kw. for 250 kw.

Table 1 and Fig. 1 show the results of this computation, with a minimum operating expense at three sub-stations, spaced 24 miles apart, and secondary copper, 746,000 cir-mils, which is evidently impossible to operate without the use of boosters in the sub-stations.

Table 2 and Fig. 2 show the results of recomputing the same problem with the secondary copper proportioned to permit a maximum drop in line and track of 300 volts, about the worst condition in which operation is practicable.

It is apparent that economy of operation is usually sacrificed to regulation.

LONDON, BRIGHTON & SOUTH COAST RAILWAY ADOPTS SINGLE-PHASE

One of the most interesting decisions that has recently been made has been that of the directors of the London, Brighton & South Coast Railway Company, with reference to the electrification of the portion of the suburban line in the southern suburbs of London, about which reports have already been published in these columns. It will be remembered that Phillip Dawson has been the consulting engineer for the line, and that some time ago he decided upon the single-phase system and recommended it to the directors of this railway. Tenders were accordingly asked for the work, and the directors have now decided that they will place their contract with the Allgemeine Elektricitats-Gesellschaft, of Berlin, who will work in conjunction with the British Thomson-Houston Company. The system to be adopted is that known as the Winter-Eichberg. Considerable excitement has been aroused in the English daily press by the fact that such an important contract should be given to Germany, but both Mr. Dawson and the British Thomson-Houston Company state that only a comparatively small portion of the work will actually be done in Germany. It is true that the first motor equipments will be made there, as the German company has had considerable experience in making this type of motor, and can furnish it more quickly than it could be procured in Great Britain, but thereafter all of the other equipment and all of the electric switch gear and necessary apparatus will be manufactured in the British Thomson-Houston Company's works at Rugby. The whole of the overhead construction, a type of work which has not yet been seen in Great Britain, will be done by Robert W. Blackwell & Company, of London, and it is also understood that the cars will be manufactured by the Brush Electrical Engineering Company. It will therefore be seen that, after all, a very small portion (about £20,000) of the total amount of the work, which will amount to about £250,000, will be done out of Great Britain. The experiment will be looked forward to with intense interest by engineers in England as well as elsewhere, and when completed, undoubtedly there will soon thereafter be a large development in electrification of suburban railways, leading in a few years to the electrification of some of the longer and more important lines.

In an unguarded moment recently, General Superintendent Robert Lee, of the Cincinnati Traction Company, expressed the opinion before several newspaper men that a fortune awaited some one who could invent a transfer that could not be "worked." His wants were published, and within a week he had hundreds of letters, not only from points in Cincinnati and vicinity, but from people all over the country, asking for plans, specifications, plots and explanations.

OCEAN SHORE RAILWAY

The largest electric railway project being carried out on the Pacific Coast at present is that of the Ocean Shore Railway Company, which is building between San Francisco and Santa Cruz. The road will be double-tracked throughout, and the main line will be 81 miles in length. The San Francisco terminal will be at Army and Illinois Streets, on the south waterfront of the city. Here sufficient property has been secured to afford ample facilities for handling freight, convenient connections being made with the Southern Pacific, Santa Fe and the new Western Pacific tracks. Leaving Army and Illinois Streets, the road will run through the Islais Creek district in the southern part of the city on a private right of way, all grade crossings of streets being avoided by subways or culverts. Proceeding in a generally southwestern direction, the ocean is reached at a point about 3 miles south of the Cliff House, and the road then hugs the coast all the way to Santa Cruz, passing by San Pedro Point, Half-Moon Bay, Purisima, Pescadero and Scott's Creek. A branch line about 3 miles long, which will be used principally for passenger traffic, will run north from the main line along the beach through the Richmond district, as shown on the accompanying map, across Golden Gate Park and terminate at Fulton Street and Eleventh Avenue. There connection will be made with the lines of the United Railroads of San Francisco.

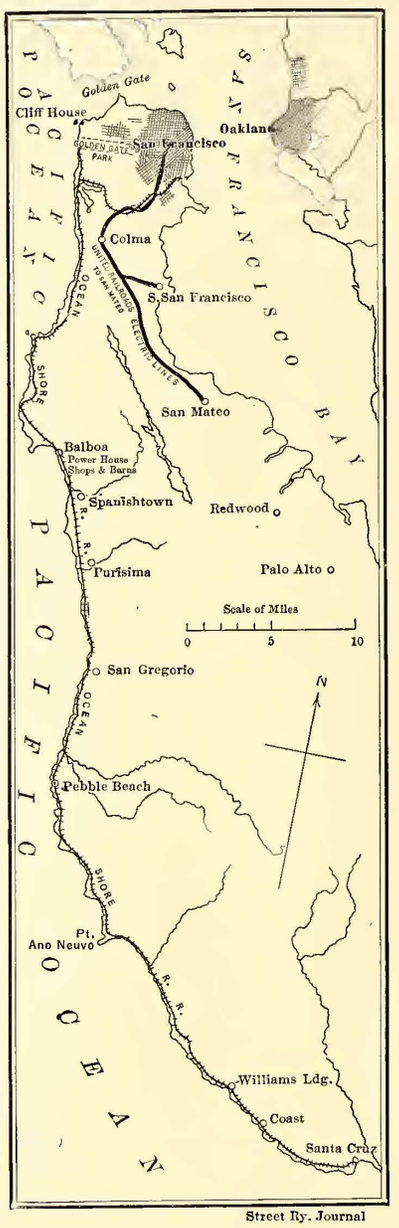
A private right of way has been secured for the entire length of the road, and it will all be double-tracked at the start, as the business and traffic in sight could not be satisfactorily handled by a single track. The maximum grade on the road will be less than 2 per cent, and although the survey carries the line over several rocky points, only one tunnel, 400 ft. in length, will be necessary. Several heavy fills will be required, however, and it is planned, instead of bridges, to build temporary wooden trestles, filling them in afterward for a permanent roadbed. The track will be laid with 70-lb. A. S. C. E. standard section rails, and well ballasted with disintegrated granite quarried on the right of way.

The scenic features of the line will be unusually attractive, as during the trip from San Francisco to Santa Cruz the cars will be in sight of the Pacific Ocean for over 60 miles. Santa Cruz is already one of the best known coast resorts in the State, and with the improved transportation facilities (something it has not had with the present round-about steam road) it will undoubtedly rapidly increase in popularity.

The Shore Line Investment Company, the land company allied with the railway corporation, owns over 3500 acres of land at different points on the line, and it expects to develop the property for resort purposes. On Half-Moon Bay, a pleasantly situated body of water 22 miles south of San Francisco, this company owns 1300 acres of land. It is laying out a new town to be called Balboa, where will be located one of the largest and most modern watering places on the Pacific Coast. A large tourist hotel is planned, also a recreation pier, various amusements and games will be provided for, while one of the best attractions will be an immense salt-water bath pavilion, larger than any now in existence. Hot water for the baths will be obtained from the condensing plant of the Ocean Shore power house which will be located at Balboa. The proximity of Balboa to San Francisco, and the ease with which it can be reached over the new railway, will undoubtedly result in building up a very popular resort. The land is being platted and sold for residences, as this will be an all-the-year-around resort.

The power house at Balboa will be a concrete structure, built so that it will admit easily of future enlargement. It will be a steam plant and have an initial capacity of 6000 hp. Crude oil will be used for fuel, storage capacity being provided by two 28,000-barrel tanks. The oil will be unloaded from ships and pumped through an 8-in. pipe line directly to the storage tanks. This pipe will extend out into the bay for ½ mile, and as a pier of that length would detract from the picturesqueness of the bay, it will be secured in position by dolphins. The boiler equipment will consist of five Babcock & Wilcox water-tube boilers, provided with special oil burners. A steel reinforced concrete stack 125 ft. in height and 15 ft. in diameter will be built.

The main generating units will consist of two McIntosh-Seymour vertical compound condensing engines, each driving a 2000-kw, 2300-volt, three-phase, 25-cycle, fly-wheel type generator. One 200-kw exciter will be driven by a Harrisburg engine, and a second exciter will be motor-driven. Two Wheeler admiralty surface condensers will be installed, the condensing water being exhausted into the bathing pavilion tanks as mentioned above.



MAP OF TERRITORY TO BE TRAVERSED BY THE OCEAN SHORE RAILWAY

The 2300-volt current will be stepped up to 30,000 volts for transmission to the sub-stations by seven 1000-kw transformers (one spare). Ten sub-stations will be installed, located about 10 miles apart on the southern end and 8 miles apart on the San Francisco end. The sub-station equipment will consist of a 500-kw rotary converter and three 185-kw step-down transformers, this equipment being doubled where the load will be heavy. Two cars will probably be built for portable sub-stations. The transmission and feeder lines will be of copper, and the trolley No. 0000 grooved. The trolley will be hung with a catenary suspension, and will probably be insulated for 6000 volts, so in case it is decided to install a single-phase system later it can be done with little extra cost.

There are no other special features connected with the electrical installation except that special precautions will be taken to make both the low-tension and high-tension lines as fog-proof as possible. Considerable trouble has been experienced from the ocean fogs by transmission companies along the coast. Profiting by this experience, the Ocean Shore engineers have designed the insulation of their lines with a high factor of safety, and will probably introduce special devices to avoid any possible break-down.

The General Electric Company has secured the contract for all the electrical equipment of the power house and sub-sta-

tions, and the engines, pumps, condensers, boilers and other steam equipment will be installed by Charles C. Moore & Company, of San Francisco.

An order has been placed with W. H. Holman, of San Francisco, for forty passenger cars. These will be 50 ft. in length, and about half of them will have three separate compartments, for ladies, smokers and baggage. Two toilets will also be provided. The cars have been designed by the Ocean Shore Company, and will be of a specially strong construction, with four I-beam sills and enclosed vestibules for the motorman. Four 125-hp GE 66 motors will be mounted on each car, and they will be arranged for multiple control in case the management wants to run trains for special occasions. The regular service will be maintained with single car, and it is planned to make the 81-mile trip between San Francisco and Santa Cruz on a flyer service, with stops at Balboa and Pescadero, in 2 hours and 15 minutes. As all the cars will be operated at high speeds, a special form of trolley, other than the wheel trolley, will be installed on the cars. All cars will be equipped with the new type of Westinghouse combination straight and automatic air brake, arranged for quick control.

A complete freight equipment will be procured, as that end of the company's business will undoubtedly prove to be very profitable. The territory adjacent to the road contains rich agricultural lands, and at the southern end is one of the largest redwood forests in the State, so the outlook for a good freight business is excellent. The company at present has two steam locomotives and forty freight cars, and is doing all handling of its own freight and construction materials.

C. E. Loss has the contract for the construction of the road, and active work is now in progress at several points. From Santa Cruz north 16 miles has been graded and 6 miles of track laid. Six steam shovels are being employed and between 1000 and 1200 men are at work. The grading, bridging and track work will all be carried along together.

All sub-stations and permanent buildings will be constructed of concrete. Passenger stations of a neat frame design will be constructed at principal stopping points, including three or four prominent street stations in the city on the main line.

At Balboa will be located the principal car house, and also the company's shops, which will be suitably equipped for repairing and building cars complete.

The Ocean Railway Company is composed entirely of local capitalists and the bonds have all been taken in San Francisco. The company is capitalized for $5,000,000 and bonded for an equal amount. The following are officers of the company: President, W. E. Dean; vice-president and general manager, A. D. Bowen; vice-president, J. Downey Harvey; secretary and treasurer, Burke Corbett; directors, the above officers and Charles Carpy, Charles C. Moore and Charles Webb Howard. Sidney Sprout is mechanical and electrical engineer, and J. B. Rogers is chief engineer. Cory, Meredith & Allen, of San Francisco, are consulting electrical engineers, and Sargent & Lundy are also retained as consulting engineers.

RECENT WORK OF THE HUDSON RIVER ELECTRIC POWER COMPANY

The Hudson River Electric Power Company, which owns and operates extensive water power plants on the upper Hudson River, at Spier Falls, Mechanicville, Schoharie Falls, and on the Sacandaga River (the latter in course of development), is rapidly extending its sphere of activity in the eastern portion of New York State. The company is now supplying most of the electric power used in the cities of Albany, Troy, Green Island, Watervliet, Ballston, Saratoga, Glens Falls, Schenectady and Amsterdam, and includes among its more important customers the United Traction Company, of Albany; the Schenectady Railway Company, the General Electric Works, at Schenectady; the Fonda, Johnstown & Gloversville Railroad, and the Hudson Valley Railway. About 40,000 hp is at present being distributed in this and adjacent territory, and contracts to the extent of 50,000 hp are under consideration.

One of the more recent extensions to the company's service is the supplying of power for the operation of all the traction lines operated by the Utica & Mohawk Valley Railway Company. The power company has been furnishing current to the Utica & Mohawk system since July 1, 1905, and has just been notified by the latter company that it will require additional power next year as the result of the electrification of the West Shore Railroad between Utica and Syracuse, which is controlled by the same interests.

To meet the present needs of the Utica & Mohawk Valley Railway, the power company has erected a modern 5000-hp steam turbine generating plant at Utica. The plant will have an ultimate capacity of 10,000 hp, and will include the latest apparatus. Steam turbines of the Curtis type are used with Deane condensers, and in the boiler room are installed Franklin and Babcock & Wilcox water-tube boilers. The boilers are fitted with a balanced draft system, by means of which the blower and damper are automatically controlled, and the heated gases are retained and consumed before they escape to the flue. This system embodies several new features in steam boiler engineering, and the results so far have been very satisfactory. It is said a much cheaper class of fuel can be used and better results obtained with this system than could be secured with stokers and a very high grade of coal.

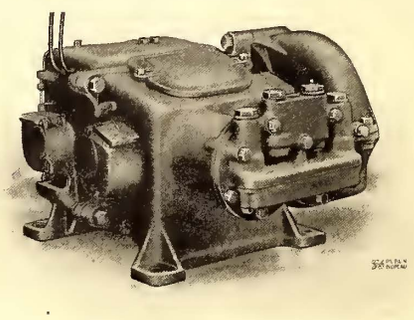
Power from the Utica plant is being delivered to the Utica & Mohawk Valley Railway Company at Utica, Frankfort, Little Falls and Oriskany for the operation of the entire railway system. The station will soon be connected by transmission lines with the water-power plants owned by the power company at Spier Falls, Mechanicville and Schoharie Falls, and ultimately with the proposed development on the Sacandaga River above Spier Falls. By reason of having plants located in different parts of the country and operating as a unit, the power company is therefore enabled to maintain a high class of power service, for if any of the individual plants are affected temporarily, a complete shut-down will not occur on the system, as the other operating stations can take care of the load until the plant affected can be put in service again.

In connection with its present service, the Hudson River Electric Power Company is constructing a 60,000-volt transmission line from Ballston to Utica, via Amsterdam. This line will be supported entirely on steel towers, doing away with the old-style wooden poles. The towers are to be 50 ft. high and will consist of structural iron or steel. The foundations will be made of concrete and crushed stone, and the base of the towers will be bolted to these foundations. The towers will be set about 550 ft. apart, or ten to the mile, and will be arranged to carry two three-phase circuits. The security of the tower system over pole lines is claimed to be considerable, as the towers will not be affected by lightning discharges, as with wooden structures. Special towers are being designed for long crossings and for river work. The first of these towers will be tested in the power company's testing yard at Watervliet in a few days, and after receiving the engineers' approval, the work will be started at once on the line extending from Ballston to Amsterdam and from there to Utica.

A magnificent parlor car, built by the Niles Car & Manufacturing Company for the Detroit, Monroe & Toledo Short Line, will soon be placed in operation on limited service between Toledo and Detroit. The car has chair seats, twenty-five in the passenger compartment and seven in the smoker; observation end, wash room, toilet room and handsome interior finish.

DIRECT-CURRENT MOTOR AIR COMPRESSORS

Realizing the need of a reliable and durable air compressor, the General Electric Company has recently put on the market a direct-current motor-driven machine embodying these characteristics, as well as those of compactness and quiet operation. While intended primarily for the operation of air-brake systems, these compressors are readily adapted for any service requiring air under pressure. As the illustration shows, this compressor is very compact and self-contained. The construction is thoroughly dustproof, while at the same time every



DIRECT-CURRENT MOTOR AIR COMPRESSOR

essential part is easily accessible. All bearings are supplied with dustproof doors, providing perfect protection from dirt and affording immediate access for inspection. In addition to these features, the motor frame is bolted directly to the compressor frame by body bound bolts, which insure perfect alignment and mesh of the gears. This makes it possible to remove and replace the motor without skilful readjustment. All motors and all compressors of the same size are duplicates and perfectly interchangeable. Careful provision has been made for the lubrication of all bearings, and the enclosed construction affords complete protection from water and dust.

The motor on these compressors in every detail is made strictly in accordance with the standard practice of the General Electric Company in railway motor construction. The four-pole cast-steel magnet frame extends in both directions to form a complete box-shaped covering for the armature and field coils. In one end is a removable head which permits the insertion and withdrawal of the armature, and a dustproof spring door allows ready access to the commutator and brushes. For the same reason the pole pieces are secured to the magnet frame by two bolts, the heads of which are on the outside of the frame, where they are accessible when it is necessary to remove a field coil.

The armature core is of the laminated construction, with liberal air ducts for ventilation. Form-wound coils are used, carefully insulated from the core with a very durable fabric of high insulating properties, and great care is given to the insulation of the connections of the commutator leads. The windings are protected from oil by large deflecting shields at the ends of the shaft which revolve in ring-like enclosures, adapted to receive the deflected oil and deliver it into pockets outside the motor.

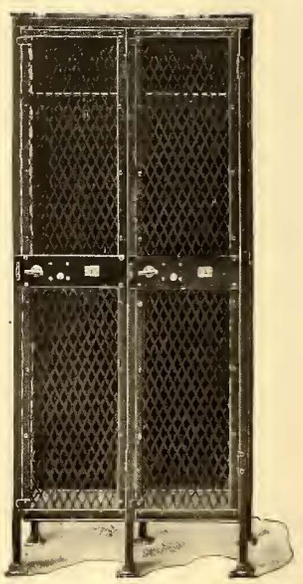
Bolted close to the side of the motor is the compressor frame, giving the assembled machine a rectangular shape. A large opening, fitted with a cover, allows ready inspection of the crank-pins. At one end, the drain, filling pipe and air vent are located, and at the other end of the frame there is a large opening through which the crankshaft may be removed. On the side furthest from the motor are twin air cylinders cast integrally with frame. These project outward horizontally side by side, in a position most favorable for radiation of the heat of compression. Each cylinder head contains one outlet and one intake valve. These valves operate in a vertical position and are of the tubular type. Special attention has been paid to make these valves as simple and as cheaply renewable as possible. Before the air reaches the vales it is filtered through curled hair and copper screens, which effectually prevent foreign substances from clogging the valves.

In this compressor all bearings are liberal in size and have removable and renewable linings, and the crank bearing is split and provided with a hinged cap so that it may be easily adjusted. With the exception of the crank and wrist-pins, the oil waste method of lubrication is used. This method has proved most successful for street railway service. The gearing consists of a gear and pinion having accurately cut herring-bone teeth. Both gear and pinion are secured to their respective shafts by a taper fit, and means are provided so that they may be easily removed. To protect the gearing, a case is furnished, split in two pieces, so that it can be opened conveniently. The two parts are bolted together and rigidly secured to the motor and compressor frame, forming an oil-tight compartment in which the gears run.

The compressors are manufactured in several sizes to meet the requirements of all classes of operation. For controlling their action, the company makes a small and reliable governor, which will open and close the circuit positively, maintaining a constant predetermined pressure in the receiving tank. No starting box or external resistance is required, and the outfit is compact, serviceable and reliable. In this connection the company also manufactures complete air-brake equipments of both the regular air and automatic air types, suitable for all classes of electric railway service.

METAL FURNISHINGS FOR CAR HOUSES AND OFFICES

In view of all the efforts being made to minimize the fire danger by employing fireproof or slow-burning materials for building construction, it seems rather curious to find that many corporations do not realize that the fire risk is due more to the presence of inflammable furnishings in the building rather than to the construction of the building itself. However, there is no longer any necessity for using wooden shelving, partitions, closets or lockers, because so many improvements have been made in recent years in the manufacture of metal furnishings for the same purposes. It is hardly necessary to state in how many respects expanded metal construction is superior to wood, but it suffices to point out that it is not inflammable, is far more sanitary, retains its neat appearance indefinitely, easier to transport and costs practically nothing to maintain.

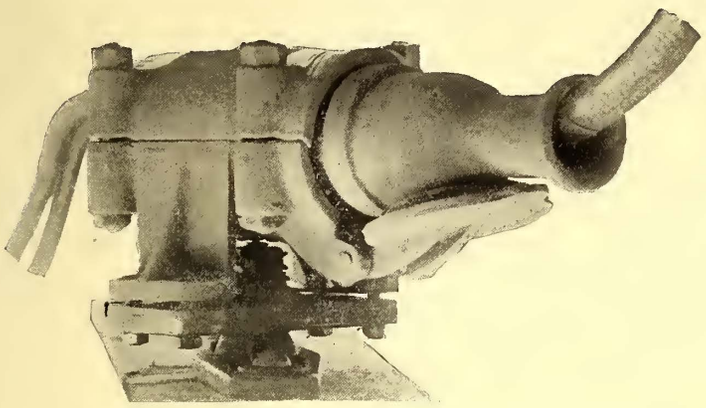


LOCKER MADE OF EXPANDED METAL.

A complete line of expanded metal furnishings, known as the "Pen-Dar" system, is made by Edward Darby & Sons' Company, of Philadelphia, these manufactures including such specialties as metal lockers, shelving, partitions, tables, etc. A characteristic example of this company's work is the metal locker shown in the accompanying illustration. The locker is built up of sheets of steel plate, which are cut, expanded and then rolled in such a manner that they present smooth surfaces, entirely free from rough edges or corners. This style of locker allows a free circulation of air, and therefore is thoroughly ventilated. Each locker is equipped with one shelf, three nickel-plated coat hooks, individual brass number plates and special three-point locking device, which securely fastens the door at the top, center and bottom with a single turn of the locking lever.

A NEW CHARGING RECEPTACLE

The extensive use of electrically-operated vehicles and the varied application of storage batteries for train lighting, small electric locomotives, storage battery cars, etc., has created a demand for convenient and durable accessories, one of the most important being a charging receptacle that will withstand hard usage and can be handled without danger of short-circuiting the line when inserting or removing the plug. With this idea in mind, the Westinghouse Electric & Manufacturing



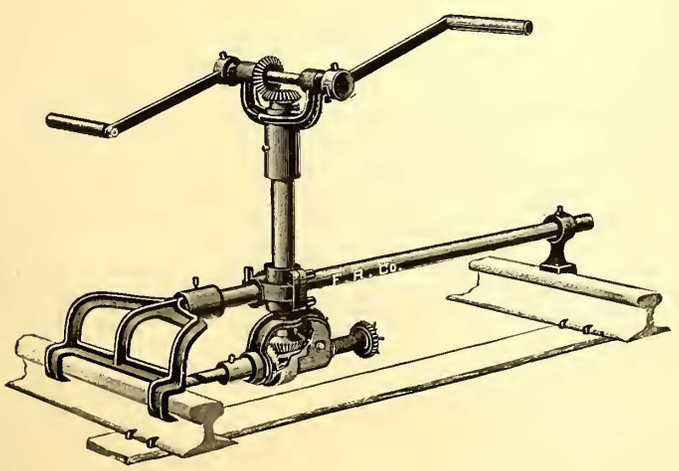
CHARGING RECEPTACLE, WITH CABLE ATTACHED

Company has developed and placed upon the market a charging receptacle to meet the most rigid requirements.

It consists of a cast metal case, circular in form, that occupies a minimum amount of space. Within the case are suitably mounted contacts for receiving the plug. A hinged lid at one end, held normally closed by a coiled spring, affords access to the interior. The receptacle being entirely enclosed, effectually protects it from dirt and water. The plug and contacts within the receptacle are so designed that it is impossible to cause a short-circuit when inserting or withdrawing the plug. The receptacle may be provided with a swivel attachment, conforming to standard railway practice, which is a decided advantage, as it admits the pulling out of the plug when the vehicle or car starts, the receptacle swinging in line with the cable and allowing the plug to pull out without danger of breaking the cables or contacts. The construction is rugged and all parts are well made, insuring a long period of service.

TRACK DRILL FOR HEAVY RAIL

As the result of experience gained in drilling the holes for bonding the rails on the recent extension of the Boston Ele-



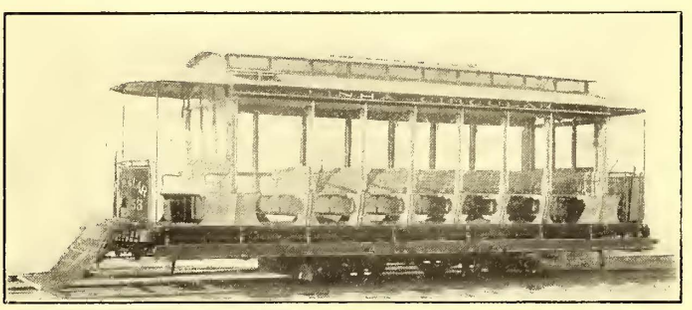
RAIL DRILL APPLIED TO TRACK

vated Railway, the Frank Ridlon Company, of Boston, has developed an improved track drill capable of drilling 7/8-in. bonding holes in heavy rails day after day without breaking down. The machine, as now constructed, weighs 185 lbs., and when once adjusted may be quickly set in place for each new hole. The gearing is of cut steel. As shown in the illustration, the drill is designed to be run by two men, and is of such height that they can do this standing. The handles are long and may be grasped by both hands.

An automatic friction feed is provided with this drill to make adjustments for fast or slow feeding. This also acts as a quick return of the spindle by reversing the cranks, and the drill backs out much faster than could possibly be done in any other way. The frame is adjustable in every way that is required of a track drill and may be worked directly over a tie. This company also manufactures a lighter track drill if desired.

OPEN CARS FOR BAHIA, BRAZIL

A number of ten-bench open cars, mounted on the No. 27-E type of single truck, has just been shipped by the J. G. Brill Company to the Linha Circular, of Bahia, Brazil. The order for these cars was obtained through the car builder's Brazilian agents, Guinle & Company, of Rio Janeiro. Bahia, which is the capital of the State of Bahia, is situated on the coast, 800 miles north of Rio Janeiro. It has a population of 200,000, and is one of the chief shipping ports of South America. The business part of the city, 3 miles long, lies on a narrow strip of land following the shores of the bay, and but little above the level of the water, while the residence portion is built on a bluff



VIEW OF ONE OF THE NEW TEN-BENCH OPEN CARS SENT TO BAHIA, BRAZIL

which rises back of the business section, 120 ft. to 150 ft. in altitude. The two parts of the city are connected by a sloping street, inclined railways and hydraulic elevators. The lower city has a tram line which was electrified nearly ten years ago. The lines of the Linha Circular, which were electrified recently, are about 10 miles in length, and are in the upper city, or residence section, which is finely laid out on a plateau of considerable extent, and has wide streets lined with handsome villas.

As the illustration shows, the cars are of the standard open type of the builder, with bulkheads at each end, having seats on either side. They are 28 ft. 8⅜ ins. long over the crown pieces and 30 ft. 4⅜ ins. over the bumpers; the width over the sills, including the sill plates, is 6 ft. 3 ins., and over the posts at the belt, 7 ft. ½ in.; the length from the center of the corner post over the crown piece is 4 ft.; from the corner post to the first side post is 3 ft. 5 ins., and the distance between the centers of the side posts is 2 ft. 8 ins.; the height from the track over the running board is 17⅛ ins., and from the running board to the car floor, 15 ins.; from the car floor over the monitor deck, 8 ft. 1¼ ins. The side sills are 3¾ ins. x 7 ins., with 7-in. x ½-in. sill plates on the outside. The thickness of the corner posts is 3⅝ ins., and of the side posts, 2¾ ins. The trucks have a 7-ft. wheel base and run on 33-in. wheels. The round-corner seat-end panels, platform gongs, signal bells, brake handles, draw-bars, angle-iron bumpers, sand boxes and other specialties are of the builder's manufacture.

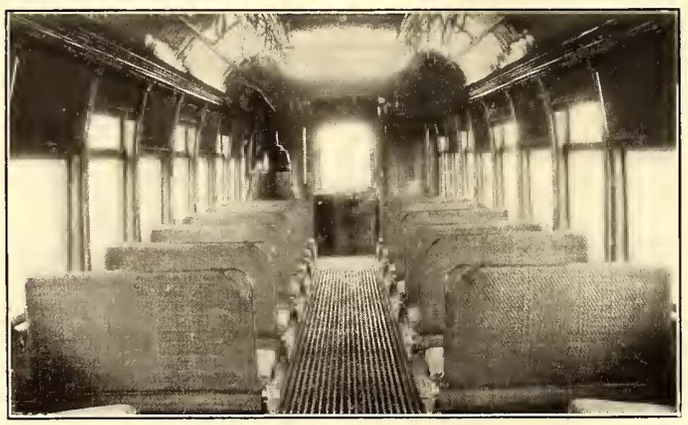
THE PRIME MOVER OF THE FUTURE

At the meeting of the Western Society of Engineers held in the Monadnock Block on the evening of Dec. 1, Charles E. Sargent gave an address entitled "The Prime Mover of the Future." This, according to Mr. Sargent, is the gas engine, which in the larger sizes, he says, has a thermal efficiency of 20 per cent to 24 per cent, as against 12 per cent in the steam engine. Mr. Sargent stated that so far as initial cost was concerned, a complete gas engine installation, including producers, buildings and all necessary parts, was about the same as a steam installation when boilers, pumps, buildings and stacks were considered. Points of advantage possessed by the gas engine were that it could be started and gotten under load much quicker than a steam engine, and that the "stand-by" losses were not so heavy as in steam installations.

In the discussion, certain members expressed dissent with this view, and believed that the steam turbine would be the prime mover of the future.

MORE SEMI-CONVERTIBLE CARS FOR WHEELING, W. VA.

Ten semi-convertible cars have just been added to the equipment of the Wheeling (W. Va.) Traction Company, which were built by the G. C. Kuhlman Car Company, of Cleveland.

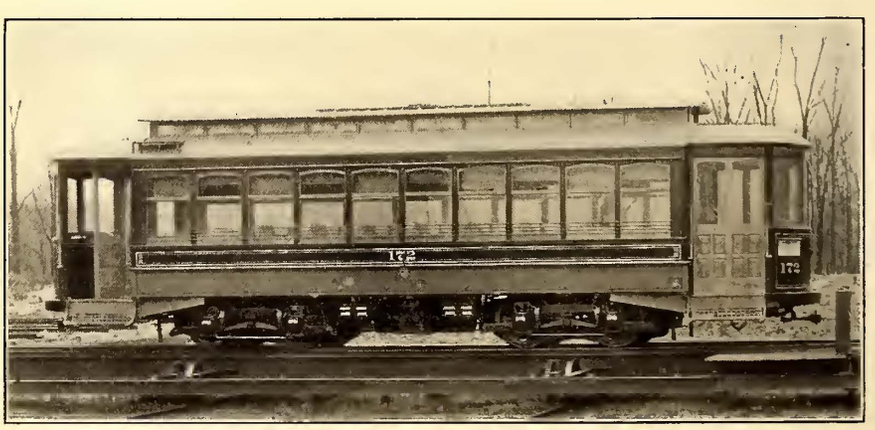


INTERIOR OF WHEELING SEMI-CONVERTIBLE CAR

The Wheeling Traction Company has 50 miles of track and operates 130 cars. The city of Wheeling has a population of 40,000, and is the leading industrial and commercial center of the State. It is noted for its nail factories, and has large tobacco works, blast furnaces and breweries. The company's lines reach Moundsville Camp Ground.

The cars are 28 ft. long over the bodies and 39 ft. over the vestibules, and are 8 ft. wide over the sills, including the panels, and 8 ft. 3½ ins. over the posts at the belt. The sweep of the posts of these cars is 1¾ ins.; the distance between the centers of the posts, 2 ft. 8 ins.; the height from the floor to the ceiling, 8 ft. 5 ins.; the height from the track to the under side of the side sills, 2 ft. 8¼ ins.; the height from the under side of the sills over the trolley board, 9 ft. 3¾ ins.; from the track to the platform step, 16⅛ ins.; from the step to the platform, 14½ ins., and from the platform to the car floor, 8 ins.; size of the side sills, 4 ins. x 7¾ ins.; center sills, 3½ ins. x 4¼ ins.; end sills, 5¼ ins. x 6⅞ ins., and the sill plates, which are on the inside of the side sills, are 12 ins. x ⅜ in.; thickness of the corner posts, 3⅝ ins., and side posts, 3¼ ins. The seats are 36 ins. long, while the width of the aisle is 23½ ins.

The cars are of the "grooveless-post," semi-convertible type, built under the patents of the J. G. Brill Company. The seats, door-controlling mechanism, angle-iron bumpers, sand boxes, platform steps and other specialties are also of that company's manufacture. The Wheeling Traction Company has operated semi-convertibles for a number of years, the J. G. Brill Company having supplied it with three lots of cars practically the same as those just furnished by the Kuhlman Car Company, and all have been mounted on the Brill No. 27-G type of truck, which is the standard truck of this system.



NEW DOUBLE-TRUCK VESTIBULE CAR FOR WHEELING, WEST VIRGINIA

WEIGHTS OF ELECTRIC LOCOMOTIVES

On Dec. 14 S. T. Dodd, of the railway department of the General Electric Company, delivered an address before the local branch of the American Institute of Electrical Engineers in Pittsfield, Mass. The subject covered was "The Design of Electric Locomotives for Heavy Railway Service." Making a comparison between steam and electric operation of trunk lines, the speaker discussed the subject under the head of comparative cleanliness and convenience, reliability of service, overload capacity, cost of operation and maintenance.

Discussing the advantages and disadvantages of the various types, the speaker pointed out that it was too early to say what the final limits of weight and cost would be, but that from such designs as had been made up to the present some approximate figures might be quoted. The weight of mechanical equipment, including cab, trucks and running gear will probably be from one-half to two-thirds of the total weight of the locomotive, depending on the type of locomotive and its requirements. A fair comparison may be obtained by comparing the weights of electrical equipment with various locomotives.

The direct-current locomotive has been built with electric equipment running from 50 lbs. to 80 lbs. per horse-power, while for the high-speed bipolar gearless type of motor, as illustrated on the New York Central locomotive, the electric equipment is as low as 25 lbs. per horse-power. The disadvantages of this type of locomotive are the presence of the commutator and the limitation of voltage which it imposes. The polyphase locomotive is built with electric equipments weighing about the same as the d. c. locomotive. The disadvantages of this type are the multiplicity of overhead wires and the small air gap of the motors, entailing greater cost of maintenance. Single-phase locomotives are built with electric equipments running from 85 lbs. to 110 lbs. per horse-power. The disadvantage of this type is the presence of the commutator, which it shares with the d. c. locomotive, and the small air gap, which it shares with the a. c. polyphase locomotive. Motor-generator locomotives of the Ward-Leonard type can probably be built with electric equipments weighing in the neighborhood of 55 lbs. to 100 lbs. per horse-power. The disadvantage of this type is the complication of switching apparatus for starting and operation.

FINANCIAL INTELLIGENCE

WALL STREET, Dec. 27, 1905.

The Money Market

There has been a decided change in the local money market during the past week. The tone was strong throughout, despite the unexpected gain in cash reported by the New York City banks last week, and the improved condition and outlook at Chicago. Money on call loaned as high as 90 per cent, the highest price attained for this class of accommodation in nearly six years. The advance was due to the active preparations by the banks, usual at this time of the year, in connection with the Jan. 1 interest and dividend disbursements, while another important influence was the urgent demand for funds resulting from an active speculation in stocks. Money for fixed periods was in limited demand, many of the larger stock and mercantile houses being well supplied with time funds for two and three months ahead. Nevertheless, there was no disposition on the part of lenders to press their funds upon the market. Sixty-day money continued to command a premium of ½ per cent, making the total charge for that maturity about 6½ per cent, while three and four months' funds were obtainable at 6 per cent. For the longer periods 5¼ per cent was freely bid for six months' accommodation, with little obtainable under 5½ per cent. Commercial paper has ruled steady at 5½ and 6 per cent for the best names. The amount of prime material coming upon the market, however, is very small, merchants as a rule obtaining assistance direct from their respective banks. Foreign exchange has ruled strong until near the close, when demand sterling broke sharply on rather heavy offerings of loans bills, the proceeds of which were employed at the high rates for money prevailing in the local market. The European markets have been extremely quiet, owing to the Christmas holidays, but money and discount rates have not changed materially. The bank statement, published last week, was unexpectedly favorable. The increase in loans was much smaller than generally anticipated, amounting to only $1,543,100. Cash increased $483,300, but as the reserve required was $284,975 more than in the previous week, the surplus was increased by $198,325. The surplus reserve now is $4,159,400, as against $15,247,225 in 1904, $12,574,625 in 1903, $6,549,200 in 1902, $7,891,350 in 1901, and $11,525,900 in 1900.

The Stock Market

The closing week of the year is always a period of greater or less disturbance in the money market, and the present one is no exception to the rule. Throughout the entire week call money on the stock exchange ruled at very firm figures, and toward the close rates soared to the highest point attained in several years. However, stocks were not visibly affected by this evidence of stringency until very late in the week, and then only to a comparatively limited extent. In consideration of the previous sharp advance in prices for stocks generally, many issues having not only touched the highest of the year, but also the highest in their history, the reaction that took place in response to the big jump in the money rate was indeed slight, and the main influence of the disturbing element noted was rather in the direction of curtailing business than in any other. The market having emerged from the Chicago bank troubles, without showing any ill effects of the same, it was in a position to respond to any and all developments of a favorable character that transpired during the week under review. Thus, while these were not of a momentous character, they were sufficient to carry stocks of nearly all classes to a materially higher level. Of course, the deplorable state of affairs in Russia, the Christmas holidays and the present low state of the reserves of the clearing house banks, tended in a measure to check buying for the bull account, particularly on the part of outsiders. Nevertheless, the same powerful and mysterious buying power that has been under the market for months past, and which is popularly supposed to represent some of the largest banking and other interests in this country, again materialized, with the result as previously stated. Sensational advances were scored in some of the copper stocks, notably Anaconda, which was partly explained by the increase in the latter's dividend and partly by the immense strike of new ore made at the company's mines. The steel stocks moved into a position of greater prominence, and the common sold higher than in years, while the preferred made a new high record · explanation for the advance being the immense amount of unfilled orders now on the company's books. Many other industrials moved up sharply, but at the same time the standard railway stocks were by no means laggards, a number of them attaining decidedly higher figures. The most striking cases were Union Pacific, St. Paul, Reading, Atchison, Southern Railway and the trunk line stocks.

The great development of the week in reference to the local traction stocks was, of course, the consummation of the deal whereby the Interborough Rapid Transit Company secures control of the Metropolitan properties, thereby giving to the former virtual ownership of the traction facilities in the Borough of Manhattan. In response to the highly important news, the shares of all the companies directly interested made pronounced advances, and in the case of Interborough on the "curb" a new high record was made. Disappointment was manifested in some quarters on account of the fact that the Brooklyn Rapid Transit system was not included in the gigantic transaction, and in consequence thereof the stock of the latter did not participate in the buoyancy of the other shares. However, it is felt in usually well informed circles that Brooklyn Rapid Transit will eventually be included in the combination, and this sentiment, together with the present unprecedented earnings of the property, prevented any genuine liquidation.

Philadelphia

Increased dullness characterized the market for the traction shares during the past week, and although prices moved with more or less irregularly, the net changes were unimportant. In the early dealings values displayed a declining tendency in sympathy with the weakness prevailing in the general securities market, but toward the close the market became firmer, and in most instances the early losses were more than recovered. Railways General was about the only stock to show weakness at the close, about 1000 shares changing hands, at from 7½ to 7, and closing at the lowest. It is understood that the company has sold its interests in the Michigan Traction Company, but no details of the sale has been made public as yet. It is stated, however, that the minority stockholders will receive the same terms as the majority holders of the stock. Philadelphia Rapid Transit opened at 30¾, and ran off to 30, on selling by New York interests, but later the price rallied to 31¼. About 11,000 shares changed hands. Philadelphia common was comparatively quiet, upwards of 3500 shares being traded in at from 51⅞ to 51½ and back to 52¼. Small lots of the preferred brought 49¾ and 50. Other transactions included Consolidated Traction of New Jersey at 82½, Philadelphia Traction at 100¼ and 100⅝, Union Traction at 62 and 61¾, and United Companies of New Jersey at 271.

Baltimore

The Baltimore market has been very quiet but strong. United Railway issues were in better demand than of late, but offerings at the present prices appeared to be limited. About 200 shares of the free stock sold at 14 and 14½, while 150 of the deposited stock brought 15½, an advance of ½ point. The 4 per cent bonds rose ⅝ to 93 on the purchase of $29,000, and $27,000 of the free incomes changed hands at 65¼ and 65½, an advance of a full point over last week's closing figure. Trust receipts for income bonds deposited brought prices ranging from 64½ to 64 for $21,000. City & Suburban 5s sold at 112½. Other sales reported were: $2,000 Baltimore City Passenger 5s at 105½, $2,000 Baltimore City Passenger 4s at 101½, and $1,000 Lexington Street Railway 5s at 104.

Other Traction Securities

Trading in the Chicago market was extremely quiet, and prices generally displayed weakness. West Chicago declined from 55 to 54 on the exchange of 25 shares, and North Chicago lost 2 points to 81 on the sale of 10 shares. Northwestern Elevated was sold rather freely, upwards of 1000 shares changing hands at from 26 to 25½. Metropolitan Elevated preferred sold at 68½ and 69¾ for 52 shares. The Boston market was quiet but firm. Odd lots of Boston Elevated brought prices ranging from 154 to 154½, an advance of ½ point. Boston & Worcester sold at 28. Massachusetts Electric were less active but firmer, 250 common selling at 15, while several hundred shares of the preferred brought 57½ to 58½. West End common sold at 98 and 98½, and the preferred

stock sold at 114. In the New York curb market Interborough developed considerable activity and strength. Opening at 219 the price advanced to 221, and on the announcement of the deal, whereby the company acquires control of the Metropolitan system, the price advanced sharply to 240⅝, the highest price at which the stock has ever sold. Subsequently there was more or less selling to realize profits, which caused a reaction to 236. About 40 shares changed hands. The securities of the new company to be formed to take over the Interborough and the Metropolitan Companies were traded in for the first time on Wednesday, and displayed considerable animation and irregularity. The new common stock, when issued, sold to the extent of 7000 shares, at from 65 to 58⅝, and back to 59¾, while upward of 3000 shares of the new preferred stock brought prices ranging from 102 to 100. The new Consolidated 4½ per cent bonds rose from 95 to 98¼, but later there was a reaction to 97½. About $400,000 changed hands. New Orleans Railway & Light issues also displayed pronounced strength, both the common and preferred making new high records, the first named selling at 40 and the preferred at 86½. The directors have declared a quarterly dividend of 1¼ per cent on the preferred stock, payable on Jan. 15, to stockholders of record on Dec. 30. This is the first dividend declared since the reorganization of the property. The 4½ per cent bonds sold at 91½.

Intimations of the plan to increase the dividends on Cleveland Electric Railway caused heaving trading in that stock in Cleveland last week. Nearly 5000 shares changed hands, with an advance from 84 to 88½; late in the week, however, it declined to 86½, and on Tuesday of this week there was a further decline to 85, due probably to franchise conditions. Northern Ohio Traction & Light was very active, with a slight advance to 32⅛, and another advance to 32⅜ on Tuesday. Aurora, Elgin & Chicago had another upward movement on announcement of the plan for consolidation with the Elgin, Aurora & Southern; over a thousand shares sold, with an advance from 35½ to 37½ for the common and 97½ to 99¼ for the preferred. Lake Shore Electric moved up from 16½ to 17, and on Tuesday of this week advanced to 17½, on sales of several hundred shares. The new preferred stock advanced to 60. Western Ohio receipts advanced to 19, Elgin, Aurora & Southern to 50¼, and Toledo Railway & Light to 32⅝. About $100,000 of Aurora, Elgin & Chicago 5s sold with an advance from 98 to 98¾. Western Ohio 5s sold at 87½.

Cincinnati, Newport & Covington continues to feature in Cincinnati, about 1500 shares selling up from 48⅝ to 51⅛. The preferred sold at 97 to 97½. Cincinnati Street Railway sold at 146 and 146½, a fractional decline. Detroit United was active at 95½ to 96, a gain of 2 points from last week's high.

Security Quotations

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

	Dec. 20	Dec. 27
American Railways	52	52½
Boston Elevated	154	155
Brooklyn Rapid Transit	88	89
Chicago City	198	200
Chicago Union Traction (common)	12⅛	12⅞
Chicago Union Tracton (preferred)	—	—
Cleveland Electric	80	80
Consolidated Traction of New Jersey	81	81
Consolidated Traction of New Jersey 5s	107½	107
Detroit United	94¼	94¾
Interborough Rapid Transit	218	235½
International Traction (common)	36¾	37
International Traction (preferred) 4s	75½	75
Manhattan Railway	163	163
Massachusetts Electric Cos. (common)	14	14
Massachusetts Electric Cos. (preferred)	58	58
Metropolitan Elevated, Chicago (common)	27	27
Metropolitan Elevated, Chicago (preferred)	68	69
Metropolitan Street	120⅞	*126½
Metropolitan Securities	75⅝	80¾
New Orleans Railways (common)	37½	39¾
New Orleans Railways (preferred)	85	86½
New Orleans Railways, 4½s	90½	91
North American	99	100
North Jersey Street Railway	25	25
Philadelphia Company (common)	51¾	52
Philadelphia Rapid Transit	31	31
Philadelphia Traction	100¼	100½
Public Service Corporation 5 per cent notes	95½	95½
Public Service Corporation certificates	66	67½
South Side Elevated (Chicago)	97	96
Third Avenue	124	129
Twin City, Minneapolis (common)	116½	117¼
Union Traction (Philadelphia)	62	61¾
West End (common)	98	98
West End (preferred)	113½	113½

* Ex-dividend.

Iron and Steel

According to the "Iron Trade Review," the Carnegie Steel Company last week booked the heaviest tonnage of structural steel of any week in its history, in spite of the fact that it was unable to promise delivery on any of the material before three or four months, while in some instances shipments will be delayed fully six months. Sales of rails during the past ten days aggregate nearly 200,000 tons, a remarkable total in view of the heavy orders already on the books. The Eastern bar iron manufacturers have reaffirmed their official price of $30 for bar iron, but are exacting premiums of from $5 to $10 per ton. Considerable activity in pig iron is reported at Pittsburg. There is a strong demand for basic iron in the East.

BASIS OF THE SALE OF THE AUGUSTA PROPERTIES

In the Street Railway Journal of Dec. 16 brief mention was made of the sale of the properties of the Augusta-Aiken Railway & Electric Company, of Augusta, Ga. Since then a statement has been secured from official sources to the effect that the control of the stock of the company, preferred and common, was deposited with a committee, consisting of R. L. Williams, of Middendorf; Williams & Company, Baltimore, Md.; C. G. Goodrich, cashier, Georgia Railroad Bank, Augusta, Ga.; Thomas Barrett, Jr., Augusta, Ga.; Henry Buist, Esq., Charleston, S. C., and John Blair MacAfee, Philadelphia. William T. Van Brunt, of New York City, made an offer to purchase all of the stock that these gentlemen held as a committee (which the depositors had given authority to sell) as well as all of the bonds represented by the committee and depositing stockholders. The stock was transferred on Saturday, Dec. 16, to Mr. Van Brunt, who paid $30 per share for the preferred and $15 per share for the common stock. The bonds were sold to him for 85 and interest. Approximately, 4000 shares of preferred and 9000 shares of common stock were transferred. The officers and directors of the Augusta-Aiken and underlying companies tendered their resignations, and new officers and directors were elected, Mr. Van Brunt being made president. Approximately, $600,000 of the bonds changed hands.

SALE OF THE MICHIGAN TRACTION COMPANY—OTHER TRACTION MATTERS IN MICHIGAN

The Michigan Traction Company, which extends for about 27 miles from Kalamazoo to Battle Creek, and including city lines has a total mileage of 54 miles, has been sold by the Railways Company General to a syndicate composed of Myron W. Mills, president of the Lansing & Suburban Railway Company; George G. Moore, vice-president, and James R. Elliott, general manager of the same company. These gentlemen also have a controlling interest in the Lansing & Suburban Traction Company and the Lansing-Jackson Railway Company (the latter is now under construction), besides being interested in the Jackson & Battle Creek Traction Company, and it is understood that an affiliation will be made with the Jackson & Ann Arbor Traction Company. The latter company has recently been reorganized, with W. A. Boland, of New York and Jackson, Mich., as president. With him are associated Henry R. Carse, cashier of the Hanover National Bank, of New York; Charles W. Osborne, who is connected with Russell Sage and Silas B. Dutcher, also of New York. Plans are under way to complete in the spring the Jackson & Ann Arbor line through to Detroit by way of Ypsilanti and Plymouth. Mr. Boland is director of the Jackson Consolidated Traction Company and of the Jackson & Battle Creek Traction Company, in which the Mills-Moore syndicate is interested. It is likely, therefore, that sooner or later all of these lines will be placed under one management, with the result that through electric service will be given from Kalamazoo to Detroit. The statement is made by parties in interest that it is unlikely that any combination will be made with the Detroit, Ypsilanti, Ann Arbor & Jackson Traction Company.

TRACTION MERGER IN NEW YORK

The interest of Thomas H. Ryan and his associates in the Metropolitan Securities Company and the Metropolitan Street Railway Company, of New York, controlling all the surface lines in the boroughs of Manhattan and the Bronx, has passed to the Interborough Rapid Transit Company, operating the subway and the elevated lines in Manhattan and the Bronx, through purchase made by August Belmont & Company. An early rumor was to the effect that Brooklyn Rapid Transit was included, but this was shown to be without foundation when the official statement was issued at 6 p. m., Dec. 26, from the office of August Belmont & Company. The plan adopted provides that for Interborough stock there will be issued 200 per cent in 4½ per cent collateral trust bonds and 90 per cent in the common stock of a new holding company; Metropolitan Street Railway stock will be exchanged for 100 per cent in 5 per cent cumulative preferred stock of the holding company and 50 per cent in common stock. Metropolitan Securities stock, after the payment of an additional call of $25 a share, will get 85 per cent in the common stock of the new holding company. Under the terms of the traction merger the new common is underwritten at 60. The Metropolitan Street Railway stockholders can get $30 per share in cash and $100 in new preferred stock per share of Metropolitan.

The total capitalization of the combined property will aggregate about $374,000,000.

The new capitalization provided for in the proposed plan will be as follows:

NEW CAPITALIZATION

Stock to be Issued in Exchange—		Charges
Preferred 5 per cent cumulative	$52,000,000	$2,600,000
Common	83,000,000	
Bonds to be Issued in Exchange—		
Collateral trust 4½ per cent	70,000,000	3,150,000
Total	$205,000,000	$5,750,000
Common stock to be issued for cash	17,000,000	
	$222,000,000	

OLD CAPITALIZATION

		Present Dividends
Metropolitan Street	$52,000,000	$3,960,000
Metropolitan Securities (50 per cent paid)	30,000,000	.....
Interborough	35,000,000	2,800,000
Total	$102,000,000	$6,760,000

NEW WORKING CAPITAL PROVIDED

Call on Metropolitan Securities—25 per cent	$7,500,000
$17,000,000 new common stock (if issued at 60)	10,200,000
Total	$17,700,000

The official statement reads as follows:

Mr. Belmont and Mr. Ryan, after consultation with their respective associates, have approved a plan for the union of the Interborough and Metropolitan interests, which will be formally submitted to the stockholders of the corporations involved as soon as the lawyers have completed the necessary papers. The plan contemplates the organization of a new company, which shall issue its securities in acquiring the shares of the Interborough, Metropolitan Street Railway, and Metropolitan Securities Companies, upon the following terms:

For every share of Interborough stock:

New collateral trust 4½ per cent bonds, secured by the deposit of Interborough stock	$200
New common stock	90
For every share of Metropolitan Street Railway Railway stock:	
New 5 per cent cumulative preferred stock	100
New common stock	50
For every share of Metropolitan Securities stock (with $75 per share paid):	
New common stock	$85

It is confidently believed that the proposed arrangement will not only be beneficial to the stockholders of the corporations involved, but that it will be advantageous to the city and to the public. It is admitted in this connection that the transportation facilities in this city are already superior in rapidity, comfort, character of equipment and low cost of travel for long distance to those of any other city in the world. Yet they should be further greatly improved by reason of the greater opportunity now offered to cooperate harmoniously with the city in providing for important extensions and additions to the facilities of travel within the boroughs of Manhattan and the Bronx.

Rumors of such a deal as that put through have been current from time to time for years. The consummation of the project, it may be said, however, came when all were off guard. That such was the case is probably due to the fact that the Metropolitan Street Railway interests prepared themselves to enter on a large scale upon the construction of new subways, which would compete with the Interborough lines for the long-haul traffic. Only last spring Mr. Ryan secured the services of Paul Morton as the head of his proposed subway undertaking. Later, after Mr. Morton had been chosen chairman of the Equitable Life, the Ryan interests secured the services of John B. McDonald, who constructed the present subway.

Having established an extensive department especially adapted to care for the construction of subways, the Metropolitan interests, in competition with the Interborough Company, set out to secure franchises for new subways. These franchises have not yet been awarded, and now the Interborough Company will be the only traction company in the field prepared to bid on new underground lines.

Since the opening of the subway a year ago last October, the Interborough Company has been competing keenly with the Metropolitan surface lines, and the reports of the two companies have indicated clearly that the Metropolitan lost a large amount of traffic to the Interborough. It has lost apparently not only on the long haul but on the short-haul traffic as well. The earnings for Metropolitan have not been sufficient to meet the 7 per cent dividend guaranteed on the stock by the Metropolitan Securities Company, and the latter has been obliged for several years to make good deficits which have now reached a total exceeding $5,000,000.

The Metropolitan Street Railway Company for several years prior to 1900 controlled practically all the traction lines in old New York City, with the exception of the Third Avenue Railroad Company. In that year, after the famous stock market episode in Third Avenue Railroad stock, in the course of which the Third Avenue road was thrown into the hands of a receiver, the Metropolitan Street Railway Company secured control of that road, including all its controlled lines. After control was secured, the Third Avenue road was leased to the Metropolitan for 999 years, the Metropolitan agreeing to pay dividends on a sliding scale from 5 per cent up to 7 per cent. After July, next year, the Metropolitan will have to pay 6 per cent on Third Avenue stock for four years, and 7 per cent thereafter.

In 1901, when the Interurban Street Railway Company was formed, the Metropolitan Street Railway Company controlled all the traction lines in Manhattan Borough as well as the Union Railway running in the Borough of the Bronx. Subsequently the Interurban Street Railway Company assumed the present name of the New York City Railway Company. The financial operations through which the Metropolitan lines passed in 1901 included the leasing of the Metropolitan Street Railway Company and all the traction lines controlled by it to the New York City Railway, then the Interurban Company, for 999 years at a fixed rental of 7 per cent on Metropolitan Street Railway stock. The payment of this dividend was guaranteed by the Metropolitan Securities Company, which was formed with a capital stock of $30,000,000, half of which was paid in when the company was organized.

All the stock of the New York City Railway Company is held in the treasury of the Metropolitan Securities Company, which thus controls all the surface traction lines of the two boroughs. In addition to the stock of the New York Railway Company, the Metropolitan Securities Company also holds all the stock of the People's Traction Company and of the New York, Westchester & Connecticut Railway and $3,379,200 of Third Avenue Railroad stock.

In September, of this year, the Inter-State Tunnel Railway Company was formed with a capital of $7,500,000 to build a tunnel from Jersey City to Chambers Street, Manhattan. The New York City Railway Company has a half interest in this company.

THE INTERSTATE COMMERCE COMMISSION'S STATISTICS OF RAILROADS

One of the publications annually issued by the Interstate Commerce Commission is a brief report on the income accounts of operating roads, which is intended to show, at the earliest practicable date, the principal items included in railway income accounts. The preliminary report for the past fiscal year includes returns for 752 companies, representing an operated mileage of 214,477.82 miles, which is presumably about 99 per cent of the mileage that will subsequently be covered by returns in the final report for the same year. The gross earnings of the railways for the year ending June 30, 1905, on the mileage just stated were $2,073,177,325. This total comprised earnings from the passenger service, $572,109,366; earnings from the freight service, $1,449,182,702, and miscellaneous earnings, $51,885,257. According to this preliminary report, the gross earnings from operation averaged $9,666 per mile of line. The final report for the year ending June 30, 1904, showed that the total gross earnings of the railways on 212,243.20 miles of line for that year were $1,975,174,091, being equivalent to $9,306 per mile. Of the gross earnings per mile of line, the passenger service contributed $2,667 and the freight service $6,757. The operating ex-

penses of the railways embraced in the current preliminary report amounted to $1,383,584,404, thus averaging $6,451 per mile of line. For the year ending June 30, 1904, the operating expenses reported finally were $1,338,896,253, or $6,308 per mile. This advance report gives the ratio of operating expenses to earnings as 66.74 per cent. The final report for the year 1904 gave 67.79 per cent. The preliminary report shows that the net earnings of essentially the same roads were, for the year ending June 30, 1905, $689,592,921, and for the year ending June 30, 1904, $634,674,561.

The railway companies for which returns are included in this advance report also received $114,636,642 in the form of income from investments in the stocks and bonds of railway and other corporations and from other miscellaneous sources. The net earnings increased by this sum give a total income of $804,229,563. The aggregate deductions chargeable against this income were $713,994,800. The principal items included in such deductions were interest on funded debt, rents of leased lines, permanent improvements charged to income, taxes (which were $58,533,381) and dividends. Thus the surplus resulting from the operations of these roads, which the preliminary report covers, was $90,234,763. The complete report for the year ending June 30, 1904, covering both operating and leased roads, showed a surplus of $56,729,331, and the like report for 1903 a surplus of $99,227,469.

CHRISTMAS FESTIVAL IN JERSEY

The employees of the Paterson division of the Public Service Corporation, including the lines in Jersey City, Hoboken and Paterson, held a Christmas festival in the club room of the car house of the company at Paterson, on the evening of Wednesday, Dec. 27. This room the men decorated at their leisure with greens, and arranged two Christmas trees, which were electrically illuminated with 8-candle-power lamps. The room as well was tastefully illuminated with colored electric lights, some 700 of which were used. The wiring was done by employees of the United Electric Company, a subsidiary of the Public Service Corporation, without cost.

The programme of entertainment for the evening consisted of nine numbers, all vaudeville. Music was furnished by a special string quartet, whose efforts were roundly applauded. During the evening each child present was presented with a box of candy and an orange, at the expense of the company. The men themselves, to lend to the spirit of the occasion, each contributed from 10 cents to 15 cents for a prize. The contents of these packages were unknown, and much fun was caused when they became known, as they savored mostly of the ridiculous. In connection with the distribution of the boxes to the children, Mr. Bolen, superintendent of the division, early conceived the idea of having the boxes modeled after a trolley car. The result was that each box was a tasteful souvenir modeled along the lines mentioned, and so arranged that the car windows, after the removal of the candy, could be adjusted to permit of the lighting of car by means of candles placed inside.

This is the second entertainment of its kind that has been held on this division. To expedite the movement of those in attendance special cars were provided by the company, four of which left Hoboken for Paterson loaded with merrymakers.

The officers of the company all entered heartily into the spirit of the entertainment. In addition to Mr. Bolen, to whom was entrusted the details, these were present: Albert Stanley, general superintendent; Col. Hine, assistant to the president; Division Superintendents Dust, of Newark; Williams, of Jersey City; Bliss, of Hoboken; Duck, of West Hoboken, and Albert Eastman, superintendent of employment of the company.

ROCHESTER STOCKHOLDERS NOTIFIED OF SALE OF THE PROPERTY

Stockholders of the Rochester Railway Company, the sale of which to New York Central interests was noted in the STREET RAILWAY JOURNAL recently, have been officially notified by circular, through E. W. Clark & Company, of Philadelphia, and Hodenpyl, Walbridge & Company, of New York, of the sale as follows:

"We have entered into a contract to sell to the Mohawk Valley Company all of our holdings of the common stock of the Rochester Railway & Light Company for one hundred and twenty-five dollars ($125.00) per share, stock to be delivered and paid for on or before Feb. 1, 1906, at the office of the New York Central & Hudson River Railroad Company in New York City. The contract of sale provides that the purchaser shall take at the same price, all of the said common stock that may be offered, provided, however, that in order to bind the purchaser to take any such additional shares of common stock, the vendors must give to the purchaser, on or before the 15th day of January, A. D. 1906, notice in writing of the number of such additional shares of the common stock which they propose to sell under the terms of this contract. The common stock of the Rochester Railway & Light Company is liable to 30 per cent assessment, and in the contract of sale it is set forth that the purchaser does hereby undertake and agree to protect and save harmless from and against all such assessment and liability, the vendors and any and all holders of said common stock who may sell the same under and by virtue of the terms of this contract."

REPORT OF THE BOSTON ELEVATED RAILWAY

The comparative income account of the Boston Elevated Railway for the year ended Sept. 30 is given below, together with the balance sheet:

Sept. 30	1904-05	1903-04
Gross receipts	$12,689,676	$12,436,594
Operating expenses	8,617,653	8,631,553
Earnings from operation	$4,072,023	$3,805,041
Other income	51,893	.....
Gross earnings	$4,123,916	$3,805,041
Charges	3,288,831	2,975,268
Balance	$835,084	$829,773
Dividends	798,000	798,000
Surplus	$37,084	$31,773

ASSETS

Sept. 30	1904-05	1903-04
Construction	$9,031,994	$7,313,099
Equipment	1,951,156	1,845,500
Real estate	5,479,967	5,337,145
Subway and tunnel construction and equipment	389,065	319,578
Cash on hand and in bank	7,733,580	3,564,190
Stocks, bonds and miscellaneous	2,920,019	2,044,859
Bills and accounts received	725,884	.....
Sinking and other special funds	481,566	.....
Total	$28,713,235	$20,423,859

LIABILITIES

Capital stock	$13,300,000	$13,300,000
Funded debt	7,500,000	.....
Audited values and accounts	353,144	288,530
Salaries and wages	140,794	131,329
Divisions not called for	7,873	12,835
Matured interest coupons unpaid	36,095	20,017
Rentals unpaid	339,123	333,873
Outstanding tickets and checks	26,618	25,037
Interest accrued not due	256,679	114,513
Taxes accrued not due	1,036,563	908,456
Rentals accrued not due	146,895	142,849
West End lease account	1,207,201	1,207,202
Sinking and special funds	1,708,800	1,579,750
Surplus	2,673,445	2,359,462
Total	$28,713,235	$20,423,859

The items which make up the total charges of the Boston Elevated are as follows:

Sept. 30	1904-05	1903-04	1902-03
Taxes	$1,047,333	$925,419	$917,019
Rentals leased roads	1,233,199	1,852,643	1,817,645
Rental of subway	228,540	197,206	197,892
Interest on funded debt B. E. & W. E.	779,757	.....	.....
Total	$3,288,831	$2,975,268	$2,932,556

Boston Elevated passenger statistics for the year make this comparative showing:

Sept. 30	1904-05	1903-04	1902-03
Revenue miles	$48,069,404	$48,317,981	$47,476,702
Revenue passengers	246,941,776	241,681,945	233,563,578

The average persons employed by the Boston elevated were 7471; single surface trackage is 428,471 miles; elevated, 16.015 miles. Total additions to property during the year amounted to $2,036,862, and the cost of removal of snow was $190,139. Damages paid for injuries were $460,167. Legal expenses were $311,628. Wages paid were $3,851,891.

INTERCHANGE OF FREIGHT IN INDIANA

The freight agents of the interurban roads entering Indianapolis have been asked to attend a meeting next week, called by a committee appointed by the Indiana Electric Railway Association, to consider means whereby freight may be received at any point on any electric line and shipped through by interurban. All of the electric lines have some system of carrying light freight, but no traffic agreement has ever been made whereby a transfer to other lines could be effected. It is proposed that a rate agreement be made on a percentage basis between the lines, according to the miles of transportation given by each line. If such an arrangement is made it will mean much to shippers, as a cheap rate will be provided for produce and market stuffs, as well as for heavier freight.

THE BUFFALO-ROCHESTER PROJECT REVIVED

The Buffalo & Rochester Railway Company, which some time ago was denied by the Railroad Commission a franchise to build an electric railway from Buffalo to Rochester, has dissolved, and the directors are organizing the Buffalo & Rochester Traction Company to buy its own private right of way and build the road despite opposition of steam railroads. The capitalization is $3,500,000, and the same Philadelphia and Buffalo names that appeared in the first proposed road are in the new road. On Nov. 23, 1904, the first road was incorporated. On June 21, 1905, it was denied the right to build because its proposed route was along highways. In September it obtained a court writ to dissolve on Dec. 13. There is about $60,000 in the treasury to be distributed. Surveyors engaged indicate that the only difference in the new route will be a shifting from the highways to the farm lands. The western terminus of the road will be at Depew. It will enter Rochester over the Genessee street route. Between these points it will tap Looneyville, Crittenden, Grimsville, Wende, Pembroke, Alden, Corfu, Batavia, Stafford, Le Roy, Caledonia, Mumford, Wheatland and Chili. The directors are: Henry H. Kingston, J. Andrew Harris, Jr., John J. Collier, Horatio A. Foster, T. Henry Dixon and Samuel Welch, all of Philadelphia, and William B. Cutte, George A. Ricker and Herbert P. Bissell, all of Buffalo.

LYNCHBURG TRACTION & LIGHT ASSOCIATION'S YEAR

The annual meeting of the Lynchburg Traction & Light Company's Employees' Benefit Association, was held in the rooms of the association a few days ago. The report of the treasurer showed that during the year the sum of $4,318.27 had passed through his hands. Of this amount $1,317 was paid to members for sick and death benefits, and after all expenses had been paid for the year there remained on hand the sum of $467.79. This report showed that the net income from the "Penny Arcade" at Rivermont Park, which was operated last summer by the association, was nearly $1,500.

The report of President Apperson, which follows, was received with great enthusiasm by the members:

Gentlemen—It is with a great deal of pleasure that I submit herewith the third annual report of your association.

This has been the most prosperous year of our existence. While the receipts from dues were less than last year, our total receipts from all sources exceed our expenditures, and leaves quite a satisfactory balance on hand, notwithstanding that we have paid almost twice as much in sick benefits as was paid last year.

It is very gratifying to be able to report that our membership is larger than at any time since our organization.

The success of our venture in operating the Penny Arcade and bowling alleys at the park is better shown by the treasurer's report, attached hereto.

I fully appreciate the assistance and interest shown by each individual member, and I trust that all of you will continue to show in the future the same unselfish interest in the association's affairs that you have shown in the past.

The treasurer's detailed report shows fully the assistance and relief extended to our members.

With my best wishes to you all, and for the continued prosperity of the association, I am very respectfully,

R. D. APPERSON,
President.

The election of officers for the ensuing year resulted as follows: R. D. Apperson, president; A. E. Anderson, vice-president; A. T. Powell, secretary and treasurer; Drs. Martin and Taliaferro, surgeons; Rev. James M. Owens, chaplain; R. L. Stabler, W. H. Crutchfield, O. W. Gettle, A. J. Cochran, A. J. Kohler and J. J. Thornhill, board of trustees.

LAYING FOUNDATION STONE OF ENGINEERS' CLUB IN NEW YORK

The foundation stone of the new building of the Engineers' Club, on West Fortieth Street, New York City, opposite Bryant Park and the new Public Library, was laid Dec. 23, at 2:30, by Mrs. Andrew Carnegie, whose husband declared the task well and truly done. The ceremony was quite informal, but the club was well represented by its officers and committees, including President W. H. Fletcher and Past President John C. Kafer. The architects, Messrs. Whitfield & King, were also present. Fortunately the weather cleared during the afternoon, and thus the party were enabled to inspect the building, now up to the ninth story in the steel work and to the third in marble and brick casing. The records deposited in the stone included a Bible of 1905, a club book of 1905, copies of the "Herald," "Tribune," "Sun" and "Times" of December 23; a copy of the certificate of incorporation, a booklet of the old club house at 374 Fifth Avenue, a half dollar, quarter dollar, dime, nickel and 1 cent; a card of W. L. Crow, the builder; a copy of Mr. Carnegie's letter of gift to the Engineering Societies and the Engineers' Club, a chronological history of the club, a list of members elected since the publication of the club book this year, a list of the incorporators of the club, the programme of competition for the selection of architects for the two buildings, and floor plans of the new house.

HEADLIGHTS CAUSE PROTEST IN MASSACHUSETTS

So much inconvenience has been occasioned to people who walk or drive in Washington Street, in Wellesley, Mass., lately, by the powerful lights in use on the cars of the Natick & Cochituate Street Railway, that the townspeople took their complaint before the Railroad Commissioners. The board heard the objections and announced that they had been considering the matter of headlights for street cars, and were intending to issue a general order soon after Jan. 1 covering the use of lights on all street railways. In general, the country districts favor the lights, and the more thickly populated suburban districts find them a great annoyance. The Railroad Commissioners recognize the fact that the companies have been led to introduce the lights in place of the old headlights, because the introduction of high-speed cars has made it necessary to throw a beam of light far enough ahead to enable the motorman to see an obstruction in time to stop; also, that the companies go to an expense in providing the lights, and that their prime motive is the safeguarding of people using the highways as well as people traveling in the cars. In their general order, they will try to cover all cases, in a general way; but even after the issue of that order they expect that special conditions may necessitate special rulings.

The complaint from Wellesley comes chiefly from the central part of the town, along Washington Street. Richard Cunningham, chairman of the Selectmen, said the beam of light from the cars was a quarter of a mile long, and on curves often swung out 50 ft. or 60 ft. across the roadway. The glare blinds both horses and drivers, often frightening a horse so that it will crouch in his tracks, apparently helpless. Bicycle riders and automobilists also had complained of great inconvenience from the headlights. Acetylene lights on autos make less trouble for users of the street, for the reason that they are placed well down toward the ground, whereas, the big lamps on the cars are placed above the ordinary headlight. He had seen the searchlights shut off, sometimes, as the car approached a horse and carriage, apparently indicating that the motorman regarded the effect of the light as dangerous. Mr. Cunningham realized that the searchlights were needed only on high-speed cars, but said the Natick line had been restricted to a speed of 15 miles in Wellesley. He thought the motormen should shut off the searchlights through the center of the town. To A. D. Claflin, president of the Boston Suburban Railway Company, owners of the Natick line, Mr. Cunningham said another company (the Boston & Worcester) was now using the searchlights on Worcester Street, but Worcester Street had little driving traffic, and the cars ran on a double-track reserved space much of the way, with carriage travel on either side. Several others also testified as to their experiences when suddenly confronted by the new lights.

For the railway company President Claflin said there was no desire to inconvenience the public, but the lights had been introduced because the company believed that there was greater safety for everybody concerned with the lights in use than without them. The motormen were instructed to turn off the lights in the square and also on signal from anybody encountered on the road. H. A. Plimpton, who presented the case for the town, made a brief summing up, and the matter was taken under advisement.

REMOVAL OF PHILADELPHIA OFFICE OF "STREET RAILWAY JOURNAL"

The Philadelphia office of the Street Railway Journal, which for so many years has been located at 929 Chestnut Street (in the City Trust Building), will, on Jan. 1, be removed to the Real Estate Trust Building, Broad and Chestnut Streets.

NEW PUBLICATION

Year Book of Legislation, 1904. Published by the New York State Library; 596 pages. Price, $1

This book is divided into three parts; the first is a digest of the messages of the governors of the different States, including selected topics in the President's message; the second is an index of legislation briefly indexing or summarizing 2190 laws and constitutional amendments; the third is a review of legislation, made up of the contribution of different specialists from all parts of the country. Then Prof. B. H. Meyer, of Wisconsin, discusses the legislation in 1904 in transportation, and includes a review of the laws passed by the different States affecting electric railways. The book is well supplied with indices and provides a most convenient method of maintaining a general survey of current legislation.

STREET RAILWAY PATENTS

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

UNITED STATE PATENTS ISSUED DEC. 19, 1905

807,431. Electric Controlling Mechanism for Railway Appliances; Walter J. Bell, Los Angeles, Cal. App. filed June 3, 1905. A contact wire is stretched between a pair of bell-crank levers, which are connected to the trolley wire. When a car passes, the trolley wire is pressed upward and imparts such motion to the bell cranks as will permit the contact wire to sag and make connection with a suitable contact on the car, thereby completing a circuit by which signals, switches, etc., may be operated.

807,461. Car Fender; Edward C. Haynes, Portland, Ore. App. filed Aug. 23, 1905. Comprises parallel bars spaced one above the other and extending transversely of the car, resilient fingers secured to the upper bar and extending downward in a curve in front of the lower bar, and springs connecting the fingers with the lower bar.

807,477. Trolley; Allen P. Lord, Bradford, Pa. App. filed Jan. 9. 1905. Consists of a pair of guard arms journaled on the outer ends of the trolley wheel axle, and having counter-balanced lower ends. When the arms contact with an obstruction, they will be depressed to permit the obstruction to pass, after which they swing back to their normal upright position.

807,486. Switch-Operating Mechanism; John A. McCaskey, Hubbard, Ohio. App. filed April 17, 1905. Comprises a stub-shaft vertically mounted in the roadbed, and having a crank connected by a lever to the switch point. Fingers fixed on the upper end of the shaft and adapted to be engaged by a suitable operating lever on the car.

807,490. Car Fender; Frederick W. O'Connor, Toronto, Can. App. filed May 8, 1905. Details of construction of a fender and means for automatically maintaining the same at a constant height above the roadway.

807,520. Controller; Ferdinand Volk, Pittsburg, Pa. App. filed Feb. 4, 1905. The usual controller has detents upon its upper surface with which a dog upon the controller arm engages at the successive notches. The handle must be slightly turned independently of the arm, in order to release the dog and pass the next notch.

807,564. Conveyor; Pierre Lorillard, Tuxedo Park, N. Y. App. filed April 10, 1905. An escalator made up of laterally-adjacent conveyor sections and means for moving the same in closed paths, each having a flat portion along which the effective movement of the corresponding section takes place, the movements of alternate sections along their respective paths being similar in direction but opposite in phase.

807,565. Conveyor; Pierre Lorillard, Tuxedo Park, N. Y. App. filed April 10, 1905. An escalator made up of laterally-adjacent conveyor sections extending spirally from one elevation to another, and means for operating the same to impart a continuous forward movement to a passenger supported thereby.

807,653. Trolley for Electric Railways; Walter J. Barron, Brooklyn, N. Y. App. filed June 6, 1900. V-shaped guiding fingers for readjusting the trolley wheel on the wire.

807,656. Rail-Bond; Leonard B. Buchanan, Woburn, Mass. App. filed Nov. 30, 1904. Comprises a pair of caps which may be placed over the terminals of the usual rail-bond and filled with solder, so as to make an additional connection.

807,707. Electric Railway Signal; Henry A. Ammann and Albert D. Campbell, Spokane, Wash. App. filed Oct. 4, 1905. A contact finger inclosed in a housing supported between two closely-adjacent insulators, and adapted to be engaged by the trolley wheel and actuating signal circuit-controlling switches within the housing.

807,777. Car Brake; Charles Remelius, Newark, N. J. App. filed June 10, 1905. Employs co-acting devices for simultaneously actuating oppositely-moving brake-shoes at the respective sides of the car truck to grip the wheels of the truck in stopping the car.

807,800. Electric Railway Signaling Appliance; Henry A. Ammann and Albert D. Campbell, Spokane, Wash. App. filed April 6, 1905. A signal box mounted above the trolley wire, having two electric circuit-making and breaking mechanisms, including make-and-break wheels of different form, a lever operatively connected to each mechanism, and a pendulum in the path of the trolley wheel arranged to move the levers successively in opposite directions.

807,984. Electric Railway; Frank Adams, North Adams, Mass. App. filed Jan. 30, 1904. The wheels of the car contact with a shoe, which is effective to move a switch for energizing the third-rail section immediately ahead of the car.

808,013. Radial Truck for Tramway and Like Vehicles; Elmer E. Cook, Louthborough, England. App. filed Aug. 21, 1905. Comprises a frame, radially movable axles carrying axle-boxes having lateral extensions longitudinal to the truck by and on which the frame is supported and adapted to slide.

PERSONAL MENTION

MR. H. P. BRADFORD, who has been in Europe for several years in the employ of Mr. H. A. Butters and others as owners of the Geneva system, and later with Mr. C. T. Yerkes in London, is in the United States for a short stay.

MR. A. W. LEONARD, for some time general manager of the Houghton County Street Railway Company, of Hancock, Mich., owned by Stone & Webster, of Boston, and formerly with that firm in Boston, has been appointed general manager of the Minneapolis General Electric Company to succeed Mr. A. M. Robertson, who will retire from the company Jan. 1, to engage in private business.

MR. JOHN COWAN has resigned the managing directorship of the Stirling Boiler Company, Ltd., of Motherwell and 25 Victoria Street, Westminster. The directors have appointed Mr. E. G. Constantine, A. M. I. C. E., M. I. M. E., of Manchester, to be managing director, to enter upon his duties at Motherwell on Jan. 1. Mr. Cowan still retains his interest in the company and will continue to be chairman of the directors.

MR. CHARLES T. YERKES, of the London Underground Railway Company, who has been ill in his apartments in the Waldorf-Astoria, New York, with kidney trouble since coming to this country in November, was reported on Wednesday to be dying, and his relatives were summoned to his bedside. Mr. Yerkes contracted a severe cold in London, and on the steamship on the way to New York, exposure to bad weather caused a recurrence of the chronic trouble with which he is afflicted. He took to his bed immediately upon arriving here.

MR. M. M. GILLESPIE, until recently a prominent member of the staff of the British Westinghouse Electric & Manufacturing Company, was recently entertained at a complimentary dinner given at the Midland Hotel, Manchester, by his old friends and colleagues in the firm, as a mark of the esteem in which he was always held. The proceedings, which were of an informal nature, bore ample witness to the popularity of a gentleman who has been associated for over seventeen years with the Westinghouse Companies on both sides of the Atlantic. In future, Mr. Gillespie will be found at his offices, Amberley House, Norfolk Street, Strand, W. C., where he will represent, among other firms, Browett, Lindley & Company, for London and the South and West of England.

MR. MORTON BEALES was mostly kindly entertained, Dec. 2, at a farewell dinner given by his friends at the British Westinghouse Electric & Manufacturing Company, upon his resigning his position of district office manager with that company, in order to take up the position of manager to Bruce, Peebles & Company. Mr. Beales had been connected with the Westinghouse Company for the last three years, and previous to that he was commercial engineer to J. G. White & Company, having resigned his position with the Ferranti Company, on whose staff he had been for nearly ten years. His address will be No. 1 London Wall Buildings, in the new office of Bruce, Peebles & Company.