Street Railway Journal

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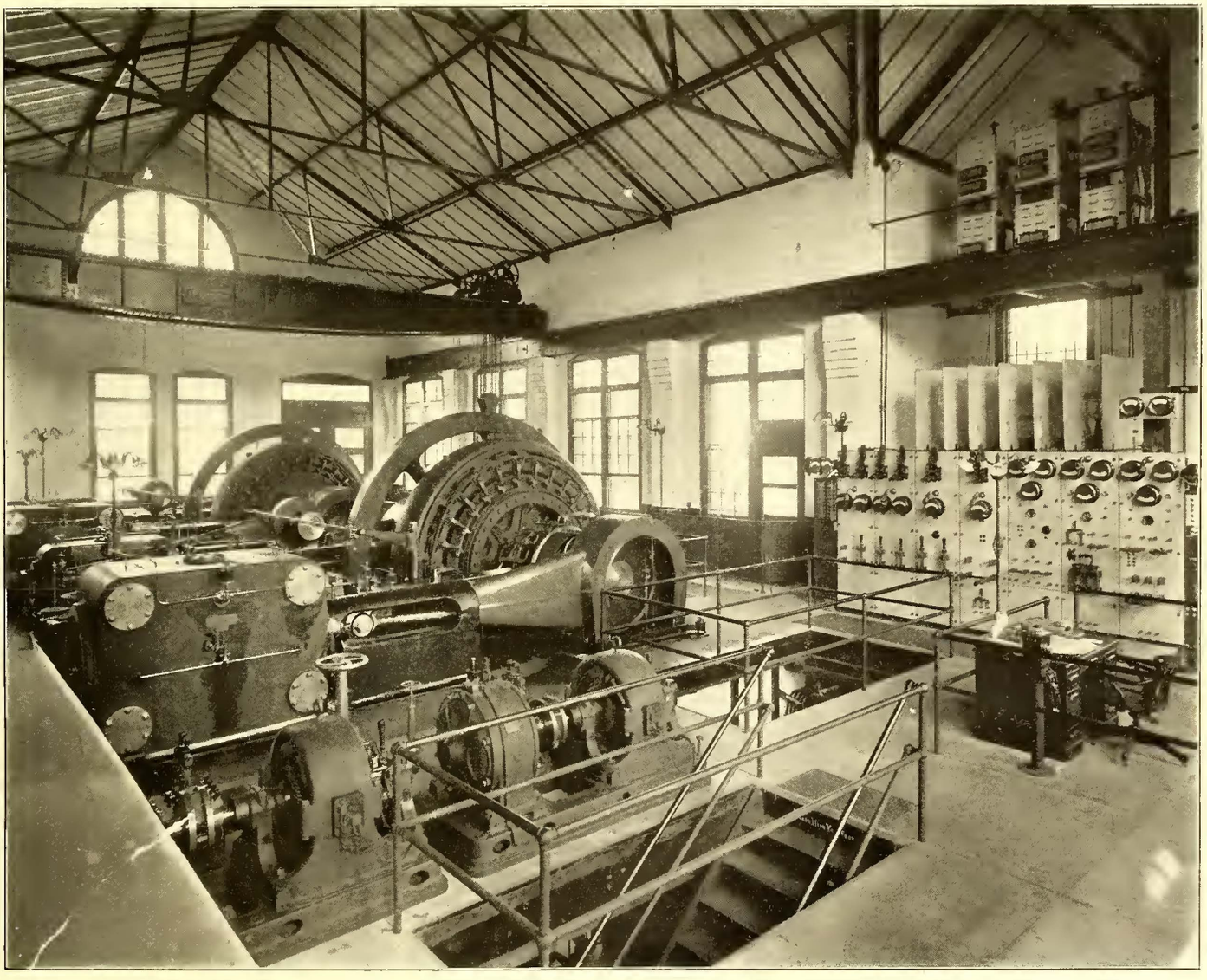
THE WORCESTER & SOUTHBRIDGE STREET RAILWAY

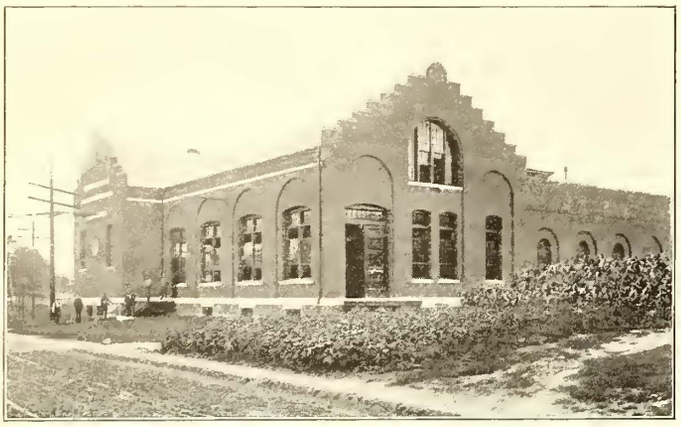
For several years Worcester has been the most active center of street railway construction in the Eastern States. The amalgamation of nearly all the lines in and about the city into the Worcester Consolidated Street Railway Company gave the opportunity to increase greatly the facilities for local traffic and improved the suburban and interurban service of many of the roads brought under the control of the general management; yet, in spite of the fact that the Consolidated operated a large number of lines extending to adjoining towns, there were left many routes which offered tempting inducements to the promoters of interurban railway enterprises. The most recent of these, the Boston & Worcester, was described in these pages two months ago. Another road which was opened this year, and which has just closed a most successful summer season, is that operated by the Worcester & Southbridge Street Railway Company, and forming the subject of this article.

Massachusetts has been conservative in the matter of its street railways, as in other things, and the managements of its two principal systems, the Boston Elevated and Worcester Consolidated, have adhered to simple direct-current distribution. The necessities of the newer roads, however, have prevented this policy from being made general throughout the State, and some of the finest examples of high-tension distribution work for long railways are now to be found there. Second to none in excellence of construction and operation is the Worcester &

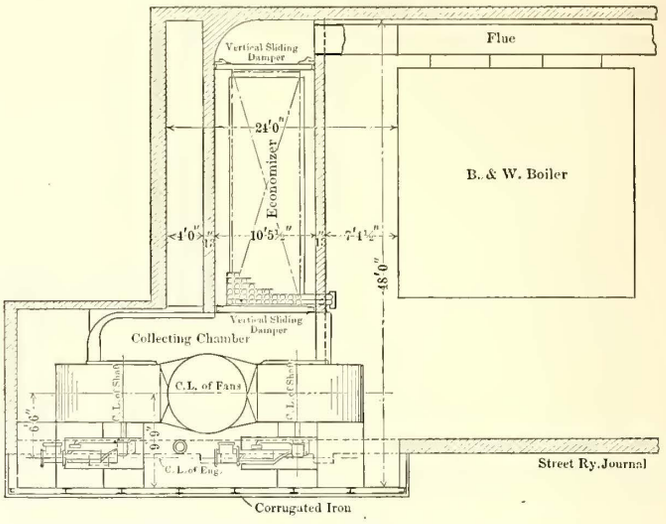


ENGINE ROOM IN CHARLTON POWER HOUSE

Southbridge. This road runs from Worcester to Southbridge, a distance of about 20 miles, owns more than half its right of way, and controls the Southbridge & Sturbridge Street Railway Company, over whose tracks it has entrance to the center of Southbridge. It also controls the Worcester, Rockdale & Charlton Depot Street Railway Company, the connecting link between the Auburn



POWER HOUSE AT CHARLTON, MASS.

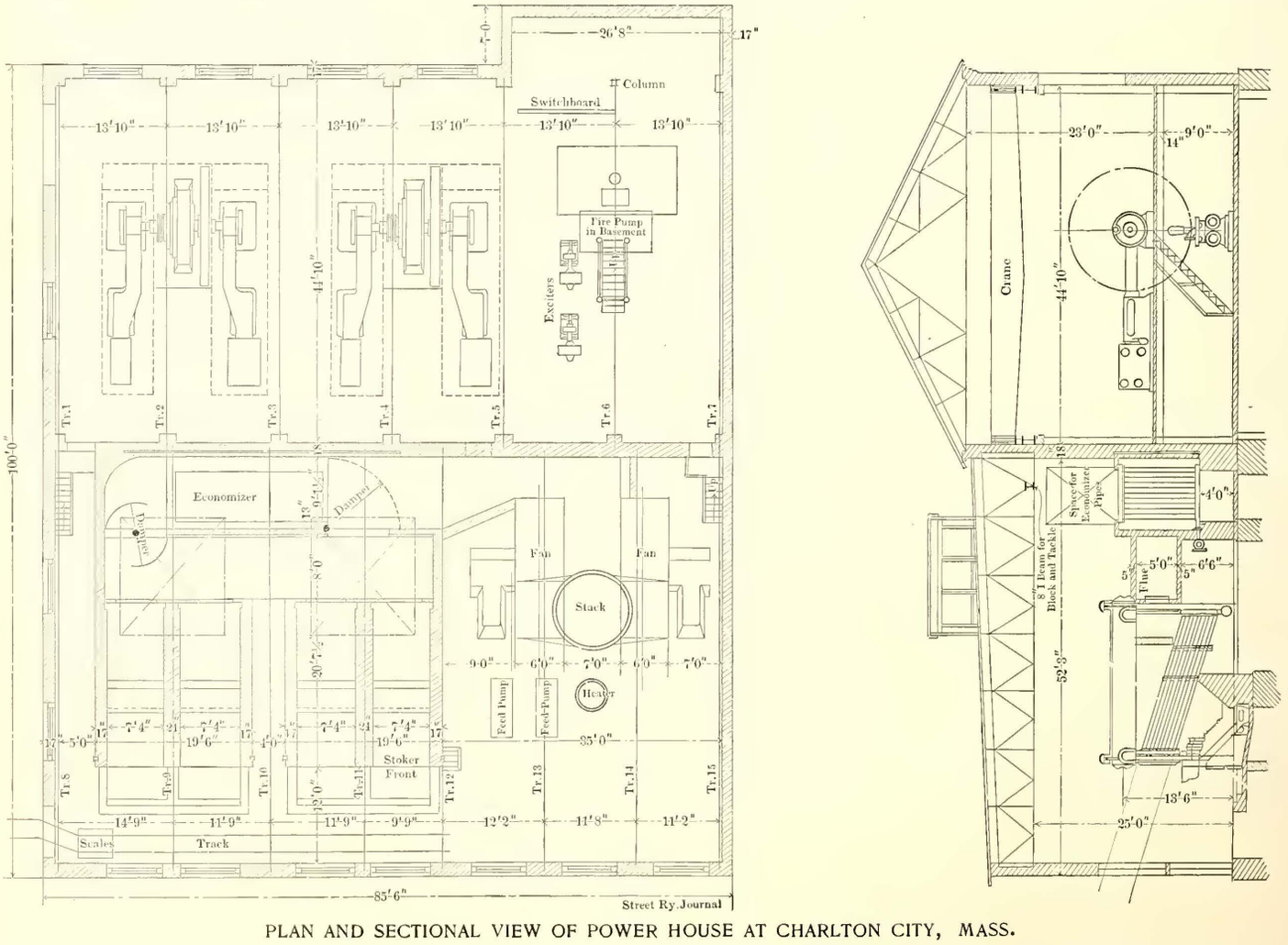


ECONOMIZER AND MECHANICAL DRAFT

& Worcester line and the tracks of the Worcester Consolidated, and by arrangement with the latter road can bring its cars directly to the City Hall Square, the heart of all the radiating lines. The following towns act as feeders: Southbridge, Sturbridge, Brimfield, Wales, Charlton, Brookfield, Oxford, Webster, Dudley, Leicester, Auburn and Worcester.

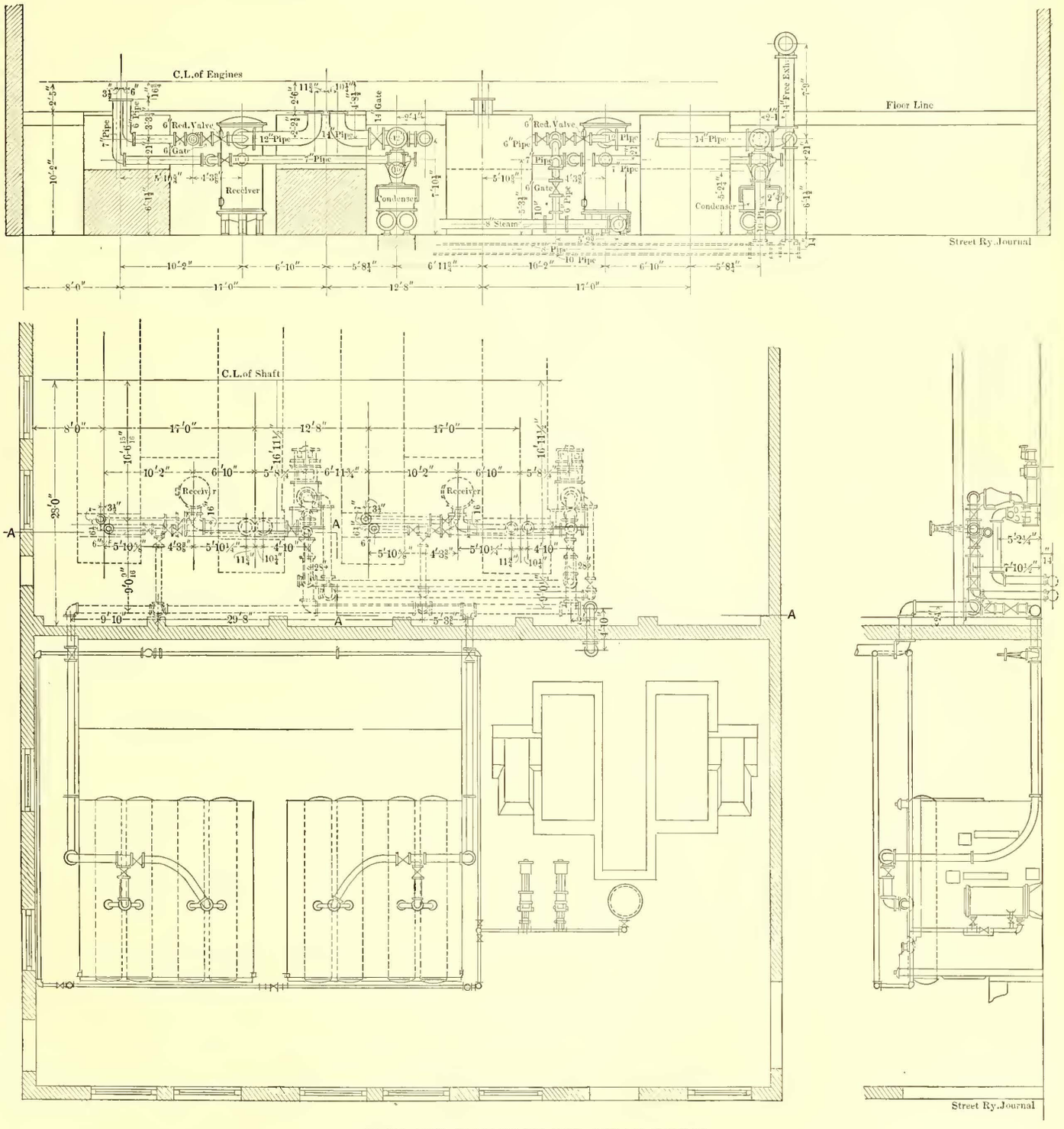
The prospects are very bright for the extension of the road and the building of branches. Already material is on the ground for the building of a branch from North Oxford to Rockdale and Leicester. The capacity of the power station is ample to accommodate much larger loads than is at present required of it, but should an increase be necessary the building can readily be enlarged and one or more additional generators be installed. The transmission is at 11,000 volts, so that the line might be considerably lengthened without changing the type of central station or sub-station equipment. That such extension will be made in the near future in the direction of Hartford is practically assured, and, when completed, this system will provide a direct and almost straight line from Worcester to Hartford, a distance of about 62 miles.

The 20 miles of road already completed run through a



PLAN AND SECTIONAL VIEW OF POWER HOUSE AT CHARLTON CITY, MASS.

magnificent New England country, with fine scenery throughout the entire distance. The service which has been provided has made this route a most enjoyable pleasure and excursion run for summer trips, but the arrangement of the closed cars is such that even in the colder weather there will probably be much pleasure riding. A half-hour schedule is at present in operation, and the service is such that, although a single-track road, there is little trouble in keeping the runs up to the time-table and preventing delays at the turnout.



PLAN AND ELEVATION FOR STEAM PIPING

POWER STATION

The power station, which supplies the entire line, is at Charlton City, a little more than half way between Worcester and Southbridge. The site is on an old water privilege, which allows ample water for condensation for the present plant, with sufficient surplus for supplying a duplication of the apparatus now installed should occasion require such enlargement. This water is excellent for boiler feeding purposes as well.

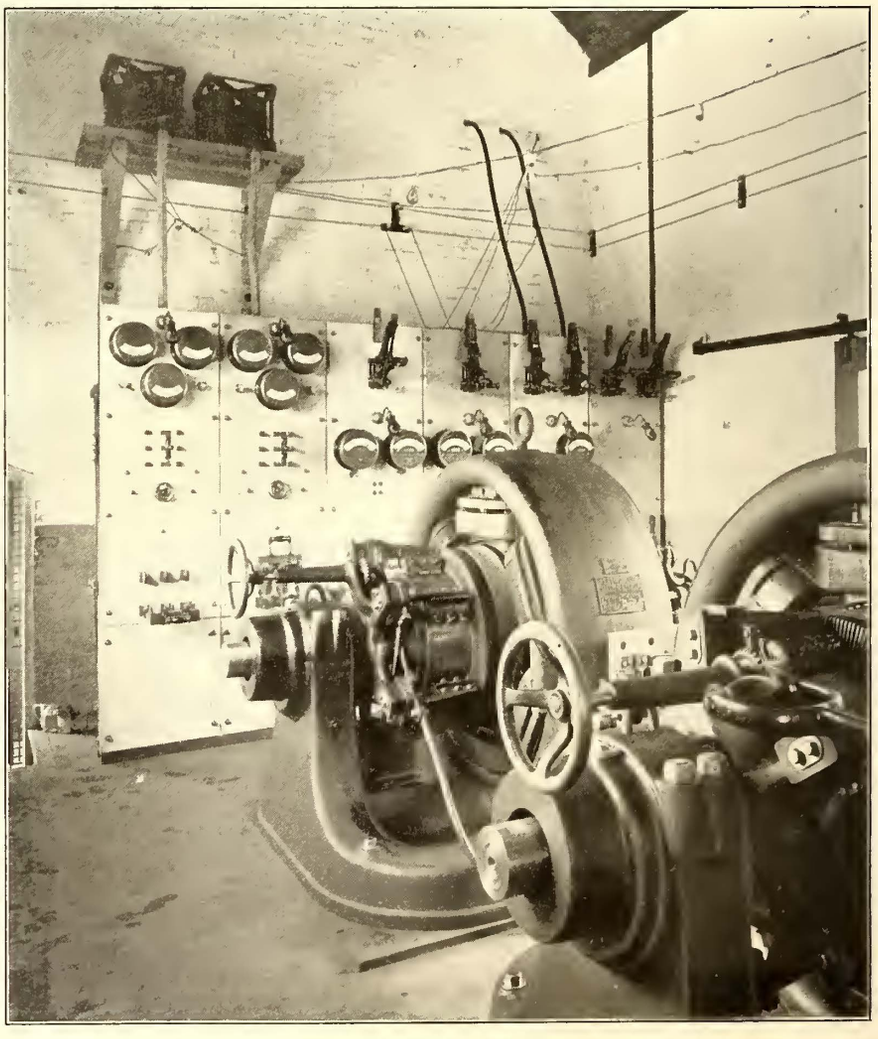
The building is a handsome brick structure with granite and terra-cotta trimmings, and is located on the banks of the stream supplying the condensing water. It has 85 ft. 8 ins. frontage by 100 ft. deep, and is subdivided by a brick wall into an engine room 44 ft. 6 ins. deep, and a boiler room. Under the floor of the engine room is a basement 9 ft. high, which is well lighted and contains the condensers, fire pumps, large transformers, some of the heavier rheostats, oil room, etc. The engine room is 23 ft. high at the sides and 45 ft. to the peak of the roof. At the end of the engine room is a shipping platform and large doors, while the entrance for ordinary usage is at the front. At the side of this entrance the front wall projects out considerably, giving accommodation for the high-tension switchboards.

ONE OF THE SUB-STATIONS.

The building has damp-proof granite underpinning extending entirely around it. The roofs are made of fireproof material, terra-cotta slabs supported on steel trusses and evened off with cement to receive black slate for the pitched roof, and tar and gravel on the level portions. The boiler room is ventilated by two deck houses on the roof immediately above the boilers, each 12 ft. square, and fitted with pivoted sash, while sufficient ventilation is given to the engine room by the large windows extending up into the peak of the roof at the gable ends. The floor of the basement under the engine room and that of the boiler room are made of concrete cement. The engine room floor is constructed of masonry arches supported by steel girders, and consists of crushed stone and Portland cement concrete. All foundations for engines and generators are laid up in solid brick work in Portland cement mortar and thoroughly grouted in liquid Portland cement. All visible masonry, including settings for fans, pumps, condensers, etc., and all ceilings, are coated with water fireproof paint.

The boiler equipment consists of four 300-hp water-tube boilers made by the Babcock & Wilcox Company, arranged in two batteries of two boilers each. The safe working pressure for these boilers is 160 lbs. Roney mechancial stokers, operated by Westinghouse engines, are attached to each boiler. Induced draft is supplied by two engine-driven, direct-connected fans, placed at the base of the stack. This stack extends a few feet only above the roof, the mechanical draft being depended upon at all times. As each fan is large enough to operate a plant of twice the size of the one now installed, no difficulty from lack of draft is possible even should one of them become entirely disabled. Above the boilers are placed economizers made by the Green Fuel Economizer Company. The mechanical scrapers for keeping the tubes of these economizers in a clean condition are operated by shafting belted to the fan engines at the base of the stack. The feed-water is passed through a National feed-water heater supplied with steam from the auxiliaries, and is raised to a temperature of about 290 degs. F. before entering the boilers. Two Dean feed pumps, either of which is large enough to supply the four boilers, are installed. Between the engine room and the boilers is the Holly steam loop and gravity return system, which returns all water of condensation to the boilers, the steam jackets with which both the high-pressure and low-pressure cylinders of the engines are fitted being connected thereto.

Behind the boiler house is a well, from which ample condensing water can always be obtained, as it is supplied from the creek before mentioned. The coal pockets are also behind the building. Tracks, turntables, cars, etc., furnished by the C. W. Hunt Company, of New York, are laid so as to facilitate the handling of coal, and a weighing scale is placed at the entrance to the boiler room. The piping, which, like the rest of the plant, was designed by Westinghouse, Church, Kerr & Company, of New York, is of extra heavy pipe. No elbows are used, the pipes being bent. The pipe covering was furnished by the H. W. Johns-Manville Company, of New York. The piping between the boilers and engines is placed under the engine room floor. In the spaces between the machinery foundations are placed two Worthington jet condensers. These run at a speed of from 19 r. p. m. to 22 r. p. m., and their dimensions are 8-in. x 12-in. x 14-in. x 10-in. stroke.



ROTARY CONVERTER IN SUB-STATION

The two engines are of the cross-compound type, 16-in.

and 32-in. by 42-in. stroke. They represent the latest form of the well-known Rice & Sargent design, and were built by the Providence Engineering Works. Both high-pressure and low-pressure cylinders are jacketed with live steam, and between the two cylinders, underneath the floor, is a superheating receiver. The rated capacity of each engine is 600 hp. Wright governors are used, and the Monarch engine stop has been installed on the engine throttles and on the condensers.

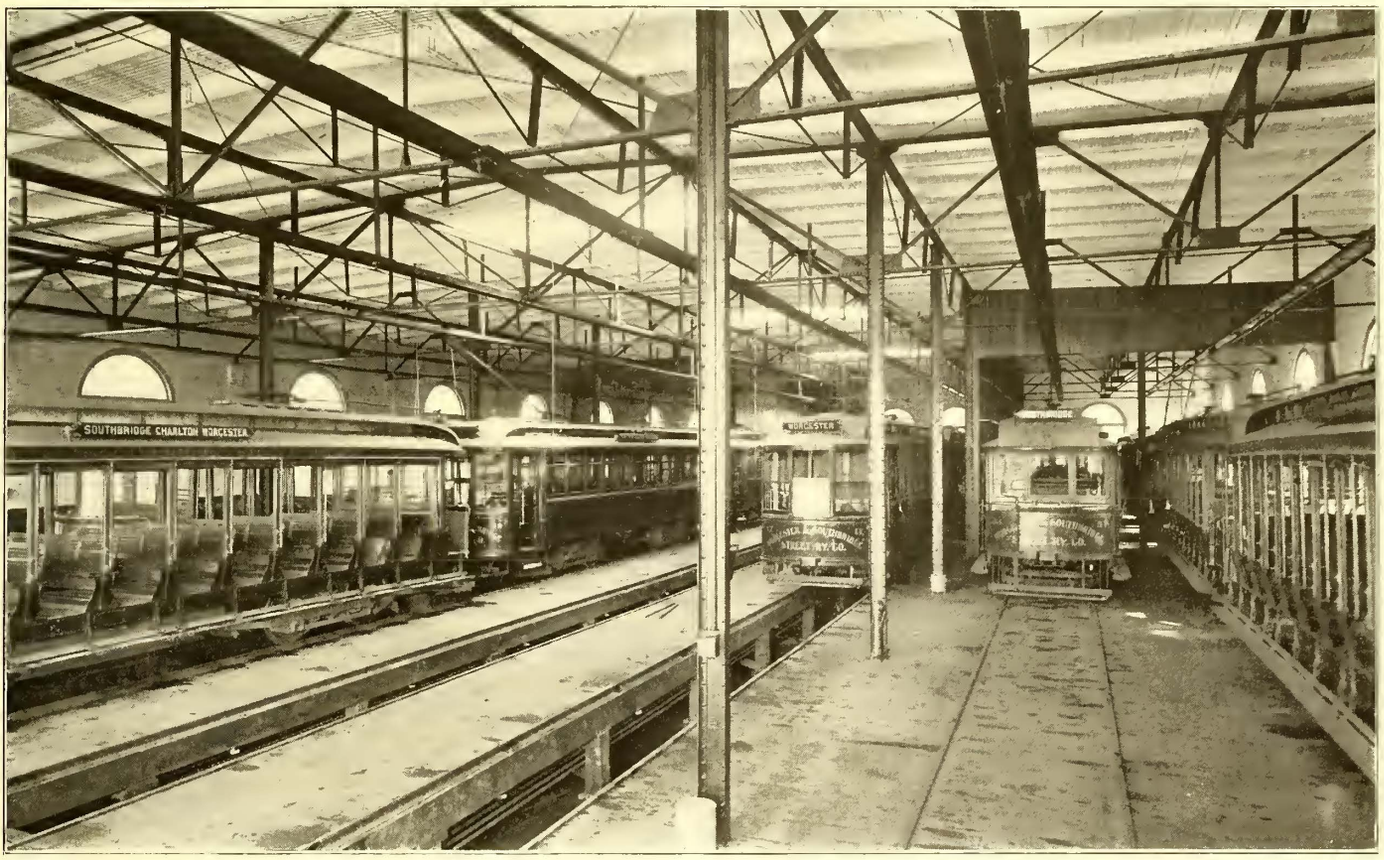
The generators are double-current machines with both the direct-current commutator and alternating collector rings at the same end of the armature. They have a capacity of 400 kw each, and the entire load can be taken from the machine as either direct current or alternating current. This is a great advantage in a railway system of this type, as the traffic at times is extremely heavy near the end of the road, while at others it is quite evenly distributed throughout the entire length. The direct-current voltage is 550 volts, the alternations are 3000 per minute, and the speed 115 r. p. m. The generators are separately excited, but have a compound winding from the direct-current side. On account of the alternating-current regulation they are not over compounded. Arrangements are made at the switchboard so that the shunt winding can be excited from the direct-current side of the machine if desirable, but in general the induction-motor exciter sets are used on the field.

The generators are separately excited by two direct-connected motor-driven exciters. The motors are Westinghouse Type C induction motors, 20 hp, 335 volts and 720 r. p. m. They take current directly from the alternating end of the double-current generators without transformation. In starting, the "auto-starter" is used. This consists of a resistance box on which is placed a double-throw switch. In one position the right connections and combinations of resistance are made for starting the induction motor, and when up to speed it is put directly into circuit by throwing over the switch. The motors are connected by a flexible coupling to 550-volt direct-connected generators of 15-kw capacity. Either one of the exciter sets can furnish enough current for both generators.

The transformers which convert the generator current at 335 volts to the line current at 11,000 volts are placed in the basement. The floor above them is open, so that at all times they are ready for inspection. There are three transformers of 200 kw each and of the oil-cooled type.

The switchboard apparatus is all of Westinghouse standard make. The low-tension board, containing the 550-volt trolley current and the 335-volt alternating current from the generators, sets out into the room, leaving considerable space behind it. This space is increased by the extension forward of the front wall, and a roomy alcove is made for the high-tension apparatus. The low-tension board and a high wire fence at each end prevent access to this part of the station. There are seven panels of blue Vermont marble on the low-tension board, three being used for alternating current and four for direct current. Alternating current is used for lighting the power station and car house, auxiliary switchboards being placed in both buildings for this purpose. A storage battery is provided, and, by means of throw-over switches on the lighting boards, the circuits can be connected to this source of current when the plant is shut down.

There is a traveling crane running the entire length of the engine room. This crane has a capacity of 20 tons, and was built by the Whiting Foundry Equipment Company. A steam-driven Westinghouse air compressor is installed in the basement which furnishes compressed air for blowing dust out of the generators, etc. This compressed air is also used in connection with the automatic oiling system. The oil is circulated by means of gravity and is forced to the upper tank by the compressed air.



INTERIOR OF CAR HOUSE

Cross filters are used for purifying the oil. There is a fireproof oil room in a corner of the basement. This room is 8 ft. by 12 ft., built of brick, with iron doors, and so arranged that the lubricating oils and grease can be placed in it directly from a car on an adjacent track. In the basement is also a Worthington fire pump having a capacity of 1000 gals. per minute, or four good 1¼-in. smooth-nozzle streams.

CAR HOUSE OF WORCESTER & SOUTHBRIDGE RAILWAY

SUB-STATIONS

There are two sub-stations, one at North Oxford, on the road to Worcester, and the other near the Southbridge terminus. Each of these stations is equipped with six 75-kw oil-cooled step-down transformers, and two 200-kw rotary converters. The switchboards consist of two alternating-current panels, two direct-current panels and a double feeder panel. There are also high-tension alternating lightning arresters and circuit breakers. Besides being built with large waiting rooms for passengers, the sub-stations will form an important adjunct in the development of the freight and express business contemplated by the company.

CAR HOUSE

The main car house is situated at Charlton City, near the power station. It is directly on the railway, and contains the operating offices of the company. The dimensions of the main building are 90 ft. 8 ins. wide by 191 ft. 8 ins. deep, and there is an addition on one side used as a supply house, etc., 22 ft. by 42 ft. The capacity for storage is twenty-eight cars of the largest type. On one side two tracks are partitioned off from the main room, making a paint shop 104 ft. in depth, and on the other side a repair shop 62 ft. in depth is made by enclosing two tracks. The car house is built of brick with granite foundations and sandstone window ledges and trimmings. The roof is supported on steel trusses and columns, and is covered with tar and gravel on flat portions and black slate on the pitched roofs. The doors extending across the entire front of the car house, as well as those closing the paint shop and repair shop, are of the steel rolling type, made and erected by the Kinnear Manufacturing Company, of Columbus, Ohio. The interior is lighted by large windows in the exterior walls, and by 8-ft. x 22-ft. skylights placed in the roof.

The ground floor of the supply house offers accommodation for repair wagons, two stalls for horses, and a fireproof oil room. The second floor is utilized for storing supplies of a costly or delicate nature; there is also provided a room having a capacity of 1500 cu. ft. for sand, which feeds by gravity to an outlet at the floor level of the car house. The entire surface of the main floor has been excavated to the depth of 4 ft. and concreted and so graded as to drain to a given point.

At the corner of the main building is a two-story addition used for office purposes, etc. On the first floor is the employees' lobby, or lounging room, 16 ft. by 22 ft., containing a fireplace, reading table and lockers. The locker room proper adjoins this room, as do also bath and toilet rooms. The second floor contains the general office, superintendent's private office, supply room, lavatory, etc. The finish of this portion of the building is red oak, with floors of Southern rift pine. The windows are provided with screens, outside awnings and shades, making a very pleasant interior. In the basement of the office is a low-pressure 60-hp tubular boiler, used for heating the entire car house. There is also a hot-water heater for supplying the bath fixtures. Two standpipes are located in the car house, each fitted with 100 ft. of 2½-in. linen hose, and outside are five two-way hydrants. These are all connected with the fire pump in the power station. In addition,

AN ELEVATED CROSSING

chemical fire pails are distributed throughout the entire building.

ROLLING STOCK

The equipment consists at present of twenty long, double-truck cars, eight closed and twelve open. These were all built by the Osgood Bradley Car Works, of Worcester, and are equipped with Laconia trucks and Westinghouse No. 49 (35-hp) motors. The closed cars are 42 ft. 4 ins. over all, with 32-ft. car bodies. The width is 7 ft. 10 ins., height inside 8 ft., and height from head of rail to top of roof 11 ft. 4½ ins. The cars are finished in cherry, with plate-glass double windows, 24 ins. x 26 ins. and 10 ins. x 26 ins., fitted with spring-rolling Pantasote curtains on Hartshorn rollers, and equipped with fixtures made by the Curtain Supply Company, Chicago. The cars are of the straight-sided type, with vestibules 4 ft. 8 ins. at each end. Folding doors are used at the sides of the vestibules, and single sliding doors at the end of the cars. The vestibule shades for these latter doors are on vertical rollers at the side of the jamb, and unroll as the door is closed. They were supplied by the Trolley Vestibule Shade Company. The capacity is forty-eight passengers, and the seating arrangement is similar to that originated in Worcester some years ago and found to be very satisfactory where the traffic is made up of mixed local and long-distance riders. At the center of the car are five walk-over seats on each side, and at the ends are longitudinal seats. The seats are covered with red plush, and were furnished by the Heywood Brothers and Wakefield Company, of Wakefield, Mass. The walk-over seats are of the well-known Wheeler pattern, with grab handles at the upper corner. At the ends of the cars hold-straps are provided for standing passengers. The cars are painted a handsome olive green with neat gold lettering.

The open cars are 44 ft. 9 ins. over all, 7 ft. 1 in. wide at the sills, and 7 ft. 6 ins. wide at the seat rail. They are 7 ft. 6 ins. high inside, and the distance from head of rail to top of roof is 11 ft. The cars have bulkheads fitted with plate-glass windows, but no vestibules. The roofs are of the steam-car type. There are fifteen benches, eleven of which have reversible backs. The finish is of ash with solid bronze trimmings. Pantasote side curtains which can be pulled down to the floor of the car in bad weather are placed between the side posts.

The trucks for both open and closed cars are of a type perfected especially for this class of service, and built by the Laconia Car Company Works, of Boston. They have a wheel-base of 5 ft. 4 ins., and the diameter of the wheel is 33 ins. A ⅞-in. flange is used. Each truck carries two of the 35-hp motors, making a total of 140 hp per car. The gear ratio is 18 to 64. The other electrical equipment comprises two trolleys, two controllers, two circuit-breaker switches, fuses, lightning arresters, etc. Arc headlights are used made by the Dayton Manufacturing Company, of Dayton, Ohio. Both open and closed cars are equipped with the Standard Traction Brake Company's system of motor-driven compressors and air brakes, and are supplied with whistles, as well as gongs.

There is also operated a parlor car, which can be used as a directors' car or leased to private parties. This car is very handsomely fitted up with mirrors, buffet, writing desk, etc., and is equipped with wicker easy chairs, instead of fixed seats. The buffet is supplied with glasses, plates and silverware, every article being marked with the name of the car, "Huguenot." There are smoking and toilet rooms and every convenience ordinarily found on the steam roads. Arrangements are being made with connecting lines so that this car can be operated on any road in the State, and it has already become so popular with excursion, theater, wedding and special parties that engagements are booked for months ahead.

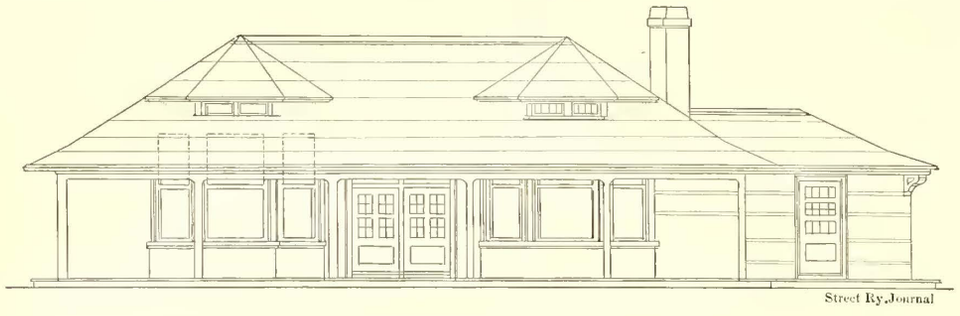
Several express, baggage and mail cars have been ordered from the Wason Manufacturing Company, of Springfield. These will be used for the freight and express business, as well as for carrying the mails. A special compartment in each car for the use of the mail clerks will be fitted up.

STATION AT PINEHURST PARK

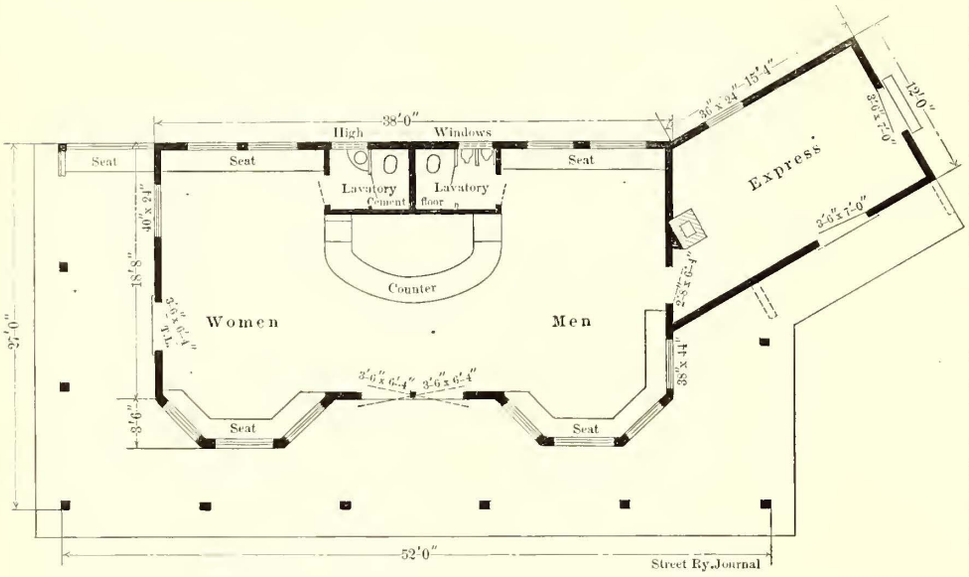
THE ROAD

No expense has been spared in making the permanent way, overhead construction, waiting stations, etc., of the Worcester & Southbridge Railway up to the best standards of electric road building in the country. The larger portion of the line runs on the company's own right of way, and about half of the entire line is rock ballasted, the remainder being gravel. The rail is a 70-lb. T, A. S. C. E. section, laid in 60-ft. lengths on 6-in. chestnut ties placed 20 ins. center to center. The overhead material was manufactured by the Albert & J. M. Anderson Manufacturing Company, of Boston. Mr. John P. Coghlin, of the Page Electric Company, Worcester, was the road's electrical engineer, and in addition to the laying out of the power plant also erected for the company all the overhead work. Plain iron brackets attached to wooden poles spaced 70 ft. apart support the trolley wire. Double trolley wires are used, obviating the necessity of overhead switches at the turn-outs, as well as giving sufficient carrying capacity to dispense with other feed-wires from the main and sub-stations. The trolley wire is of the grooved type, held firmly in screwed clips without soldering. No. 0000 B. & S. gage is used. The 11,000-volt three-phase transmission lines are carried at the top of the poles on heavy porcelain insulators with extra wide petti-

coats. supplied by C. S. Knowles, of Boston. A feature of interest is the placing of signboards bearing the names of the stops along the line. These are suspended from brackets on the poles, and are painted white with black lettering. Eight waiting stations have been erected at



FRONT ELEVATION



GROUND PLAN OF WAITING STATION AT CHARLTON CITY, MASS

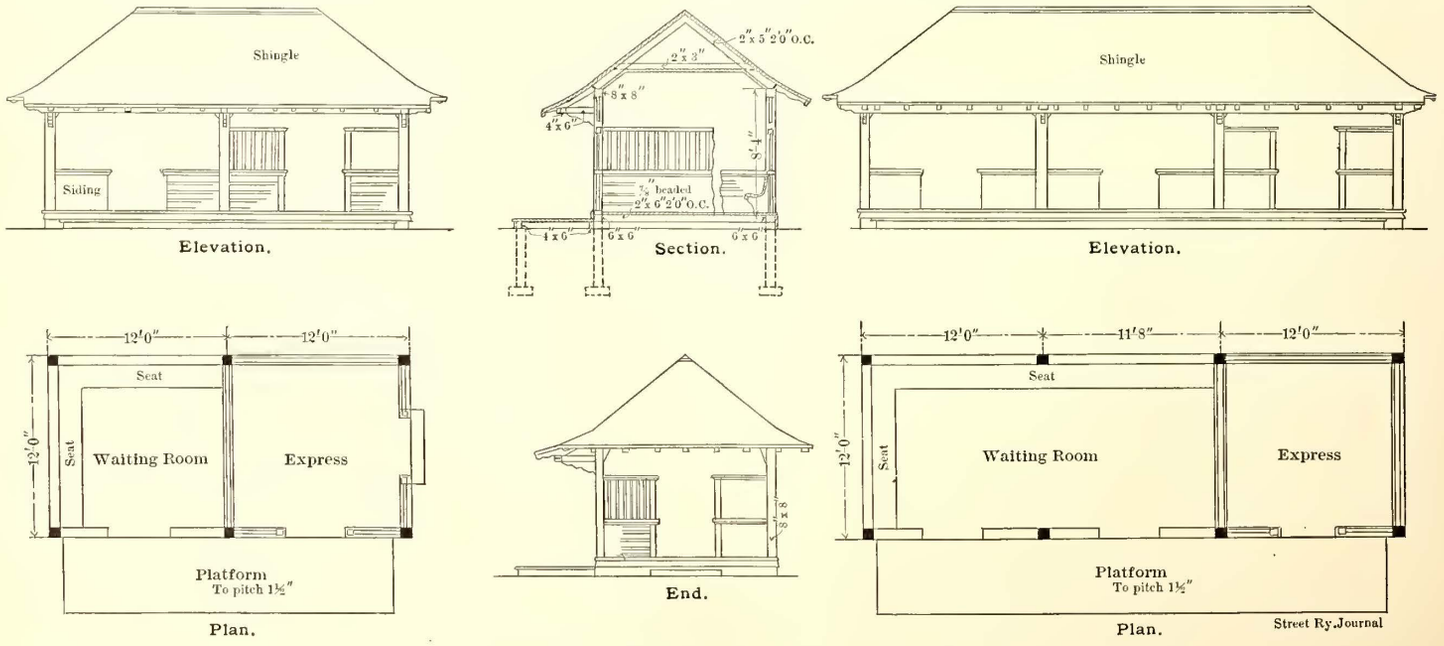
points along the line. A portion of each station is adapted to handling the express business, while the remainder is devoted to the accommodation of the road's patrons. These stations will be open in the summer time, but in winter glazed sash are placed around them. The accompanying illustrations show the general types placed along the road, and the more pretentious one built at Charlton City.

Besides five instruments connected with the exchanges of the New England Telegraph & Telephone Company at different points of the line, the road has a private telephone system of its own, and a private exchange with switchboard at the company's office in Charlton City, and is used as a despatcher station. Each car is provided with a portable telephone outfit, and connection to the line wires can be made at any place by means of a jointed pole carried in the car and equipped with contacts at the end. There are also telephones at the turnouts, sub-stations, etc., all connected to a main switchboard in the general office. All despatching is done by telephone. The road is also thoroughly protected against accident by an automatic block signal system put up by the United States Electric Signal Com-Company, West Newton, Mass.

The entire electrical equipment of the power plant, sub-stations and rolling stock was furnished by the Westinghouse Electric & Manufacturing Company.

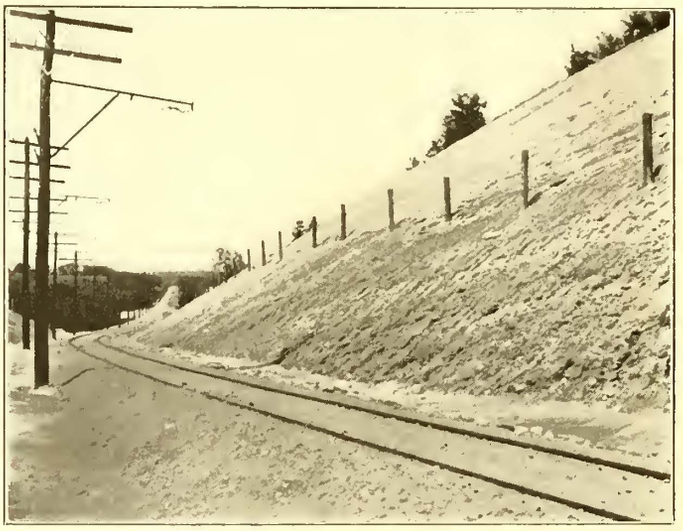
OPERATION

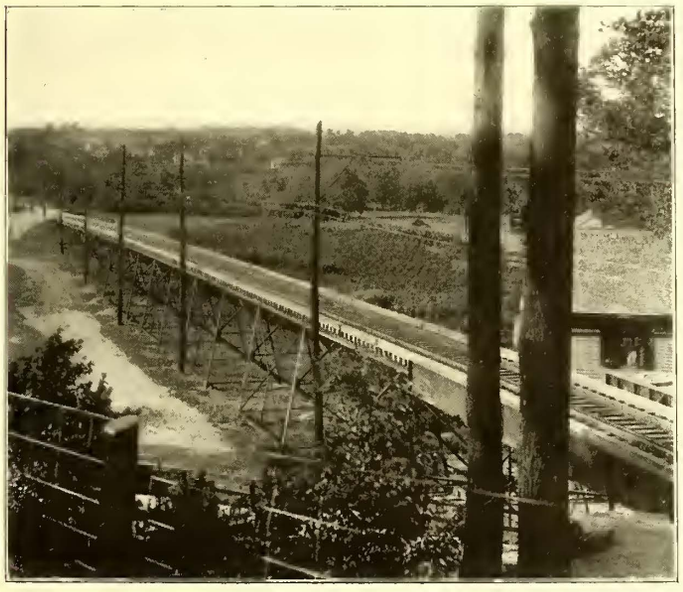
By a twenty-five-year traffic arrangement with the Worcester Consolidated, the Worcester & Southbridge can carry its passengers directly to City Hall Square, in the heart of the trolley systems of central Massachusetts, where transfers are given to the other lines. At a point just outside of Worcester, when leaving the city, conductors and registers are changed, and on approaching the city a Worcester Consolidated conductor and register are put on at New Worcester, where the companies' tracks connect. The rush to Pinehurst Park and Prospect Park, on the Southbridge road, in the town of Auburn, last season taxed the facilities of the road to the utmost, and far exceeded the most sanguine hopes of the officers. Arrangement are now being made for the building of a thoroughly up-to-date theater at Pinehurst Park.

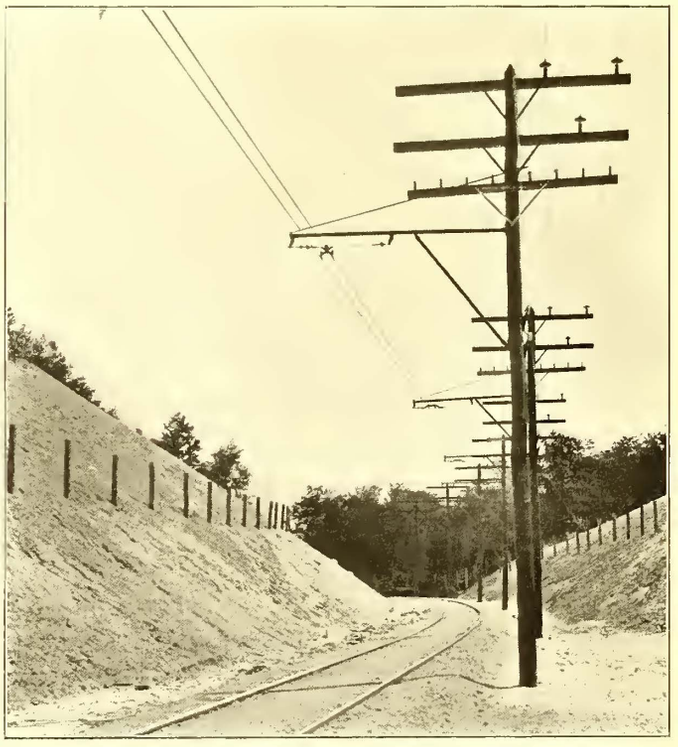


COMBINATION PASSENGER AND EXPRESS STATIONS

These are two of the most picturesque pleasure grounds near the city of Worcester, and the company's business last season shows how highly they are appreciated by the people. To provide for the increased traffic expected for next year additional turnouts and tracks are being provided between the parks and the city and additional open cars. Two other resorts are being fitted up farther down the line,







TYPICAL VIEWS ALONG THE ROADWAY

which will, it is hoped, divert some of the attendance from the present resorts.

The present schedule provides for a half-hour headway. It is intended to shorten this next season, probably at least 15 minutes. The distance of about 20 miles between Worcester and Southbridge is made in 75 minutes. The steam railroad time-table makes the time between the two stations from 70 minutes to 120 minutes.

The handling of freight and express matter is to be made a special feature by the management. The waiting stations described, together with special accommodations and arrangements at the terminals, among which is the securing of a large terminal near the Boston & Albany Railroad station in Worcester, give excellent facilities for competing with the old express service. It will be possible for the storekeepers in Southbridge to use the private telephone line of the railway company in ordering goods in Worcester and receive them within a few hours, while shopkeepers in both Southbridge and Worcester can send goods to the respective terminal and have them delivered to all parts of the system. Deliveries are made several times a day. Stamps sold by the railway will be used to prepay express charges, greatly simplifying the clerical work. The express cars will also carry United States mail.

ORGANIZATION

The officers of the Worcester & Southbridge syndicate are: Fred Thayer, president; Wilford A. Bailey, secretary, treasurer and general manager; George W. Wells, vice-president, and E. L. Parker, auditor. O. Willis Rugg, of Worcester, is engineer, and George M. Thompson, of Wakefield, Mass., consulting engineer and appraiser. The board of directors consists of Fred Thayer, Wilford A. Bailey, Edmund L. Parker, Samuel H. Colton, Frank D. Perry, Calvin D. Paige, George W. Wells and Albert B. Wells. The direct supervision of the road is under the superintendent, Leavenworth Wheeler, whose office is at Charlton City. H. W. Culver is chief engineer of the power station, and C. F. Harding, electrical engineer.

Third-Rail Electric Traction in Italy

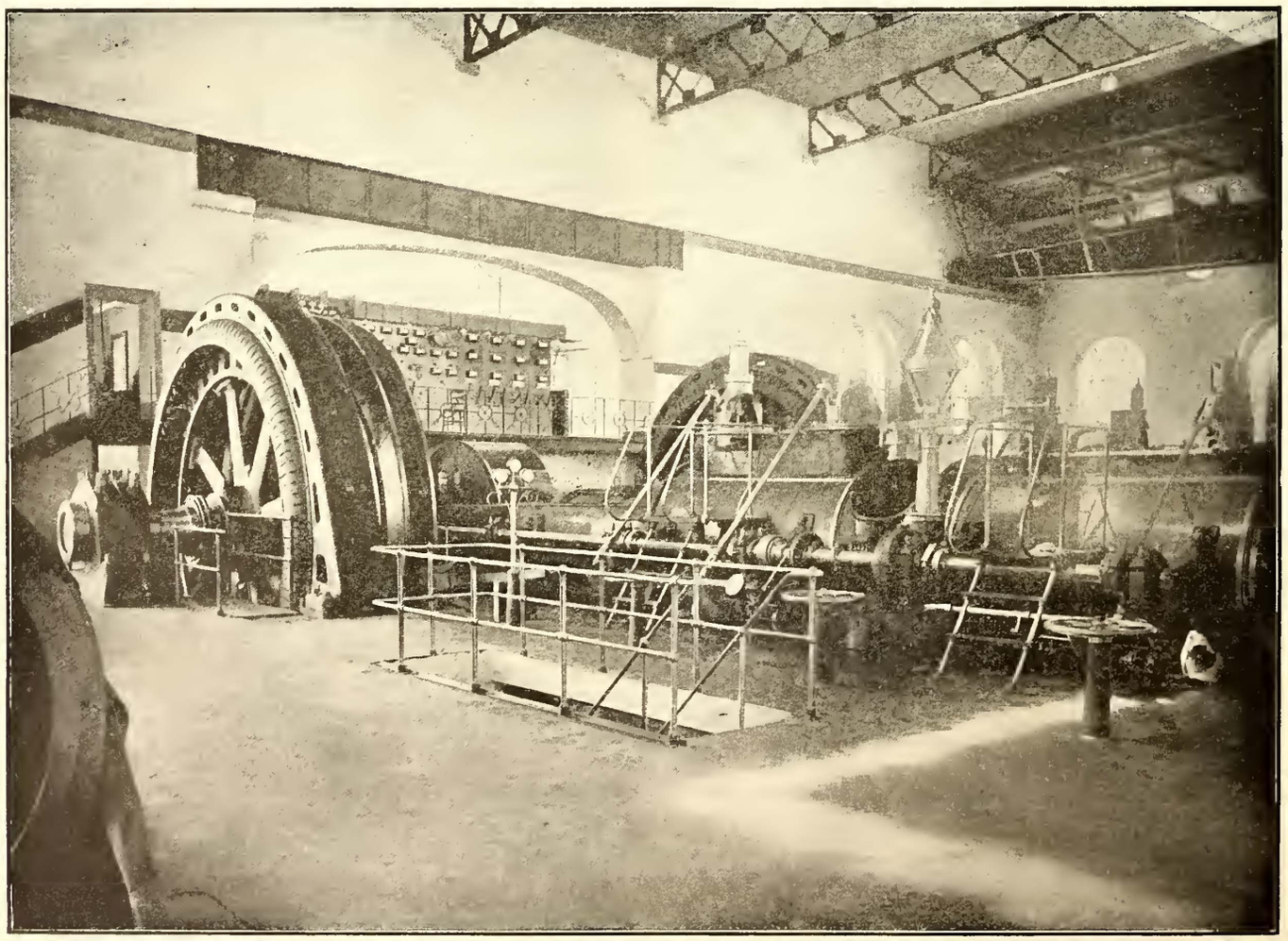
One of the very few interurban lines in Europe, and one of the few converted steam railroads in the world, is the third-rail electric railway between Milan and Porto Ceresio in Italy. This line is a part of the system of the Mediterranean Railroad Company, one of the largest railroad companies of Italy, and a description of some of the important features of the line was published in the STREET RAILWAY JOURNAL for August, 1901. At that time particulars were given of the distribution system and the rolling stock. They will not be repeated here, but a description will be given of the steam plant which has not been described, and which possesses a great number of novel features. The steam plant, although a very complete one, is for temporary use only, as the company is developing a water-power which is eventually to furnish power for the entire line, as well as for other industries in the neighborhood. On the completion of the hydraulic plant, now under construction, the steam plant will be used as a reserve.

The entire line, including power stations, was installed for the Mediterranean Railroad Company or to give the company its Italian title, "Società per le Strade Ferrate del Mediterraneo," by the "Compagnie d'Electricité Thomson-Houston de la Méditerranée." At present 47 miles of the line are in operation from Milan to Porto Ceresio, but the company proposes to extend the electric service to certain branch lines extending from Gallarate to Arona and to Laveno, which will comprise 25 miles more of track. The maximum schedule speed of the electric cars is from 50 miles to 60 miles an hour.

PARABIAGO SUB-STATION AND CROSSING OF HIGH-TENSION LINES WITH TRACK

The generating station of the plant is situated at Tornavento on the Ticino River.

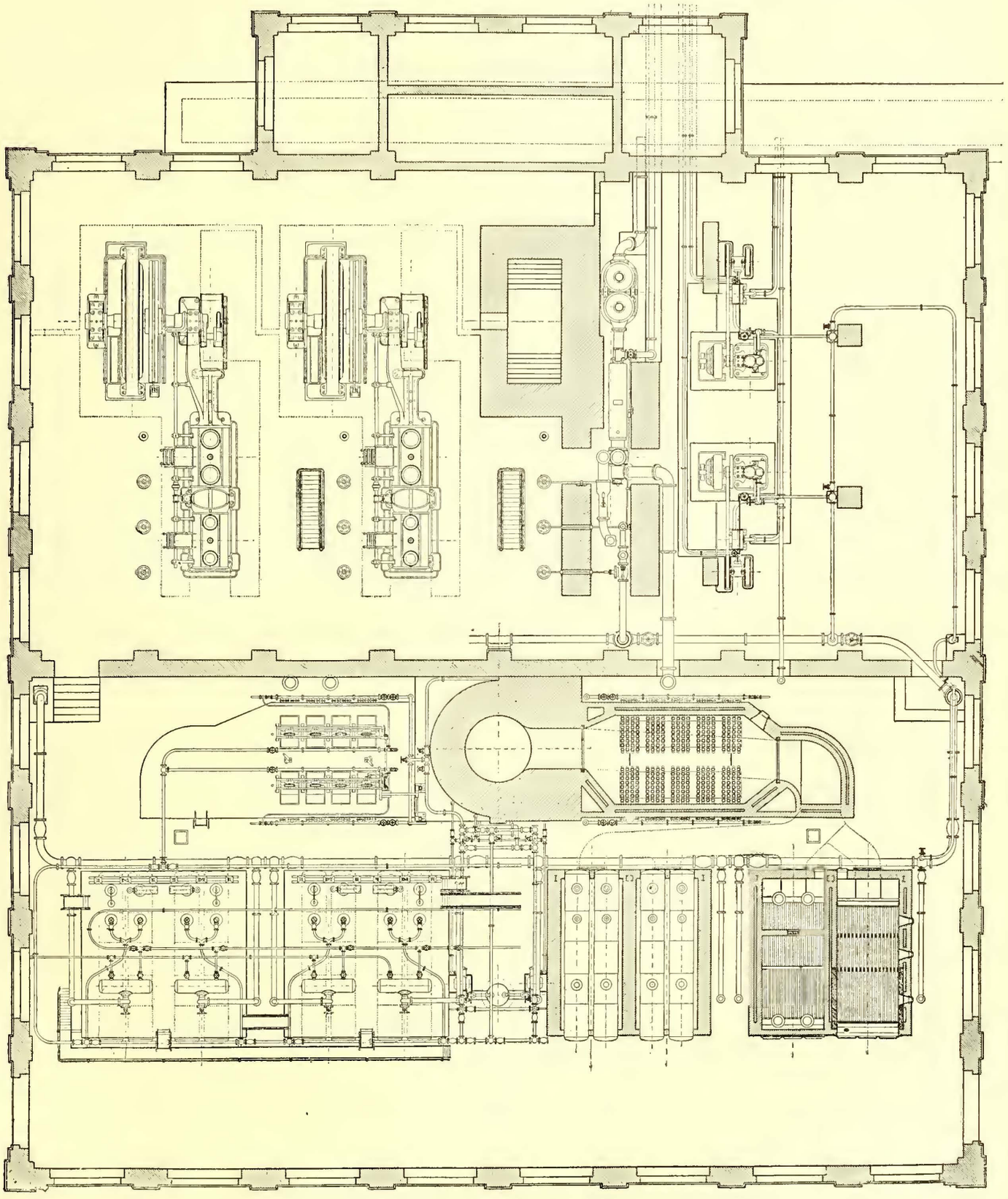
The present steam generating station consists of three high-tension, three-phase, 25 cycle alternators supplied by the General Electric Company, with a normal rating of 750 kw, but capable of working up for a short time to 1400 kw. Each alternator is coupled directly to a horizontal



GENERAL VIEW OF POWER STATION AT TORNAVENTO

tandem-compound steam engine. These steam engines, as well as the boiler plant, were supplied by the well-known firm of Franco Tosi, of Legnano. Although coupled to single-crank engines and driving rotaries, no trouble has been experienced in the synchronizing and the parallel running of the alternators. Since a number of very competent engineers had, during construction, expressed their doubt as to this result, it may be of interest to give in detail some particulars of the design and construction of the steam plant. The engines are also of interest, from the fact that poppet valves are used, which, though popular in Europe, are not in common use in this country for engines of the size of those in this plant.

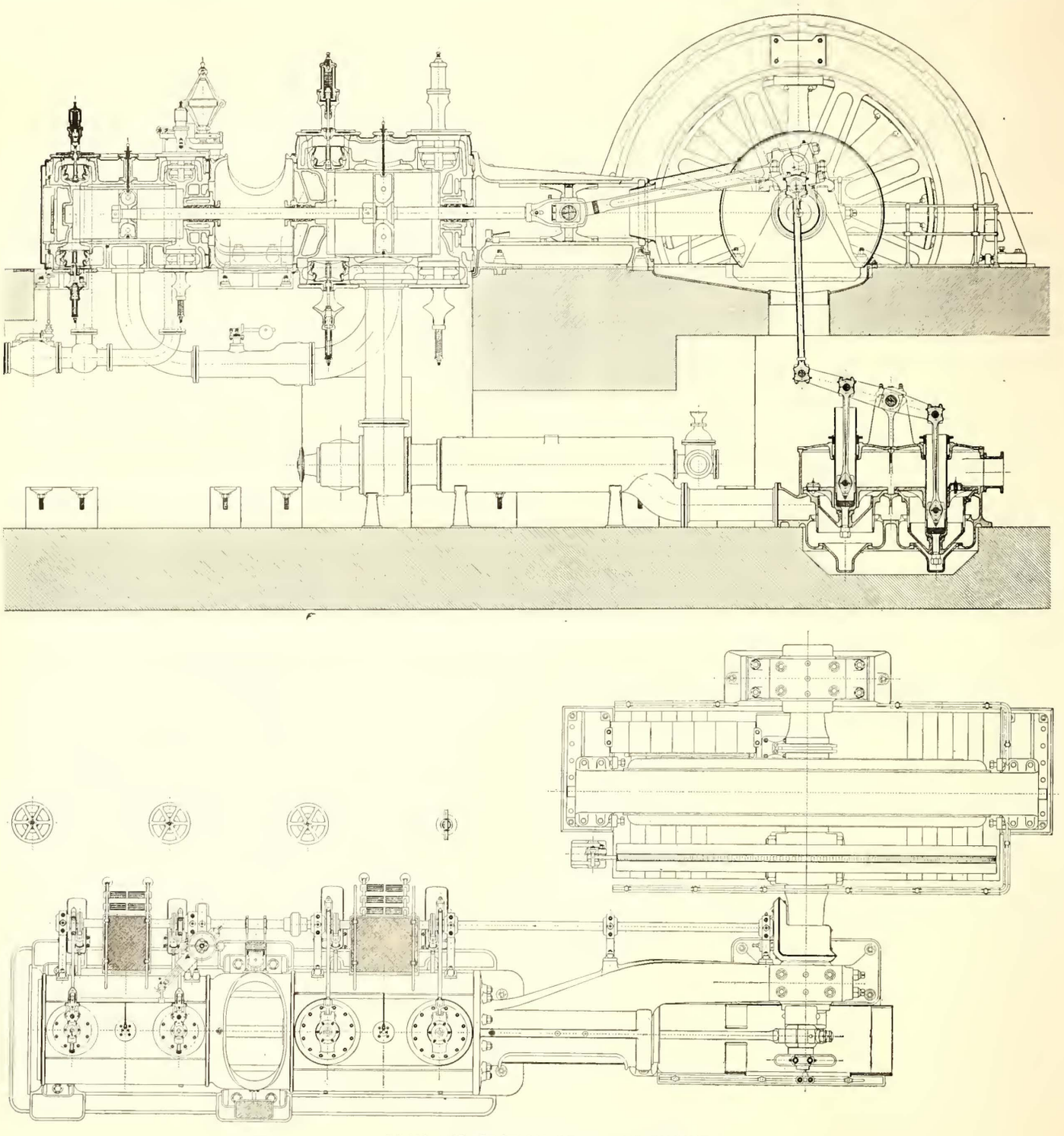
The three horizontal tandem compound condensing engines are of the following dimensions: Diameter of high-pressure cylinder, 29 ins. (725 mm); diameter of low-pressure cylinder, 48 ins. (1200 mm); length of stroke, 54 ins. (1350 mm). The number of r. p. m. is 94, and with an initial steam pressure of 147 lbs. (11 atm.), the engines develop from 1500 hp to 2000 hp each. In view of the



PLAN OF POWER STATION AT TORNAVENTO, SHOWING PIPING

great and instantaneous variations of load the engines are of especially heavy construction. Both engines are jacketed and the steam has to pass through the jacket to reach the steam valves. The cylinder heads are also jacketed in connection with main jacket.

The low-pressure cylinder is connected to the bayonet



PLAN AND SECTION OF 2000-HP ENGINE

frame and the high-pressure behind, so as to reduce the heat transmitted to the frame.

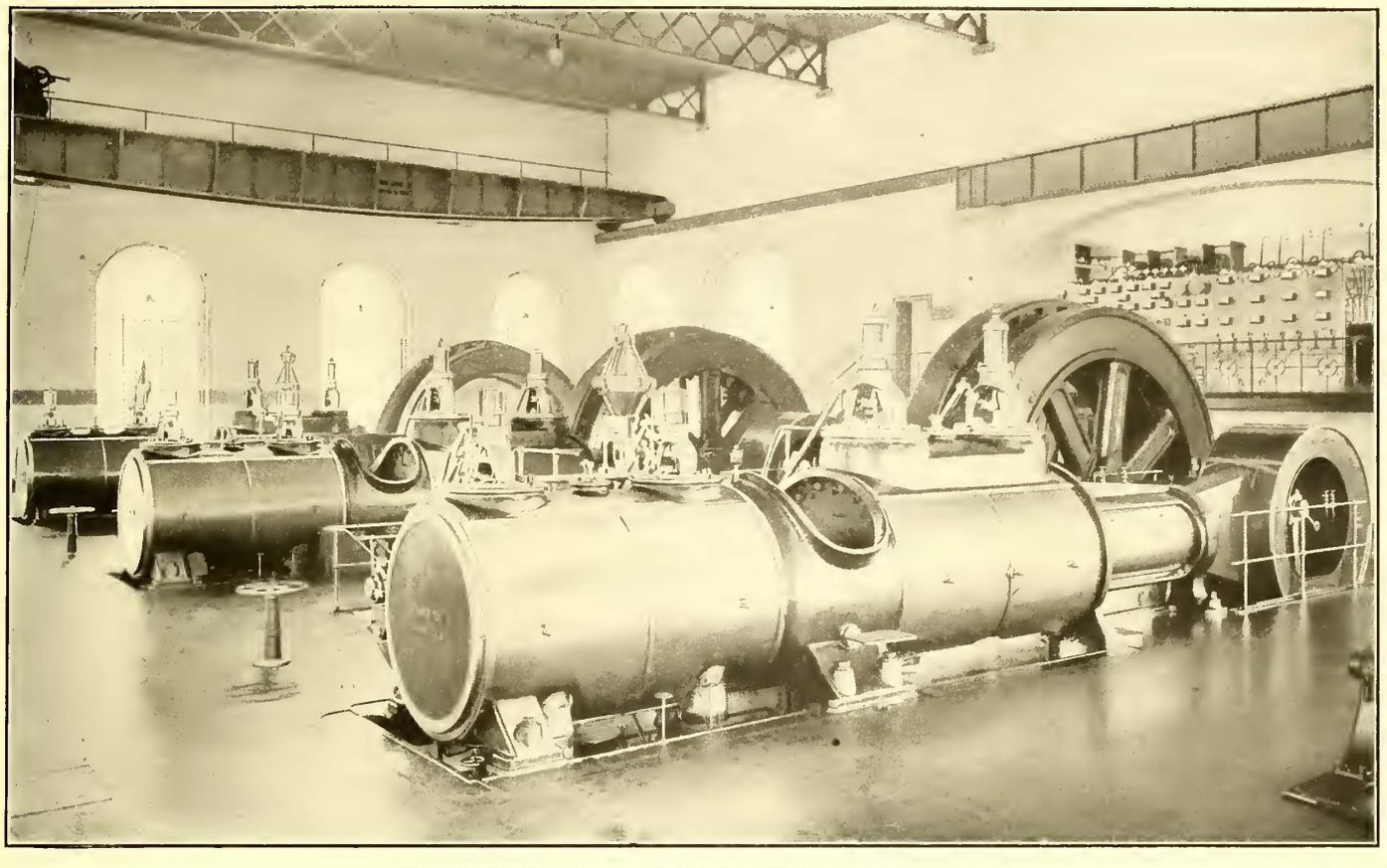
Each cylinder has four valves for the distribution of steam. These, as shown in the cylinder sections, are four-seated poppet valves by which the valve lift is reduced, and quick closure is obtained without throttling the steam.

The steam and exhaust valves of the low-pressure cylinder, as well as the exhaust valves of the high-pressure cylinder, are moved by means of cams which can be adjusted by hand to change the amount of load and compression. The valve gear for the high-pressure steam valves is a patented trip device, the advantage claimed for which is that the valve can be raised slowly, and thus without shock from its seat, and then opened quickly. As will be seen, rolling levers are used with air buffers of special device. Silent running is thus obtained, especially with small loads.

The governor is of the high-speed Porter type, driven from the revolving gear shaft by means of a worm gear. It will regulate the cut-off in the high-pressure cylinder from 0 to 60 per cent. The cut-off in the other cylinders can be varied by hand. The speed of the engine can be changed by means of a weight sliding on the governor lever.

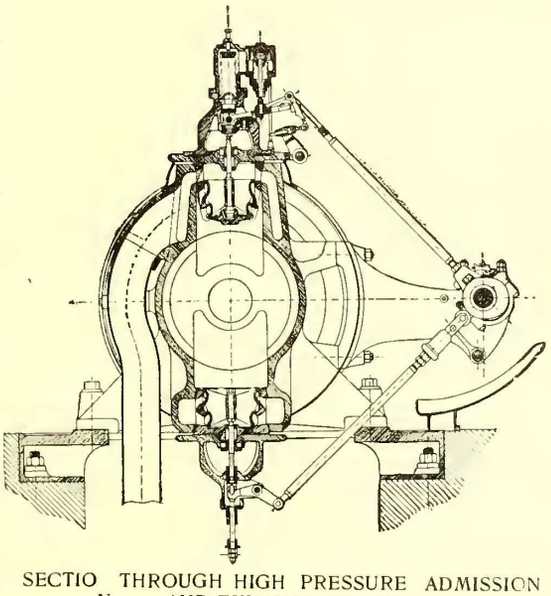
The pistons are made in one piece. The piston rings are in two halves, and to renew them or set them out it is only necessary to disconnect the piston rod from the cross head and slide the piston and rod backward until the rings clear the end of the cylinder. The adjustment or joint of the rings against the surface of the cylinder is effected by a

number of flat springs equally divided around the inner circumference of the ring, where they are held in slots cut into projecting lugs. The low-pressure piston is also easily accessible between the two cylinders.



THREE ENGINE AND GENERATOR UNITS, TORNAVENTO

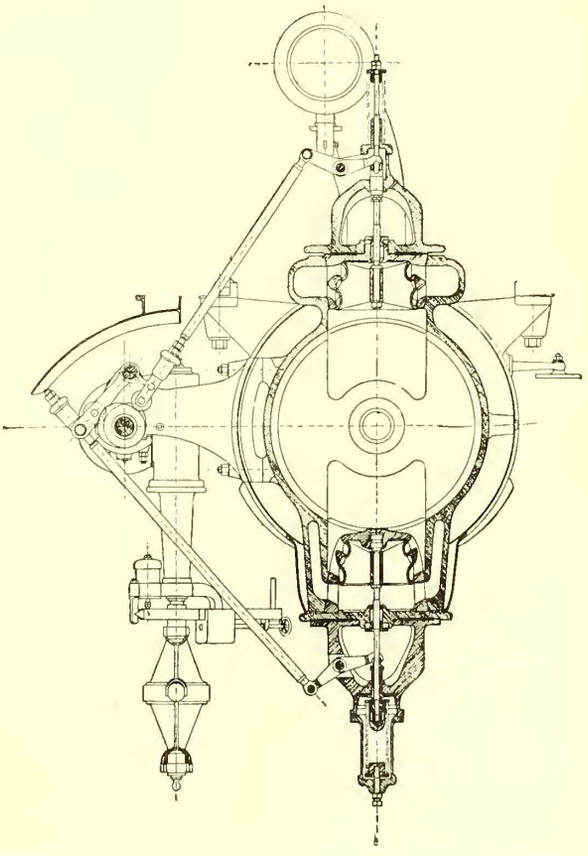
The bayonet frame is cast in one piece with the crank bearing, and rests on three supports. The crosshead guide is bored with recesses at both ends so that the slippers will obtain oil at each end of stroke. The crank shaft is of Siemens-Martin steel in one piece, and carries, adjoining each other, the flywheel of 18 ft. ½ in. (5500 mm) diameter, weighing thirty-seven tons, and the revolving part of the alternator. The crank bearing and the outboard bearing have babbitt metal lined bushes in four pieces, adjustable by means of set screws. The crank, which is shrunk on the shaft and keyed, the connecting rod, the cross-head and the crank-pin are all of Siemens-Martin steel, finished bright.



SECTIO THROUGH HIGH PRESSURE ADMISSION
N AND EXHAUST VALVES

The Duplex single acting air pump is driven from the crank-pin by means of a connecting rod and beam. Suction valves are omitted so that the resistance to the water entering the pump is reduced and a good vacuum obtained. The passages for the flow of water and air are of ample size in order to secure noiseless running at high speed, and the delivery valves are made easily accessible.

Both cylinders have direct lubrication to the inside; the horse-power cylinder has an additional oil supply through the steam valves. These oil supplies are fed from a sextuple pump, which draws from one oil receiver. The oil storage and pump are mounted in a very compact form on the brace



SECTION THROUGH LOW PRESSURE CYLINDER, SHOWING ADMISSION AND EXHAUST VALVES

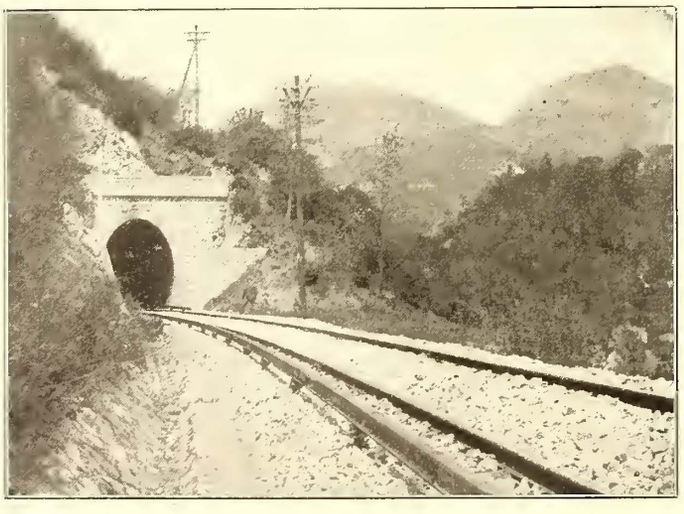
between the high and low-pressure cylinders, and the pump is driven from the gear shaft by two eccentrics.

The lubrication of all the journals and guides is made with little loss of oil is effected. This is also facilitated by the ample provision of oil trays and splashing guards.

The two vertical tandem compound high-speed condens-

INTERIOR OF SUB-STATION AT PARABIAGO

continuous from a reservoir placed about 10 ft. above the engine-room floor, and special care is taken to make the oil



THIRD RAIL AND HIGH TENSION LINE NEAR BISUSCHIO

flow rapidly over the surfaces which it has to lubricate, and then discharge through pipes into an oil filter located in the basement. From there the cleaned oil is pumped up again in the reservoir, and in this manner an abundant lubrication

ing engines are of the following dimensions: Diameter of high-pressure cylinder, 11 ins. (275 mm); diameter of low-pressure cylinder, 16 ins. (400 mm); length of stroke, 12 ins. (300 mm).

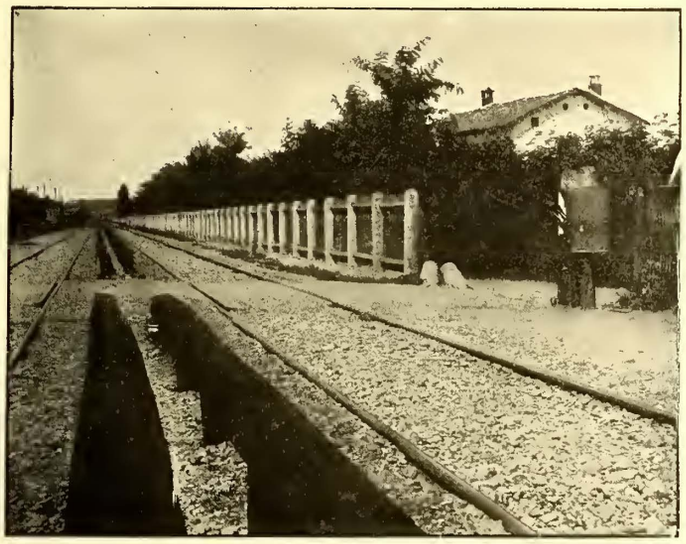
THIRD-RAIL EXPANSION JOINT, WITH PLATE REMOVED

The number of revolutions per minute is 270, and with an initial steam pressure of 147 lbs. (11 atm.) the engines develop from 85 hp to 125 hp each.

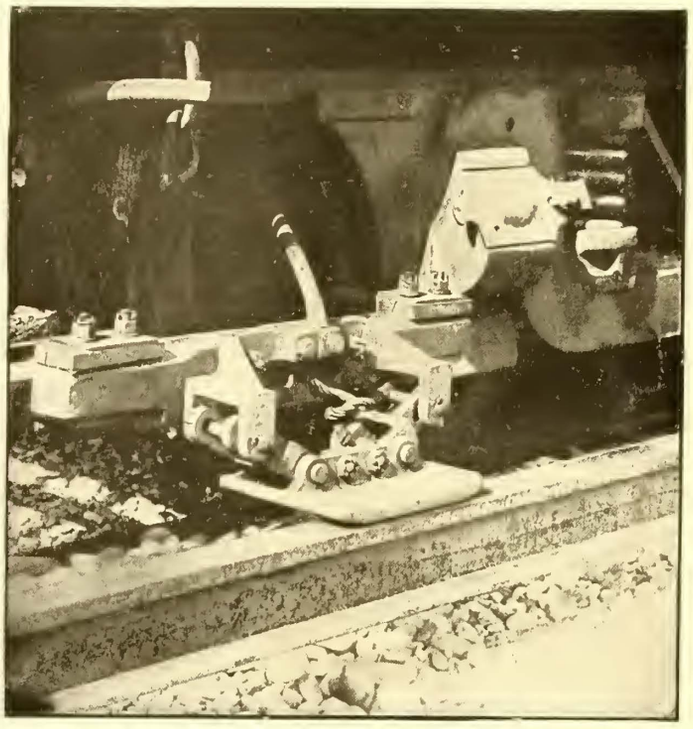
The two cylinders are cast in one piece, and have an

automatic metallic piston rod packing in the intermediate head. None of the cylinders of these engines is jacketed, but they are well covered with non-conducting material, and an exterior finish is made with planished sheet iron.

The distribution of the steam in both cylinders is effected by means of two balanced piston valves of the Tosi pattern. They are placed on the same rod and operated by one eccentric controlled by a shaft governor, which varies the cut-off from 0 to 50 per cent of the stroke.



VIEW OF TRACK AT STATION, SHOWING COVERED THIRD RAIL

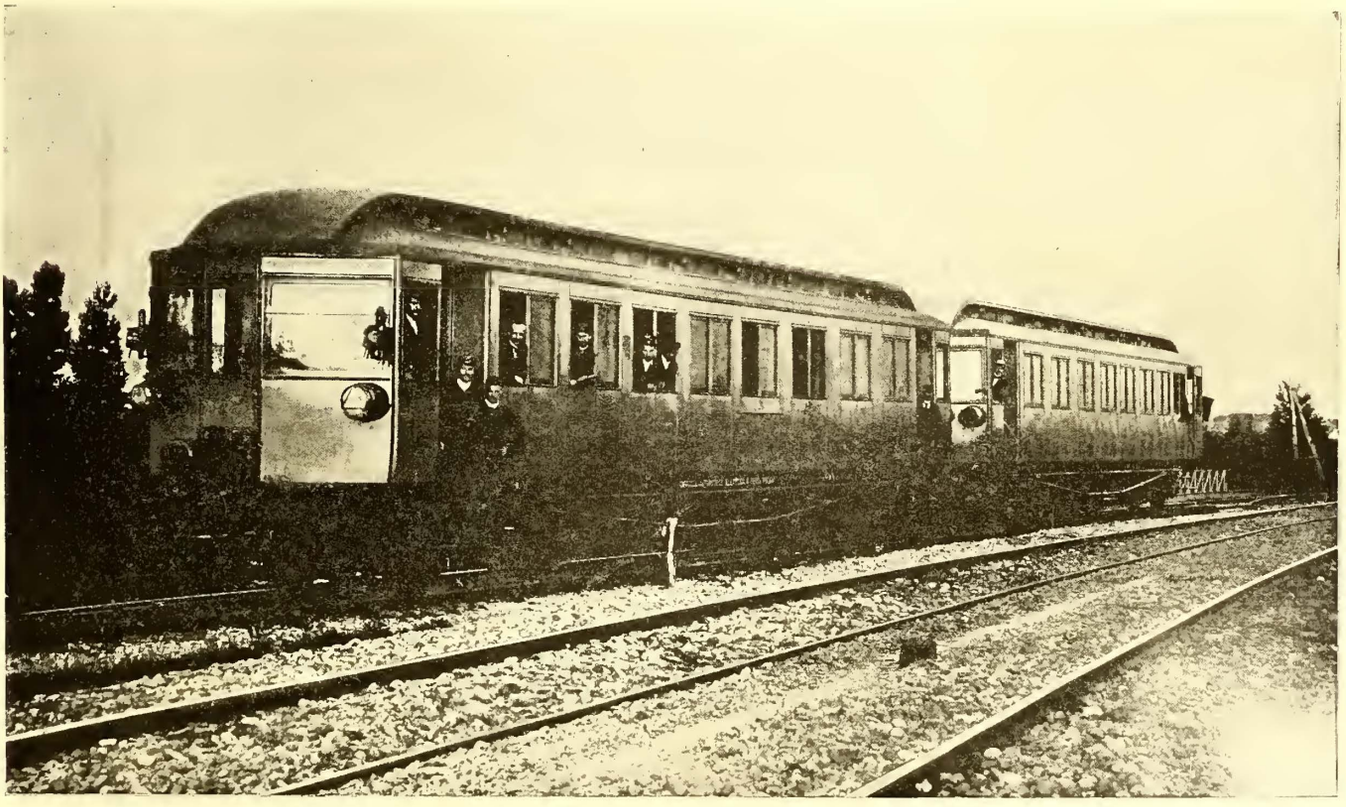


CONTACT SHOE ON MOTOR CAR

The frame is of the double-branched or "A" shape, cast together in one piece with the two bearings. The guides on this class of engines are bored. The hub of the fly-wheel is shaped into a small pulley to drive by belt the horizontal double-acting air pump placed underneath the floor with the condenser. This pulley is flanged for direct coupling to the exciter.

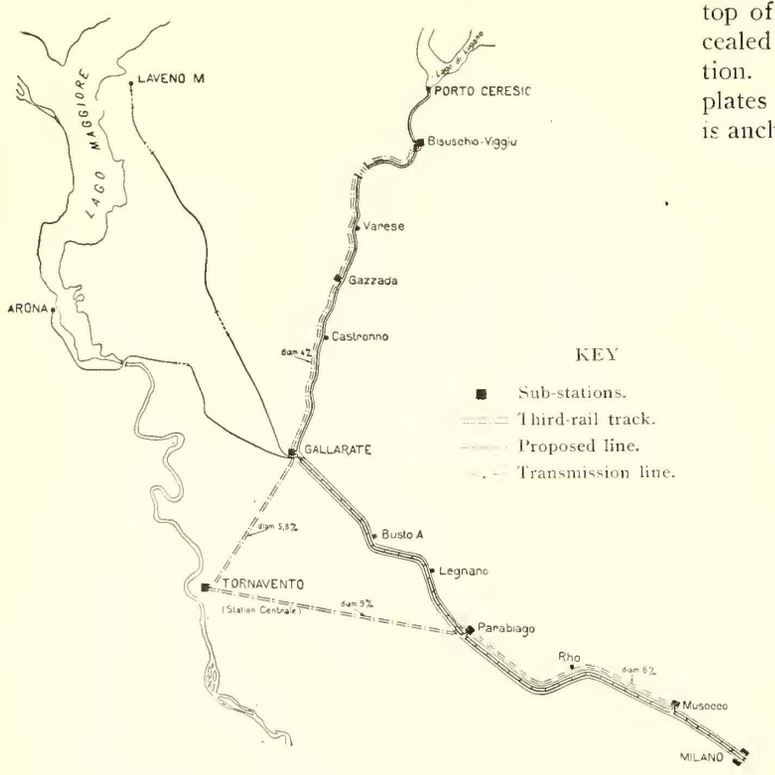
The boilers, of which there are eight, are also from the Tosi works, and are of the water-tube type. Each boiler has 312 sq. ft. (290 sqm.) heating surface, and 60.8 sq. ft. (5.65 (sqm.) grate surface. Each boiler has 144 tubes, 17 ft. ½ in. (5500 mm) long. The diameter of each of the two cylindrical steam and water drums is 3 ft. 7 ins. (1100 mm), and their length is 25 ft. 7 ins. (7810 mm).

The water tubes are inclined and fixed at each end into two headers, which are of approximately rectangular shape, and which connect on the top into two water legs terminating in the water drums. The two sides of the header are connected rigidly together by a strong and well-studied sys-



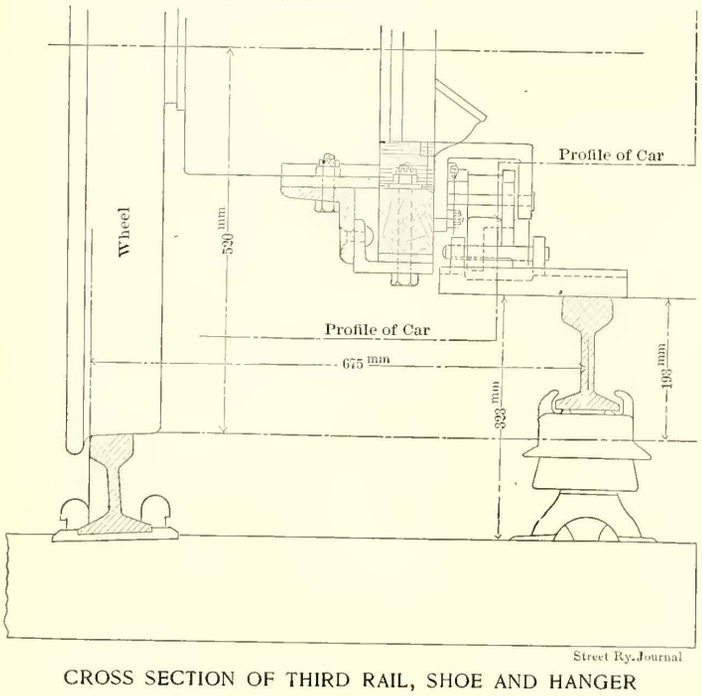
STANDARD MOTOR CAR AND TRAIL CAR

tem of braces. The outer plate of the header is provided with round holes, one opposite the end of each tube, for inspecting and cleaning the tubes or changing them. These holes are closed by means of hand hole plates of pressed



MAP SHOWING RAILWAY AND TRANSMISSION LINE

steel, and keep perfectly tight without packing, being only ground. The front of the boiler rests on a fixed support, the back on rollers, so that the boiler can expand freely without injurious tensions. The masonry serves only as enclosure, but does not carry any part of the boilers. The boilers

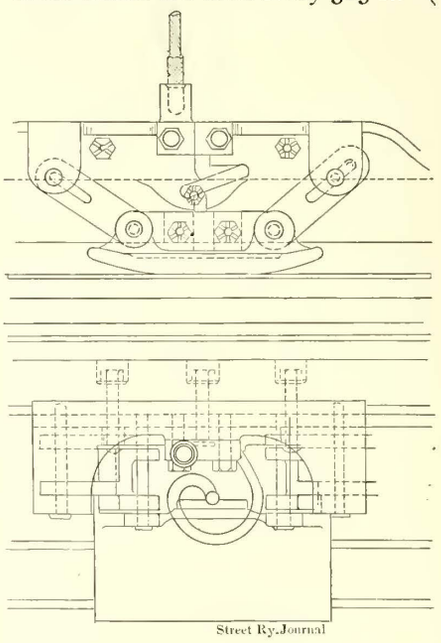


CROSS SECTION OF THIRD RAIL, SHOE AND HANGER

steam rapidly and have a large steam reserve capacity, so that a steady pressure is obtained. The system of piping, which is very similar to American practice, is clearly shown in the plan view.

Two large economizers of 5812 sq. ft. (540 sqm.), composed of thirty-two vertical cast-iron tubes connected by cross tubes, have been installed. The scrapers for these economizers are driven by electric power.

A description of the distribution system was published in a previous issue together with views of the third-rail adopted, which is 90-lb. T, mounted on reconstructed granite insulators. This rail is supported in an iron cap on top of the insulator, and the joints are bonded by a concealed flxible copper bond of 0.31 sq. ins. (200 mm²) section. To avoid creeping, the rails are connected by single plates in groups of ten each, and the middle of each section is anchored. Cross-bonds are used every 325 ft. (100 m).



SIDE ELEVATION AND PLAN OF SHOE

The shoe, which was not illustrated in the previous article, is also of novel shape. It has a bearing surface 12½ ins. long by 10 ins. wide (317 mm x 254 mm), and is hung to one side of the center so that it will clear a guard carried over the third rail in the switch yards and at the stations. This guard is not shown in the sectional diagram, as it is not used on straight tracks, but is illustrated in the half-tone illustration, which shows one of the locomotives and cars near the sub-station at Parabiago and in the view of the track near the stations.

Developing Freight on the Lake Shore

The Lake Shore Electric Railway will commence the development of its freight business on a broader scale after Jan. 1. Heretofore there have been no through freight shipments over the road because of insufficient power. The company proposes to undertake the experiment of operating freight cars between midnight and 5 a. m., when the tracks are not occupied by passenger cars. It is believed the towns along the line will offer little objection to the operation of standard freight cars during the night. The company expects to secure a large amount of business from through shipments from other connecting roads. The Toledo & Western Railway, which, as is well known, operates freight cars, recently secured an order for a large shipment of sugar beets from Michigan to Fremont, over the Toledo & Western and Lake Shore Electric roads, but the Lake Shore Company was forced to refuse the business owing to lack of facilities for handling it.

The Belgian Government, says the Brussels correspondent of the London Times, has received from an Anglo-American capitalist in London an offer to construct the proposed electric railway between Brussels and Antwerp. The capitalist offers to deposit £2,000,000 as a guarantee of good faith and to finish the line, including the tunnel under the River Rupel, within eighteen months.

Street Railway Wheels in Europe

Strange as it may seem to American readers, the car wheels used on most of the city tramways in Europe are not of chilled iron, but are of steel, that is, the tire is of steel, and is shrunk on to a separate center which is usually of wrought iron. The construction of a wheel of this kind can easily be understood from Fig. 1, which shows the side view and section of a standard wheel used by the Brussels Tramways. Fig. 2 is a section (three-quarters actual size) of the tire, the rim and a portion of one of the spokes of the same wheel. The weight of this wheel, which may be considered typical of European wheel practice, is about 170 kg (374 lbs.), of which the tire weighs 100 kg and the hubs, spokes and rim, 70 kg. The diameter of this particular wheel is 762 mm at the thread and 797 mm at the flange. When a tire develops a flat spot it is turned down on a lathe and the thickness of the tire is usually sufficient to allow of its being turned down twice. A new tire can then be put on the wheel, which is done by the usual process of shrinking it on.

The cost of a complete wheel with new tire varies according to local conditions. In Brussels it is 104 francs ($20.80), while the cost of a tire by itself is about 35 francs. To this, of course, must be added the cost of taking the axle out of the car, pressing off the wheel, heating the old tire so as to slip it off, and shrinking on the new tire. The cost of turning down the tire, which is done on a

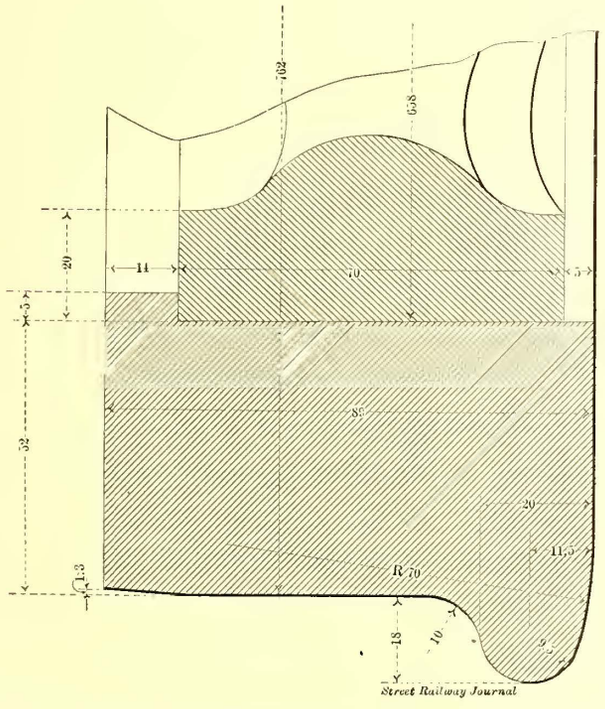


FIG. 2.—STANDARD BRUSSELS WHEEL (THREE QUARTER SIZE)

lathe, is about 3 francs, not including the time and labor of taking the wheel out of the car.

The wheel question in Europe is complicated very much by the narrow grooves used in the rails, and it has been claimed by many of the European managers that a cast-iron wheel cannot be used in these rails, as the flanges chip badly. As a rule, the flanges to fit these grooves have to be even smaller than in the wheel shown in Fig. 2, whose flange is only 25 mm ($\frac{5}{8}$ in.) wide at the throat and 16 mm ($\frac{5}{8}$ of an in.) deep. Thus the Compagnie Parisienne de Tramways uses a wheel with a flange only 13 mm x 13 mm. Originally, this company employed a much larger flange, viz., one 20 mm x 20 mm, but with the low speeds used, the smaller flange has given no trouble from derailment. The rails used on this line have a groove 28 mm x 28 mm. In Hamburg, where the groove in the rail is 32 mm x 32 mm, the wheel flange has a depth of 14 mm.

In Brussels, where the rail groove is 30 mm deep x 32 mm wide, some experiments were made with cast-iron wheels, but they did not prove very satisfactory, and the steel wheels are now used exclusively. The average life of the present tires is given by Mr. Dugniolle, engineer of the company, as about 65,000 km. At a cost for the tire of about 35 francs, plus 6 francs for two turnings, this is equal to an average of 63 centimes per 1000 km, not count-

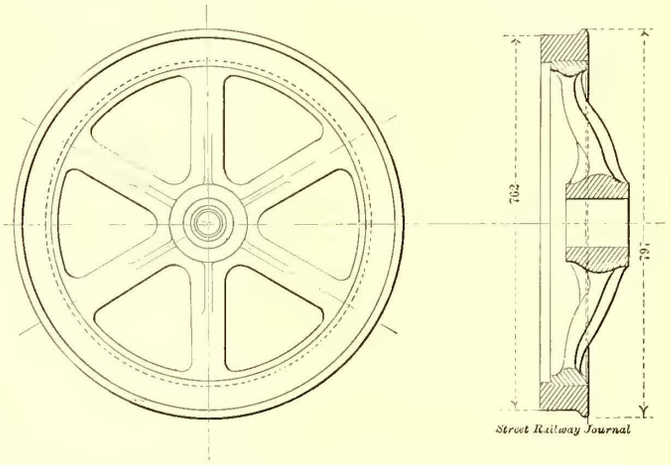


FIG. 1.—STANDARD WHEEL OF THE BRUSSELS TRAMWAY

ing the cost of removing the wheel from the car. The cast-iron wheels used in Brussels rarely ran up to 60,000 km.

The trouble experienced from chipping with chilled iron wheels in Europe cannot be attributed entirely to the narrow groove used, however, because although most American roads use a wider groove than that employed in Europe, rails have been laid on a number of systems in America where the groove is certainly no wider or deeper than almost any in Europe, yet chilled iron wheels have given no trouble. For instance, the rail used by the Capital Traction Company, of Washington, D. C., has a groove only 1 in. (25 mm) wide and 1 in. (25 mm) deep. This is, perhaps, the narrowest groove of any used in the United States, although the Havana Electric Railway Company uses a rail with a groove 1 in. (25 mm) wide and $1\frac{1}{8}$ in. (29 mm) deep, and the Boston Elevated Railway, on parts of its surface lines, uses a grooved rail with groove $1\frac{3}{8}$ in. (34 mm) wide and 1 3/16 in. (30 mm) deep. The principal difference in practice, however, is that it is the universal rule in America to lay a different type of rail for curves, i. e., one in which the groove is made wider and of a different form, while in Europe, as a rule, the same rail is used for curves as on straight track. On the Capital Traction lines of Washington, for instance, where the straight rail has a groove 1 in. wide, the curve rail has a groove $1\frac{1}{4}$ in. (31.5 mm) wide and it is, perhaps, to this fact of not widening the groove on curves that the greater part of the flange chipping experienced in Europe may be attributable.

A few companies on the Continent are using chilled iron wheels. The street railway in Milan is one of these. The rail groove in Milan is 31 mm wide and 35 mm deep, and the average life of a chilled iron wheel, according to Mr. Daveri, superintendent of construction of the Milan system, is 40,000 km before being ground, and about 15,000 km after the wheel has been once ground. All the car wheels on the Milan system are of chilled iron, and they are considered superior to steel-tired wheels.

The largest user of chilled iron wheels on the Continent of Europe is the city of Buda-Pest, where both tramway companies and the underground railway company use

wheels of this character almost exclusively. The underground railway, which is laid with T-rails, uses a wheel of the section shown in Fig. 3, while the surface wheels have a center flange, as shown in Figs. 4, 5 and 6, for running

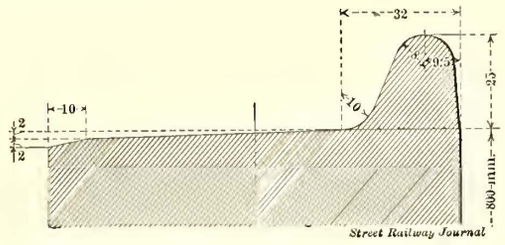


FIG. 3.—SECTION (HALF SIZE) OF WHEEL USED ON THE BUDA-PEST UNDERGROUND RAILWAY

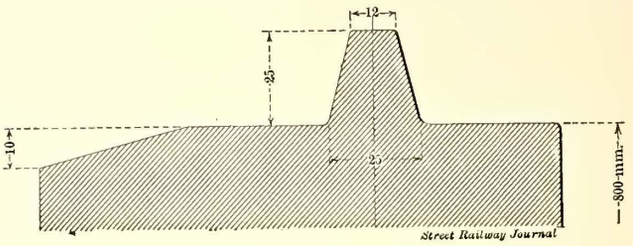


FIG 4.—SECTION (HALF SIZE) OF WHEEL FOR HAARMANN AND SLOT-RAILS BUDA-PEST SURFACE LINES

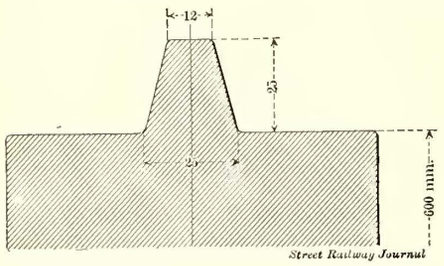


FIG. 6 —SECTION (HALF SIZE) OF WHEEL FOR HAARMANN AND SLOT-RAIL

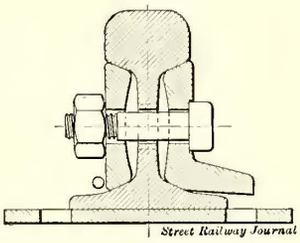


FIG. 8.—SECTION OF STANDARD T-RAIL

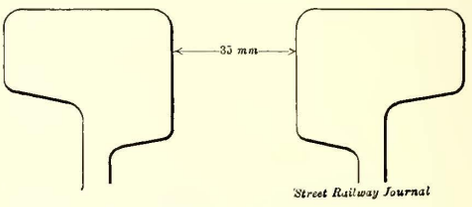


FIG. 9.—SECTION OF CONDUIT SLOT, BUDA-PEST

on the Haarmann rails and slot rails of the side conduit used in Buda-Pest. The Haarmann rails used on the Stadtbahn (surface) line, from whom the accompanying sections were obtained, through the courtesy of Mr. Stromszky, chief engineer of the company, have a depth of groove of 26 mm and a width on straight track of 35 mm and on curves of 45 mm. In Fig. 6, *A* shows the complete section of a wheel for a surface car on the Stadtbahn electric line equipped with one motor only, and *B* and *C* for cars on the same line with two motors. *D* is an underground railway wheel for use with T-rails, and *E* and *F* are sections of 600 mm wheels. These latter wheels are of small diameter, to economize height in the car. The Budapester Elektrischebahn also used chilled iron wheels exclusively for its surface cars. All the chilled iron wheels used by all the roads in Buda-Pest are obtained from Ganz & Company, and are of the "Griffin" type.

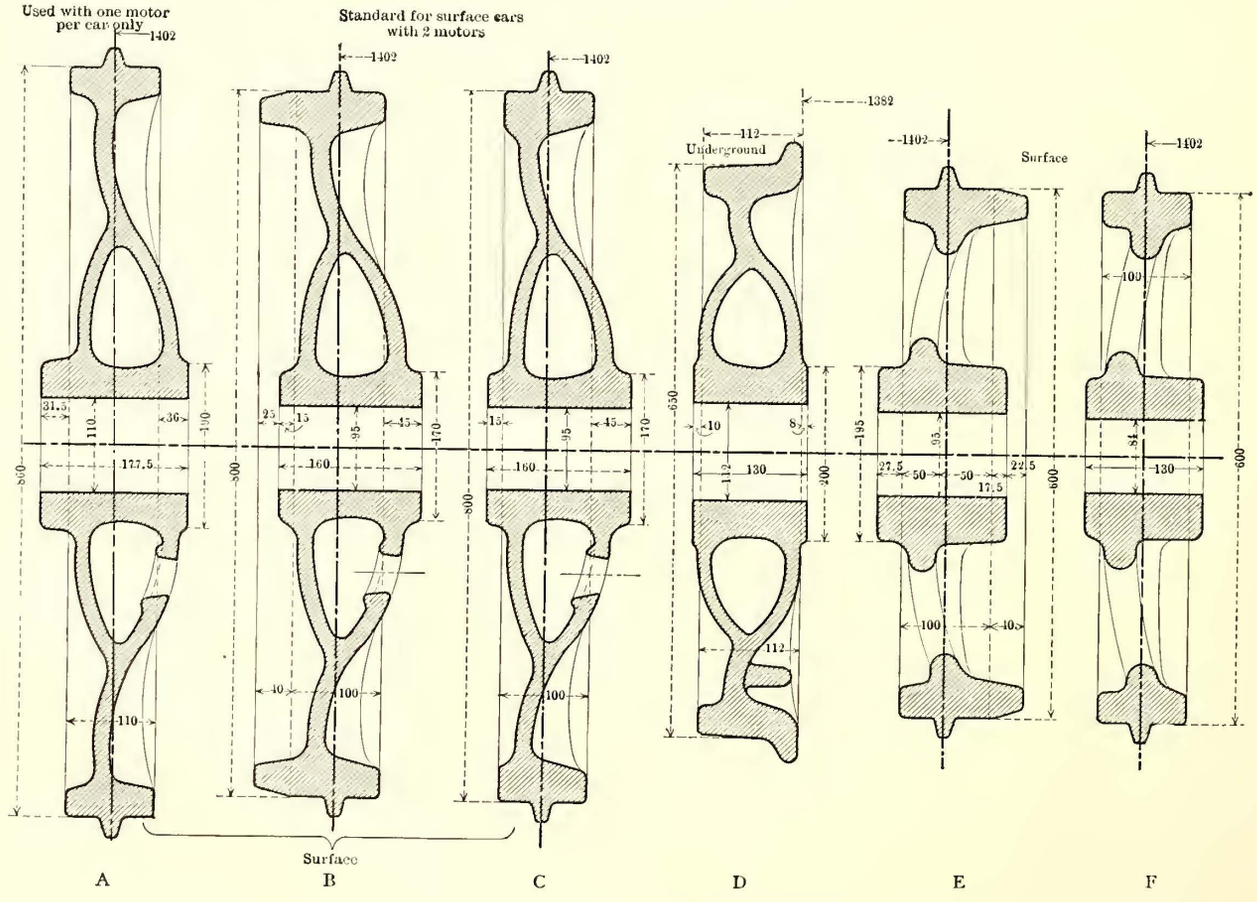


FIG. 6.—SECTIONS OF ALL TYPES OF WHEELS USED ON BUDA-PEST STADTBAHN AND UNDERGROUND RAILWAY

The wheels on the underground railway are 650 mm in diameter, and the average life of the steel wheels on this line, when they were employed, was about 120,000 km with

two turnings down of the tire. Chilled iron wheels, however, have been in use since August, 1899, and a record of all of these wheels (ninety in number) which have been employed from that time to Jan. 1, 1902, shows that all are still in good condition, so that their total life is yet indeterminable. The highest record made by any of these wheels up to this time has been 138,575 km, but twenty-four out of the ninety now in use have made over 100,000 km, and, as stated, none of them is yet worn out.

The life of the wheels on the surface lines of Buda-Pest has naturally not been so high, as the wear on the flanges has been greater, but a number of these wheels have run over 120,000 km. The average life for the 600-mm diameter wheels has been considerably over 50,000 km. The 850-mm chilled iron wheels have been in use only since March, 1901, and as none has worn out or been discarded for any reason, their average life cannot be stated, but between March, 1901, and January, 1902, seventy-six of these wheels in service on the Stadtbahn had run more than 30,000 km, and all were in good condition. The following figures show the kilometers run of ninety-five 600-mm diameter wheels taken in consecutive order from the records of the company, and extending far enough back so that most of the wheels recorded in them have worn out from one cause or another. In these records the asterisks indicate wheels that are still in good condition, *f* those discarded for flat spots, *s* for sharp flanges, *b* for broken hubs, and *p* because no suitable mate could be found for them. For convenience in comparison, the asterisks, which, as stated, indicate the wheels which were in good condition on Jan. 1, 1902, when the record was made, and the *p*, which indicates that the wheels were discarded for no fault, are placed in front of the record in each case.

RECORD IN KILOMETERS OF NINETY-FOUR 600-MM DOUBLE-FLANGED WHEELS, BUDA-PEST STADTBAHN (SURFACE ROAD)

* 69,953	42,188 *f*	15,079 *f*	*104,045
* 92,523	70,603 *b*	*120,659	*p* 99,675
89,797 *s*	111,962 *s*	89,797 *s*	98,400 *s*
p 99,675	118,849 *s*	111,962 *s*	98,400 *s*
*129,424	94,066 *s*	*129,424	121,071 *f*
94,066 *s*	98,400 *s*	110,132 *s*	96,169 *f*
* 63,761	95,938 *s*	121,017 *f*	110,132 *s*
118,849 *s*	95,938 *f*	98,400 *s*	106,445 *s*
* 63,761	74,631 *f*	42,069 *f*	* 63,135
* 93,238	42,069*f*	* 98,219	* 85,585
* 93,162	74,134 *s*	* 34,050	89,936 *f*
* 98,219	* 93,162	89,936 *f*	58,323 *s*
74,613 *f*	74,613 *s*	86,019 *s*	58,323 *b*
70,436 *b*	* 62,042	* 65,508	79,478 *b*
* 73,117	* 66,177	* 41,073	84,047 *s*
* 37,834	* 73,117	31,299 *b*	* 73,117
* 73,117	* 37,834	62,175 *s*	* 37,834
62,175 *s*	* 62,042	* 34,722	* 37,834
* 62,042	84,047 *s*	* 62,042	39,194 *s*
* 51,833	* 68,060	* 63,106	* 65,557
* 68,460	* 58,082	* 65,537	* 65,537
38,628 *b*	39,194 *s*	75,782 *f*	49,798 *f*
53,522 *f*	69,211 *f*	82,225 *f*	82,968 *s p*
82,968 *s p*	46,831 *b*	.....	.....

Figs. 7 and 8 show the standard rails on which these wheels ran, and Fig. 9 the outline of the conduit slot, which, according to the system used in Buda-Pest, forms also one service rail for the car wheels on the lines equipped with the underground trolley. Fig. 10 shows the complete steel wheel and axle used on the gearless locomotives on the underground railway, and Fig. 11, the chilled wheel and axle employed by the motor cars on the same railway, and which are equipped with gears and sprocket chains.

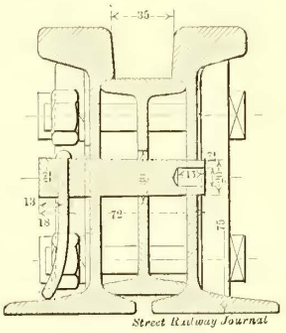


FIG. 7.—SECTION OF STANDARD HAARMANN RAIL

Rouen is another city in which cast-iron wheels are now supplanting steel-tired wheels. The chief trouble found in Rouen with the steel-tired wheel was the rapid wear of the flange. The steel wheels had to be taken out about once every four months, and about 5 mm in thickness of the tread of the wheel, i. e., 10 mm of its diameter, was removed by a lathe. The company reports that it took about a day to turn down the tires and flanges of two pairs of wheels in this way on one lathe, although the lathe had two saddles, which are worked simultaneously, and it required four men two hours to put the tire on the hub.

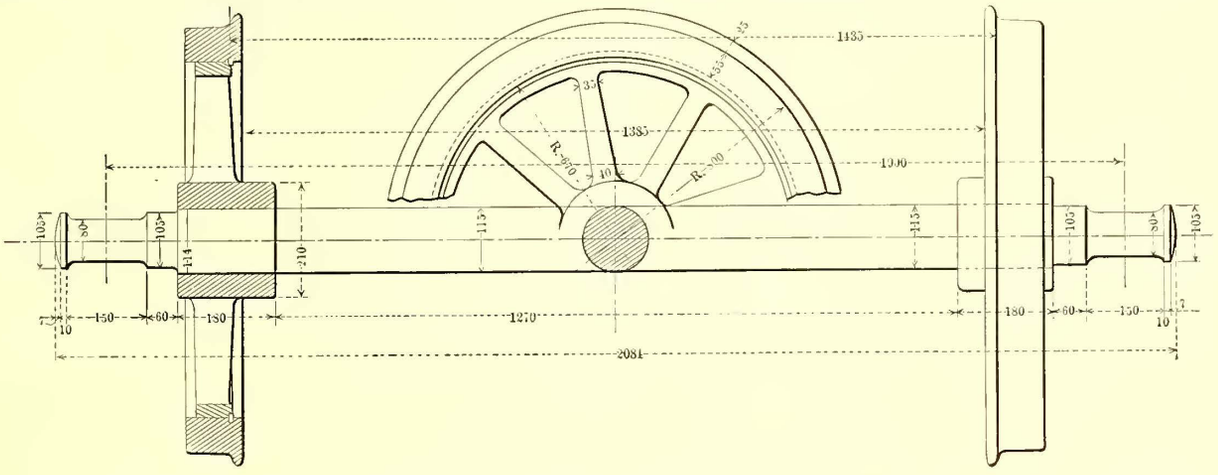


FIG. 10.—MARTIN STEEL WHEEL USED IN GEARLESS LOCOMOTIVES OF BUDA-PEST UNDERGROUND RAILWAY

Most of the English railways are, at present, using chilled iron wheels, but there seems to be a tendency toward the employment of steel wheels. The chief charge brought against the chilled iron wheels is the chipping of the flanges. This, as stated, may be largely due to the practice of using the same rail on straight track and on curves. It is also, of course, always more liable to occur when a very narrow rail groove is used. Such a groove requires a thin wheel flange, and it is difficult to cast a flange of this kind and give it enough chill to make it stand the wear, and yet not carry the chill all the way through the flange. A long thin wheel flange which is chilled all the way through is naturally liable to chip, but it seems probable that with a narrow rail groove a stubby chilled flange would wear as long as a steel flange of the same depth. Of course, grooves as narrow and shallow as many used in Europe invite trouble, no matter what type of wheel is used, and would be actually unsafe if it were not for the very slow speed at which the cars run.

There is probably no single department in railway operation where there is such a great opportunity for improvement in European railway construction and operation as in that of rail sections, and it is a somewhat peculiar fact that no effort has seemingly been made, either by manufacturers or by the street railways associations, to standardize the rail-heads in use. The number in use is enormous particularly in England, where the type of rail-head is very often dictated by the local city engineer, who wishes to establish a record for originality by insisting upon a new type of head. A good idea of the variety of sections in use can be obtained from Fig. 13, which is a reproduction of twenty different rail-heads of different cities in Europe, most of them in Great Britain. As will be seen, the grooves run anywhere from $1\frac{1}{4}$ ins. to $\frac{3}{4}$ in. in width, and 1 in. to $\frac{3}{4}$ in. in depth. Some have a flaring groove and others a very contracted one. The heads of the rails range from $\frac{5}{8}$ in. to $1\frac{5}{8}$ ins. in width. The cities from which these sections are taken were selected at random, and undoubtedly a much greater variety of patterns could have been obtained by using some of the very narrow grooves employed in some cities. A "composite" section of the wheels using these rails is given in Fig. 12. As will be seen, the wheels represent almost as wide a diversity of practice as exists in rails.

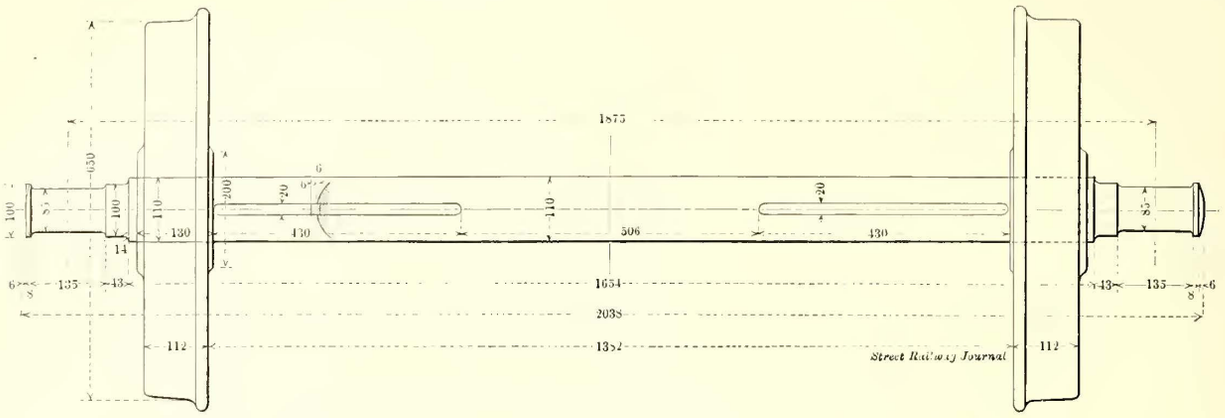
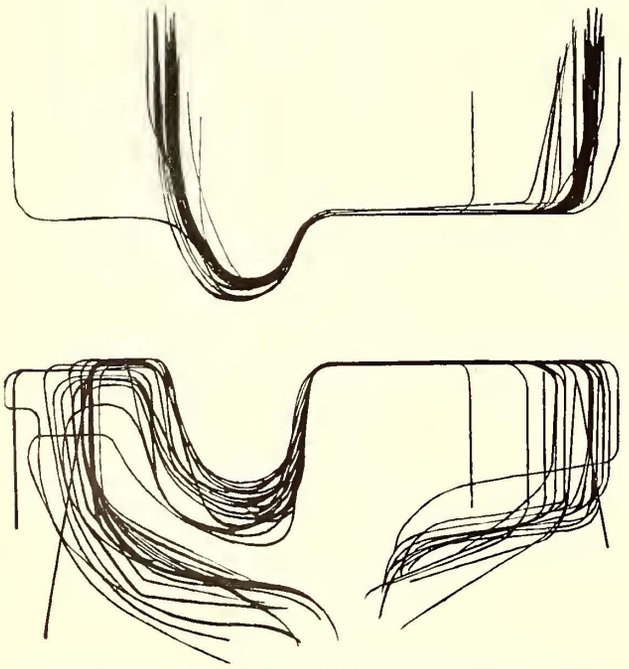


FIG. 11.—CHILLED IRON WHEEL USED ON BUDA-PEST UNDERGROUND RAILWAY



FIGS. 12 AND 13.—COMPOSITE DRAWING, SHOWING A NUMBER OF SECTIONS OF WHEELS AND RAILS USED IN EUROPE

The general shape of the "composite" section shown in Fig. 12 is, on the whole, not bad for a full grooved rail, although a more flaring lip, as mentioned below, would help the wheels clean the dirt out of the groove. The extremely narrow head in the case of one rail and the peculiar projecting lip in the case of another rail, the latter intended, doubtless, to carry vehicle traffic, will be noticed. The fishing surface under the head is about at the inclination which would be found in American rails, but in the fishing surface under the lip, the reader will notice a marked curve, somewhat in the form of an elongated S lying horizontally. The effect of this, we should think, would be to make it very difficult to hold the angle-plates in place on this side of the rail, and a straight surface at this point would be better.

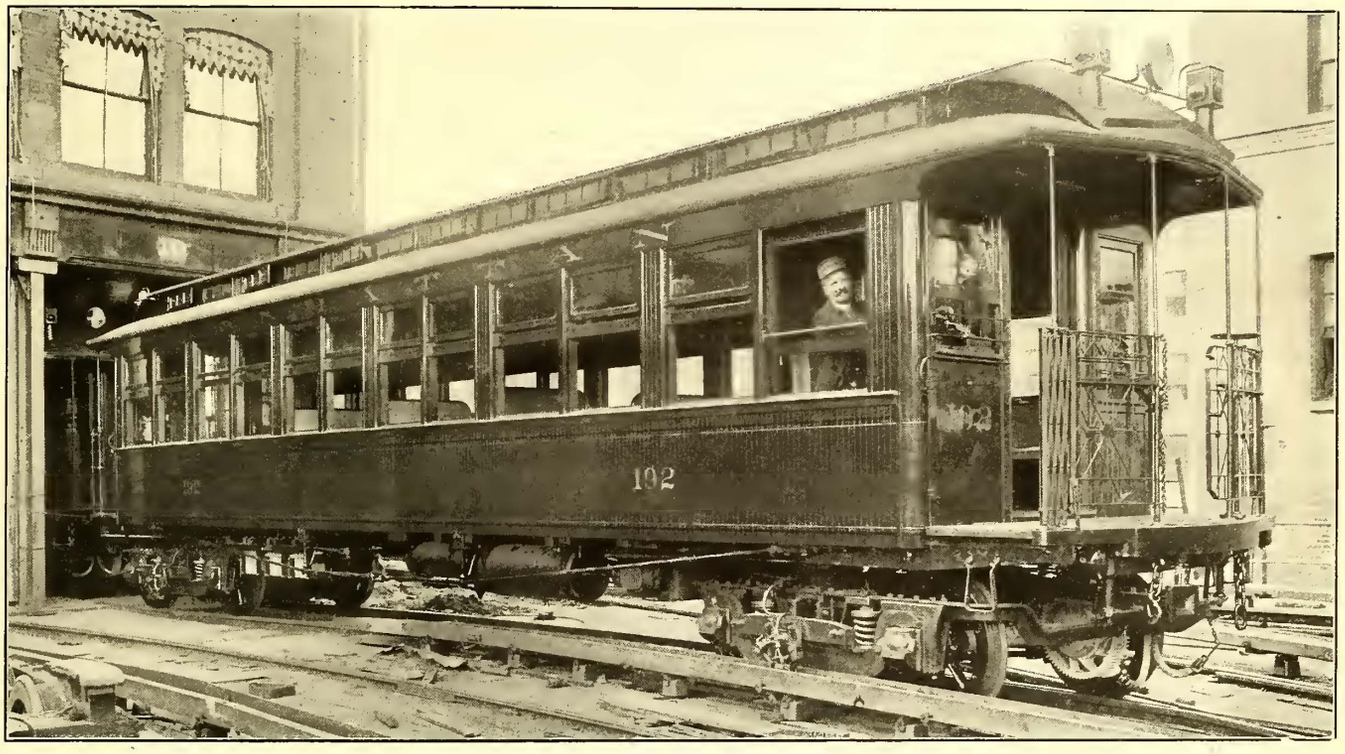
Many of these sections, however, are so nearly alike that the total number could be reduced to two or three at most, without the sacrifice of any essential in construction. If such a reform should be instituted, and it is one to which the city authorities, as well as the associations, could well turn their attention, it is to be hoped that a self-cleaning section will be adopted; that is, one in which the dirt is crowded out of the groove by the wheel flange, and not packed in by it, a fault which exists in too many of the sections now in common use. Such a section offers practically no more obstruction to vehicular traffic than those now in common use, and would be much cheaper to operate over, and will greatly reduce the possibilities of derailment.

Interurban Road for Porto Rico.

It is stated that the Vandegrift Construction Company, of Philadelphia, has in contemplation the construction of an electric railway from Catano to Ponce, a distance of 70 miles, and the development of water power for lighting and railway service. It is proposed to construct a line of ferry-boats between Catano and San Juan, on the San Juan Bay, and thus cut off 10 miles of track, which would be required to connect the two cities by rail. It is also planned to build several piers on the Catano side of the bay, to allow ocean-going steamships to dock. Passenger and wagon traffic will be carried on the ferryboats, and until the concessions for the construction of the piers are granted heavy freight for export trade will be carried out into the bay on lighters and loaded on the steamers. The road will pass through the coffee, sugar and fruit belts of the island, which are densely populated, and the belief is that large quantities of freight will be handled. Electric locomotives will be used for freight work. It is said that the plan for power development calls for the building of a power house of 5000 hp in the mountainous district of the interior of the island.

The Rolling Stock of the Manhattan Railway Company

In the issue of this paper for January 5, 1891 (International edition for January), an extended account was published of the power station, transportation system and third-rail construction of the Manhattan Elevated Railway in New York. At that time it was impossible to publish a description of the rolling stock used for the new electric equipment, from the fact that the details had not been fully decided upon. Through the courtesy, however, of J. S. Doyle, master mechanic of the company, this paper is able to present in the accompanying inset sheet and following pages full particulars and working drawings of the cars and trucks now in use on the Manhattan Elevated Railway. Two types of cars are used, open and closed. The company has at present 1286 cars of the closed type and 36 of the open type, and also are about to contract for 60 additional open cars. Of the closed cars



STANDARD CLOSED MOTOR CAR, MANHATTAN

850 are motor cars and 436 trailers. Of the closed cars 310 were constructed by the Wason Manufacturing Company and 50 by the American Car & Foundry Company at its Wilmington shops. Of the open cars 25 were built by the Jewett Car Company and 11 by the American Car & Foundry Company. The remaining cars of the equipment have been remodeled from cars used in the old service.

It is the practice of the company to operate the cars in trains. With a six-car train, which is a standard train, the first, third, fourth and sixth are motor cars. With a five or a four-car train, the first, third and fourth are usually motor cars. Five-car trains will, however, not be used to any extent as soon as the platforms on the Sixth Avenue line are extended to allow the use of six-car trains. With a three-car train the first and third are motor cars. None of the open cars is equipped with motors.

MOTOR CARS

Although it might seem that there is not much variety possible in car construction, the cars of the Manhattan Company embody a number of novel features, certain of which, such as the type of motor cab adopted, constitute great advances in the construction of cars for elevated railway service. Everything considered, this cab is probably as interesting a new feature of the Manhattan rolling stock as any other portion. It was designed and has been patented by the company's engineer, and, as will be seen, can be converted, when not in use as a cab, to form a part of the seating space of the car. When used as a cab a swinging glass door cuts off all interference with the motorman by the passengers, and, as no passengers are allowed on the front platform, an unobstructed view is obtained of the track ahead by the motorman, who is provided with a seat facing the direction in which the car is going. While in this cab the motorman has all the protection and comfort that passengers have, and it is needless to say that the motormen themselves are very much pleased with such an arrangement, and much prefer it to the outside cab.

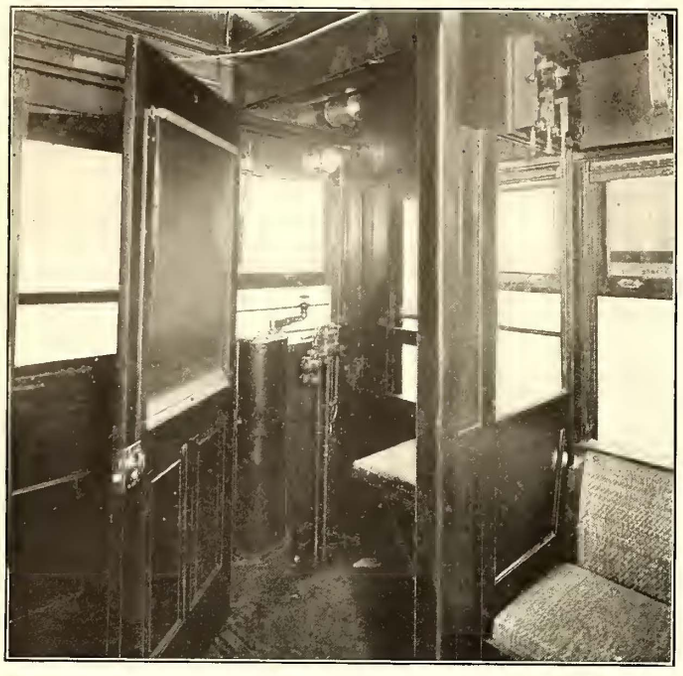
The objection to inside cabs has previously been that they took up valuable seating space, but it will be noticed that when this cab is not used by the motormen that the door closes in and protects the controlling apparatus. At the same time the motorman's seat is turned down, forming a seat for two passengers.

It might be interesting to compute how much gain such an arrangement makes in dollars and cents to the Manhattan Railway, where additional space during rush hours actually means additional nickels taken in. The seat mechanism is simple and durable, and has given no trouble. The right-hand ends of each motor car are finished off in this way with motorman's cabs, so that either end of any motor car can be used by a motorman.

A few of the general dimensions of the motor-car bodies follow:

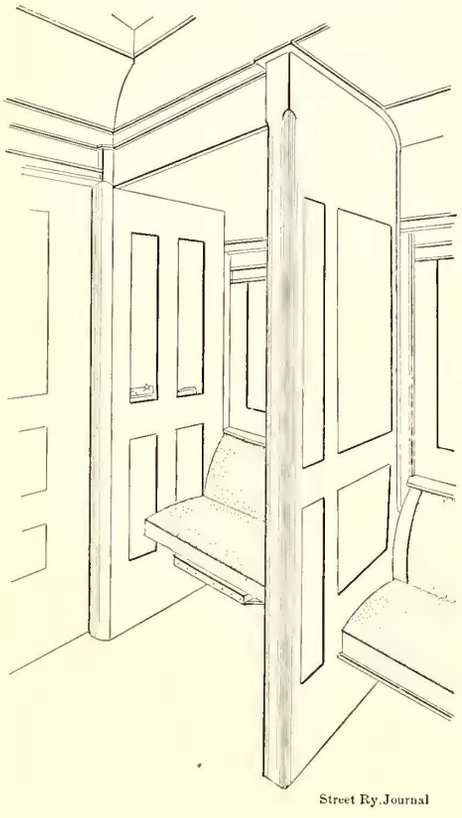
	Feet	Inches
Length of car body on center line over end plates	47	1
Length of car body over end sills	39	8
Extreme width of car over eaves	8	9½
Extreme width of car over side sills	8	6
Extreme width of car over window-sills	8	9⅛
Width between truss planks	7	9
Height of car from top of rail to top of dome roof not to exceed	12	10½
Height of car floor over top of rail	3	10⅜
Height of platform over top of rail	3	9
Height of center of draw bar over top of rail	2	4½

All timber used in the under frame is selected long-leaf yellow pine, except needle beams and end sills, which are of white oak. The end sills are secured to the intermediate sills with double tenons and four 1-in. iron rods passing



VIEW OF MOTORMAN'S CAB

through the end sills and hooked over the bolster. As shown in the floor plan, there are two $4\frac{5}{8}$-in. x $7\frac{5}{8}$-in. side sills, two $3\frac{1}{2}$-in. x $4\frac{5}{8}$-in. center sills and two $3\frac{1}{2}$-in. x $4\frac{5}{8}$-in. intermediate sills. The side sills are placed with their

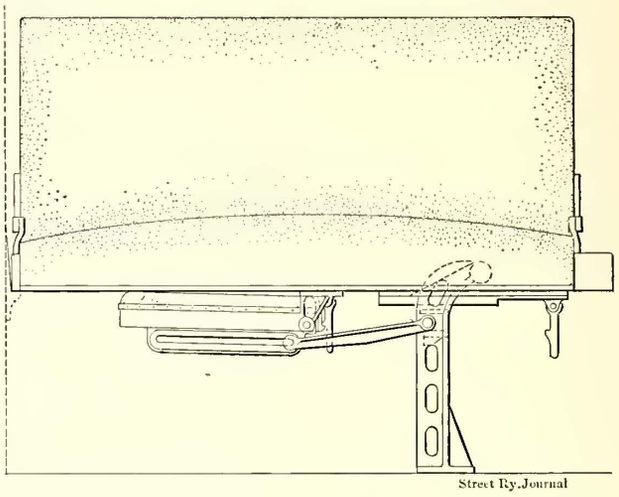


MOTORMAN'S CAB TRANSFORMED FOR USE BY PASSENGERS

outer faces 4 ft. 3 ins. from the longitudinal axis of car, and the center sills have their inner faces $5\frac{1}{4}$ ins. from same axis, while the outer faces of intermediate sills are 2 ft. $1\frac{3}{4}$ ins. from the same axis.

The body bolsters are made of two wrought-iron plates 8 ins. wide and $\frac{3}{4}$ ins. thick, placed flatwise with the ends fastened together at each end. The upper plate is let into the bottom of the side sills $\frac{1}{2}$ in. and secured to the body of the car by two $\frac{3}{4}$-in. bolts through each longitudinal sill. The plates are spread at the center to 6 ins. clear space. The needle beams are of white oak, 5 ins. wide and 5 ins. deep at the ends and 6 ins. deep at the center, and each timber is strengthened by a $\frac{7}{8}$-in. round truss-rod.

The cars are strengthened by longitudinal truss-rods $1\frac{1}{4}$ ins. in diameter, two in number, with ends upset to $1\frac{1}{2}$ ins. and about 6 ins. long for threads.

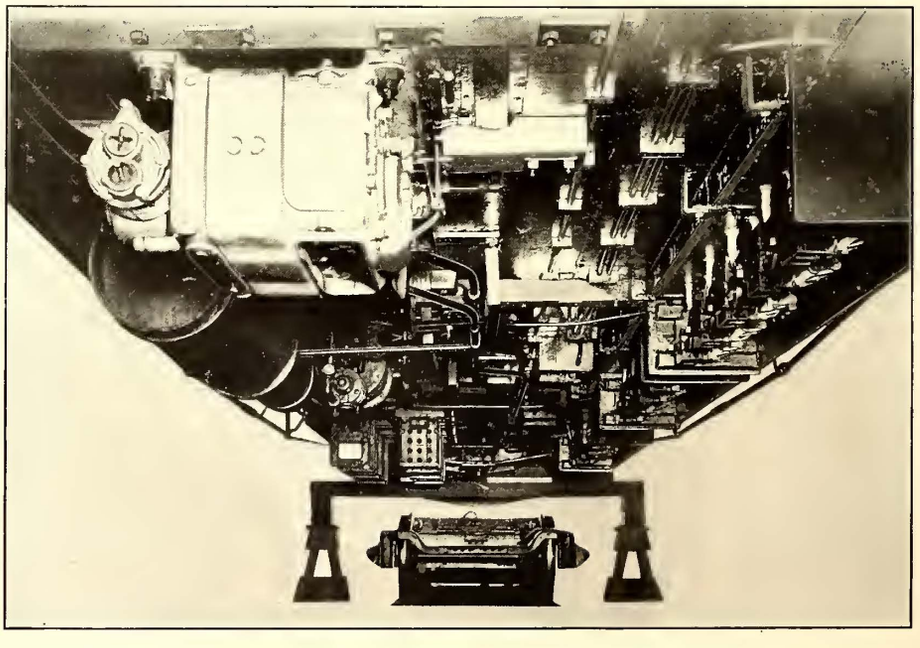


SEAT IN MOTORMAN'S CAB, LOWERED FOR USE OF PASSENGERS

The corner and door posts are made of a composite piece of straight-grained white ash and whitewood, and the side posts of yellow pine.

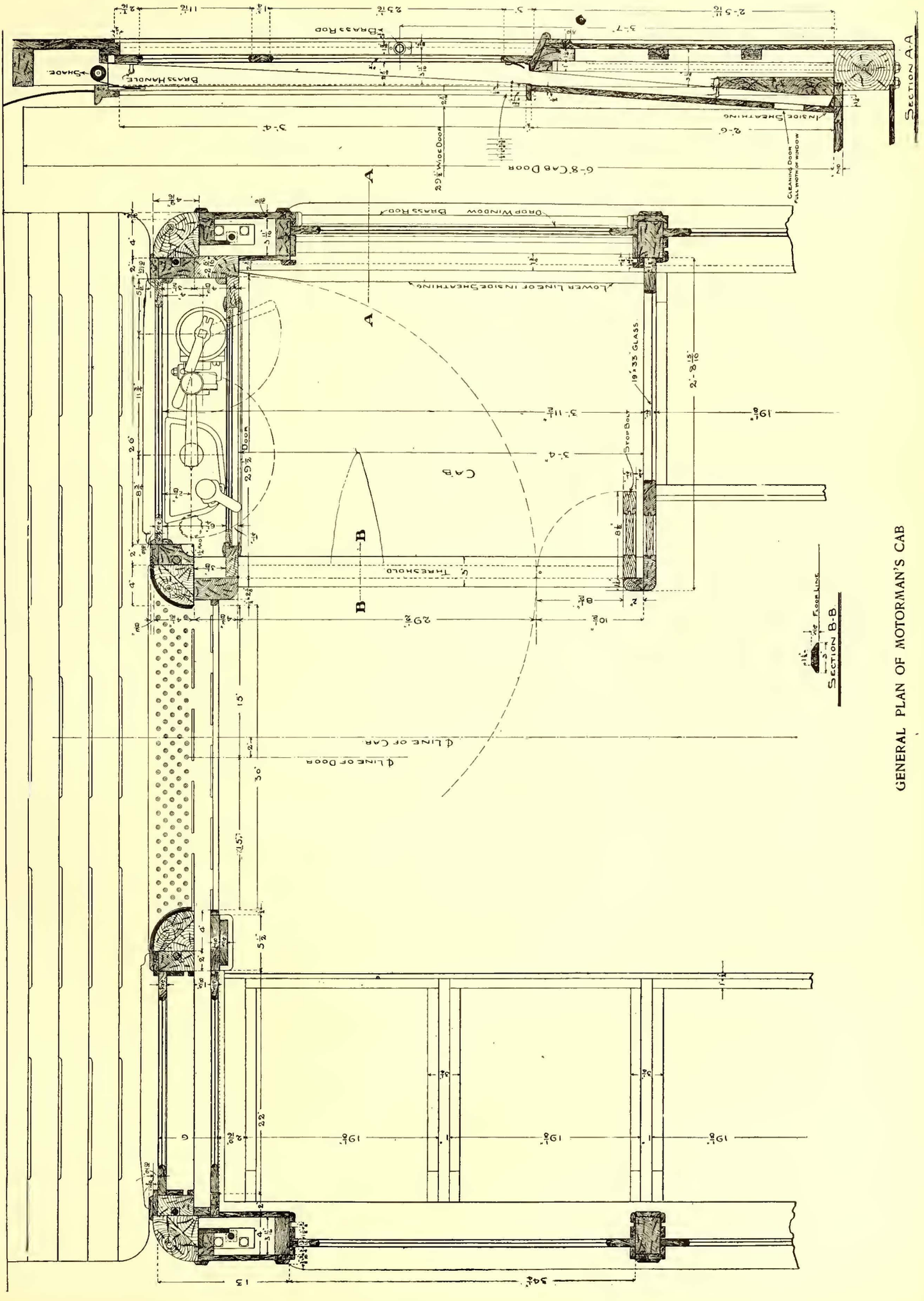
The truss plank is of long-leaf yellow pine in one piece for the full length of the car, with outer face gained out $\frac{1}{4}$ in. for each post, and is secured to each post by two 3-in. screws. The diagonal bracing under each window is of white ash.

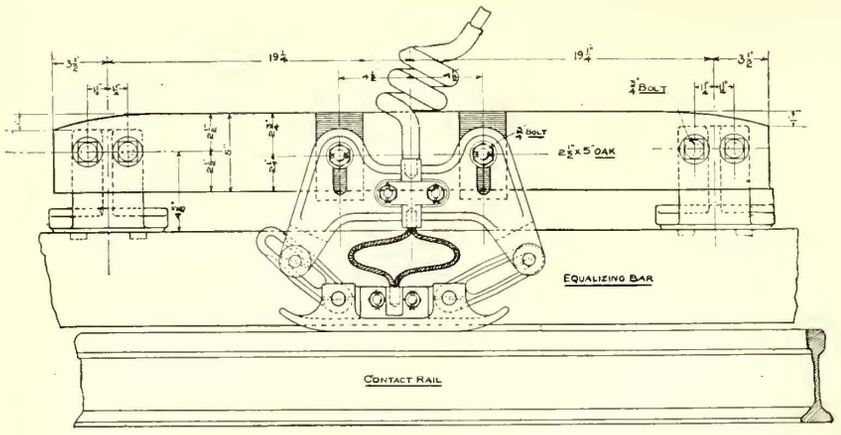
The roof is supported by five principal car lines which



VIEW UNDER MOTOR CAR, TRAILER END

are made up of $1\frac{1}{2}$-in. wrought-iron bar forged to the shape of the roof and sandwiched between two white ash car lines $\frac{7}{8}$ in. thick, bolted together. There are also sixty-four white ash lower intermediate car lines secured to the bottom of the rail of the clear story, and thirty-two clear-


SECTION A-A
SECTION B-B
GENERAL PLAN OF MOTORMAN'S CAB
CAB
DOOR
THRESHOLD
STOP BOLT
DROP WINDOW
BRASS ROD
BRASS HANDLE
SHADE
INSIDE SHEATHING
LOWER LINE OF INSIDE SHEATHING
CLEANING DOOR
FULL WIDTH OF WINDOW
19 x 33 GLASS
6'-8" CAB DOOR
2'-5 1/2" WIDE DOOR
℄ LINE OF CAR
℄ LINE OF DOOR
FLOOR LINE

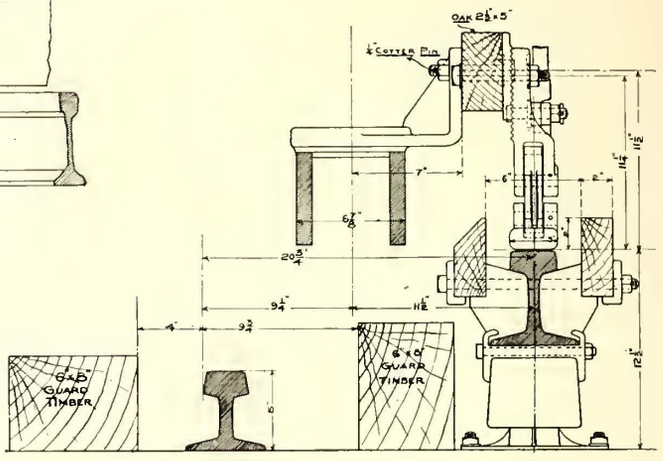


SIDE ELEVATION OF CONTACT SHOE AND HANGER

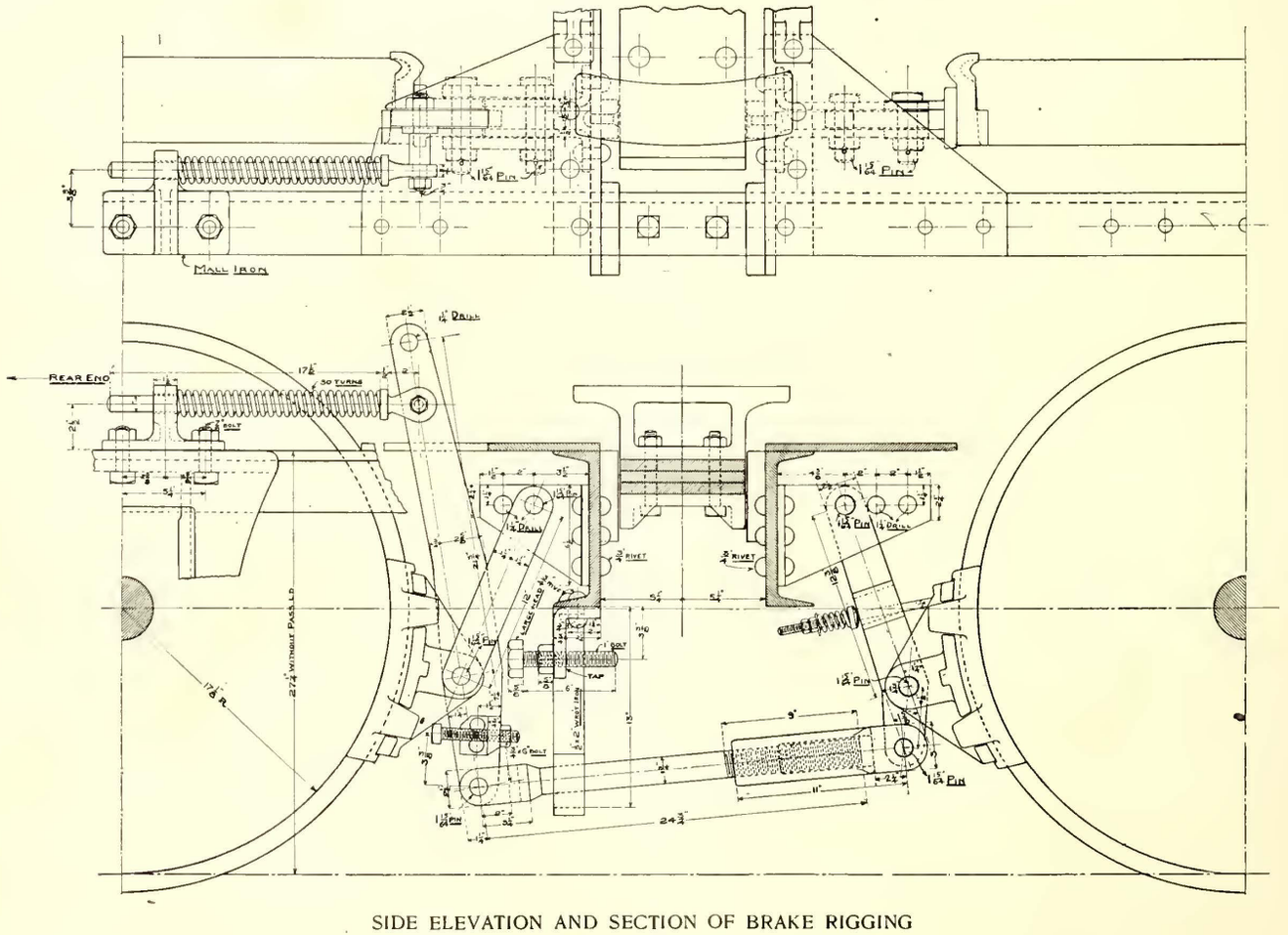
story intermediate car lines. All of white ash. The roof boards are of kiln-dried whitewood $\frac{1}{2}$ in. thick and $3\frac{1}{2}$ ins. wide, covered with cotton duck.

The trailer end platform is 8 ft. 7 ins. wide and projects beyond the end sill 2 ft. 9 ins. measured along the outside of the side sills. It is supported on four platform sills of white oak, the side and center sills being reinforced with a $\frac{3}{8}$-in. plate.

with twelve windows along each side of car body, all of which, with the exception of the cab windows, have two sash each. The sash of the cab side windows is in one piece, and is opened by dropping the sash into a pocket between inside and outside finish. The sash of the end window in the cabs is in one piece, and is arranged to raise 12 ins. Pantasote



CROSS SECTION OF SHOE AND HANGER



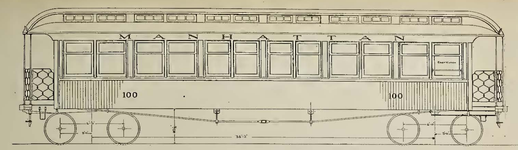
SIDE ELEVATION AND SECTION OF BRAKE RIGGING

The motor end platform is supported by rolled open-hearth steel I-beams and channel. There are two 6-in. 14.75-lb. I-beams fastened to the bolster and extending to the buffer timber, with outer ends connected by one 10-in. 25-lb. channel. The platform sills are yellow pine or white oak, $3\frac{1}{2}$ ins. x 4 ins., fitted between the end sill and the buffer timber.

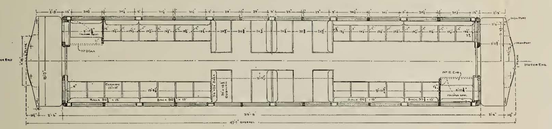
The platform gates are the Manhattan standard, operated by Gold's patent gate lock.

The inside finish of the cars is mahogany throughout, curtains, with Curtain Supply Company's fixtures, are used throughout the car.

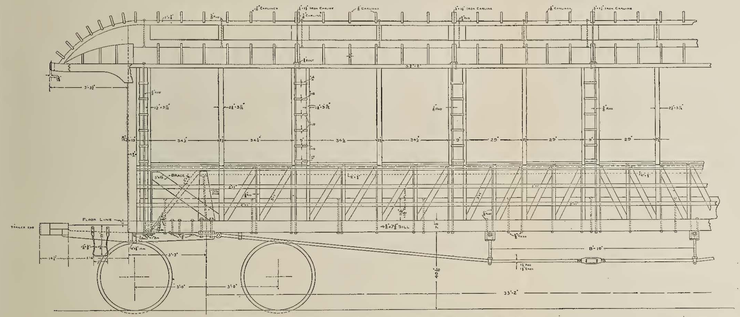
The head linings are of three-ply whitewood or birch finished in a light cream color with stencilled ornaments in gold leaf. The effect is to give a very light appearance to the car, especially at night. The fact that the voltage is very constant on the line also improves the lighting effect. For lighting the cars twenty-five 16-cp lamps are used. In addition, there are five lamps in each end of each car for head-lights, markers and cab lights. All five



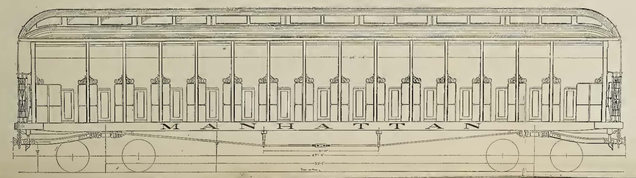
ELEVATION OF MOTOR CAR

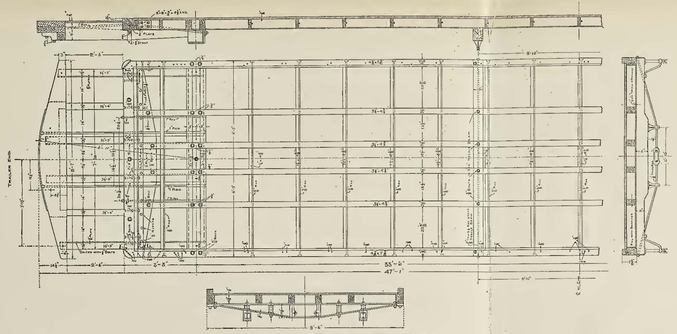


PLAN OF MOTOR CAR

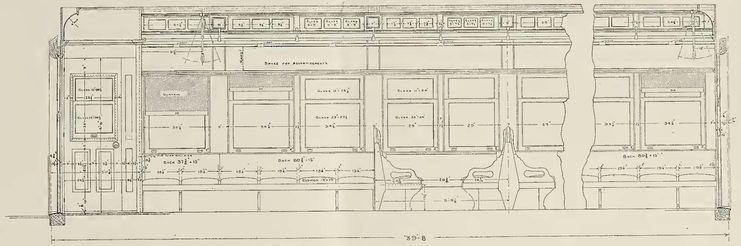


LONGITUDINAL SECTION OF MOTOR CAR SHOWING DETAILS OF FRAMING

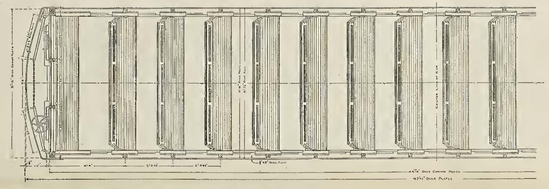




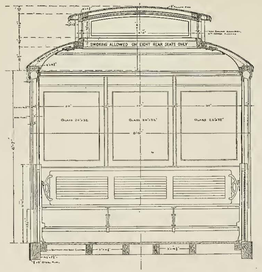
FLOOR FRAMING OF MOTOR CAR



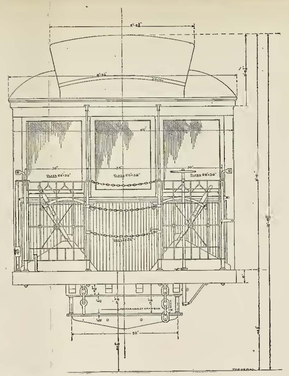
ELEVATION SHOWING INSIDE FINISH OF MOTOR CAR



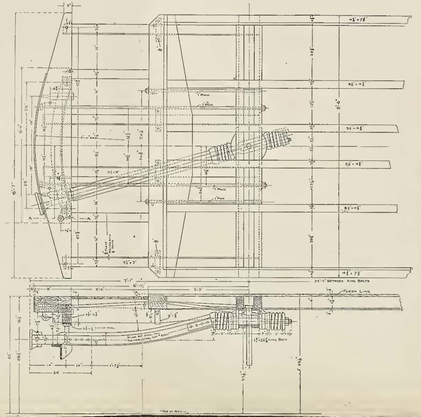
PLAN OF OPEN CAR

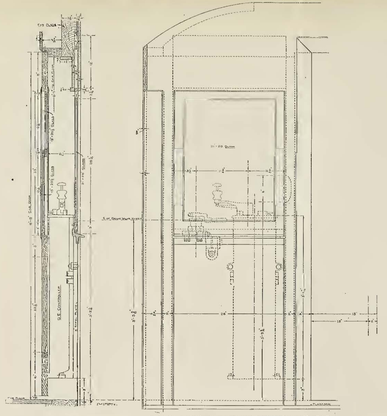


INSIDE END ELEVATION OF OPEN CAR

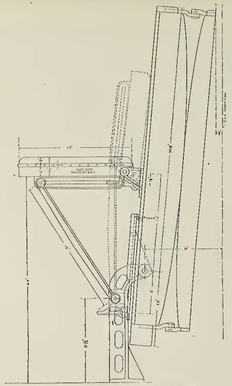


OUTSIDE END ELEVATION OF MOTOR CAR SHOWING PLATFORM AND GATES

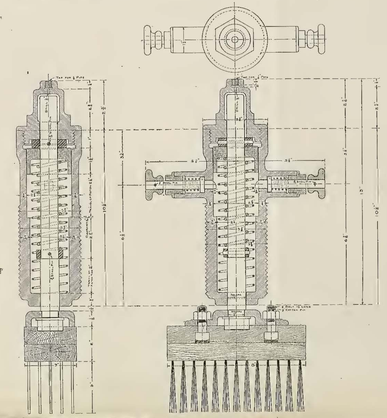


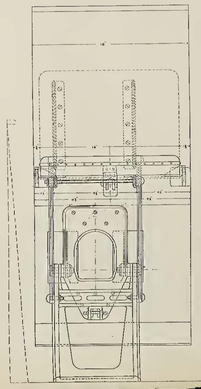


SECTION BETWEEN DOOR AND CORNER POST OF MOTORMAN'S CAB



SEAT IN MOTORMAN'S CAB, SIDE VIEW



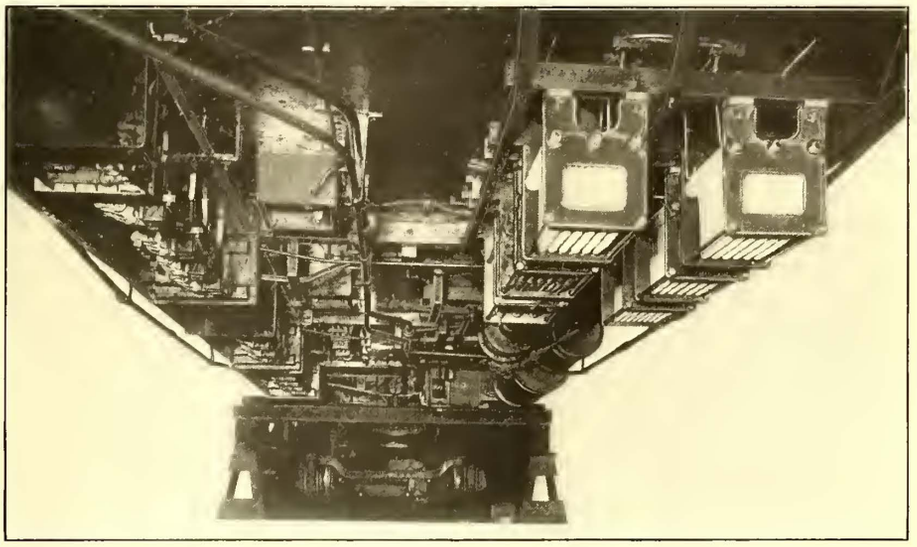


DIAGRAMS SHOWING STANDARD ROLLING STOCK OF THE MANHATTAN ELEVATED RAILWAY COMPANY, NEW YORK.

of the switches for the car-light circuits are mounted in a sheet-iron box, and quick-break lever switches are used, instead of the ordinary snap switches.

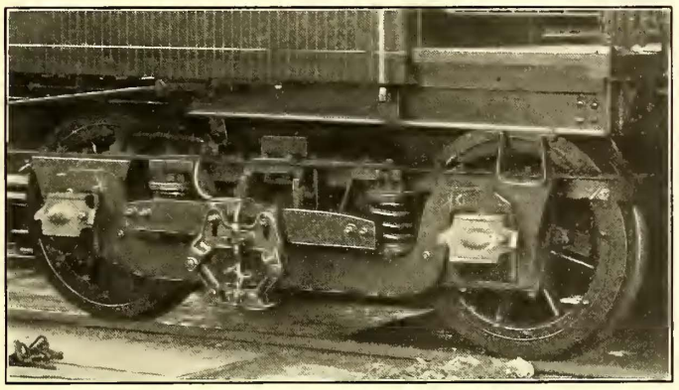
Hale & Kilburn spring seats and backs, Van Dorn couplers and Consolidated electric heaters are used.

The heater connections are somewhat different than those ordinarily employed. There are three coils in every heater, all exactly alike. The object of having the coils alike is so that the number of repair parts will be reduced, and so that different coils can be energized at different times, so that each coil gets practically the same amount of use. In this way, when one coil is worn out the entire heater can be discarded. The three circuits are labeled on the switches Nos. 1, 2 and 3, and during winter weather signals are posted at the terminals by the direction of the superintendent telling the conductors what heat switches to throw in. Each circuit takes approximately 8 amps., so that during severe weather 24 amps. can be used to heat the cars. The three switches on the heaters are of the quick-break lever type, and are mounted in a sheet-iron box at the opposite end of the car from the light switches.



VIEW UNDER MOTOR CAR, MOTOR END

The cars are equipped with the Westinghouse automatic air brakes and engineer's valve, operated by a separate General Electric motor compressor on each car.



TRUCK AND SHOE

The compressor used is the CP-14 direct-connected type, such as the General Electric Company is now building in several different sizes. It has a piston displacement of about 20 cu. ft. per minute. As this is the first large installation of direct-connected compressors, it is interesting to know that these compressors are giving very good results. The direct-connected type was adopted because it was thought best, if possible, to get a compressor without gears and pinions, and the large number of wearing parts which a geared compressor necessarily has.

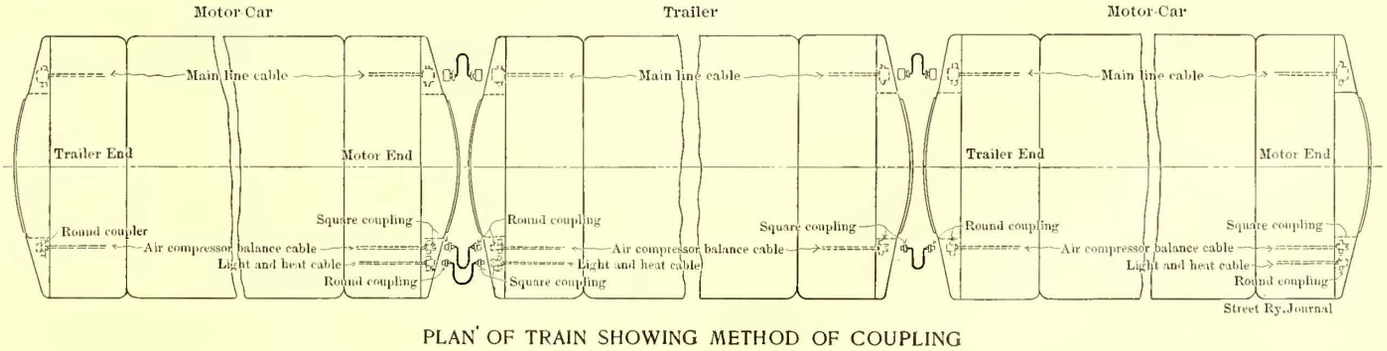
The automatic governor, which, with the compressor, was described briefly in the STREET RAILWAY JOURNAL for October, 1901, is of the MB type. It is similar to previous General Electric governors in that a flexible rubber diaphragm is used, but otherwise it is of a new design. It is operated entirely pneumatically and so no magnet coils are needed. At the same time a quick make and break on the contacts is secured.

A through air reservoir line is used which is connected to all the reservoirs in the train. In order to equalize the work that the different pumps do, a train-line circuit is also run from car to car which so connects the governors and pumps that the closing in of any governor starts all the pumps at once. This train-line wire carries current for all the pumps, so as to do away with any complications, such as relays.

The weight of a motor car with equipment complete is 51,800 lbs., divided as follows: motor-car end, 31,600 lbs.; trail-car end, 20,200 lbs. The motor trucks complete with gears, but without motors, weigh 10,100 lbs. The trailer trucks weigh 7000 lbs. each. Each motor complete with gears weighs 4420 lbs. each.

ELECTRICAL EQUIPMENT

Each motor car is equipped with two G. E.-66 motors (125 hp), both of which are mounted on the same truck, and the train unit-control system of the General Electric Company is employed. Both system and motor were described in the STREET RAILWAY JOURNAL for October, 1901.



PLAN OF TRAIN SHOWING METHOD OF COUPLING

Mention should also be made of novel type of fuses used, and which were adopted largely to avoid all possibility of

the use of a fuse or circuit breaker, which, with the large currents employed, would make much smoke or noise as it opened, and thus startle the passengers. The fuse is a copper ribbon with $7\frac{1}{2}$ ins. between terminals, $1\frac{1}{4}$ ins. wide and 10 mils. thick, and has a $\frac{1}{2}$-in. hole drilled in the center of it. This is the first time, so far as is known, that a fuse of this nature has been used. The good results obtained are due to the fact that there is a very small amount of metal in the fuse, although there is a great deal of radiating service. This fuse will carry constantly practically 300 amps., and will open 400 amps.

The chief point in favor of a fuse of this nature is that it is absolutely reliable, and that all the copper that is burned away is practically vaporized. Generally when one of these fuses blows, only a very small amount of the fuse burns away, as the ribbon is so flexible that, due to the heating action of the current, the ends turn themselves back. In this way quite often not over 1 in. of the middle of the fuse is melted away when a heavy short-circuit is opened, and very little smoke results.

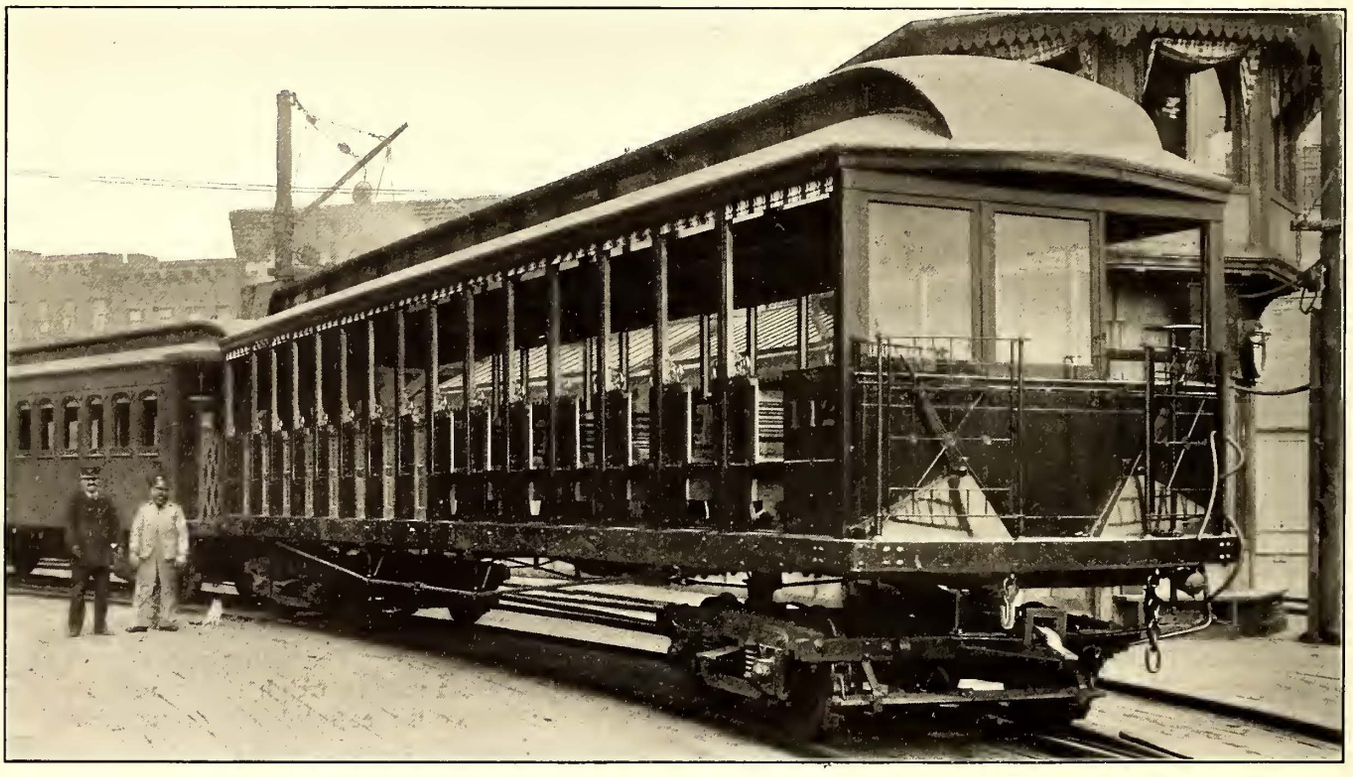
tion, which is practically fireproof, being substituted for the wood. Fireproof paint has also been used wherever practicable.

OPEN CARS

The proposition to run open cars on a railway elevated for its entire length was one to which the managers of the Manhattan Railway Company gave considerable thought before a decision was finally reached. The cars have proved very popular, however, and by the system adopted of closing all the entrances before the car starts no trouble has been experienced in the way of accidents to passengers.

The general dimensions of the open cars are as follows:

	Feet	Inches
Distance between center of trucks	33	2
Distance between wheels of each truck	5	0
Diameter of truck wheels	2	6
Length of car body on center line over end-plates	47	1
Width over side sills	8	6
Height of platform over top of rail	3	$10\frac{1}{8}$
Height of center of draw-bar over top of rail	2	$4\frac{1}{2}$



STANDARD OPEN CAR, MANHATTAN RAILWAY

There has been so much talk during the past year in regard to the danger from fire of elevated cars that it is gratifying to know the Manhattan Company has so installed the electrical apparatus and wires that the fire risk has been reduced to a minimum. The wires themselves being much more likely to cause fire than the apparatus, especial attention has been given to this part of the equipment. The insulation of the leads to the cast-grid resistance boxes has been removed between the resistance box and just below the floor. It was not thought advisable to remove the insulation from the leads to the contactors, so, instead of removing the insulation, an asbestos hose has been slipped on over the insulation. Asbestos cloth tape 3 ins. wide has also been used to wrap the cables. The bottom of the car and any place where there is any possibility of an arc has also been thickly covered with abestos sheeting. The same precautions have been used with the motor equipment and controllers. There is practically no wood on any of this apparatus, moulded insula-

The timber used in the under frame is of long-leaf yellow pine, except the needle beams and end sills, which are of white oak. The side sills are $4\frac{1}{2}$ ins. x $7\frac{3}{4}$ ins. with a 8-in. x $\frac{5}{8}$-in. steel plate running the full length of the sills. The center and intermediate sills measure $4\frac{5}{8}$ ins. x 3 ins. The needle beams, which are white oak, are 5 ins. wide and 5 ins. deep at the ends and 6 ins. deep at the center. The cars are also strengthened by two longitudinal truss-rods extending from bolster to bolster, $1\frac{1}{4}$ ins. in diameter with ends upset to $1\frac{1}{2}$ ins.

All seats, with the exception of the end ones, have reversible backs. The door-operating mechanism is of wrought-iron, with the sliding bars moving on rollers. The lever for operating the doors is on the end platform.

The weight of the open car body is 16,000 lbs. The trucks weigh 6700 lbs. each, making the total weight of an open car 29,400 lbs. Each bench holds six passengers, and passengers are not allowed to stand up between the seats.

MOTOR TRUCKS

Four hundred of the motor trucks were supplied by the American Car & Foundry Company, and 464 by the Wason Car Company, upon specifications of the Manhattan Railway Company. They are of the swing-bolster type, with 6-ft. wheel base, and the principal characteristics of both motor and trail trucks is their cheapness and simplicity.

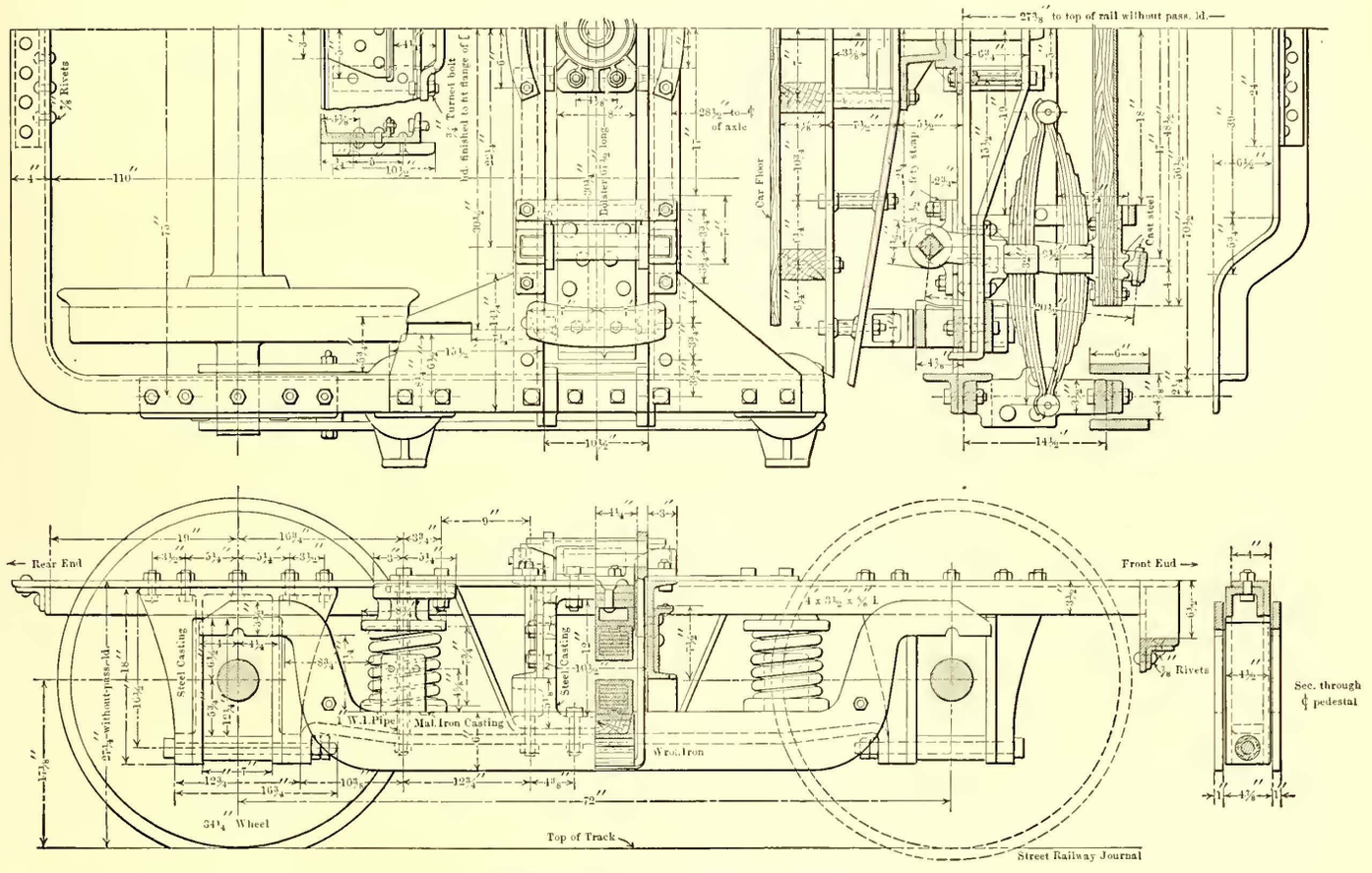
The frame is rectangular and made of angle-iron 4 ins. x 3½ ins. x ⅝ in., 14.6 lbs. per foot. The transoms are made of 10-in. channels, 30 lbs. per foot, connected to the truck frame by ½-in. steel gusset plates, securely riveted and bolted as shown. The bolsters are open-hearth steel plates 8 ins. wide by ¾ in. thick, placed flatwise and fastened together, as shown in the section. The steel has a tensile strength of 60,000 lbs. per square inch and an elongation of 22 per cent in 8 ins. The spring-plank is made of an 8-in. channel, 13.75 lbs. per foot, with an oak plank fitted to the channel. The pedestals for the journal boxes are of cast steel, and the equalizer bars are of steel 1 in. x 6 ins. in section. The journal boxes are of malleable iron. The journal brasses used are of phosphor bronze lined with babbitt. The phosphor bronze employed follows the Manhattan composition, viz.: 77 per cent copper, 8 per cent tin and 15 per cent lead. The babbitt is made up of 12.50 per cent tin, 1.25 per cent copper, 16 per cent antimony, and 70.25 per cent lead.

The third-rail shoes are of cast-iron, and are somewhat lighter in weight than those ordinarily employed. Although there is not much possibility for variety in pattern in the way of third-rail shoes, one or two points in connection with this part of the equipment is worthy of notice. Owing to the constant vibration to which the shoe and hanger are subjected, rivets are used in the links and elsewhere where possible, instead of bolts, and the "shunts," or leads, from the shoe to the hanger are made in two cables bent out in each direction so as to reduce the danger of breaking. As shown in the cross section the hanger is also made with a toothed slot, where it is bolted onto the truck frame, so that its height can be adjusted without difficulty.

MOTOR-CAR TRAILER TRUCKS

The motor-car trailer trucks have been remodeled from the former trucks used in steam operation, although a few new trucks were purchased from the Baldwin Locomotive Works. They have a 5-ft. wheel base, instead of one of 6 ft., as with the motor trucks.

The truck frame is made of 3-in. x 1¼-in. wrought-iron bars, with reinforced corners. The bolster is made of three pieces of white oak 9 ins. deep, and two 7½-in. x ½-in. wrought-iron or steel plates, the plates being placed between the timbers, and the whole securely bolted together, making outside dimensions 9 ins. high by 12 ins. wide by 5 ft. 6¾-ins. long. The springplank is 2½ ins. x 12½ ins, white oak, 5 ft. 2 ins. long, supported at each end by swing hangers. The pedestals for the journal boxes are of cast iron. The equalizer bars are of forged steel 1 in. x 3 ins., and the center plates of cast steel. The journal boxes are of cast iron.



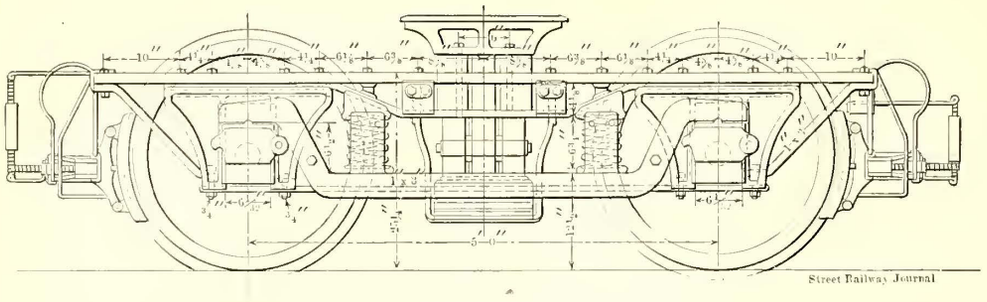
MOTOR TRUCK, GENERAL ASSEMBLY

WHEELS AND AXLES

An important innovation has been made in the design of the wheels used on motor trucks by casting one of the wheels with an extended hub to carry the motor gear. This arrangement, the invention of Messrs. Doyle and Brinckerhoff, of the Metropolitan West Side Elevated Railway, of Chicago, is also used on that road, and is, of course, intended to prevent the breaking of the axle. The breaking of an axle is a serious matter even on a surface railway, but it becomes doubly so on an elevated railway, and for this reason the improvement is one which seems very commendable. A solid gear is used with this patent

hub. While not new, this practice has the obvious advantages of eliminating all bolts and danger of the gear becoming loose.

The cast-steel wheel centers are 28 ins. in diameter, and are fitted with Midvale steel tires, giving a total outside diameter of 34¼ ins.



SIDE ELEVATION NEW TRAILER TRUCK

The axles are of acid open-hearth steel, with a tensile strength not less than 80,000 lbs. per square inch, and elastic limit not less than 40,000 lbs. per square inch. The journals are 4¼ ins. in diameter and 9½ ins. long, without collars and with large fillets at inside. The lateral motion is taken up on the journal brass keeper. The trailer wheels have cast-iron centers, with a fused steel tire, and are 30 ins. in diameter.

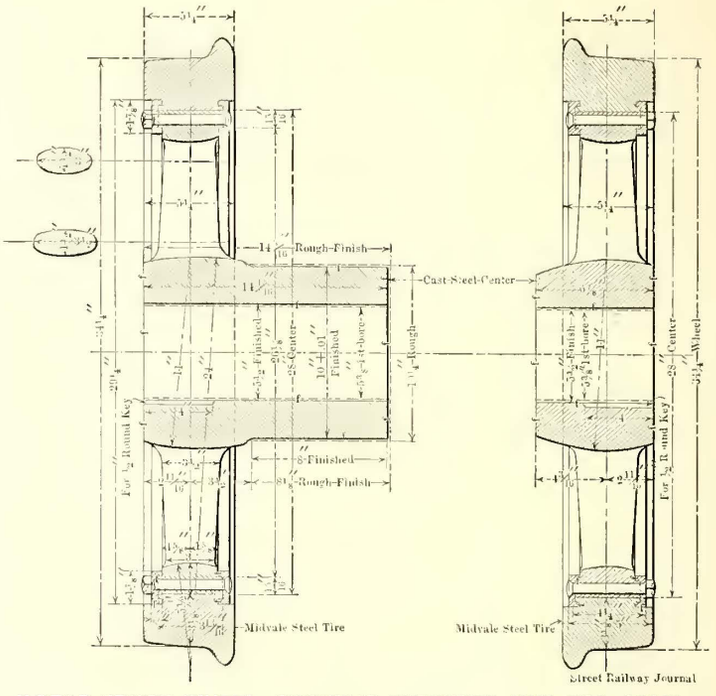
SLEET-CLEANING DEVICE

The electrical equipment of the Manhattan Railway Company was put in operation on the Second Avenue division this spring, so that as yet the company has not had any experience with sleet on the third rail. There is no doubt that this at present is the most serious problem with which third-rail roads have to contend. This question, however, has already been taken up and two types of apparatus have been designed for removing snow and sleet from the contact rail. The first is that of a steel brush operated by means of an air cylinder, and the second, an oil and salt water atomizing or spraying machine.

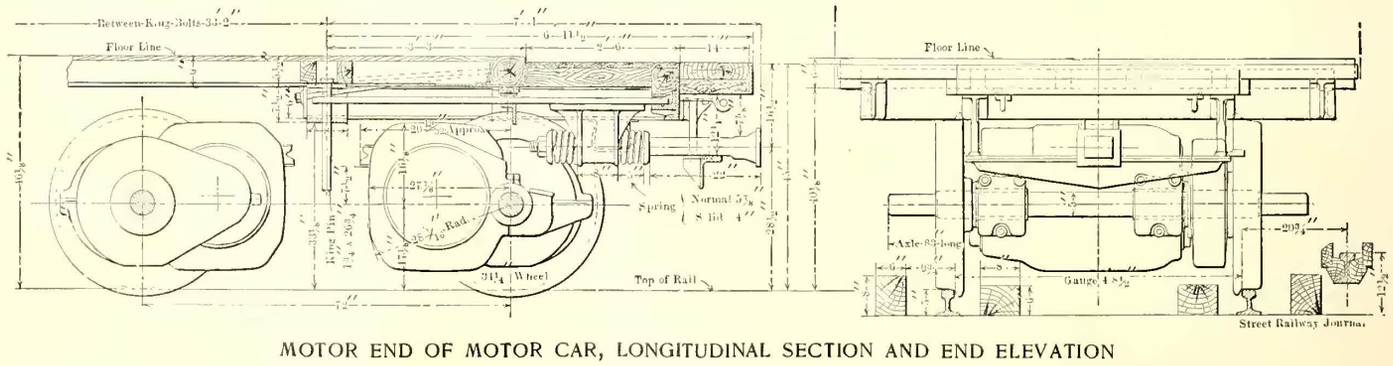
Each motor car is equipped with four steel snow brushes, and there are four motor cars in each six-car train, which necessitates providing means of placing twenty-four snow brushes in action without causing a delay to the train service. With the large number of trains on the Manhattan system, this could not be done any other way than automatically. The brushes are therefore mounted on a piston in an air cylinder, and the four-scraper cylinders on each car are operated by means of a single air cock by the motorman. If the general superintendent decides to put the scrapers in action a notice to this effect is sent to each station superintendent, who displays a sign instructing the motorman to throw the air cock and put the brushes in service. In this way all the scrapers on the entire line can be put in operation within two minutes after the general superintendent decides it is necessary.

In addition, there are ten equipments of oil and salt-water spraying machines on each of the four lines of the system. This spraying machine consists of a tank which contains either oil or salt water, and this material is delivered through an atomizing nozzle located above the contact rail. The object of the oil and salt-water machine is to provide an auxiliary means of preventing sleet from forming on the third rail.

One of the difficulties in removing snow and sleet from a third-rail system, up to the present time, has been the time required in getting the apparatus into action, and, second, improperly designed apparatus. One of the advantages of this system is that all the brushes and also the auxiliary salt-water and oil machines can be got into action within three or four minutes.



MOTOR TRUCK WHEEL, SHOWING EXTENDED HUB FOR SOLID GEAR



MOTOR END OF MOTOR CAR, LONGITUDINAL SECTION AND END ELEVATION

The Monterey Street Railway Combpany, of Monterey, Mex., which was recently organized with American capital for the purpose of building an electric traction system of the city of Monterey, in addition to acquiring some 30 miles of horse roads, has purchased the Empresa lines, which gives the new concern control of the entire street tramway system of that city. Some 70 miles of road will be converted into electric traction. The American interests are represented by the Baltimore banking house of Sperry, Jones & Co.

STREET RAILWAY ACCOUNTING

CONDUCTED BY J. F. CALDERWOOD, ASSISTANT TO THE PRESIDENT BROOKLYN RAPID TRANSIT COMPANY, AND MEMBER INSTITUTE OF SECRETARIES OF LONDON.

The Standard Form of Report Adopted at Detroit

BY J. F. CALDERWOOD

Editorial comment on the principal action taken at the Detroit Convention of the Street Railway Accountants' Association, viz., that on the report of the committee on the standard form of report for street railways, has been withheld from these columns partly owing to the same pressure of work which prevented the writer from attending the meeting, partly to allow opportunity for other expressions of opinion on the subject, but more particularly to enable the writer to review the action of the association as recorded in the minutes of the meeting. The publication of these minutes has come at a date too near the time of going to press to allow of an extended treatment of the matter in this issue, but in the near future it will be taken up in detail and given the attention which many of the radical departures from the established system formerly endorsed by the association deserve. It is to be hoped, in the meantime, that members who had the good fortune to be present at the convention, as well as the others who are now in possession of the proceedings, will send to the writer such comment on the form of report adopted as seems warranted. That the best friends of the association cannot fail to take a great interest in an action of so much importance is, of course, out of the question, and it is probable that many of them feel the sentiment of regret expressed by a member last month at the change from a form of report which has received the endorsement of so many State boards of railroad commissioners, and has been adopted on roads operating some 40 per cent of the total mileage in the country.

The Standard Form of Report

BY H. D. EMERSON

The standard form of report for electric railways, as submitted by the committee to the Street Railway Accountants' Association at Detroit, is of particular interest to those, like the writer, who are called upon to analyze corporation reports and determine therefrom the earning power of securities. We are handed the figures covering the operations of a property and a copy of balance sheets, and we are expected to determine whether the price asked for a specific security is high or low, and give the reasons as deduced from the figures presented. Heretofore the reports of many electric railway companies have been deficient in some of the essential items of information, and the suggested form has been examined with much interest and its details carefully considered.

The income account, as suggested, is a long way in advance of the old form, but appears on the face of it to contain too much detail, and I do not think a readjustment would entail any more work upon the accounting department or eliminate essential items. Primarily an income account should be a condensed statement of the total business of the corporation for the year, and should indicate two entirely different things. It should show first, the total and net profits, and second, the disposition of those profits. The meaning of the word income is well understood, and should not be misused.

The question of the disposition or handling of certain individual items, whether they be charged in one place or in another, is a question which should be discussed on its abstract merits and not from the individual standpoint of any particular corporation. It seems to me that this point was well brought out in the discussion by the association, and unquestionably the advocates of the new form are correct. There can be no question but that the carrying of a net amount into an income account does not exhibit clearly the business done; consequently, the contention that all earnings should be carried into schedule A is unquestionably correct. The English language is a live language, it is true, but at the same time it will not do to neglect dictionary definitions. The sums received for sale of power or the rentals of track or terminals are unquestionably earnings. Taxes, on the other hand, are unquestionably expenses, and any statement of earnings or profits of the company which does not first deduct these expenses is unquestionably misleading to that extent, and in this respect both old and new form are lame.

The functions, however, of a periodical statement or report are not ended when they have shown the items required by investors, but should also show details sufficient to enable judgment to be passed upon improved efficiency in the management of the property or to demonstrate retrogression. In the discussion before the convention this point was brought out, and some of the gentlemen insisted that the inclusion of certain items in schedule A would tend to affect operating ratio. It is just as well to call attention to the fact that the comparisons of the operations of properties by comparing the operating ratio is a fad, which, fortunately, is so thoroughly understood to be a fad that it is not used by up-to-date statisticians. Comparisons are purely relative, and depend for their value and accuracy upon the number of parallel conditions existing in each case. The actual expense of operation is affected by so many conditions that the percentage which the cost of operation bears to earnings is neither a guide nor an index to the relative value of the different properties.

It is, however, a fair guide when applied to the same property continuously or when comparing immediately succeeding or preceding periods. To illustrate, a comparison of the operating ratio of a street railway company now and ten years ago is absurd on the face of it, and it is just as absurd to draw any conclusion as to the relative efficiency of management of two different properties for the same year. Brooklyn Rapid Transit and Manhattan will immediately occur as an excellent illustration.

The income account, as presented, does not seem to be thoroughly consistent, and the titles of some of the items are misleading. But this is easily corrected. There is no reason why details of the principal items, gross earnings and operating expenses, should be carried into schedules and then the details of miscellaneous income be set forth in the general income account. It is clearly understood and should be practically admitted by all accountants that there are two separate and distinct parts to an income account, and that items in one should never be confused with the other. The operations of the plant and the profit produced therefrom must be clearly and distinctly shown, and then afterwards the disposition of that profit should be recorded. How would the following do for the form for general income account, all details being carried into schedules:

Gross earnings from operation	$000,000
Less operating expenses	000,000
Net earnings from operation	$000,000
Add other income	000,000

Total income	$000,000
Less fixed charges	000,000
Net income	$000,000
Less dividends	000,000
Surplus to profit and loss	$000,000

With this form of income account the general results of the workings and operations of the property are disclosed at a glance, and if the investigator desires to go into details he can turn to the various schedules showing the item under each principal account, and thus ascertain for himself the comparative efficiency of the management.

The disposition of earnings remaining after charges and dividends have been paid is not a matter which pertains to the business of the corporation for the particular year, and so it should be carried into the profit and loss account and added to the balance brought forward from previous years; specific deductions, readjustment of charges or accounts should be made in the profit and loss account, and there shown as debits or credits.

The considerations underlying the determination of a particular form of report are twofold. It shoud be the aim to produce a simple, comprehensive but easily understood summary of the business of the corporation for the benefit of the management and its security holders, and second, this form should be so devised as to entail the smallest amount of labor on the accounting department, and yet produce results in such detail as will enable mistakes to be corrected and improvement appreciated. Perhaps a better form of income account than the one suggested by the committee might be devised, but the form, as reported, follows sufficiently near established forms, well known and understood by the great majority of investors, to be thoroughly satisfactory to them. If it be accepted by the gentlemen in charge of the accounts of the principal street railways, and the specific definitions of the various items argued upon be followed by their subordinates, the results produced will be much more intelligble to the investing public than statements heretofore submitted. This will tend to produce confidence in the integrity of earnings and will tend to raise street railway investments to a higher plane and broaden the market for this class of securities.

Some Disputed Points Concerning Transfers

BY ARTHUR WENTWORTH

In the very interesting paper at the recent Detroit convention by C. D. Meneely, on the "Registration of Transfers," the point was made that there exists a wide diversity of opinion among railway men as to whether or not transfers should be registered. If anything will serve to dispel these differences of opinion it is such discussions of the subject as that given by Mr. Meneely. There is really not such a wide divergence of opinion as would at first appear to be the case. Mr. Meneely is an advocate of the registration of transfers—for his road. It does not, however, appear that he is of the opinion that the local conditions of other roads may not make the non-registration of transfers advisable. He practically admits the correctness of the position of the advocates of non-registration when he says: "Undoubtedly the fact that the transfers of other lines cannot be turned in at a cash value (under non-registration) prevents the conductor from obtaining fraudulently, either directly or through an intermediary, the transfers of intersecting and transferring lines and converting the transfers so obtained to his own dishonest gain." This makes it perfectly clear that it is not the act of registration which gives the transfer a cash value to the conductor, but the act of substitution of the transfer for a cash fare. When there is no substitution the transfer has no cash value. Mr. Meneely admits that registration of transfers makes substitution easy, but in doing so he is speaking primarily of the practice of registering transfers and cash fares together on a single register.

Will Mr. Meneely not also admit where transfers are registered separately from cash fares that substitution can be effected without great difficulty? Let us assume that a conductor has obtained through a trade twenty transfers of a connecting line which he wishes fraudulently to substitute for cash fares. Now, it is evident that if the conductor has registered faithfully all of his cash fares on a separate clock he must of necessity turn in cash equivalent to the cash fares registered, and he cannot therefore make the substitution. This is the fact upon which the advocates of separate registration build their argument that separate registration is preferable to single registration. But is it not an easy thing for a conductor when he collects cash fares to register them as transfers without exciting the notice or suspicion of his passengers, who are not, as a rule, watchful? This species of fraud can be detected only by a secret-service operator on the car. The uniformed inspector who boards the car en route can not detect it, because if he counts the transfers in the possession of the conductor it will appear that the substitution has been made when the fares were registered. Cash fares board cars at nearly all transfer points, and in a crowded car not even the watchful secret-service operator can always tell whether the conductor collects transfers or cash from his passengers. In a small load he might do so, but conductors who pilfer are themselves very cunning and watchful. When they ring up cash fares on the transfer register they usually select the opportunity favorable for it, and that opportunity occurs many times each day at heavy transfer points on crowded lines. To ring up cash on the transfer register away from transfer points requires more assurance and boldness, but it is undoubtedly frequently done without detection. The percentage of trips covered by secret-service men on a large road is so small in proportion to the whole, and the percentage of rides in which the registration of cash on the transfer register could be detected is so much smaller that it is hardly worthy of serious consideration. We have, therefore, three points upon which nearly all will agree, viz.: First, that registration of cash and transfers on one single register encourages, promotes and makes easy the substitution of transfers for cash fares, and, second, that separate registration of transfers renders substitution a little more difficult, but still enables it to be practiced to a great extent, and, third, where registration of all fares is on one clock a failure to register is equal to a failure to register a cash fare.

It would be interesting to know precisely what advantages the advocates of registration of transfers claim for their theory, but, unfortunately, Mr. Meneely in his paper did not tell us. He argued against non-registration, but his negative arguments will hardly be relied upon to establish the case in favor of registration. The only thing he said in favor of registration was: "It will be conceded, I think, by all practical street railway men that the ideal method of protecting revenue, assuming one uniform rate of fare, and a sure method of preventing transfer trading, would be to register all fares and transfers upon a single register. Under the above assumption the advantages of such a method are obvious." All practical street railway men will not agree with Mr. Meneely in conceding registration of all fares on a single clock to be the ideal method, even

if transfer trading were entirely eliminated, for the reason that every failure to register a transfer is equal to failure to register cash, and the chances of failure to register cash are multiplied by the number of transfers received. The only advantage of registration of transfers that the writer has ever heard of is that it enables secret-service men and uniformed inspectors to check the conductor to better advantage; that it enables the conductor to check himself, or any observing passenger to discover whether all fares are registered. This advantage appears to be entirely nullified by the fact that trading in transfers enables the dishonest conductor to steal by substitution and at the same time register every fare that gets on his car. If any conductor wishes to be dishonest he will naturally select the safest, easiest and most profitable way.

Again, quoting Mr. Meneely: "While the non-registered transfer may not be used by the conductor in this particular manner, its value has not been one whit diminished to the traveling public, to whom the conductor may, within limits, determine by the accounting, either sell or give away rides on the company's cars, which would otherwise go to swell its earnings." The selling or giving away of transfers could not be practiced to any great extent without detection, because it would require the collusion of a great many people to make it profitable. Where so many people are concerned it would be difficult to keep the practice a secret. Moreover, transfers are not like unlimited tickets that are good until used. They have the date of issue printed on them, and must be used on that day, and must be used within a specified fifteen minutes which is shown thereon, and must be used at a specified transfer point. The selling or giving away is not something that is distinctive of the method of non-registration. It may be done just as easily when registered as when not registered, therefore the argument does not apply to non-registration with any force. It is not quite clear what Mr. Meneely means when he says: "The non-registration of the transfer does not eliminate its cash value, except to the extent of preventing trading between conductors, and the consequent substitution of transfers for cash fares." It is not apparent what cash value the transfer has unless it can be substituted for cash. May we not prevail upon Mr. Meneely to be a little more explicit? The opinion appears to be warranted that if the managers and the accountants, who seem to be on one or the other side of this really important question, will take the trouble to state their views clearly it will be found that they differ very little on the essential points.

An ideal method of protecting the revenue and the reason for each step is as follows:

METHOD	REASON
Register cash fares only, and register each one as collected.	Everybody's attention will be focused on the cash. The only way conductors can steal will be through a failure to register cash fares.
Non-registration of transfers.	To destroy their value as substitutes for cash and thereby prevent trading.
The state of the register to be recorded and cash turned in, if practicable, at the end of each round trip. On many roads it cannot easily be done, but the method is ideal.	As a safeguard to the revenue and to avoid giving the conductor opportunity to tamper with day card or trip sheet, as may be done when register is recorded and money turned in at end of day's work.
Transfers to be turned in or placed in a conveniently located box at the end of each round trip, which can always be arranged in one way or another.	To facilitate accounting and avoid opportunity for conductor to juggle with the returns.
To provide an automatic self-recording register which will record on paper the closing number of each half trip.	To show without the aid of register takers the infallible record of each half trip, the record to be turned in by conductor with his cash and checked by the receiver.

Summing up all that has been said, the great and important question remains of devising some method of checking the cash fares and knowing whether they are all registered. The only method known at present is the employment of register inspectors and secret-service agents of a high order of intelligence and loyalty, and laying out their work in the most careful and systematic manner. If the considerable amount of money which some roads are spending to watch the registration of transfers and prevent trading, and money spent for the placing of transfer agents at points where lines operating from the same depot intersect one another, could be saved and devoted solely to watching the registration of cash fares it stands to reason that better results could be obtained. Likewise, if a self-recording register can be found (and two or more are now on the market) the money now being spent for register takers may be also devoted to the purpose of protecting the registration of cash fares. The registration of transfers brings with it so many attendant expenses and complications that it would be better to abandon it and simplify the situation by devoting all the energy and the money available to improved methods of safeguarding the registration of cash fares. The accountants should not deceive themselves by hugging the theory that non-registration of transfers violates the cardinal principle that conductors must account for all passengers carried. Registration is not accounting, but is merely one of the aids to accounting in the same manner as is the case with the gas meter or water meter. It is not intended that all passengers shall be registered or accounted for, since policemen, firemen and employees wearing the proper uniform and badge are usually carried free without registration. The advocates of non-registration claim that the transfer passenger is sufficiently accounted for when the ticket upon which he rides has been collected and returned to the company. His nickle and the transfer issued to him have presumably already been accounted for, and the return of the transfer through the proper channels and within the proper limitations should complete the transaction in all essential respects.

Desires Method of Computing Loss from Transfers

CHICAGO UNION TRACTION COMPANY, ACCOUNTING DEPARTMENT

Chicago, Nov. 20, 1902.

EDITORS STREET RAILWAY JOURNAL:

To comply with a decision of the Supreme Court, this company and the Chicago Consolidated Traction Company have increased the transfer privileges on their lines. I should be very glad to obtain the opinion of your readers among the accountants how shall I arrive most accurately at the loss that will be likely to follow from these increased facilities given the public? Answers through the columns of the JOURNAL will doubtless interest all of our members.

F. E. SMITH, Auditor.

As a result of the refusal of the employees of the Havana Electric Railway Company, of Havana, Cuba, to join the general strike of union laborers ordered for Nov. 24 in sympathy with the cigarmakers, the company experienced considerable difficulty in operating cars, and at one time had to abandon the service temporarily.

STREET RAILWAY JOURNAL

DECEMBER 6, 1902.

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NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our news columns.

All matters intended for publication in the current issues must be received at our office not later than Wednesday of each week.

Address all communications to
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The recent consolidation in New York of the elevated and underground systems has given rise to considerable speculation as to the economy which will be effected by uniting the two properties. In many of the theories which have been advanced a considerable economy in the cost of power has been suggested, but we do not believe that this will result in much, if any, saving, as the amount of power required on the united system could be generated practically as cheaply in two power stations as in one. There will be, of course, some saving in the distribution, as the present Manhattan station can supply the East Side lines of both systems while the new Interborough station can supply the West Side lines; but the principal economy will come in other directions. It will be partly in administration and general expenses, but will lie principally in the fact that the two lines will not be obliged to compete with each other, and, consequently, that the schedules can be so arranged that the maximum desirable operating efficiency can be secured at all times. Another very important advantage will lie in the fact that the extensions of the two systems will not parallel each other. The lower part of New York is so arranged that the main transportation lines have of necessity to be built on the few north and south avenues, but it is not to be expected that the two systems will always remain as they are. Additional mileage will necessarily have to be built in the rapidly developing section of the Bronx, and here the district can be divided so that the extensions will not parallel each other to any extent. In other words, the economies to be effected will lie largely in the department of operation, and this will be considerable, as has been shown by the experience in Brooklyn in the consolidation of the elevated and surface systems.

A problem of most vital interest to street railway companies at this season of the year is that of the removal of snow from the tracks, and in this connection the paper and discussion on this subject at the last meeting of the New England Street Railway Club brought out a number of points which seem worthy of special note, particularly at the present time. It was tolerably well established that no single type of electrically driven snow plow is adequate to meet all classes of storms and service. For suburban or interurban lines subject to heavy drifts in severe storms there seems to be at present little apparatus on the market that can rival a powerful double-truck rotary equipped with from 150 hp to 200 hp in propelling motors, and with about 75 hp in motors geared to drive its fans. Such a plow would weigh about 20 tons, exclusive of its electrical equipment, and it should be liberally supplied with emergency jacks, lanterns, ice chisels, sand, salt and shovels, which, when needed, are wanted badly.

For light storms and general city service some form of nose or radial plow is desirable, and this likewise should be equipped with emergency tools, and should have from 75 hp to 100 hp in driving motors if of the single-truck variety. In all classes of plows the motors should be geared for good acceleration rather than for high-maximum speed, although for suburban service a plow should be capable of getting out of the way of regular cars on clear track, which means a maximum speed of 15 miles to 20 miles per hour in most cases, at least.

The necessity of the personal interest of the operating superintendent in securing enthusiastic, persevering work from the men behind the plows and shovels was strongly emphasized. The company which cares for the physical comfort of its men is far from being a loser in the end, and proper shelter, food and hot drinks have been found to be no mean aids to the snow brigade in its successful campaigns against the storms. The assignment of various sections of the company's territory to the different foremen in the same manner that a fire department chief divides his city among his district captains was also commended.

Another point brought out was the wisdom of cutting down the service by running fewer cars on roads where the power supply is inadequate to operate both regular service and plows. If the plows are to keep the road open for traffic they must in no case fall short of power, and must do effective work in the earlier stages of the storm, being given right of way as far as possible and kept moving.

We regret that more details were not forthcoming at the

meeting in regard to motors, gearing, control of fans, power consumption of fan and propelling motors under various conditions of speed, grade and depth and quality of snow. Such figures, while largely dependent upon the peculiar circumstances which govern the operation of individual roads, are highly suggestive and helpful to managers, superintendents and engineers who have the snow equipment problem to face. Figures on first cost and maintenance would also have been specially welcome in view of the many thousands of dollars which will be paid out by every large road this winter for men and teams. These questions, together with the varying costs of electrically equipping plows, are of great practical interest, and it is to be hoped that in the near future additional data will be published in the interests of electric railway owners and operators.

Considerable space is given in this issue to a description of the third-rail electric railway between Milan and Porto Ceresio, which is interesting not only from the fact that it is the largest interurban electric railway in Europe, and, with one or two possible exceptions, in the world, but also from the fact that the practice in engine design differs radically from that in use in this country. While in this country the Corliss valve with a detachable cut-off mechanism under the control of the governor is almost universally used on all engines of any considerable size in which economy is desired, in Europe, and especially in Germany, the balanced form of poppet valve with two or more openings is used. These valves are usually operated by cams on a weigh-shaft at right angles to the main shaft of the engine, and are rotated by the latter through a pair of bevel or miter gears. The explanation of this practice undoubtedly lies in that on the Continent the engineers have been the pioneers in the use of highly superheated steam, which, as it is probably known to all, is of little value unless the steam is superheated from 75 degs. to 100 degs. F. This, with the pressures now prevalent, from 150 lbs. to 250 lbs. per square inch, means that the temperature of the steam entering the cylinder must be from 440 degs. to 505 degs. From this it is at once evident that expansion and contraction are excessive, making it impossible to use any of the forms of plain slide valve, and while the piston valve may be used if it be made to fit loosely so as to allow for expansion and permit running without lubrication, leakage will be large, and, except at high speed, would discount the gain following the use of superheated steam. As no adequate means has been devised to introduce graphite into the steam, it may be said in general that any form of valve in which one part slides over another should not be used with superheated steam, as at the corresponding temperatures ordinary lubricants fail. Hence poppet valves must be used under these conditions.

Though it would seem from the foregoing that the poppet valve should always be used, there are a number of disadvantages which, combined with more or less prejudice in favor of the Corliss valve, have led the American designer to adhere to that form. Among the disadvantages which have retarded the introduction of the poppet valve into American practice are the increased clearance volume, resulting in a greater loss from that cause, and liability of the valve cracking from the constant shock in those forms in which a releasing mechanism is used, though a carefully designed dash-pot will obviate this. This type of valve also, owing to the small area of the valve seats, is particularly liable to "cutting," causing leakage and necessitating frequent regrinding of the seats. Lastly, the mechanism of the valve gear is of necessity more complicated than the Corliss arrangement.

Collisions on Interurban Roads

Attention has been called several times in recent street railway conventions to the importance of more effective precautions for preventing collisions on high-speed interurban lines. While there are no statistics available as to the causes or number of such collisions over the entire United States, the paper before the New York Street Railway Association last September by C. R. Barnes, engineer of the Railroad Commission of the State of New York, made it plain that these accidents have increased rapidly with the increase of electric railway mileage, and that the larger per cent of them seem to be due to laxity in operating methods and discipline than to any other one cause.

It almost goes without saying at this stage of interurban development that rules somewhat similar to those of steam roads should be adopted as regards tail lights and signals for indicating following cars operating on the same time. The same rules should also apply as regards protecting the rear end of cars stopped unexpectedly between stations.

The despatching system has as its objects the prevention of head-on collisions and the avoidance of delays to all the cars on a single-track road when one or more fall behind schedule time. It is of very little value in preventing rear-end collisions, because the despatching system can never do more than maintain a time interval between trains at stations, and as ordinarily applied does not even insure this, as it leaves the space interval of the trains to the judgment of the individual train crews. Against the giving of wrong orders by the despatcher there is no safeguard beyond the careful selection of the man intrusted with the duty of despatching, and the despatcher is nothing more than human, and hence fallible. The best despatcher is likely at times to make mistakes, but this is one of the inherent weaknesses of the despatching system which cannot be eradicated unless it is by using a block-signal system in addition to despatcher's orders.

Assuming that the orders are given correctly by the despatcher, the next opportunity for mistake is the misunderstanding of orders. The telephone, as a means of transmitting orders, has been condemned as a makeshift by some steam railroad men on this account. On the other hand, certain steam railroads are making an increasing use of the telephone for train despatching in locations where rapidity in the transmission of orders is desirable and the number of trains per hour is large. While the telegraphic train-order system as practiced on steam roads is undoubtedly the most perfect and least liable to error of anything ever devised along that line, we hardly feel that the telephone should be condemned because it has in some cases been used in a slip-shod manner without proper safeguards as to the correct transmission of orders. We do not agree, therefore, with a recent speaker at an electric railway convention, "that the merit of the (telephone despatching) system is summed up in the fact that a train can be handled in ten seconds." Neither do we think that because under certain circumstances this can be done that

the telephone-despatching system is a "dangerous one," or that the safety of any system is directly proportionate with the amount of delay and red tape there is in the transmission of an order and the number of hands that it passes through. Seriously, though, there is room for much improvement in the way train orders are received on very many interurban lines, both the rules regarding the receipt of orders and the way existing rules are enforced. It is true that the telephone opens the door to carelessness in the transmission and receipt of orders, as the telegraph does not, but the use of operators at every switch on an electric interurban road is out of the question, and we are of the opinion that with proper safeguards the telephone-despatching system can be made as safe as the telegraph. There is no reason why the wording of a train order cannot be as well understood when received over the telephone by the trainmen as when delivered in the form of a telegram. If it is not, there is certainly something wrong with the rules about receipt of orders or the way they are enforced. The writing down of orders, although taking a few minutes extra time, tends to a clear understanding and also tends to eliminate the sending of ambiguous orders by the despatcher as well. As to whether the writing down of telephone orders as received by motormen or conductors is necessary is a matter upon which there is considerable difference in opinion. A number of steam railroad men now operating interurban lines do not require this; others are of the opinion that it is very necessary. A written order is probably the safest, although, of course, it requires a little more time. With proper order blanks this time need be very short, however.

The despatching system, although necessary on a single-track interurban road of any size, and a tremendous safeguard on any road, has certain inherent weaknesses, as just pointed out, and there is an increasing need on certain interurban lines for block-signal systems, which will add to the security of single-track roads by furnishing an additional check on the despatching system. There are also a few cases where double-track interurban lines have need for block-signal systems for keeping a definite space interval between trains going in the same direction. In the consideration of block-signal systems for single-track roads it has usually been assumed that several successive cars must be allowed to follow each other into a block as different sections of the same train. As long as interurban roads are operated under present conditions such practice will probably be necessary, but, of course, the door is left open for rear-end collisions as long as there is not a definite block or space interval maintained between cars going in the same direction. The tendency in the future will probably be toward shortening up the distance between turn-outs or meeting points, so that cars can be run at more frequent intervals without necessitating two cars in a block between turn-outs at once. Such improvements will be made as traffic increases, not only on the ground of safety, but of expediency, because it will permit greater traffic movement, less delay of trains and the carrying of a greater number of passengers. Of course, it is possible that in the future signal systems will be forthcoming by which signals will be located several points between turn-outs, and so arranged as to maintain a definite space interval between different sections of the same train running in the same direction between two turn-outs. Such a system would give all the security of any block-signal system without the expense of providing turn-outs at frequent intervals.

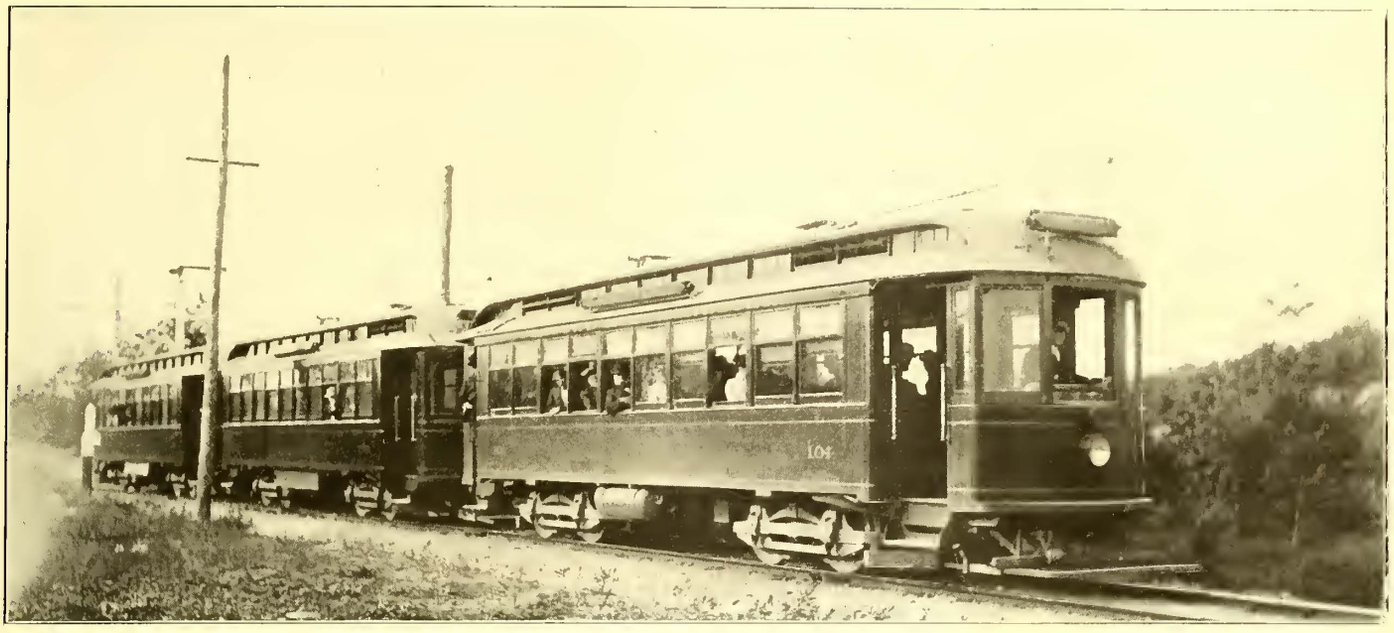
The block-signal systems employed so far on electric roads can be divided into two general classes, automatically operated and manually operated. Although the automatic signals are admitted to be by all means the most desirable, if reliable ones can be secured, practice so far has been more dependent on manually operated lamp signals. The manually operated lamp signals as frequently used have failed to offer as perfect protection to a car as they could if slightly modified. It is one of the fundamental principles of signal apparatus recognized by the American Railway Association that all failures in the signal apparatus shall be on the side of safety, or, in other words, if the signal apparatus fails, it shall give a danger rather than a clear indication. In steam-railroad practice no small part of the ingenuity of signal engineers is spent in designing apparatus which will never stick in a clear position, and so will never indicate safety when there may be danger. The simple lamp signals so frequently used by electric roads for indicating the presence of a car in a block, and operated by hand switches at each end of the block, are often arranged so that the closing of a lamp circuit gives a danger signal. No signal apparatus should be dependent upon the closing of any circuit whatever for a danger indication. It may be permissible to allow the closing of a local circuit to light red lamps for danger indications, but such circuits should not involve the use of any line wire likely to get broken, and, furthermore, it should be expressly understood when such a signal is installed that the absence of a light indicates danger just as fully as if the red light were burning. With the manually operated lamp-signal system, arranged to work according to these principles, the only chance for a head-on collision would be through the failure of the trainmen to protect themselves by throwing the signal to danger upon entering the block, or direct disobedience of the signal. There is probably an increasing tendency toward the use of semaphores, which indicates danger or safety by their position, rather than to depend upon lamps alone. From an operating man's standpoint the semaphore is desirable. It has been frequently maintained that incandescent lamps are very likely to be burned out, but the same thing might be said with even greater emphasis in regard to magnets placed in block-signal apparatus on an electric road, and such magnets are necessary to operate a semaphore.

The staff system has been frequently mentioned of late and discussed in our columns. The original simple staff system had nothing electrical about it, and consisted simply of a staff, which gave the right of way between passing points to the train which has possession of it. A late modification makes use of a staff instrument at each end of the block, with electrical connections between the instruments and with a number of staffs in each instrument. This permits the movement of a number of trains either way. It allows but one train in a block between staff instruments at one time, which, as we have pointed out before, is really the only sure preventive of rear-end collisions, but which is a practice which many interurban roads would have difficulty in adopting without increasing the present number of turnouts, Nevertheless, with so large a per cent of the collisions, rear-end collisions, this increasing of the number of turnouts is certainly a matter worth considering when a road is investing money in improvements.

The Concord & Manchester Branch of the Boston & Maine Railroad

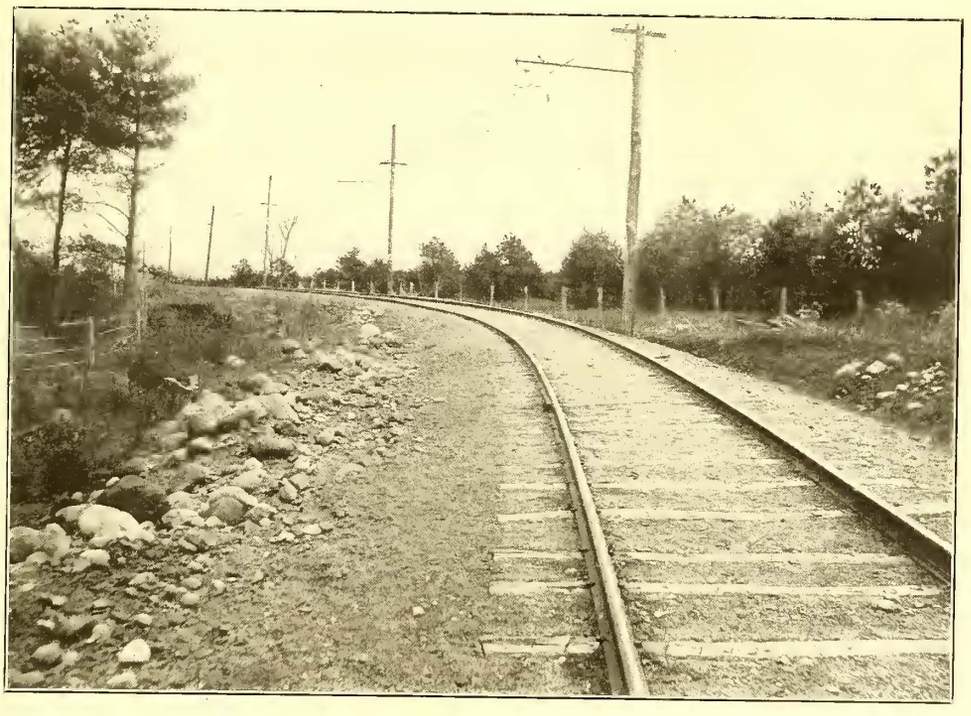
Electrical transportation has shown such remarkable progress, particularly in the last ten years, that the large steam railroads have been forced to give serious consideration to all matters of electrical development. It was at first thought that the steam roads would be threatened by a new and dangerous sort of competition. Up to the present, however, this has proved to be only for local traffic, and it is a question with the leading steam railroad managers whether this loss has not been more than counterbalanced in most cases by the effect of the electric railways as feeders to the main lines. In New England the steam railroad companies adopted a somewhat different course in dealing with the subject of electric lines in their territory than in other parts of the country. The New York, New Haven & Hartford Railroad Company purchased control of the local railway systems at certain strategic points along its route, as at Meriden and Stamford, and has also equipped with electricity some of its branch lines. The Boston & Maine Railroad Company has also entered the electric railway field, and has recently completed the construction of an electric branch between Concord and Manchester. This railway is also notable from the fact that it is said to be the first electric road of the typical sort to be built and operated by a steam railroad company as an integral part of its general system.

The primary idea of the steam railroad is to give a passenger a "lift" for a longer or shorter distance upon a definitely established line of travel; it is more or less a fixed proposition, the extension of which causes great expenditure of money and energy. The primary idea of the more flexible street railroad, on the other hand, is so to extend its lines as to be able to carry a passenger from his own doorway to practically any destination he may select. The combination of the two ideas is the ideal of modern railway practice, and its most convenient and economical working out must necessitate the operation harmoniously, or else conjointly of steam railroads and street railways in some such way as that undertaken by the Boston & Maine.



THREE-CAR TRAIN

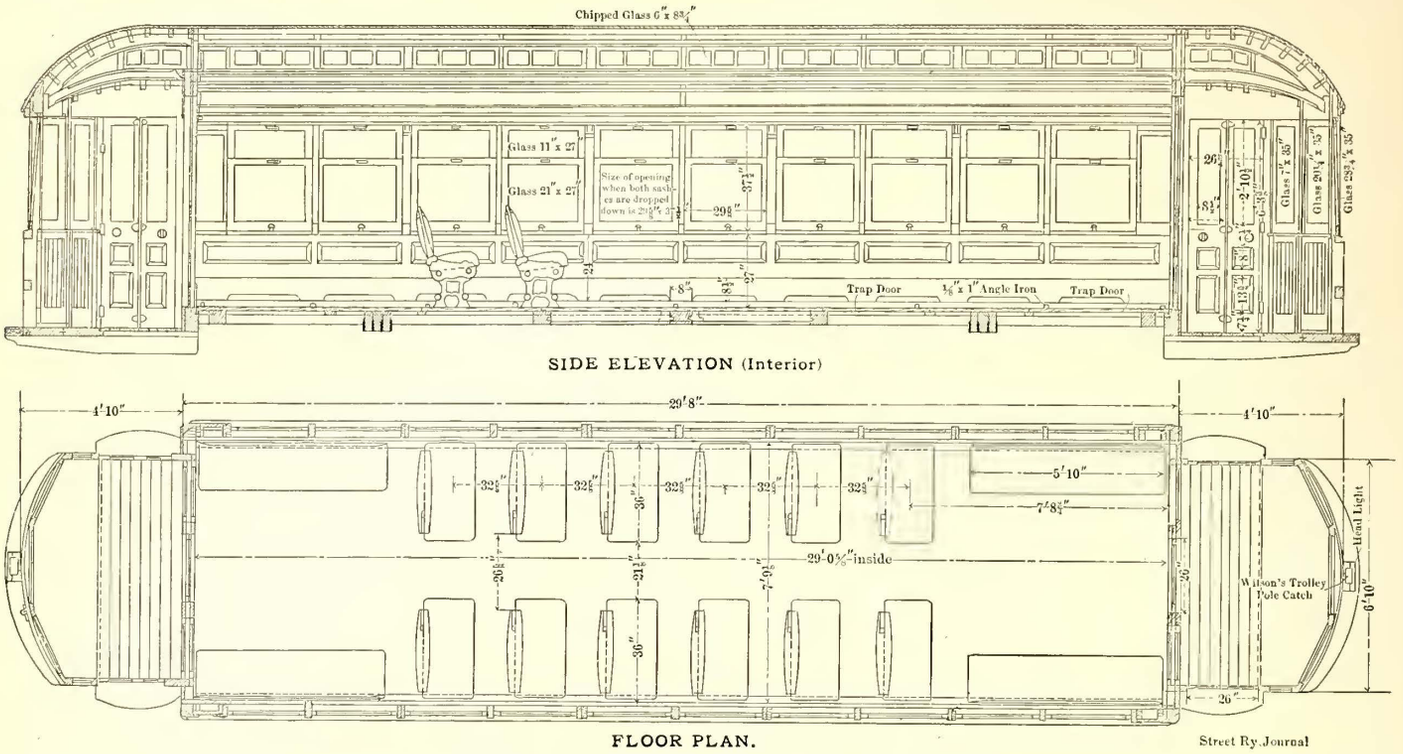
The first experiment made by the Boston & Maine was the building and operating of the local system near Portsmouth, N. H., which was supplemental to the steam road, but was operated distinctly as an independent electric railway company. The Concord & Manchester branch, however, is practically a part of the company's steam railroad system, and all the safeguards that are provided for the steam road have been utilized in this electric branch.



STEEP GRADE AND SHORT RADIUS CURVE NEAR ALLENTOWN

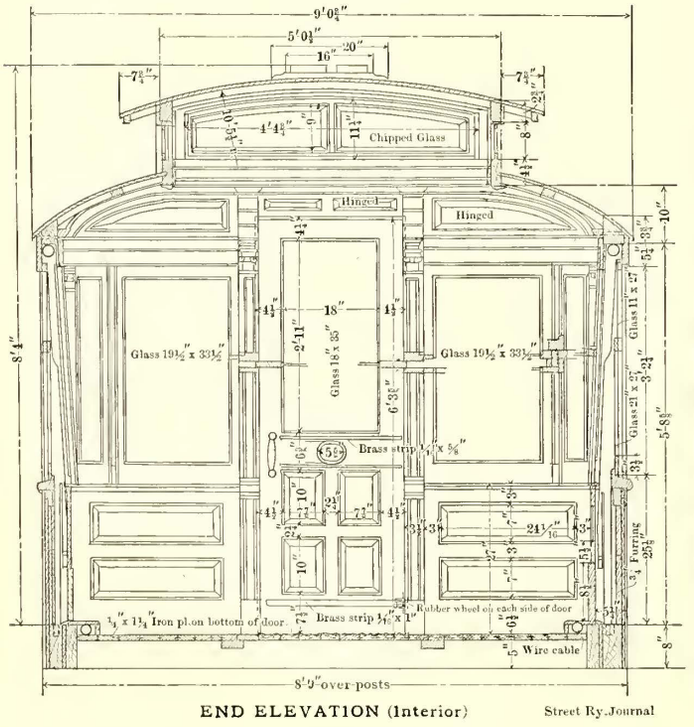
One of the obstacles which has stood in the way of the consolidation of steam roads and electric roads or the

operating of electric roads by steam-railroad managements has been the charter rights of the railroads and the restrictive laws of most States in regard to public highways. In New Hampshire, however, in 1895, an act was passed providing for the organization of street railway companies under the general law, which thus permits existing steam railroads to build branches and extensions in the shape of street railways using electricity as their motive power. The same act allowed street railways to exercise the right of eminent domain in establishing private rights of way, so that now street railway companies can either follow the public highway or their own private rights of way as appears to be most advantageous. Legislation is not yet sufficiently complete to enable an absolute union between steam railroads and existing street railways, but this particular difficulty has been overthrown in part in the case of the Concord Street Railway, operating in the city of Concord and connecting with the electric branch, by having the same officers, the stock being held by Boston & Maine officials as individuals. It is the expectation, moreover, that this difficulty will be removed by legislation in the near future.

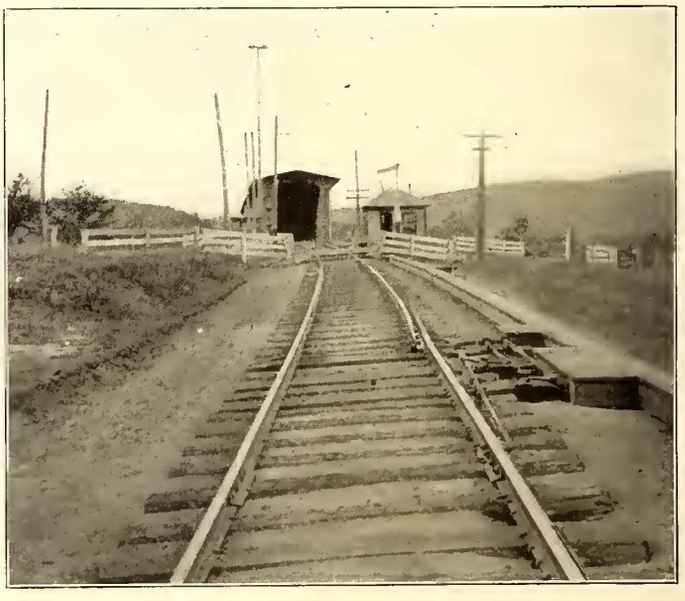


SIDE ELEVATION AND PLAN OF STANDARD CAR

The route of the Concord & Manchester electric branch follows the line of the Merrimac River between these two cities through a picturesque valley sprinkled with typical New England villages and homesteads. The distance between Concord and Manchester by the line of the road is about 16½ miles; the present running time is one hour. It has often been assumed that a roadbed as substantial as that used by steam railroads would cost more than an electric road can afford to pay, but this problem has been solved by the application of steam railroad methods to the

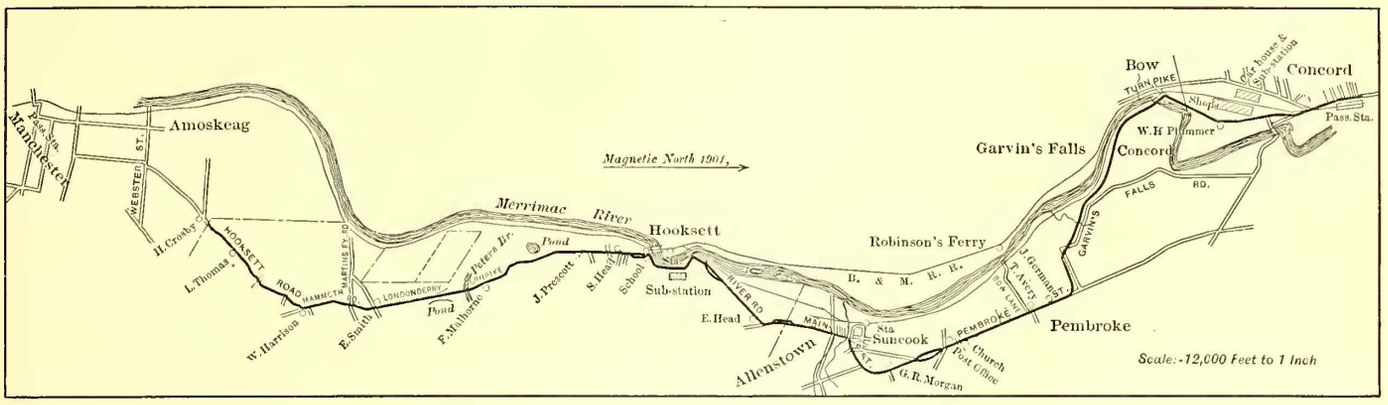


END ELEVATION OF CAR

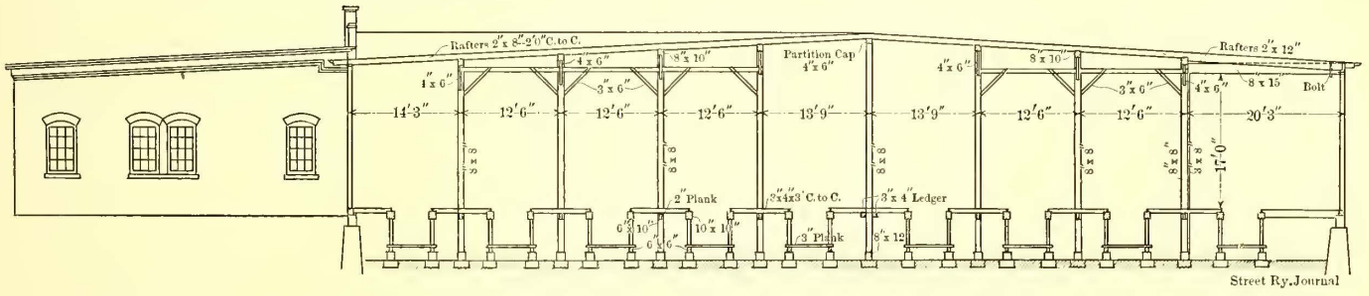


DERAILING SWITCH ON STEAM ROAD AT BOW JUNCTION

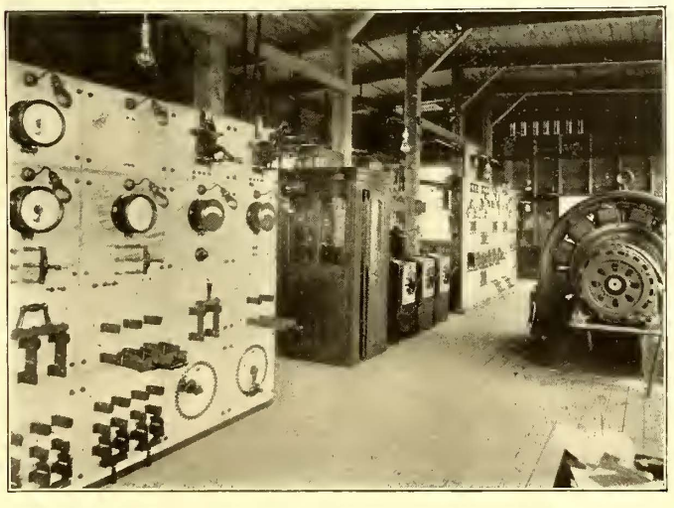
street railway field. Instead of the usual method of digging out the highway, putting down ties and rails and throwing in the dirt again, the branch line is ballasted as carefully as if it was intended to be used for standard trains. The highway was dug out to a depth of 2 ft. or 3 ft., as the nature of the grade demanded, and the wornout road material was replaced with clean gravel. This would have been altogether too expensive an undertaking if the usual street railway methods had been employed, but Frank A. Merrill, the assistant chief engineer of the company, laid the roadbed at about one-third the usual expense by the employment of a regular construction train, with dump cars, workmen's cars and steam shovel complete. As some of the grades were as high as 10 per cent, a geared locomotive, such as is used in South American mountain work, was employed. Permission, of course, was secured from the town authorities for the use of a locomotive in the streets, and, although the construction train was possibly an annoyance, its use enabled the railroad to do the work better and quicker, and to the townspeople's permanent advantage. To a considerable extent grades have been avoided. In some places "cuts" and "fills" as heavy as those on the average steam railroad line may be found, and in other places the grade of the whole street was changed at the railroad's expense in order to minimize the wear and tear. The town authorities co-operated in some instances by changing the street lines so that sharp curves would be avoided, and in one case the road was made perfectly straight in this way for a distance of something over a mile. On such curves as could not be eliminated the outer rail has been elevated as in steam-railroad practice.



MAP OF CONCORD & MANCHESTER BRANCH

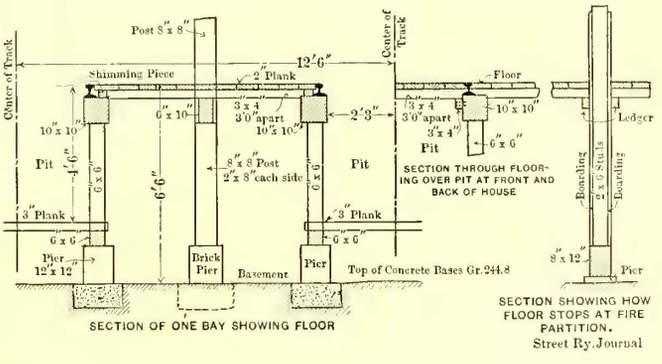


CROSS SECTION OF CAR HOUSE AND SUB-STATION AT CONCORD

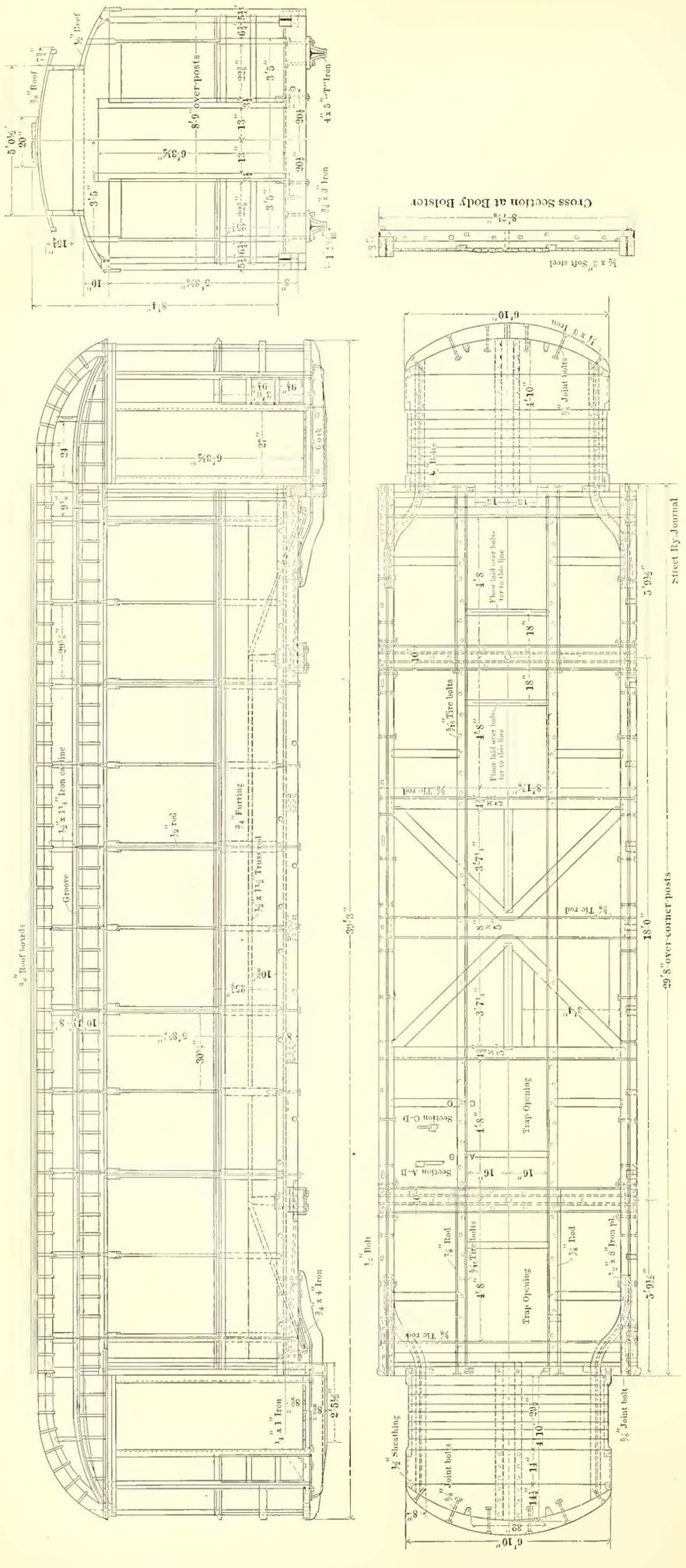


ROTARIES AND SWITCHBOARD, HOOKSETT SUB-STATION

In a private right of way near Concord the electric branch parallels for a mile or more the Hooksett branch of the Boston & Maine, and this direct comparison of the two roadbeds shows that there is little to choose between them. At the Suncook River there is a cut and fill, each of considerable depth, and a trestle bridge over the river, and except for the trolley wire the construction would be easily taken for that of a first-class steam railroad. Wherever streams are of sufficient size standard masonry culvert work has been put in and 150 tons of cast-iron pipes have been used for the smaller culverts. At Bow Station, named from the sharp curve of the Merrimac as it leaves Concord and plunges over Garvin's Falls, the river itself



METHOD OF PIT CONSTRUCTION IN CAR HOUSE



SIDE AND END ELEVATION AND PLAN OF STANDARD CAR FRAMING

is crossed on the existing railroad bridge, but all danger of accident is avoided by an interlocking-signal system with derailing switches. In another instance near Concord the highway bridge has been paralleled by a new bridge used exclusively by the street railway, which not only gives greater safety, but less liability to delay, than if the highway bridge were used.

At the present time the line has 16.27 miles of single track and 0.32 of a mile sidings. The maximum grade is 10 per cent and 250 ft. long. There is one curve with a radius of 100 ft. Seventy-two and seventy-six-pound rails are used, and ties 7 ft. long with 5-in. face and 5 ins. thick. Protected double-0000 rail bonds are employed. The highest point on the line is at the corner of Pembroke Street and Broadway, 446 ft. above sea level. The lowest point is at Hooksett, 198 ft. above sea level. The total rise of a car on a round trip from Concord to Manchester and return is 1796 ft., or nearly one-third of a mile. About 80,000 cu. yds. of gravel were used as ballasting, and 80,000 cu. yds. of earth and more than 6000 cu. yds. of solid rock were excavated. Gravel ballast is used to a depth of from 18 ins. to 30 ins.

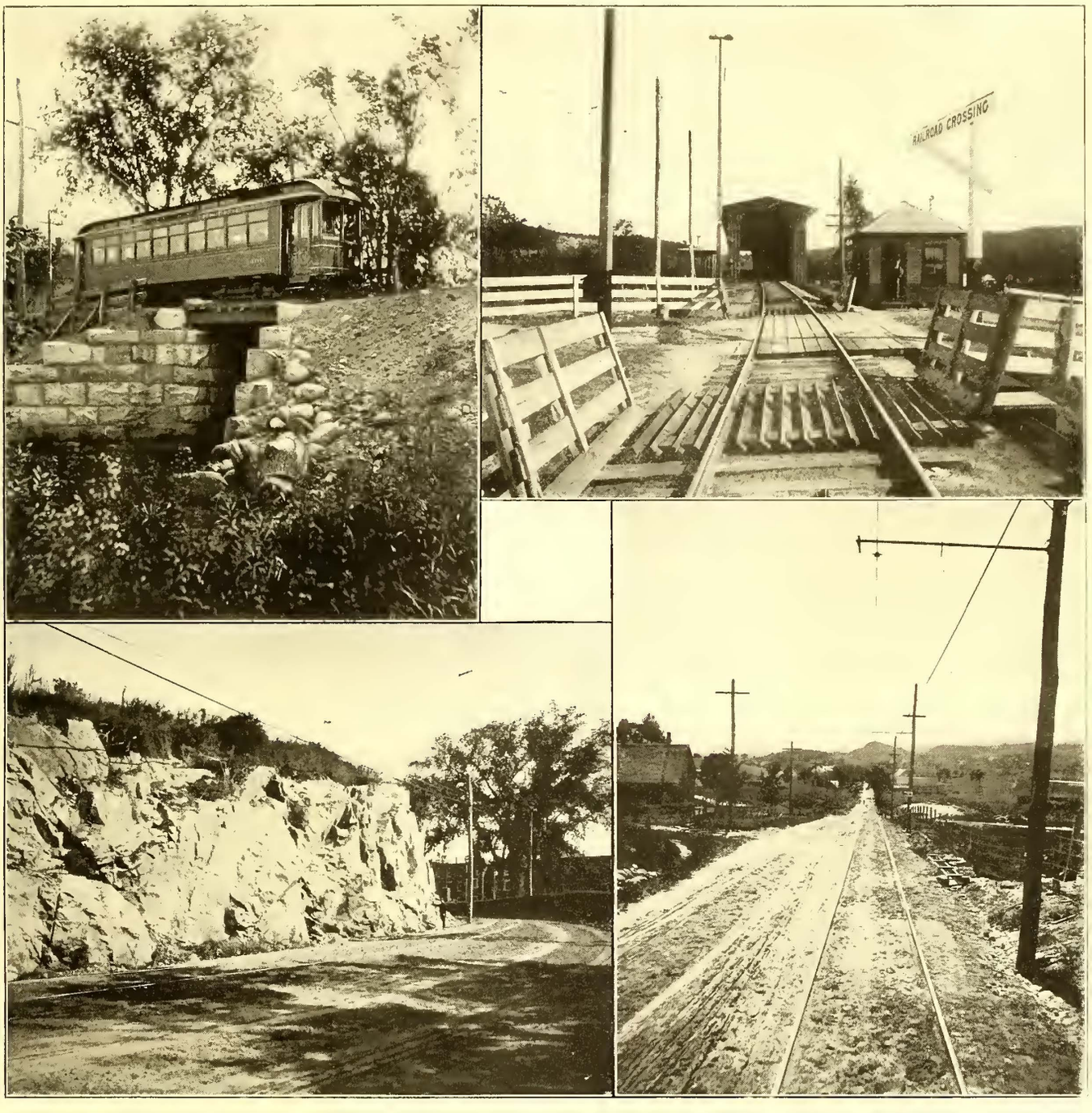
Section houses are being constructed along the line of the road, and the work of maintaining the roadbed is kept up during the whole year, as upon steam railroads. This is contrary to the usual practice of electric roads, since the roadbed is frequently neglected until it is in need of renewal over almost its whole length. By the practice of keeping section gangs constantly at work it is expected that the roadbed will always be in the best possible condition, and greater comfort will be secured for its passengers. The road is divided into three sections, with a foreman and gang to each section.

The trolley wire used is a 000 grooved copper wire. It is suspended in flexible brackets by means of Anderson LS straight-line hangers and General Electric mechanical ears. For curves Johns' milled ears are used, while the pull-offs are of the Anderson LS type. Especial attention has been given to guying the poles with heavy iron-wire stays wherever there has been danger of the trolley wire being deflected from the center of the line, as, for instance, on hillsides and curves. On heavy curves a double set of poles has been put up. All the electrical work was under the direction of F. D. Hall, chief electrician of the Boston & Maine Railroad.

The road takes its power from the Manchester Traction, Light & Power Company, and also from the Concord Street Railway. The former company has an available 10,000 hp, part of which is transmitted to the sub-station at Hooksett at a pressure of 10,000 volts, three-phase alternating current. At this station it is passed through General Electric transformers and rotary converters and transformed to 550-volt direct current. Aluminum feeder cables equal to 500,000 circ. mils copper cable are used for direct-current distribution. The Concord Street Railway power plant consists of four General Electric dynamos belted to Rollins engines, and has a total capacity of 600 hp. From this station a large aluminum feeder equal to 500,000 circ. mils. copper cable is strung nearly the entire length of the line, and is also tapped onto a large 264-cell storage battery at the Concord sub-station, for equalizing the load.

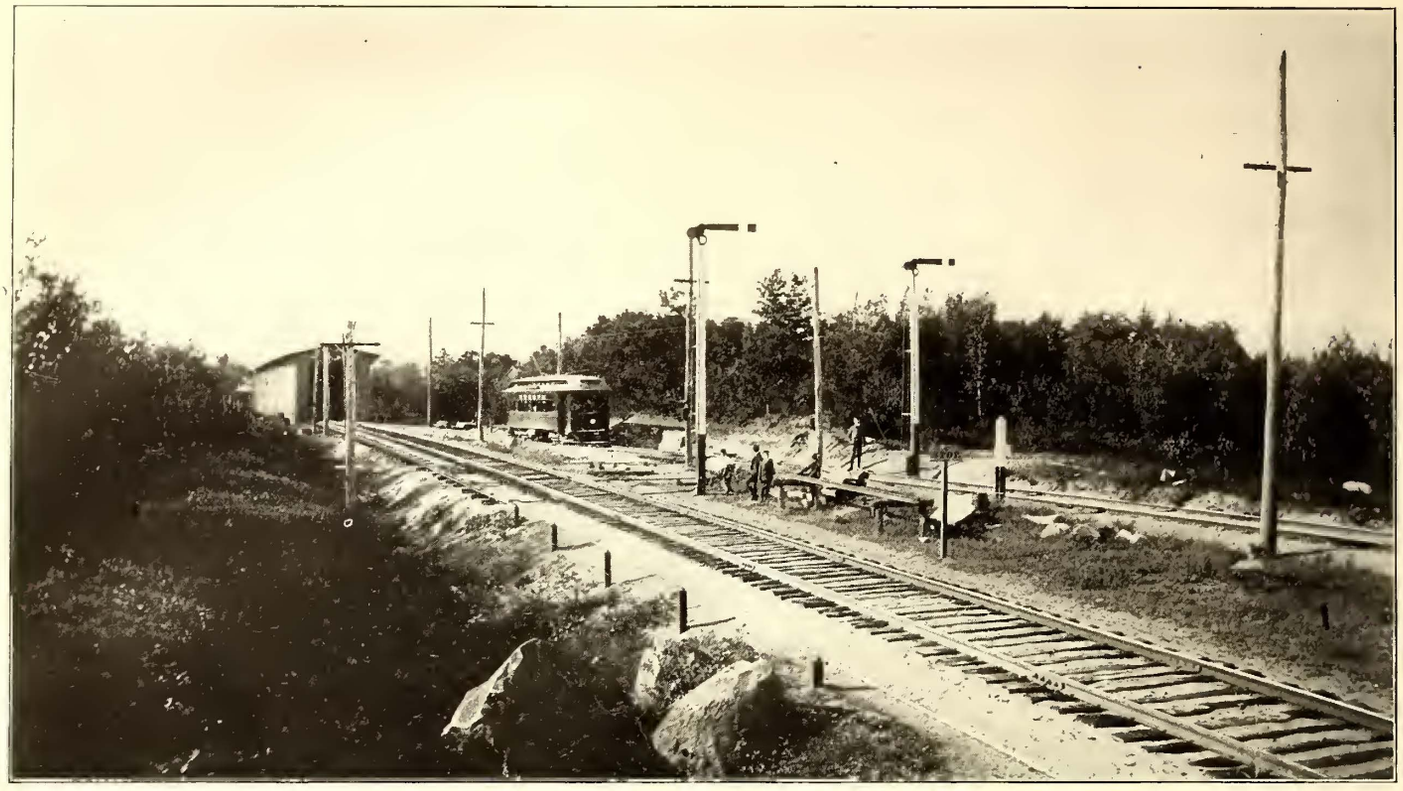
The cars used on this branch were designed by J. T. Chamberlayne, master car builder of the Boston & Maine Railroad, and were built in the shops at Concord. They are heavier than ordinary street railway cars of the same length, are 39 ft. 5 ins. long, and are 8 ft. 8 ins. wider. This width makes it possible to have a center aisle of convenient width with two comfortable seats on each side. The weight of each car is 40,000 lbs. They are finished inside in mahogany, and are equipped with large windows so constructed that the whole sash drops into a pocket, leaving the sides open and securing all the advantages of an open car without its disadvantages. Each car has an air whistle, and whistling posts, such as are used to caution locomotive engineers, are found at every street crossing and at other points where the necessity exists. At such points two long and two short blasts are given just as on steam railroads.

The cars, which are eight in number, are mounted on Laconia B3 trucks and are equipped with General Electric multiple-unit control, also with General Electric No. 67 motors, four motors to each car, or about 160 hp alto-

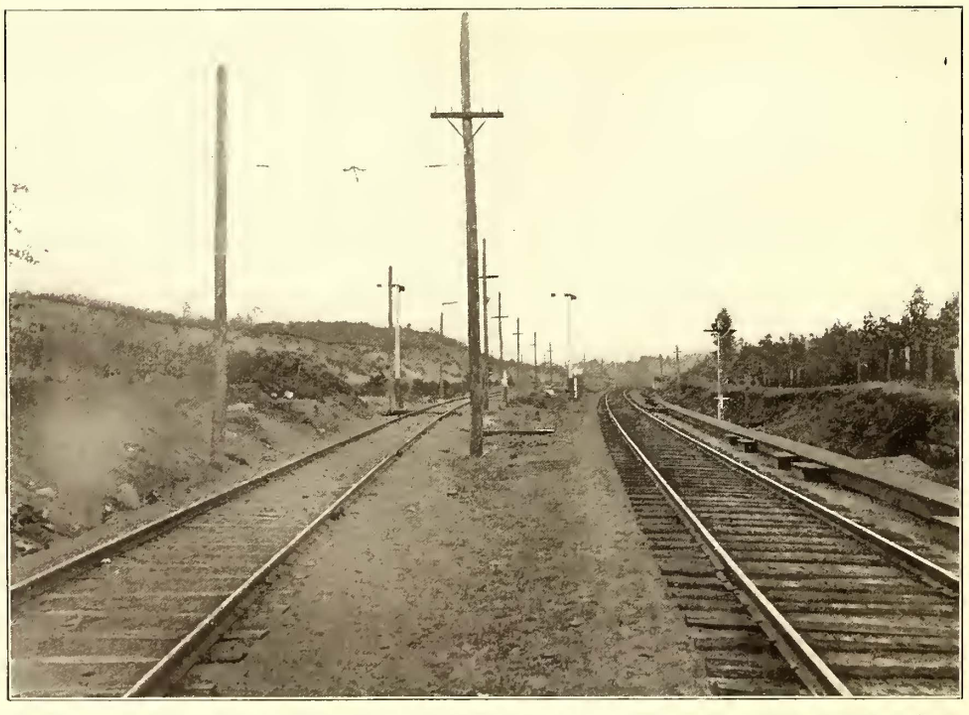


MASONRY CULVERT, JOINT STEAM AND STREET RAILWAY BRIDGE, ROCK CUT AND LONG GRADE, SHOWING WHISTLING POST AT SIDE OF TRACK

gether. They have electric magnet circuit breakers and Christensen automatic air brakes. Single-motor cars are generally used, but during heavy traffic trains are run with two and three cars, operated by one motorman, with a conductor for each car. The trolley wheel is form 11, Union standard, which is somewhat larger and heavier than the ordinary trolley wheel, and when operated as in trains the trolley of each car is used against the trolley wire. It has been found by experiment that a train of three cars can start on a 4 per cent grade at the terminus of a line 9 miles from the nearest sub-station without reducing the voltage below 500 volts. The wheel used was supplied by the Laconia Company, and has a 33-in. diameter, 3-in. tread and ⅞-in. x 1-in. flange.



SOUTHERN END OF BOW RAILROAD BRIDGE, USED BY STEAM AND ELECTRIC TRAINS, SHOWING SEMAPHORES AND DERAILING SWITCHES



ELECTRIC ROAD PARALLEL TO STEAM TRACKS

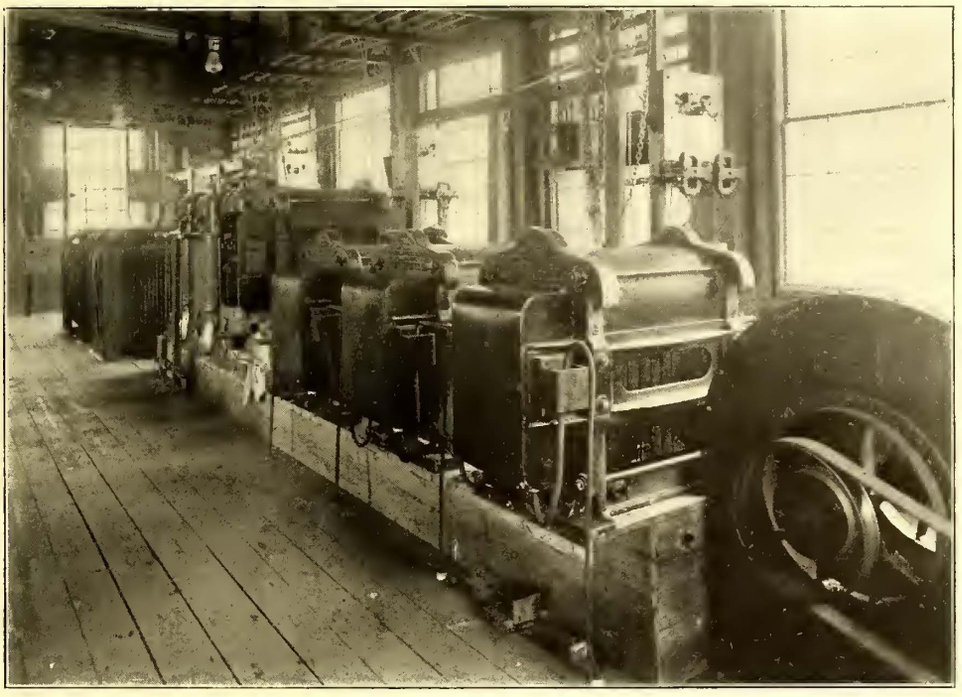
As already stated, the Concord & Manchester electric branch is run entirely on steam-railroad principles with the exception that motors are substituted for steam engines.

Printed time-tables are used showing the leaving time at the principal stopping points. Motormen and conductors are obliged to carry watches of standard makes and have them regulated by the official watch inspector, and are compelled by heavy penalties to live up to the running schedule. At the central car house is a train despatcher and at every siding is a telephone. If a car is delayed more than two minutes at the siding the rules require the conductor to call up the despatcher to receive instructions. From steam railroad practice also the joint responsibility of motorman and conductor, as in the case of locomotive engineer and train conductor, has been adopted, and the conductor does not leave the telephone post until he has repeated his instructions to the motorman, so that in case of doubt the instructions may be verified by the latter.

Extra cars are run as sections of the regular car run. Superintendent H. A. Albin, a graduate of the Massachuseets Institute of Technology, who has had charge of this line since its inception, has adopted a device for indicating extra cars, which consists of target signals by day and lanterns by night, both carried on the hood,

corresponding to the colored lights and colored flags carried on the pilot of locomotives to denote following sections. A green light or target on a car means that the line is clear to the next crossing point, while a red target or red light shows that a car is following, and the motorman cannot leave the siding until a car appears with a green target or green light. The absence of signals denotes danger. If for any reason a car be delayed beyond a reasonable limit it loses its regular run and becomes a section of the following car.

This branch road is also unique as a street railway because it has a fully equipped passenger agency in charge of the resident assistant general passenger agent of the Boston & Maine Railroad at Concord, F. E. Brown. One of Mr. Brown's innovations is the use of coupons corresponding to railroad tickets. For example, four fares are taken up during the progress of the car over the line. Instead of taking up these four times, necessitating four times of making change with the passenger, the whole amount is collected and a coupon for each interval to be traversed is given. The conductor, after selling the ticket, has only to collect a coupon at each of the four stages of the journey, and it is therefore possible to keep a complete check upon the business and furnish the road with all the statistics required, besides avoiding disagreements as to whether or not a passenger has paid. The fares are registered on a New Haven double register.



TRANSFORMERS AT SUB-STATION AT HOOKSETT

An effort has been made to inspire among the employees the same spirit of loyalty that is so often found among men on the steam railroad. Pains are taken in selecting good men and every inducement is given for faithful and permanent service. The Brown system of discipline is used, by which a record is kept of every man. Infractions of rules are recorded by a system of graded marks, and when a man falls below a certain percentage he simply loses his place, but meanwhile he has the right to see his own record at any time, and may claim a hearing on any marking. The record is taken into consideration at the time of the annual examination, which includes tests for color blindness and physical condition, as in the case of steam railroads. Motormen and conductors receive $2 per day as wages.

The superintendent of this street railway system reports to the general superintendent of the Boston & Maine Railroad Company, just as the superintendent of any other division does. The passenger agent's department does the same class of work that is done for a steam railroad, and takes the same care of its patrons. Altogether, although the Concord experiment is young, the officers of the Boston & Maine are convinced that it demonstrates the fact that steam railroads and street railways may work in harmony to their mutual benefit and to the great enhancement of public convenience and comfort.

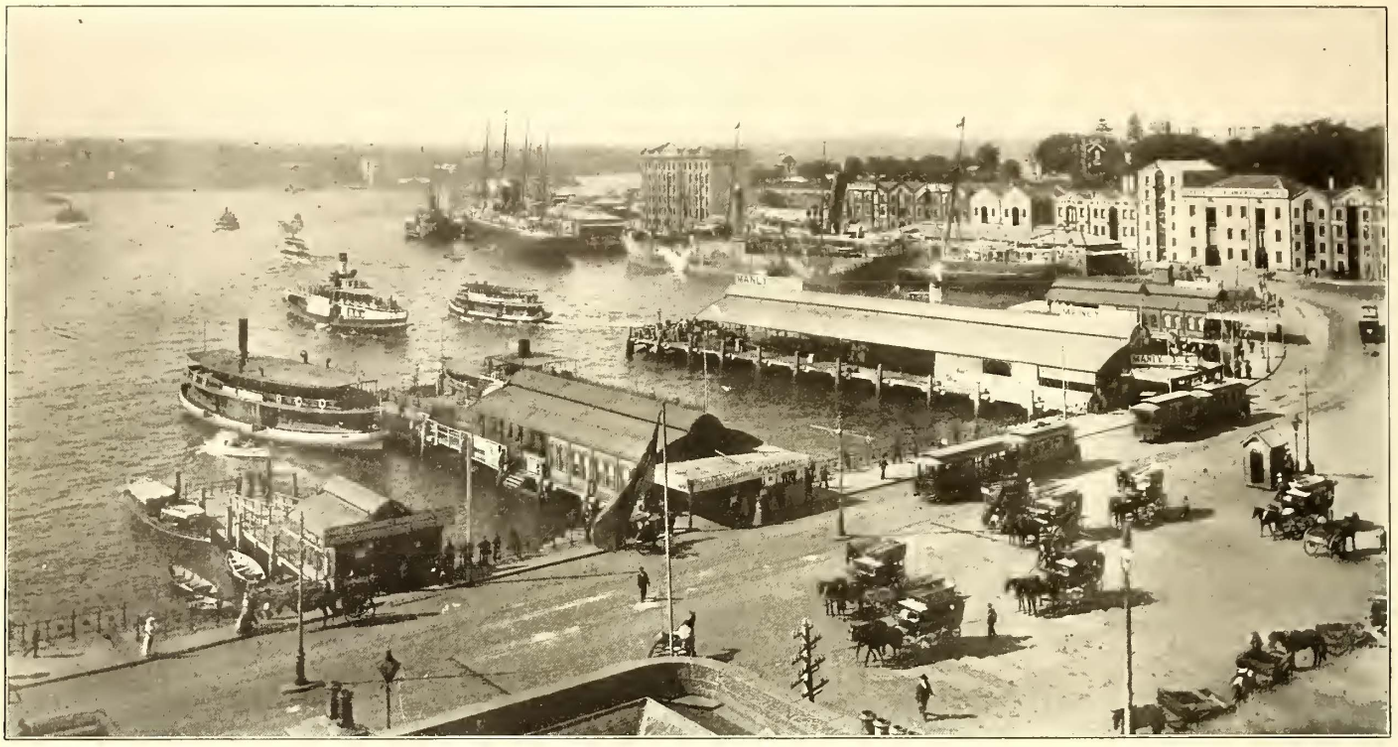
Rehearing Asked for Chicago Union Traction Transfer Cases

The Chicago Union Traction Company and the Chicago Consolidated Traction Company have asked for a rehearing of their transfer case before the Supreme Court of Illinois. This is the case which has attracted so much attention recently, the decision of the court making obligatory the giving of universal transfers. The companies maintain that they are entitled to a rehearing, because a number of the points that were made by the court were not mentioned in any brief or oral argument, and were of vital significance to the companies. It is also averred that the court has expressed opinions in vital matters which were not issues in the case before it. Some of the points on which the companies relied with much confidence, it is claimed, were overlooked entirely by the court, and that part of the argument seems to have escaped perusal; and, further, that the court has a clearly erroneous conception of the power of the city of Chicago to pass the ordinance which was the basis of the suits. The court held that this power is found in a clause of the cities' and villages' act, which, after conferring upon a city the power to tax, regulate and fix the compensation of hackmen, grants the same power over "all other" individuals or companies pursuing like occupations. The Supreme Court has proceeded upon the theory that all doubts as to whether street-car companies are included in the expression "all others," are to be resolved in favor of the city. The attorneys for the companies maintained that all authorities show conclusively that any reasonable doubt is to be resolved against the existence of any municipal power that may be the subject of discussion.

Railway agents of Salt Lake, who held a meeting in that city recently to consider the question of competition between electric railways and steam railroads, concluded that competition is not the same in all localities. According to the findings, in some localities the competition has been beneficial by building up suburban traffic to a point never reached before. Much of this patronage, it seems, is obtained by steam roads, while in other instances railroads affected by electric traffic have closed way stations, making it possible to give better express service for long distances than was possible before the electric competition.

The Electric Railway in Sydney

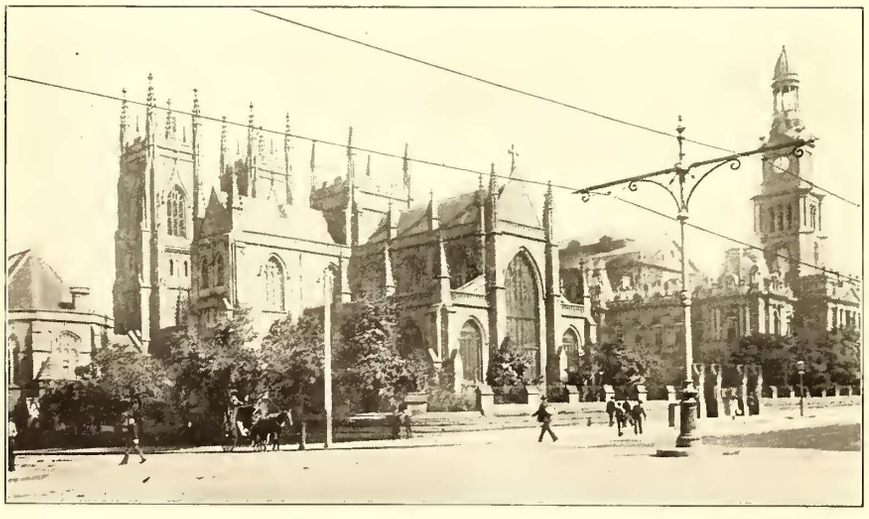
The city of Sydney, in New South Wales, boasts of having the largest and most complete electric railway system in Australia. The enterprise is owned and controlled by the government, three commissioners appointed by the Premier for a term of seven years being in direct charge of this department of public service. The work of organization and construction has occupied five years, and the plans of the government provide for still further extension and improvement in the service.



CIRCULAR QUAY AT SYDNEY, SHOWING TROLLEY LINE

A description of the initial plant for this system was printed in the Street Railway Journal in October, 1897, but since that time important changes and modifications of the original plans have been made, and the present equipment is, of course, along entirely different lines from those first contemplated. The first electric line in Sydney was installed about 1890, and comprised a short steam line between Randwick and Waverly, which could not be made to yield a profit until it had been converted into an electric road. This experiment was, however, soon discontinued, and the electrical apparatus removed to North Sydney and erected at the terminus of the cable system for an extension to Middle Harbor. The next development was the extension of the Ocean Street cable line as far as Rose Bay, the new part being operated by electricity.

This line skirts the shores of Sydney Harbor, and has many steep grades and sharp curves. A view of the circular quay, showing the trolley lines in operation at the present time, is presented on this page.



CENTER POLE CONSTRUCTION ON GEORGE STREET, SYDNEY, BEFORE CHURCH OF ENGLAND CATHEDRAL AND TOWN HALL

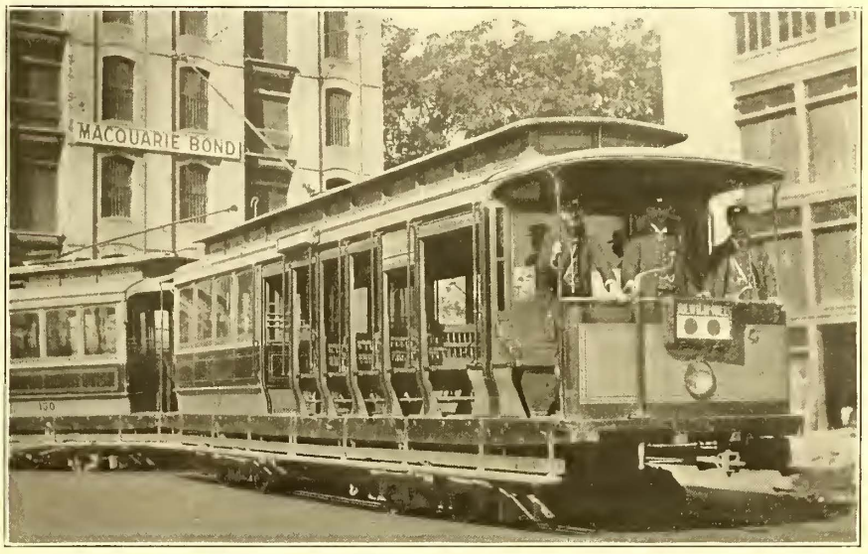
From these modest beginnings developed the present city and suburban system for Sydney, which includes 145 miles of track and 527 cars. In the center of the city along George and Harris Streets, center-pole construction with double-bracket arms and cast-iron ornamental bases set in concrete is used. A view of the line passing the Church of England Cathedral and the public buildings shows this form of construction. In all other parts of the city span-wire construction, using both wood and Mannesmann steel poles, has been adopted. Grooved girder rails weighing about 85 lbs per yard are laid on concrete foundation with a wood block roadbed. Both Brown plastic and Washburn & Moen solid crown bonds are used, and copper cables are laid between these tracks and are bonded to alternate rails. These cables are laid against the inner rails of their respective tracks, and the two tracks are cross-connected every 60 yards.

Two types of car have been adopted, both of which are illustrated herewith. One of them was built by the Brill Company, while the other was furnished by the Clyde Engineering Company, of Granville, Australia. Both

Peckham and Brill trucks are employed. Christensen air brakes have also been adopted.

A great deal of attention has been given the problem of collecting fares and arranging rates that would prove satisfactory to the community served and sufficient to support the system. The plan adopted is similar to that commonly used in European cities, and consists in dividing the city into sections. A fare of a penny (2 cents) is collected for each section traveled over. Different colored tickets are issued by the conductor for the several sections, and it is optional with the passenger whether he will pay for one section at a time or for the entire distance he wishes to go at once. Each ticket is numbered, and inspectors are likely to enter a car and examine each passenger's ticket at any time, thus reducing the chance of dishonesty to a minimum.

Power for the operation of this system is furnished by the Ultimo power house, which has lately been enlarged and extended, the original installation having been made in 1898. The old electrical equipment consisted of direct-current generators, but when the new lines were built and the steam roads converted to electricity it was decided to build an addition to the old station and install a three-phase 25-cycle 6600-volt system, with rotary sub-stations. The original plant occupied a building close to the tracks of the government railways and only a short distance from the shores of Darling Harbor, from which a supply of water for condensing purposes was obtained. It is a brick and steel structure, arranged with the offices in front and the engine and boiler rooms behind the offices. Fourteen multi-tubular 300-hp hand-fired boilers, 16 ft. long and 7 ft. in diameter, with seventy-two tubes 4 ins. in diameter, furnished steam for four engine-dynamos. The machines were General Electric direct-current, compound-wound railway generators directly connected to cross-compound horizontal engines built by the E. P. Allis Company, of Milwaukee. The engine cylinders were 26 ins. and 48 ins. in diameter for high and low pressure, with a 48-in. stroke, and their speed 100 r. p. m. Provision has now been made for an additional equipment of three 1500-kw generators with the necessary engines, boilers and auxiliary apparatus, in the extension to the Ultimo power house. The principal features of the completed plant are illustrated in the accompanying views and diagrams. The introduction of alternating-current generators, of course, necessitated the designing of a new system of distribution. Five sub-stations have been built; one each at Newtown, Randwick, Waverly, Hunter Street and North Sydney. In each of these sub-stations, with the exception of that at Randwick, there have been installed two 450-kw rotary converters, six 175-kw air-blast transformers, and two 500 amp.-hour storage batteries, each provided with a 50-kw booster set for charging purposes. Randwick sub-station contains only one rotary converter and one storage battery.



AMERICAN CARS ON SYDNEY TRAMWAY

COMBINATION CAR MADE IN AUSTRALIA

The new building, known as the Ultimo power house extension, was designed by J. G. White & Co. The boiler room is 176 ft. long by 84 ft. wide, and occupies two floors. Two steel coal bunkers, capable of holding 2500 tons of coal, occupy the space directly under the roof. Two chimneys have been built, each 224 ft. high, and are covered with cast-iron caps each weighing 6 tons, and made up of twenty segments. A brick party wall separates the engine room, which is 96 ft. wide, from the boiler room. Foundations have been built for six units, which will permit doubling the capacity of the present alternating-current plant.

The sub-station buildings are brick structures with brownstone trimmings and red tiled roofs. They are divided longitudinally into two parts— one for the rotary converters and the other for the storage batteries, a double interlocking door preventing the fumes from the latter room penetrating the former.

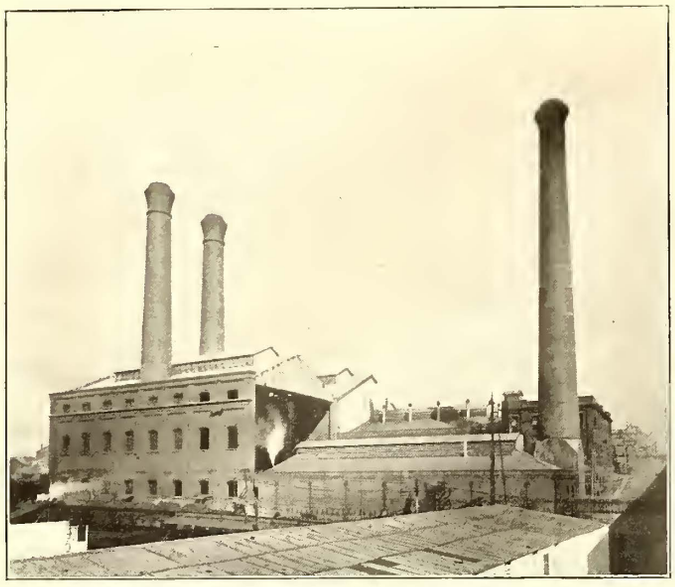
The battery room is 50 ft. long by 40 ft. wide, two stories high. The floor up-stairs is covered with sheet lead, with the seams burnt together, while the first floor is of cement.

The rotaries occupy a room in each station 50 ft. long by 30 ft. wide, one story high, with a monitor at the top. The floor is of cement, and is tiled around each rotary for a

distance of about 2 ft., thus giving a very finished appearance to the machinery.

POWER HOUSE EQUIPMENT

Thirty-two boilers, made by the Babcock & Wilcox



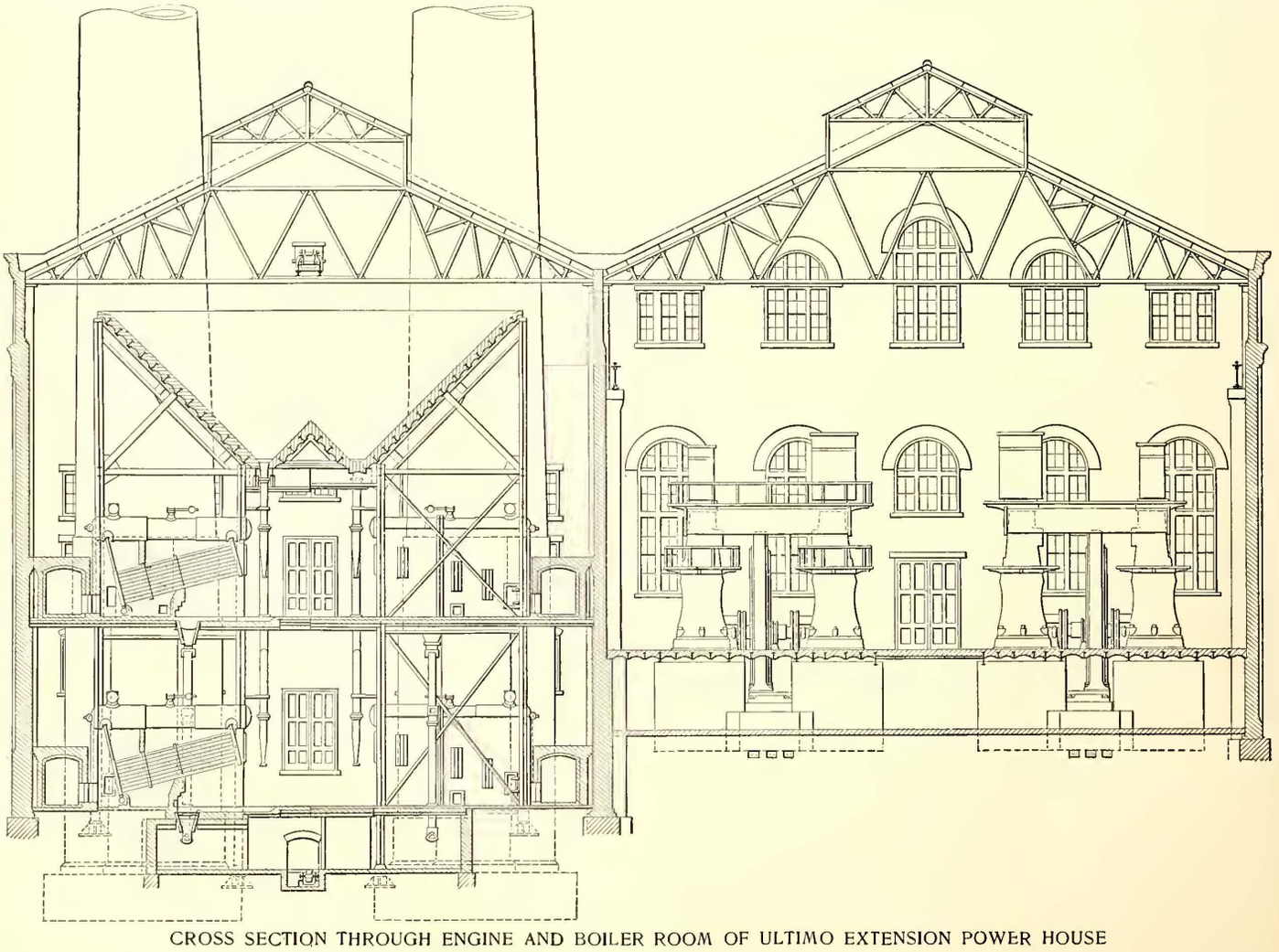
ULTIMO POWER HOUSE EXTENSION BEFORE BOILER ROOM WAS ENCLOSED

Company, are set in batteries of two each, eight batteries on the lower floor and eight on the upper floor. Each boiler is rated at 450 hp, has 2852 sq. ft. heating surface, and was built to operate under a steam pressure of 160 lbs. per square inch. The front of each boiler is arranged for the reception of Babcock & Wilcox patent chain-grate stokers. Coal is fed from the overhead coal bunkers by means of iron chutes and feeds over the whole width of the grate, the thickness of the coal layer being regulated by means of the vertically sliding arrangement of fire doors. The stokers are operated by means of shafting and eccentrics. The John A. Mead system of noisless coal and ash conveyors is in use. The apparatus is operated by an electric motor, and includes a crusher operated by a second motor, and twenty center-dumping ash cars.

Three Worthington feed-water pumps are provided, each having two high-pressure steam cylinders 9 ins. in diameter, and two low-pressure steam cylinders 14 ins. in diameter; four single-acting outside-packed plungers 7½ ins. in diameter, all of 10-in. stroke. Each pump is guaranteed to deliver 240 gals. per minute when running at a piston speed of 52 ft. per minute on each side. The two feed-water heaters are each provided with 1500 sq. ft. of heating surface, and are arranged so that the exhaust steam from the boiler feed, circulating and air pumps will be carried through the heaters.

The steam piping was furnished by the Best Manufacturing Company, of Pittsburgh, and extra heavy piping and fittings were used. Ample provision was made for expansion by using wrought-iron bends.

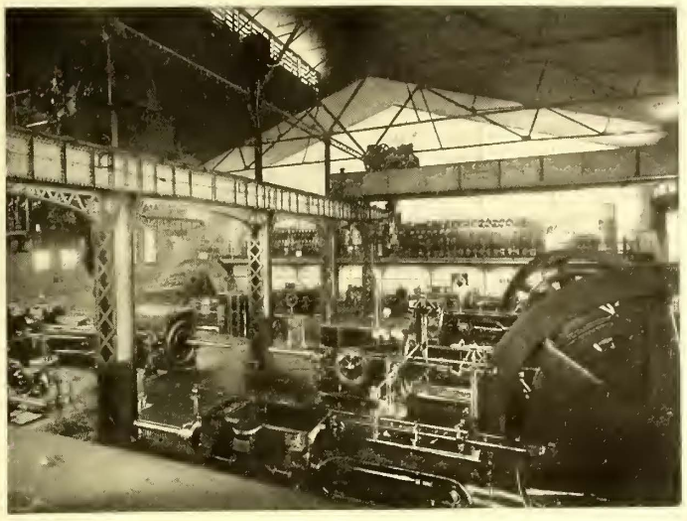
The three main engines were built by the Allis-Chalmers Company. They are vertical, cross-compound condensing machines of the Reynolds-Corliss type, with high-pressure cylinders 32 ins. in diameter, and low-pressure cylinders 64 ins. in diameter, 60-in. stroke, and operating at 75 r. p. m. with 150 lbs. steam pressure. The steam from the boilers is led directly into a Reynolds separator placed in the basement, flowing from there into the high-



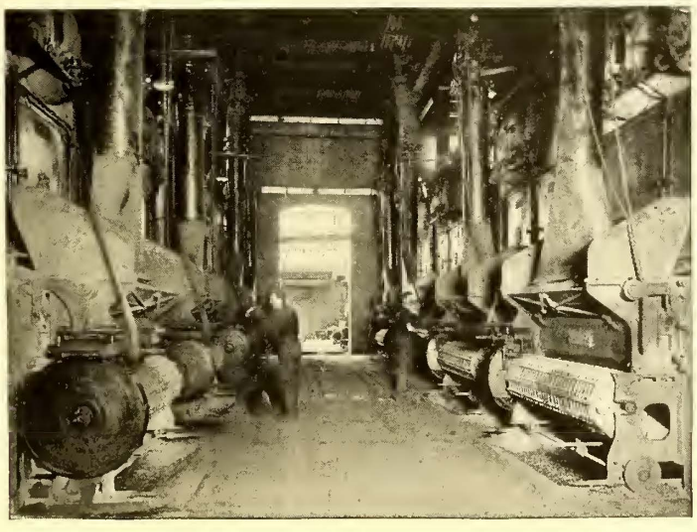
CROSS SECTION THROUGH ENGINE AND BOILER ROOM OF ULTIMO EXTENSION POWER HOUSE

pressure cylinder, and thence through a receiver and reheater into the low-pressure cylinder. A small motor operated by the switchboard attendant is provided for controlling the speed of the engine within 2 per cent.

Two 150-hp horizontal tandem compound engines made by the Harrisburg Foundry and Machine Works, operating at 270 r. p. m., and each direct-connected to a six-pole 100-kw 125-volt compound-wound generator, are located between the main engines and the high-tension switchboard gallery. These engines are equipped with an automatic self-lubricating device whereby the bearings on the engine frame, crank-pin, cross-head pin and guides will be lubricated from a reservoir of pure oil, which constantly seeks its level, in the engine base beneath the crank-pin. The crank delivers the oil from this reservoir in a continuous supply to the crank-pin, from which it is thrown off by centrifugal force into a pocket provided in the inside of the oil hood, and from this pocket flows through tubes to the crank-shaft bearing, and thence back to the reservoir.



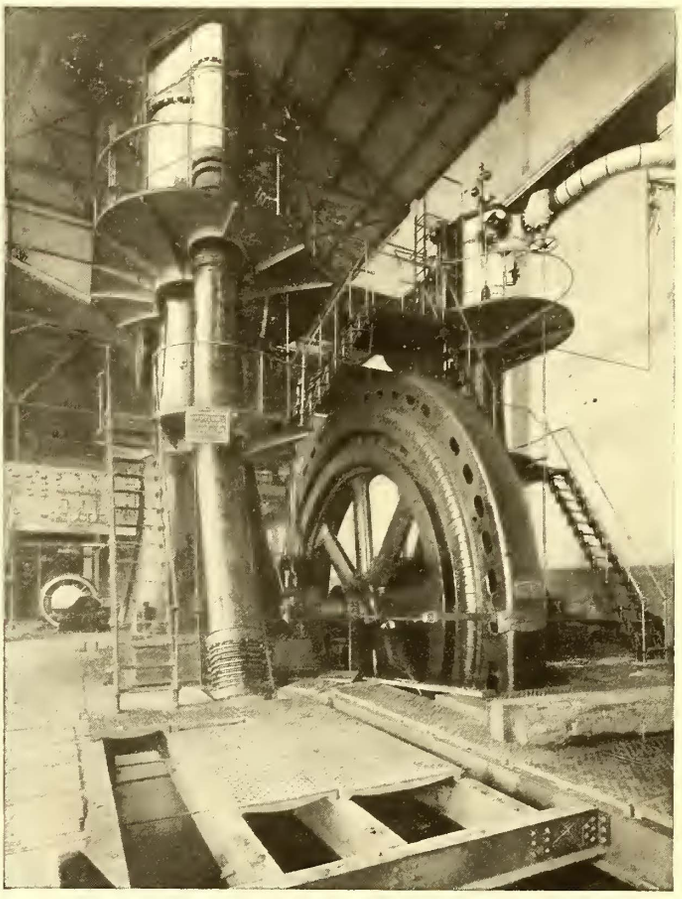
OLD ENGINE ROOM AT ULTIMO POWER HOUSE



VIEW OF LOWER BOILER ROOM

Each main engine is provided with a Worthington surface condenser which, together with its air pump, is located in the engine basement close to its respective engine foundation. Each condenser has a total of 3600 sq. ft. of cooling surface. Adjacent to the condenser is located a Worthington vertical compound beam air-pump having its steam cylinders of 9-in. and 16-in. diameter, and its air buckets of 20-in. diameter, with a common stroke of 12 ins. The circulating pumps in the boiler room are of the Worthington horizontal compound outside-packed plunger type. The water used for condensing purposes is pumped from Darling Harbor, and the piping is so arranged that any circulating pump can supply any condenser with cooling water. The two condensers for the exciter engines are similar to those for the main engines, except that they are smaller and are provided with combined air and circulating pumps attached to the same steam cylinder. A gravity oiling system is provided for the main engines.

A General Electric 1500-kw 6600-volt three-phase generator, running at 75 r. p. m., is directly connected to each of the main engines. The armatures are stationary,



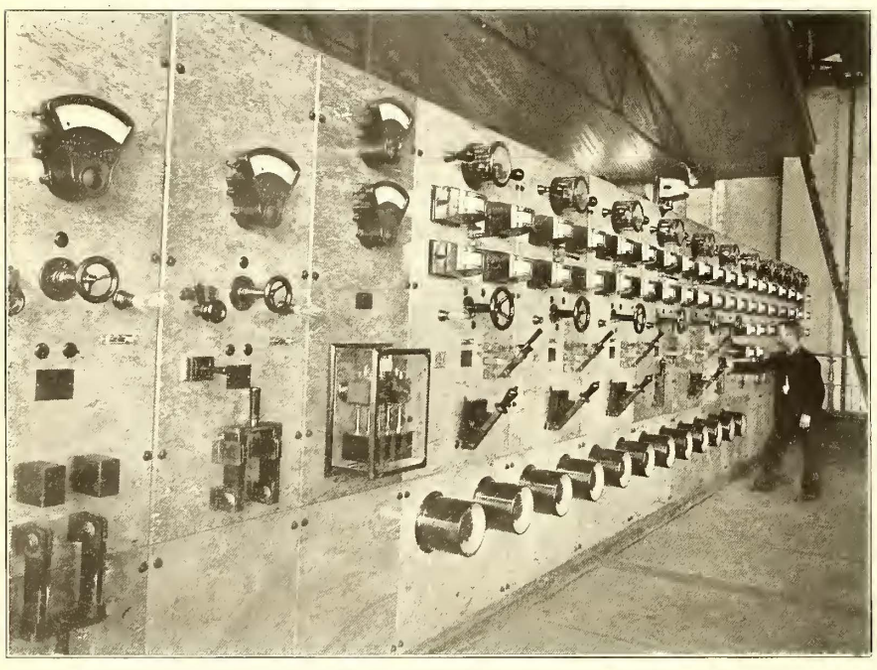
ONE OF THE NEW GENERATING SETS IN THE ULTIMO EXTENSION POWER HOUSE

while the field poles are attached directly to the periphery of the engine fly-wheel. The fly-wheel hub and spider is a casting in two parts, and the hub is fastened to the shaft by means of six long bolts through the hub and tightened in place while hot. The rim is made up of eight cast-steel segments, four of which are equal to the circumference of the wheel, the other four being placed beside the first four, but arranged to break joints. Forty field poles, which at seventy-five revolutions will give a frequency of 25 cycles, are bolted to the outer face of the engine fly-wheel rim, the bolts passing right through the rim of the wheel. Exciting current is led by means of two cables fastened to one of the spider arms, from the collector ring on the shaft to the field winding. The stationary armature is divided into four parts for convenience of shipping, and are bolted together when assembled, giving an internal diameter of 280 ins. The coils are rectangular, wound on forms and placed in the slots when the armature is assembled.

A raised gallery across the dynamo room, between the old and the new portions of the station, provides an excellent location for the switchboard. There is space on this board for controlling three exciters, two of which are now

installed, six three-phase generators, three of which are at present installed, and five sub-station feeders, all of which are now installed. These feeder panels were placed at the end of the board so that extensions could be provided for without disturbing the rest of the switchboard. There is also an exciter summation and a generator summation panel. The instruments and low-voltage controlling apparatus are mounted on blue Vermont marble panels, while the high-tension parts, consisting of switches, bus-bars and transformers, are placed some distance behind the operating board. Each generator and feeder is controlled by three oil switches connected to a common shaft, which is operated by a lever from the front of the operating board by means of rods and bell cranks. Each oil switch is placed in a separate brick compartment. Arcs which may be accidentally formed in one compartment, cannot be communicated to the others. Generator switches are provided with reverse-current relays which light up a red lamp on the front of the board should any reversal of current take place, but do not trip the switch, as this is not thought advisable. Feeder switches are provided with overload relays, which, in addition to tripping the switch, should the current rise above a predetermined amount, also light up a red lamp in the front of the board, thus drawing the attendant's attention to this switch. Each generator panel is provided with a recording and an indicating wattmeter, a main ammeter and voltmeter, and a field ammeter. Each feeder panel is provided with a recording wattmeter and three ammeters, one for each phase. The generator summation panel is provided with one recording wattmeter, three ammeters and three voltmeters, thus showing the grounding or unbalancing of any phase. Two indicating wattmeters determine the instantaneous power factor. Ammeters, voltmeters and indicating wattmeters are of the horizontal, edgewise type with black enamel finish, while the recording wattmeters are of the round pattern, balanced induction type. Exciters are provided with astatic ammeters and voltmeters, while the exciter summation panel is provided with a Thomson recording wattmeter. Both the exciter and generator field rheostats are placed in the basement and controlled by means of a long shaft with gearing.

WAVERLY SUB-STATION



HIGH TENSION AND EXCITER BOARD AT ULTIMO POWER HOUSE

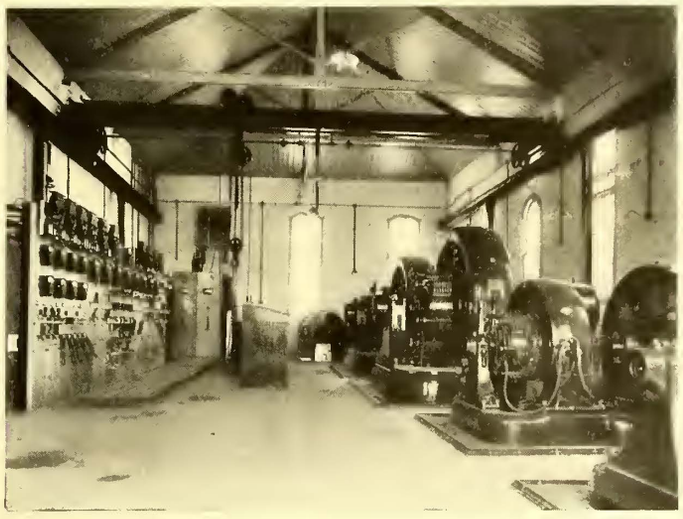
LAYING HIGH TENSION CABLES IN SYDNEY

A duplicate set of three conductor cables connects the sub-stations with the switchboard at the Ultimo power house. The cables are placed in two troughs and surrounded by an insulating material. One of the troughs in which the high-tension and 600-volt feeder cables are laid is about 8 ins. deep by 11½ ins. wide, while that intended for the return cables is 5 ins. deep by 6 ins. wide. The cables are laid in trenches 3 ft. below the street surface, and are supported by bridges of wood and surrounded by a compound composed of Stockholm tar, resin and sand, the trough being then covered with an iron bark plank held in place by three layers of common brick. Each phase of the three conductor cable is composed of nineteen No. 16 B. W. G. wires (equivalent to about No. 4-0 B. & S.) stranded together and insulated with 7-32-in. paper, the entire three conductor cable being covered first with 6-32-in. paper, then with lead, and outside of all with impregnated jute. The section of the cable running to the North Sydney sub-stations is submerged under the waters

of the harbor, and this cable is armored in addition to the ordinary covering with two layers of No. 11 S. W. G. steel wire, and outside of this with a covering of impregnated jute. Wirt alternating-current short-gap lightning arresters are provided, both at the Ultimo and sub-station ends of each duplicate feeder, for taking care of any electric surgings which may be set up in the feeders due to sudden heavy changes of load or short circuits.

SUB-STATION APPARATUS

The sub-stations are laid out on a general plan and the equipment is similar in all of them. They are provided



ROTARY CONVERTER ROOM IN WAVERLY SUB-STATION

with two six-pole 450-kw rotary converters running at 500 r. p. m. They are provided with four-pole 40-hp induction starting motors. The 6000-volt currents, upon entering the sub-station, pass the high-tension switchboard, and are conducted to two sets of three 175-kw delta-connected air-blast transformers, where the voltage is transformed from 6000 to 375 for use in the rotary converters.

BATTERY ROOM, WAVERLY SUB-STATION

These transformers are cooled by a blower set consisting of a 1-hp induction motor direct connected to a steel-pressure blower. The high-tension switchboard consists of two blue Vermont marble panels, on each of which are mounted a horizontal edgewise voltmeter graduated to read to 8000 volts, and the switch handles. The switches are of the oil type, and are placed in brick compartments, located some distance behind the marble panels. These switches are arranged to trip on an overload by means of relays, a red lamp placed in the front of the marble panel indicating when the switch is open. The 600-volt switchboard is of the ordinary railway type, built of blue Vermont marble, and provided with astatic instruments, circuit breakers, etc. In each battery room is located a storage battery consisting of 280 cells. Each cell contains ten negative and nine positive plates, and is made of wood lined on the inside with sheet lead. The cells are mounted on a wooden platform built up of three 11-inch hardwood timbers placed on edge and floored over. This platform is insulated from the floor by glass blocks, and each cell is insulated from the wooden platform by porcelain insulators, four under each cell. The guaranteed capacity of each battery is 500 amp.-hours. The charge and discharge of the battery is regulated by means of a differentially wound 50-kw booster directly connected to a 100-hp multipolar motor running at 900 r. p. m.

Meeting of the New England Street Railway Club

The New England Street Railway Club held a largely-attended meeting in Wesleyan Hall, 36 Bromfield Street, Boston, on Tuesday evening, Nov. 25. President Farrington was in the chair, and introduced, as the prineipal speaker of the evening, John P. Conway, of the Old Colony Street Railway Company, of Quiney, Mass., the subjeet being "Snow Equipment and Organization for Properly Handling Snowstorms—Rotary vs. Shear Plows." This paper has already been published.

In the discussion which followed the reading of the paper, Mr. Rood, of the Woreester Consolidated Street Railway Company, stated that his company had used a rotary snow plow with great success in the outlying distriets between Woreester and Clinton. Drifts from 6 ft. to 10 ft. high were eleaned out with little trouble, and lines were kept open without difficulty. Mr. Skane, of Broekton, said that his eompany had obtained satisfactory results with both rotary and shear plows. With the former they used two W. P.-50 motors to drive the fans on the rotary, and Westinghouse 37-hp motors to drive the plow itself. He had found no trouble with loose paving stones. Mr. Goss, of the Milford & Uxbridge, said that his road uses an eight-wheeled rotary with two small fans on eaeh end, and that winter before last it handled drifts which shear plows could not touch. It was then stated that a nose plow only crushes and presses heavy drifts of snow into a more compact mass, whereas the rotary plow throws slices of snow off to one side and gradually eats its way through.

W. E. Wilder, of Worcester, then presented a paper on the equipment side of the work of snow fighting. He said that it was hardly correct to speak of "rotary vs. shear plows," as there is really no comparison between the two. The shear plow is adapted to handling the lighter snow and the rotary the heavy drifts. It is surprising how little regard has been paid to the steam road experience of the last sixty years, whieh has cost so much in lives, money and time. Suburban and interurban practice should follow the steam road as far as possible if the lines are to be kept open satisfactorily. No obstruction should be allowed above the head of the rail for a distance of at least 30 ins. on each side. If there is not power enough in the power house to properly run the plows power should be obtained from any source possible. The best way to fight snow is to have enough plows, properly equipped and eapable of handling the heaviest storms. Four-wheeled plows are out of the question for either suburban or interurban roads. Mr. Wilder said that he thought an equipment of four 38-hp motors too light for the heavy eight-wheeled plows now in service. Nothing under four 50-hp motors should be put in. When one eonsiders the steam railway plows, driven at from 20 miles to 40 miles per hour by several locomotives, eaeh ranging from 1000 hp to 1500 hp, and weighing from 75 tons to 150 tons, the comparison between the 20-ton eleetrically-driven plow becomes decidedly marked.

Rapid aeeeleration is a desirable feature and greatly augments the efficiency of the plow on the electric road.

The wedge-nosed plow has not been mueh improved since horse-car days. If the resistance of the snow exceeds the weight of the plow, the outfit beeomes easily derailed, and it has long ago been discarded by steam roads. Its short wheel base of 12 ft. to 14 ft., eompared with its over-all length of from 40 ft. to 44 ft., produces a leverage which easily derails the plow. Rotary plows are espeeially adapted to sharp cuts and bad places where huge drifts abound. Snow from 1 ft. to 2 ft. deep can be cleaned out at a speed of from 8 miles to 10 miles per hour by a rotary plow, and when 6 ft. to 8 ft. deep, at a speed of from 1 mile to 2 miles per hour. A rotary plow is very handy in raising blockades and

digging out stalled trains. Usually the schedule has gone to pieces when the rotary plow has been called in. Motors that drive the fans are generally speeded too high. The rotary plow quickly does the work of an army of shovelers, and saves much expense and loss by its use under conditions of heavy storm.

The Russell plow is an example of a square or shovel plow, which has been used with great success on steam roads. No records of accidents have yet been made by it. This plow moves snow in the line of least resistance, and cannot be derailed, as every pound of snow on the plow adds so much to the plow's weight, and consequently to the tractive effort. Mr. Wilder then spoke of a plow which he designed last winter for the Worcester Consolidated Street Railway Company, which was very successful. It has plows mounted on each of its two trucks, and is of the radial type, the trucks accommodating themselves to sharp curves easily. A jack can be put on at any point of the plow. There is no leverage, as the forward wheels are but 5 ft. 6 ins. from the very front of the plow, which is 8 ft. wide, with wings extended, and 20 ft. from center to center of trucks. It is 37 ft. 6 ins. over all, and its diggers will remove 3 ins. of solid snow from the rails. A stream of dry sand can be turned in front of the wheels, and no salt is required. It has sheltered double-glass windows, and in operation last winter ran 150 miles at an average speed of 8 miles per hour without being once stalled or derailed.

F. G. Henderson, of Newton, emphasized the importance of a suitable house on the plow for the proper care of the men's comfort, and urged the necessity of the superintendents' getting out with the men in the field and showing a live interest in the work. He suggested a very deep nosed plow, and stated that he had himself laid out the idea of one of the earliest nose plows built in the East, and had watched the development of plows with much interest. Colonel Parker, of the Lexington & Boston, said that his road was largely troubled with snow, which would drift in over stone walls on country roads. He has a plow of the rotary type, being a Peckham double-truck plow, equipped with four General Electric 67 (38 hp) motors, with low-speed gearing for driving the car, and with two General Electric 67 motors, geared for passenger car speeds for driving the fans. Last winter there was but one opportunity to use this plow, but on the Lexington & Woburn line Superintendent Greene has gone through a drift 10 ft. deep and 1000 ft. long in two hours, the plow moving steadily all the time. He figured that it would have cost at least $500 for shoveling if the road had not had the plow. On country lines which drift badly a rotary plow seems almost a necessity. A double-truck plow rides very much steadier and does its work far better than does a single-truck equipment. In ordinary storms a single-truck nose plow is highly satisfactory. The Lexington & Boston also have a large double-truck plow, equipped with four General Electric 57-motors, but this is not required to be used except in the heaviest storms. Colonel Parker added that both of his rotary plows were equipped with air brakes.

President Farrington then emphasized the need of confidence being felt by the man who is operating the plow. He said he had repeatedly seen men run into a drift and turn the power off the moment they struck the snow for fear of being derailed. He said that a man should keep the power on in practically every case, whether the plow was derailed or not, and should stick by his machine, even if it was derailed. He had found it much easier to put a derailed single-truck plow back on the track, and urged the necessity of loading down the plow as much as possible to give it adhesive weight, recommending the carrying of a liberal supply of salt and sand.

The paper by William Pestell, on "Car House Labor-Saving Services," was postponed.

The New York Central After the Electrics Again

A writ of certiorari, granted by Justice Nash, of Rochester, on the application of the attorneys of the New York Central & Hudson River Railroad, has been served on the State Railroad Commissioners,di recting them to certify to their proceedings in granting to the Rochester, Syracuse and Eastern Railroad Company a certificate to construct and operate a line between Rochester and Syracuse.

When the certificate was granted the Central opposed the application. The commissioners stipulated that the trolley line must be built on private property, except where it ran through cities, towns, and villages, its total length being 81.6 miles. In its application for the writ of certiorari, the New York Central Company argues that its line runs through all of the towns concerned between Rochester and Syracuse, by a route six-tenths of a mile shorter than the electric railway. It points out that the West Shore road also runs through most of those places, and that a third railroad connects Rochester and Syracuse by way of Auburn.

The Central points out that it has expended a large amount of money on its road and stations, and that the construction of the proposed electric railway would divert its business and seriously diminish its revenue. The writ is returnable within twenty days.

Efficient Discipline*

BY THOMAS E. MITTEN

Railroad service requires men who are steady and reliable in habits. Efficient discipline demands that they be well-trained and prompt in obedience to orders. In addition to a carefully prepared book of rules, it is essential that there be a well-defined policy covering the method by which discipline is to be maintained, the underlying principles of which must be thoroughly understood by those to whom its enforcement is entrusted. All matters of discipline should be under the general direction of a chief operating head, with whom subordinate officials should be in close touch and accord, and to whom all employees should have the right of appeal.

Much depends upon the selection of new men, and in order that the employment shall be sufficiently attractive to interest the better class of wage earners, a fair wage, at least equal to that paid for a like class of men in other lines of work, should be assured to applicants as soon after they have entered the service as is practicable. The acceptance or rejection of applicants should be entrusted only to those who, from their experience have become good judges of human nature, and are thoroughly conversant with the requirements of the position for which application is made.

The habits and history of each applicant should be carefully inquired into, his physical condition determined, and a conclusion as to his fitness for the service arrived at, independent of any outside influence.

Instruction should be given to new appointees only by the most competent men in each branch of the service, who should believe in and be fully familiar with the policy of the management. It should be thorough and systematic in character and subject to careful review before the final acceptance of applicant is decided upon.

Men who are undesirable do at times secure employment even after the most careful scrutiny of their history and personal appearance, and being on good behavior during instruction, are passed as satisfactory, but prove later to be an actual detriment to the service. Such men should not be allowed the latitude and consideration given to old employees, but removed by prompt discharge as soon as their unfitness is assured.

Other men, during the early stages of their employment, make mistakes which are due largely to an insufficient understanding of what is required of them; such errors are best corrected by subjecting the offender to further instruction, the logical conclusion being that under these circumstances punishment administered educationally will ultimately correct the man of his shortcomings or prove him unfit for the service.

Men employed for a sufficient length of time to have become thoroughly familiar with the duties which they are required to perform, have, as a rule, acquired a certain pride in their knowledge and skill, and also in the fact of their extended service. Punishment of any character inflicted upon such men almost invariably humiliates to such an extent as to leave in their minds a feeling of resentment. More can be accomplished, generally speaking, by a plain, straightforward talk, such as will appeal to their manliness.

A book record should be kept covering the history of each employee during the period of his employment, in which proper entry should be made regarding all matters which have a bearing upon the efficiency of the service rendered.

When accused of shortcomings men should be notified by written communication, setting forth their offense in detail, to which they should be permitted to make a written reply, as by so doing they avoid the necessity of being called to the office with consequent loss of time and wage. If the reply is unsatisfactory they should be so informed, and, unless they then appear at the office and make a satisfactory explanation, an entry, covering the facts in the matter, should be duly made on the record.

For repeated infraction of rules, or in case of serious accident, the party at fault should be given a hearing before the officer by whom discipline is administered, who in rendering decision should take into consideration the gravity of the offense with which the man is then charged, the length of time in service and previous

* Paper read at the meeting of the New York Railroad Club, Nov. 21, 1902.

record. In case of a man's discharge being necessary the record will show that he has practically discharged himself, having been given every opportunity to mend his ways before being dismissed. As every effort is made to reclaim erring employees before their services are dispensed with consistency demands that when once discharged they be never again re-employed.

Under this method the number of discharges are reduced to the minimum consistent with the maintenance of good discipline. Employees are made to feel that after having served a company sufficiently long to have become identified with its practice they become a part of its system, and are not to be divoreed therefrom unless absolutely necessary for the good of the whole. It should be impressed upon them that their employment is of a fixed and permanent charaeter, promotion being open to all, dependent solely upon the faithful performance of duty and fitness for increased responsibility.

The right of appeal to the chief operating head is considered to be of the utmost importanee, in that it insures to each employee a review of his case before an unpredjudiced judge, who should possess the absolute confidenee of his men. Without such a court of appeal employees, who feel that they have been dealt with unjustly, having no means of redress, are in some instances almost forced into forming assoeiations for their own protection.

Those entrusted with the enforcement of discipline are also, by this method, made to be more careful in their rulings, and where in any doubt will be found to submit almost invariably the question to the chief operating head for decision before taking definite action, realizing that by so doing they avoid the possibility of being overruled.

Subordinate officials should, wherever possible, be selected from the ranks, preference being given to those who have served as instructors. They should be calm and considerate in their treatment of men, and consistent in the enforcement of rules.

Discipline sometimes becomes lax and inefficient owing to superannuated employees being retained in the service, who from no lack of willingness, but entirely owing to their infirmities, are unable properly to perform their duties. A most satisfactory solution of this question seems to have been found by some of the larger companies, who have set aside a fund for the pensioning of such employees as become incapacitated after long years of faithful service; this not only permits the retirement of those who have outlived their usefulness, but also serves to instill in the minds of all employees a feeling of security and confidence.

Suspension from duty and from pay, whieh was at one time the generally recognized punishment administered for minor offenses, is rapidly falling into disuse, having proven mischievous in its effects, not only by its leaving the man so punished in a disgruntled state of mind, but in addition often resulting in his family being subjected to severe hardship by the loss of revenue incident thereto.

Arbitrarily discharging employees guilty of violating certain specified rules, without reference to their previous record, was at one time considered absolutely necessary in order to prevent the increase of certain classes of accidents. While the fear of discharge seemed in some instances to make men more careful, very good men were at times necessarily sacrificed to maintain this principle, the result as a whole being found generally unsatisfactory, as the feeling beeame prevalent that as the best and most careful of men were liable to accident on oecasion no man could be absolutely sure of retaining his position.

Within the last few years over fifty-seven railroads have abandoned the methods of punishment formerly used, and are now relying almost entirely upon the Brown system of discipline by record, either in its entirety or in some modified form, it having become apparent that as the requirements of the service grow more exacting, making necessary the employment of a higher degree of intelligence, men with minds capable of such training are not to be controlled by the arbitrary methods formerly used, but that they respond more readily to moral suasion and appeals to the better side of their natures.

The Trolley in the Eternal City

The trolley system is being extended in Rome, and this modern vehicle now traverses many of the ancient highways formerly trodden by the army of the Senatc and people of Rome. The seven hills of the city have created considerable difficulty in the way of electric railway construction. This has been especially true of the Quirinal hill, which formed a serious barrier between the old part and the new parts of the city. This difficulty has been finally overcome by constructing a tunnel under the Quirinal, upon which is the royal palace. The eastern end of this tunnel commences near the art museum on the Via Nazionale, and emerges at a point near the Place d'Espagne near the Piazza Collona and the Corso.

Electrical Testing Laboratory

The lamp testing bureau, which was conducted for several years under the auspices of the Association of Edison Illuminating Companies, has, during the last year, extended its field of operations in response to a general demand for a similar organization covering other branches of electrical work. It will be remembered that the bureau was established to meet the requirements of the Edison operating companies for a testing laboratory which would determine the effieiency and life of incandeseent lamps and furnish them other data for securing uniformity in praetiee. During the last seven years this bureau has inspeeted upwards of 25,000,000 incandescent lamps, and has measured the eandle power and life of over 125,000 sample lamps. The work of the bureau has attracted a great deal of attention outside of the field in which its operations have, up to the present time, been confined, and the advantages of having a similar organization equipped for general electrical testing purposes has been reeognized, especially by street railway companies, which cannot afford the expense of organizing, equipping and supporting such a department of their own. The lamp testing bureau has been induced to offer its facilities for making electrical tests for purchasers and users of electrical material, supplies and apparatus, so that they may be able to know the properties and values of the goods which they use. It has aecordingly fitted up three large floors at 14 Jay Street, New York, as a general eleetrical and photometrical testing laboratory, and is prepared to test electric lamps, electrieity meters, electrical instruments and apparatus, and to provide incandescent lamps accurately calibrated as secondary standards of candle powers, amperes and watts, and Clark eells as standards of e. m. f. A specialty will be made of the calibration of instruments against authoriative standards as well as performance tests of electricity meters. It is also equipped for making extensive tests to determine the accuracy of indicating and recording instruments for railway power stations, and of the complete equipment of electric railway systems. Several electric railways have already taken up the matter of testing their station instruments, their transmission system and the lighting of their cars. This last feature is particularly important on large roads and in the principal cities.

As already mentioned the lamp testing bureau has fitted up three floors, 90 ft. x 23 ft., at 14 Jay Street, for work of this character, and the equipment has been selected entirely with the view of affording facilities for carrying on work of this kind. It is not intended for original investigation, but for commercial testing, covering a very wide range, and at the same time maintaining a very high standard of accuracy. One floor is fitted up as a general electrical laboratory, with portable instruments as well as instruments of preeision, including an accurately-adjusted Wheatstone bridge of the Anthony pattern, wound with manganin wire; a Thomson double bridge by Wolff, of Berlin, for the measurement of low resistances and of the conductivity of specimens of wire; potentiometers by Leeds & Co., of Philadelphia, and by Wolff, with a complete outfit of standard cells and with the requisite chemicals and apparatus for the preparation of standard cells; a complete set of manganin resistances by Wolff, running from 0.0001 ohm to 100,000 ohms, which are used as standards of resistance, and, in connection with the potentiometer, for the accurate measurement of direct currents up to 2000 amps.; the platinum dishes and sensitive balance required to make standardizations by the silver voltameter. For alternating-current measurements, besides a very complete set of portable and semi-portable voltmeters, ammeters and wattmeters, there is a Rowland eleetrodynamometer, with shunt box, by which a great variety of alternating current work can be done, including much that is entirely outside of the range of the ordinary instruments. Standard condensers, keys, secohmmeters are at hand for cable testing, determining coefficients of induction, capacity, etc. Alternating-current instruments are checked or standardized by reference to standardized direct-current instruments, using reaetanceless transfer instruments. The standard photometer, which is equipped for making all kinds of photometric measurements, is also on this floor. The accessory apparatus for correcting measurements made with the Hefner amylacetate lamp and the 10-cp pentane lamp, taking account of atmospheric conditions, is also at hand.

On another floor 300 cells of accumulator are arranged in several batteries and used for testing purposes; also a small converter, which can be driven by storage battery current to furnish alternating current for making instrument checks, and vibration-free meter boards, with the neeessary arrangement for making accurate tests, and complete laboratory investigations on recording electricity supply meters, using current from storage batteries. Facilities are also provided for testing heavier apparatus.

The equipment also includes a motor-dynamo, which supplies current to lamps on life test, working photometers for life-test measurements, and the racks on which lamps on life test are set up to burn. These racks are at present capable of holding and supplying 1100 incandescent lamps. The various pressures required are supplied to these lamps from a special sectional transformer, the e. m. f. of which is controlled by an attendant constantly on duty. Any integral voltage can be steadily maintained between 100 volts and 150 volts. The finer adjustments of voltage on individual lamps are made by placing suitable resistances in series with them.

Owing to the growth of this business and the expansion of the field it has been found desirable to transfer the management of the bureau to an incorporated company, and provide additional facilities as occasion required. The president of the company is J. W. Lieb, Jr., of the New York Edison Company, and the manager, Wilson S. Howell, who has been in charge of the testing work of the Edison association since its inception. The bureau testing officer is Dr. Clayton H. Sharp, a graduate of Hamilton College, New York, and of Cornell University. Dr. Sharp has also studied in the University of Leipsic, where he undertook special work in physics. He was for a number of years instructor in physics and applied electrictity at Cornell University. Dr. Sharp is assisted by a corps of experts in every department of electrical testing work. Dr. A. E. Kennelly, of Harvard University, is associated with the bureau in the capacity of consulting engineer.

Double-Acting Two-Cycle Gas Engine

The accompanying cuts illustrate the principal features of a new double-acting two-cycle gas engine, designed by Ernst Koerting, and manufactured by the De La Vergne Refrigerating Machine Company, of New York. It will be noticed that the crank end and the head end of the power cylinder are similar to the corresponding parts of a double-acting steam engine, and that the admission valves are located in the valve boxes, which are bolted to the cylinder heads. Exhaust valves are not required, as the products of combustion escape through slots or ports in the middle of the cylinder leading to the exhaust pipe. These slots are covered by the motor piston itself, which is made very long, and is backed at each end by self-closing spring rings. Two double-acting auxiliary pumps are employed for supplying the combustible mixture, one furnishing gas and the other air, and both proportioned so that their combined action insures a proper mixture. The gas and air are compressed to about 9 lbs. per square inch. The compression spaces of the pumps are divided so that the crank ends of the pumps discharge into the crank end of the power cylinder, and the head ends of the pumps into the head end of the power cylinder.

By reference to Fig. 1 it will be seen that the piston is at the outer dead point, and the exhaust ports exposed toward the head end of the engine. In operation, as soon as the piston begins to uncover the exhaust ports the pressure of the residual products of combustion in the cylinder drops rapidly to that of the atmosphere, enabling the inlet valve to be opened and admitting a fresh charge from the pumps. Air only is supplied at first to separate the burnt gases from the succeeding mixture, and afterwards gas and air are admitted in proper proportions. As soon as the exhaust ports are again covered by the receding piston the air and gas pump pistons reach the dead point, and the supply of the combustible mixture is interrupted. The next step is the closing of the inlet valve when the charge is compressed in the cylinder, and ignition takes place at the dead point of the stroke. The ignited charge exerts its driving power and expands with the

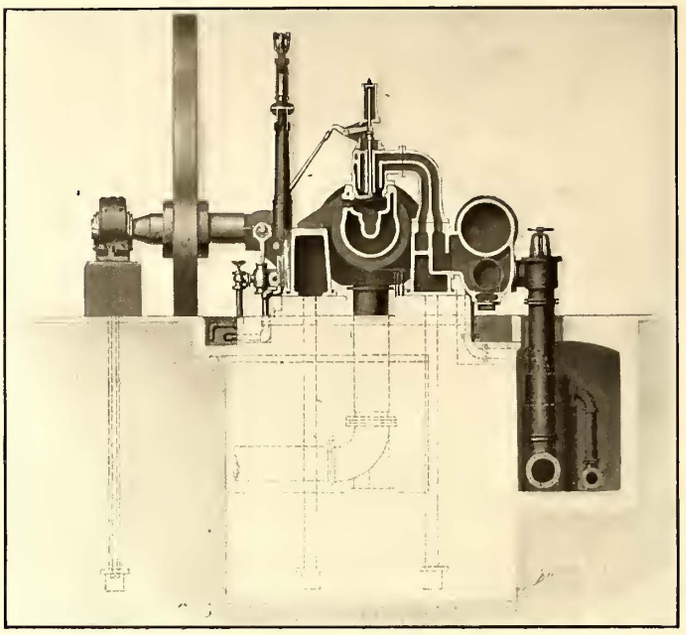


FIG. 2.—SECTIONAL VIEW

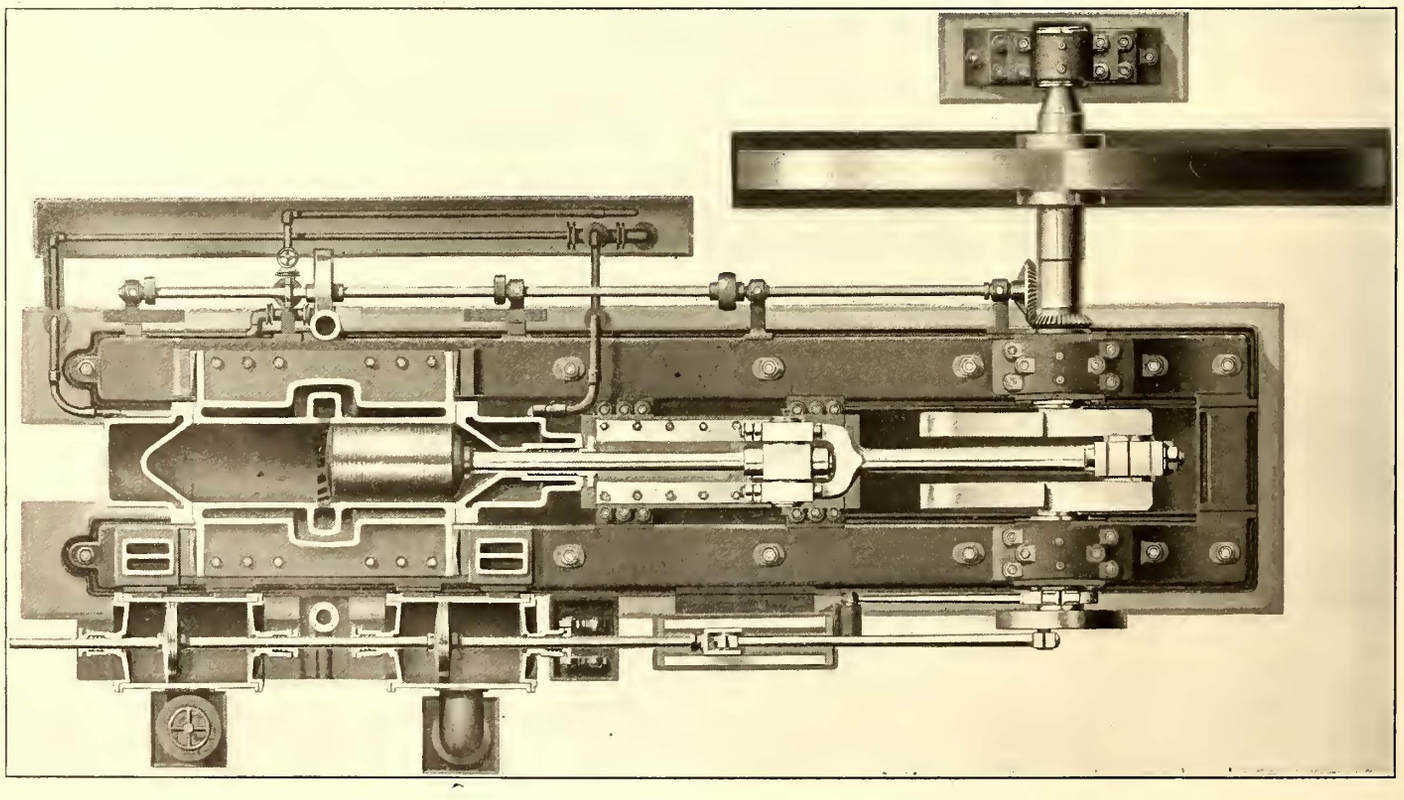


FIG. 1.—PLAN OF TWO-CYCLE GAS ENGINE

next movement of the main piston. Just before arriving at the other dead point the piston uncovers the exhaust ports and the consumed charge is then blown out. The same operation takes place on the opposite end of the piston. The separating layer of air between the hot consumed gases and the fresh charge is insured through a special feature of the gas pump, which is built so that no gas is delivered until after a certain point in its compression stroke is reached. The valve gear in this pump is so arranged that the maximum capacity will not exceed 50 per cent to 60 per cent of the total displacement. The amount of gas thus furnished corresponds to the maximum power of the engine. When the load on the engine is reduced the gas pump begins to furnish gas as a correspondingly later period, thus discharging a diminished quantity of gas into the working cylinder. This is accomplished either by the valve gear of the pump and controlled by the governor, or by a by-pass located between each pump end and respective compression channel which leads to the inlet valve on the main cylinder. The throttling device in this by pass is also under the control of the governor. The engine, therefore, operates with a variable amount of mixture, and the air first sent into the power cylinder stays near the middle while the combustible mixture remains at the head of the cylinder, near the inlet valves and igniters. Two spark coils at the ends of the power cylinder are operated by a separate shaft driven by spur gearing from the cam shaft, and the regulation is such that the time of ignition can be changed during the running of the engine to suit whatever kind of gas is being used. Moreover, the point of ignition may be set so that it will take place only after the piston has passed the dead point. The engine may be started very slowly without pre-ignition. The engine is started with compressed air; those to which a blowing cylinder is attached requiring less than 150 lbs. pressure and those without such cylinders 90 lbs. to 120 lbs. per square inch. This does not exceed the amount of compression under which the engine runs. The power cylinder and piston are cooled by circulating water, the stuffing boxes in the cylinder heads are surrounded by water, and the cylinder walls are also cooled except at the middle, where the exhaust slots are located.

The cylinder is equipped with relief valves, which serve also as safety valves. Hand-hold plates are provided for cleaning the exhaust ports. Experience has shown, however, that the inside of the cylinder remains very clean It was found that even after long-continuous running the exhaust ports especially remained perfectly clean, which is the result of the violent discharge of the burnt gases occurring alternately from right and left. In engines where the gases are always blown out in the same direction, scale or crusts of oil are liable to form, which become intensely hot, and may eventually cause premature ignition. Formation of the oil crusts is further effectively prevented by the cool piston sliding over the bridges that separate the exhaust ports, thus keeping the temperature of these so low that the adhering lubricating oil does not vaporize.

The engines are built in sizes ranging from 400 hp to 2000 hp, and are adapted for all classes of power plants. Fig. 3 shows twin Koerting engines directly connected to an alternating-current generator. The revolving field in such machines can be utilized for a fly-wheel.

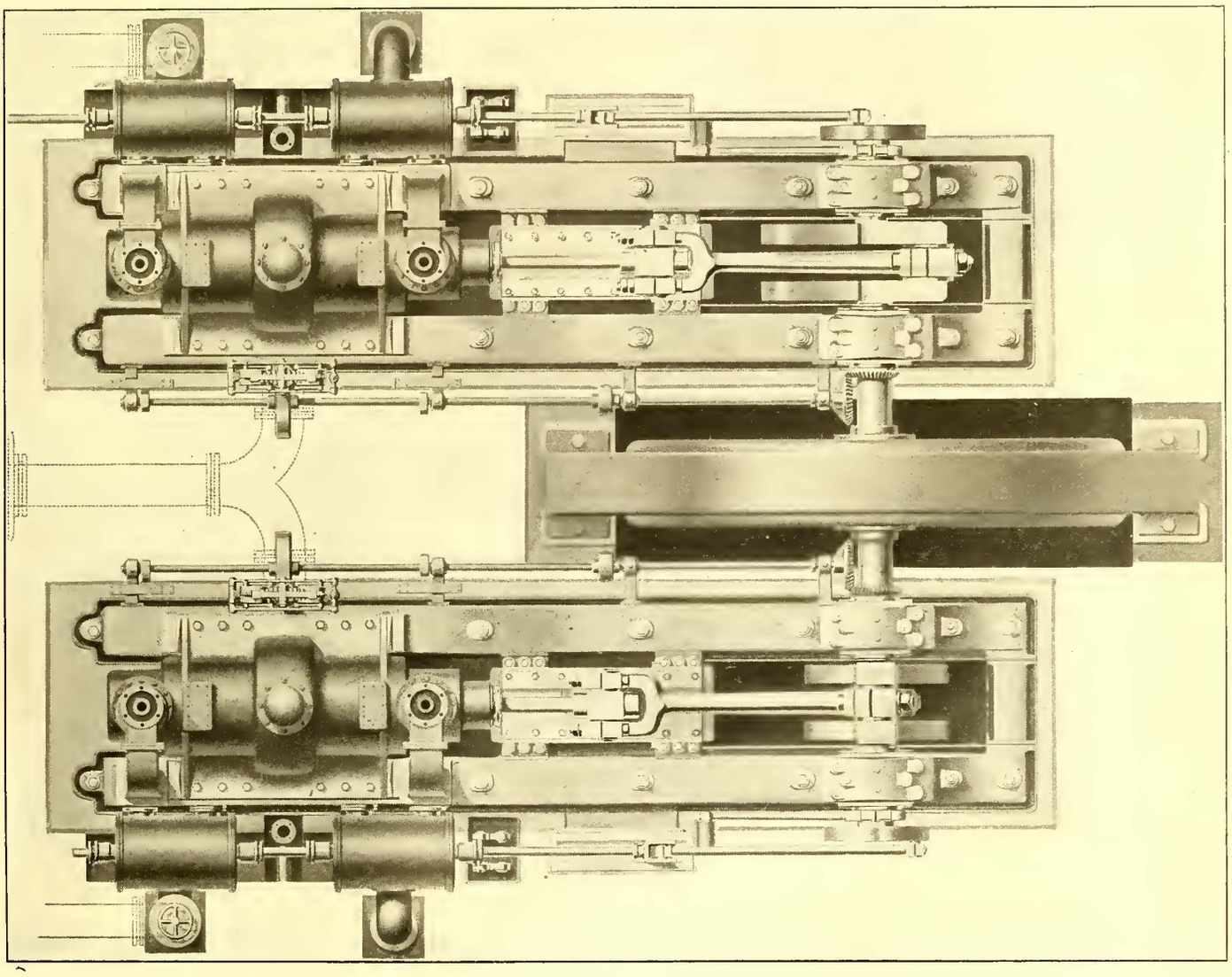
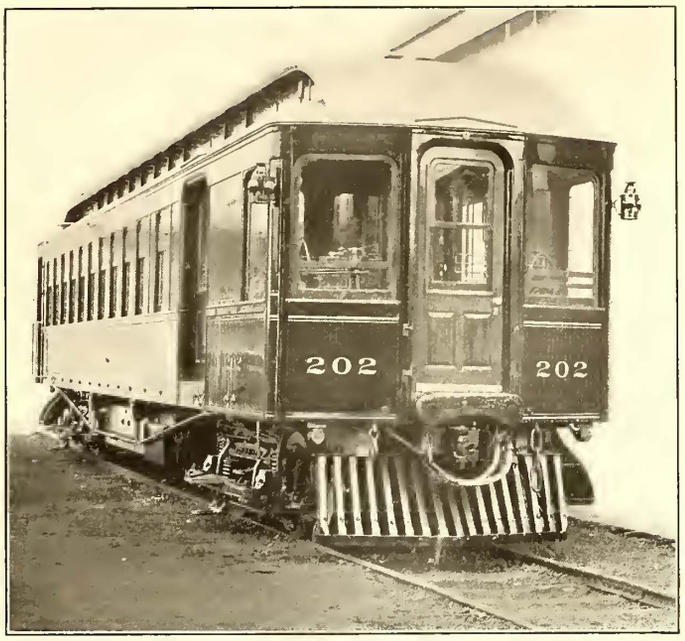


FIG. 3.—LARGE DIRECT-CONNECTED GAS ENGINE AND ALTERNATOR

"The Suburban Railroad and Its Effect on Municipal and Urbana Life," was the subject of a paper read a few evenings ago before the Cleveland Council of Sociology, by W. F. Carr, a prominent attorney of Cleveland. He declared that he believed in lower fare, but said that the earnings of the street railway companies had been greatly exaggerated. He mentioned no names, but incidentally he criticised the politicians who have been making political capital out of the street railway situation. "Let us treat the matter as a business proposition; take the street railway problem out of politics." A plea was made by Mr. Clark for the general handling of all freight by electric railway.

High-Speed Cars for the Wilkesbarre & Hazelton Third-Rail Road

Six combination passenger and baggage cars reeently built by the J. G. Brill Company, of Philadelphia, for the Wilkesbarre & Hazelton Railway Company, represent eminently the high standard to which interurban car building has been brought; and in plan, construction and equipment are highly significant and suggestive of the trend of this rapidly developing form of service. The cars have been built in conformity to conditions closely approximating those of steam roads. The line extends through a populous district between the cities of Wilkesbarre and Hazelton, a distance of 40 miles. Outside of the cities T-rails are used and the current will be collected from a third rail. A speed of over 60 miles per hour will be regularly attained between stations, notwithstanding frequent heavy grades, one of which is 3 per cent for 2 miles.



END VIEW OF HIGH-SPEED CAR

LARGE COMBINATION CAR FOR THIRD-RAIL ROAD

INTERIOR OF PASSENGER COMPARTMENT

The general dimension of the cars are: Length over end panels, 43 ft.; length over platforms, 51 ft.; width over outside sheathing, 9 ft. 6 ins.; height from bottom of sill over roof, 9 ft. 8½ ins.; inside length of passenger compartment, 29 ft. 11 ins.; inside length of baggage compartment, 11 ft. 11½ ins. The side sills are 5¼ ins. x 8⅞ ins., reinforced for the overhang at baggage compartment end of car by ½-in. x 8-in. plates; intermediate sills, 4½ ins. x 7¼ ins. The center sills are double, with ½-in. plates sandwiched between, size over all, 6 ins. x 8¾ ins. The intermediate and center extend from bumper to bumper. Body trusses of 1½-in. diameter, and double trussed needle beams are amply able to counteract deflection from the unusually heavy electrical apparatus. The flooring is double, the lower being laid transversely and the interspace, 5¾ ins. filled with mineral wool to deaden sound. The double side posts, 5¼ ins. thick, have ½-in. rod running through. The corner posts are 5½ ins. thick. Ten ⅝-in. x 1½-in. steel car lines are sandwiched between extra heavy wooden car lines.

Double sliding doors are provided at the passenger end of the cars, and single sliding door at baggage end. Each side of baggage compartment has a 42-in. sliding door. The sliding door in the partition is panelled, not glazed. The vestibule side doors are hinged to the vestibule post next the car body. These doors, when closed, are locked by the close-fitting of the trap door covering the three risers. Swinging doors leading to trailers have half-drop sash. The motorman's cab in vestibule has sliding door to platform and drop sash in side and front windows. The cab is provided with a hinged set. The upper sashes of the car windows are stationary and are of decorated plate-glass. The lower sashes raise.

The interiors of the cars are finished in solid mahogany, with pilasters handsomely carved and panels richly inlaid. The headlinings are of three-ply curly birch in natural color and decorated in silver. The passenger compartment is seated for thirty-eight. The cane seats are 40 ins. long, and have high reversible backs and mahogany arm rests. Four double seats in the baggage compartment are arranged to drop against the walls. A saloon of standard character and fittings occupies a corner of the passenger

compartment against the partition. The trimmings throughout, and basket racks, are of solid bronze. The cars are furnished with "Dedenda" gongs, automatic air sand-boxes, M. C. B. couplers and two-stem spring buffers. The cow-catchers at either end are so placed as not to interfere with coupling. Their construction is unusually powerful, as will be seen in the illustrations.

The trucks are Brill No. 27-E; wheel-base, 6 ft. 6 ins.; 36-in. steel-tired wheel; diameter of axles, 6 ins.; at gear seat 7½ ins.; at wheel seat, 7 ins.; journals, 4¼ ins. x 8 ins.; length of truck frames, 11 ft. 3 ins.; weight of each truck without motors, 13,000 lbs. The transoms are secured to the solid forged side frames in a manner which insures squareness and enormous vertical strength, namely, double-corner brackets, 1 in. thick, and forged from a single billet, are heavily bolted to frames and inside of angle-irons transoms; single-corner brackets of the same character are bolted to frames and outside of transoms.

An extremely interesting part of the equipment is the brake system, said to be the most complete ever furnished to any form of rolling stock. No less than four braking appliances are used. The outside brakes are operated by two methods: Westinghouse automatic air, and a vertical hand wheel in the motorman's cab. The inside brakes also have two systems of control: Westinghouse magnetic, and a vertical wheel in the vestibule. The cars are arranged for running in both directions, are adapted for use either singly or in trains, and are equipped for head-end train control. The total weight of a fully equipped car is 84,000 lbs.

Snow Melter

In many cities the street railway companies in winter are not allowed to pile up the snow which they remove from their tracks on the rest of the streets, but have to remove it to dumps. This often is very expensive, and considerable attention has been given to the subject of snow melters. Several of these have been tried on the New York city streets, and one of them is illustrated herewith.

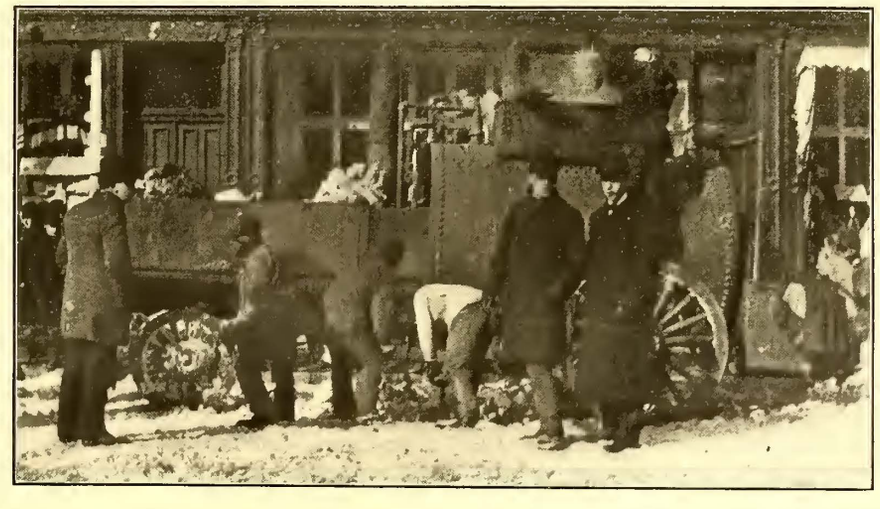
This melter, which is placed on the market by the General Supply Company, of New York, uses a hot-air blast, which is brought into direct contact with the snow to be melted. The melter itself consists of a double-end furnace of large grate area, surmounted by a horizontal water jacket of crescent-shaped cross section, with two inverted L-shaped flues. The dimensions of the melter are those of an ordinary truck. It is mounted on four wheels, and may be easily moved from place to place by a team of horses.

The water jacket forms the bottom of an iron frame or box, into which snow may be shoveled direct from the street, or into which a load of snow may be directly dumped. The furnace burns coke and is large enough to hold a cart-load at a time; it makes no smoke and very little ash. All the steam generated in the water packet is expelled through steam jet nozzles into the flues, producing a strong forced draft. The outlets of the flues are so directed that all the intensely heated products of combustion, together with all the steam from the boiler, are forced into the melting enclosure under the snow, and thus all the heat of combustion of the fuel is utilized.

The snow, as it is thrown into the melting enclosure, is struck by a blast of heated gases from the flues and is melted as fast as a gang of laborers can shovel. When the snow is melted the water resulting therefrom runs down the sides of the boiler into a trough which extends around the base of the machine, and from there it is piped away into the nearest gutter or sewer.

The melter has repeatedly melted 70 yds. of snow per hour, and with a good fire has run over 80 yds. On one occasion, after a snowfall of 8 ins., it melted the snow from an entire block in 37 minutes. This was at the rate of over 100 yds. to the hour. The amount of snow melted depends upon the skill of the fireman, as the more fuel there is burned the more snow there will be melted, there being no escape for the heat except to melt the snow if the melting inclsure is kept filled.

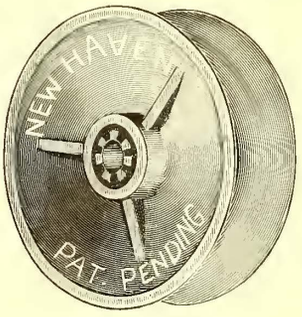
The average density of new-fallen snow, according to the standard of the United States Weather Bureau, is one-tenth that of water. In other words, 1 cu. ft. of new-fallen snow weighs about 6½ lbs., or 1 cu. yd. weighs about 175 lbs. This new-fallen snow is usually loose and soft. As soon as it is trodden upon or shoveled into heaps or into carts, the volume is greatly reduced, and the weight per cubic yard is correspondingly increased. In actual practice it has been found that a cubic yard of handled snow weighs from 500 lbs. to 800 lbs. Running at 50 yds. per hour, therefore, the snow melter will melt about 25,000 lbs. to 40,000 lbs. of snow per hour. Theoretically, 1 lb. of coke will melt 103 lbs. of snow at the temperature of 32° F.; hence, to melt 40,000 lbs. of snow about 400 lbs. of coke per hour would be required, provided there was no loss of energy whatsoever. In actual practice it has been found that the snow melter, running as above, burns about 500 lbs. to 600 lbs. of coke per hour. At this rate the efficiency of the machine is from 66 2-3 per cent to 80 per cent of the total energy expended. Assuming the cost of coke to be $5.00 per ton, the cost of running the machine per hour would be from $1.00 to $1.50 for fuel. As the machine melts 50 yds. of snow per hour, the fuel cost per yard would be from 2 cents to 3 cents, plus the cost of horses, driver and fireman, or, perhaps, 2 cents per yard, making a total of less than 6 cents per cubic yard.



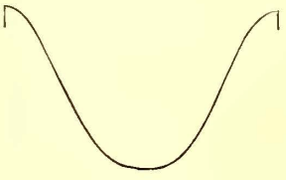
MELTING SNOW ALONG TROLLEY ROADS

New Type of Trolley Wheel

The New Haven Car Register Company, which some time ago signalled its departure from the field of fare registers only by bringing out a number of other devices, has recently put on the market a new trolley wheel. A view of this wheel and diagram showing the shape of the groove are published herewith. The



NEW TROLLEY WHEEL



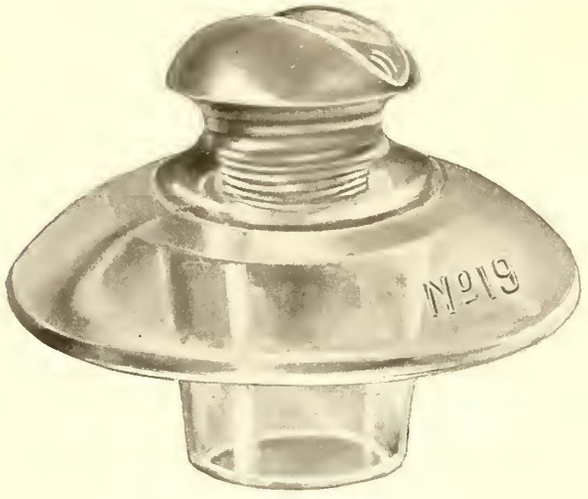
SHAPE OF GROOVE

wheel itself is made out of a special compound for which a long life is claimed, but the special feature of the wheel is the bearing. The hole for the shaft is first drilled and then rifled, and into the interstices thus left a special lubricating graphite compound is forced under hydraulic pressure. The result is that the wheel has an automatic lubrication, in fact the manufacturers insist that the bearing is not to be oiled. A number of these wheels have already been put in service, and are reported to be giving very high records as regards mileage.

The International Traction Company, of Buffalo, is operating special cars for smokers in Buffalo. They are small open cars. run as trailers, and have proved very popular.

High-Voltage Transmission Insulators

The accompanying illustration shows a high-voltage transmission glass insulator manufactured by the Brookfield Glass Company, of New York. This company has been very successful in the manufacture of glass insulators for high-voltage work, and the one



HIGH-VOLTAGE GLASS INSULATOR

illustrated was constructed for a transmission line carrying 45,000 volts. The diameter of the insulator is 7½ ins.; its height is 5½ ins., and the distance measured around the insulator from the cable to the pin is about 12 ins. The groove for the cable is 1¼ ins. in diameter, and the weight of the insulator is 4½ lbs.

New Trolley Wheel and Harp

A new trolley wheel and harp, embodying novel improvements, are herewith illustrated. Fig. 1 shows the device from above; Fig. 2 is a side view; Fig. 3 a longitudinal section, and Fig. 4 a section taken in the transverse and in direction of the axle.

These improvements relate to the harp, wheel, axle and its bearings. The wheel, *A*, is a composite wheel, consisting of the grooved central conductor, *B*, made of an alloy of best mixture for being revolved by tractive force from a line wire without liability of rapid reduction of the metal. This grooved conductor is liable to become worn, and is therefore arranged to be removed readily and replaced, the movable part being inserted between the iron clamping-plates, *C C*. It is electrically connected with the same. This composite wheel is mounted on a hardened steel axle, *D*, and is removably secured in its hub, so that it may freely revolve with the wheel when the latter is revolved by the action of the line wire, *W*. The holding of this axle with wheel, *A*, is effected by spline, *a*, rigidly secured to the wall of the axle and fitting in the seat, *c*, provided in the hubs of the clamping-plates, *C*, as seen in Figs. 3 and 4. This axle contains a central chamber, *E*, which serves as

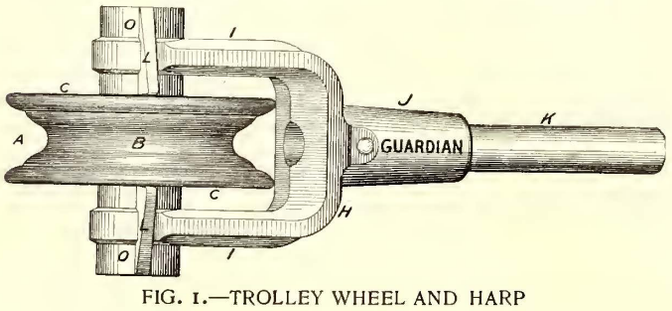


FIG. 1.—TROLLEY WHEEL AND HARP

a reservoir for a lubricant and feeds the latter to the outer surfaces of the journals, *e e*, of this axle, through the ports, *f*, shown in Fig. 4. The outer ends of this central reservoir, *E*, are temporarily closed when filled, by disks, *g*, of heavy paper board, for preventing the escape of the lubricant by way of the ends of the axle. The journals, *e e*, of this axle project laterally from the clamping-plates, so as to give to the wheel an extensive axle-base and ample area for best electric connection with the bearings carried by the harp.

The harp, *H*, is provided with branches, *I I*, which are horizontal in relation to the stem, *J*, which receives the arm, *K*, of the trolley pole. In this form of construction of the harp, the inclination of stem, *J*, operates to guard the wheel from entanglement with span wires and adjuncts thereto, should it accidentally jump from the line wire, while at the same time the horizontal upper edges of the branches, *I*, operate to cast the transverse span wires

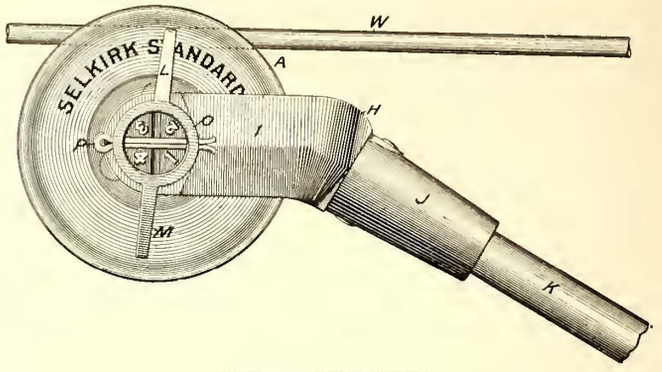


FIG. 2.—SIDE VIEW

upward towards the crown of the wheel for free passage rearward of the same. This harp is also provided with upper fenders, *L*, and lower fenders, *M*. These fenders operate to prevent the line wire and the switch plates from engaging with any portion of the harp when the wheel has escaped from the line wire.

The journal ends of the axle, *D*, have their bearings in bush form pieces, *N*, which are held in the eyes, *O*, of the harp, by cotter-pins, *P*, holding with the wall of the eyes and also with one of the transverse grooves provided in the end wall of these bush form bearings, *N*. These pieces, *N*, may be rotated in either di-

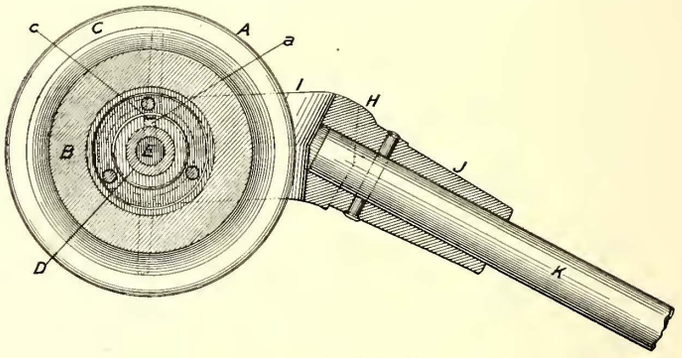


FIG. 3.—SECTIONAL VIEW

rection, and also be withdrawn from eyes, *O*, by means of a suitable screw-threaded hole in the end closing walls of those pieces.

This harp and wheel are manufactured by the Railway Appliance Company, of Albany, N. Y. The trial services of these wheels, for three months under supervision of Alexander Selkirk, the general manager of the company, and inventor of the improvements, have convinced those who witnessed their performance that this wheel is adapted for city and long-distance and high-speed service.

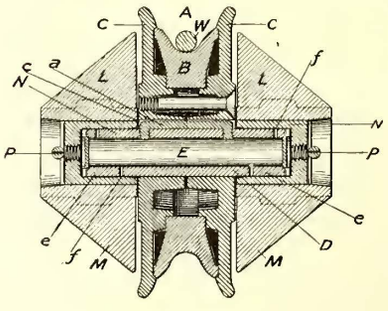


FIG. 4.—TRANSVERSE SECTION

Wheels with central conductors of 3⅛-in. diameter of groove bottom, after running continuously for four weeks, and covering 3300 miles, show a wear of the groove bottom of less than 1-16 of an inch all around, while others in service forty days, running 4800 miles, show a reduction of only one-eighth diameter of the groove bottom. In this wheel the diameter of the groove bottom is 3⅛ ins., requiring less than 6500 revolutions per mile, while at the end of the service the diameter of the groove bottom is only 2 ins., requiring 10,000 revolutions per mile run. These service trials of this wheel show that the central conductor, *B*, will run over 18,000 miles before being worn out and required to be replaced by a new piece.

These trial records also showed that the balance of these wheels were perfect from first to last, with their centers of revolution coincident at all times with the centers of their axles, so that with good lubrication of the journals of the latter, drag of the line

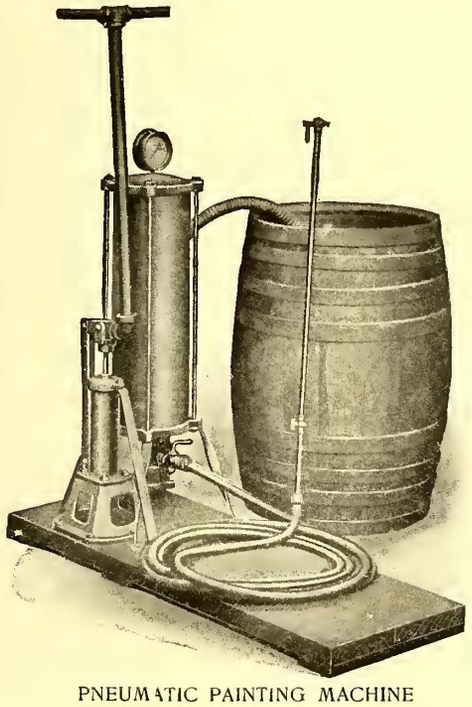
v ire on the wheels was only nominal, and not such as would wear the wire. It was also found that with proper pressure of the wheels to the wire the contact evidently was constant, as vibrations from these wheels could not be felt by the conductors through the trolley rope. The wheels ran silently and without sparking, and not a fuse was blown out on any car during the trial.

The Railway Appliance Company proposes to furnish on order with each assembled harp and wheel, an extra central conductor, *B*, axle, *D*, and bush bearings, *N*, (one pair) for replacing the similar original parts when worn out, so that those extra pieces may be in readiness for replacing the worn parts when removed. A lubricant charger, axle remover and wheel holder are also furnished for convenience for removing and replacing the wheel and axle and charging the latter with lubricating substance.

Pneumatic Painting Machine

The substitution of spraying machines for the paint brush constituted one of the most important savings in the economy of labor which has been effected by the use of machinery. Many thousands of these machines are in use in the United States for painting or whitewashing large surfaces. The purposes to which they are largely put in railway service are the interior and exterior painting of power stations and repair shops and the painting of cattle guards, freight cars and structural work of all kinds. The average labor cost of brush work is said to be from 12 cents to 15 cents per 1000 ft., while the cost with a machine is not over 1 cent for coating the same surface.

Painting machines do not work on the principle of squirting the paint against the object to be covered, for paint is expensive,



PNEUMATIC PAINTING MACHINE

and such a method would be wasteful. The machines discharge the liquid through a hose and special nozzle, in the form of a kind of misty spray, which gives a uniform and even coat and which will go into cracks and crevices in a way which is impossible with a brush.

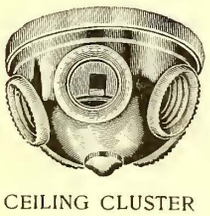
The accompanying engraving shows the Hook pneumatic painting machine, manufactured by F. E. Hook, of Hudson, Mich. The paint or whitewash is forced through the hose by pneumatic pressure, which is provided by a brake lever, as shown in the illustration, and which is arranged so that after pumping for a short time the pressure is sufficient to emit a spray for at least ten minutes without further operation of the pump. The valves are located at one side instead of directly under the pump, so that the liquid passes through the valve chamber into the receptacle without coming into contact with the plunger of the pump. The receptacle is made of 8-in. steel boiler tube, with heavy reinforced heads, and the complete machine is mounted on a substantial platform. Ceilings of the ordinary height can be reached by means of an extension head accompanying the machine, and without moving from the floor. The pump is so arranged that the paint or whitewash is kept in agitation before being sprayed, and is thus thoroughly mixed. Mr. Hook manufactures paint for use with the machine, but nearly any of the mineral or lead oxide oil paints can be used in it.

The American Car Company

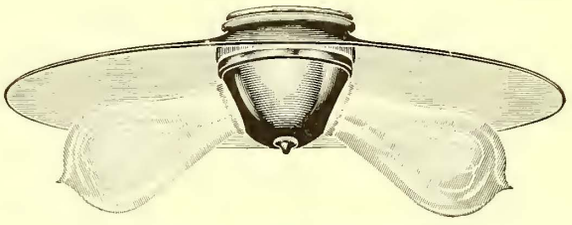
The American Car Company, of St. Louis, has elected permanent officers. The business and good will of the old company, it will be recalled, were purchased some weeks ago by J. G. Brill & Co., of Philadelphia, and local parties. It was reincorporated at an increased capitalization under the name of the American Car & Truck Company, but the old name has been readopted. It was partly on account of this change that the permanent officers were not announced before, although they were chosen about two weeks ago. The officers are as follows: John A. Brill, president; L. E. Curwen, vice-president; James Rawle, treasurer; H. A. Morseman, assistant to the president and purchasing agent; John R. Williams, secretary and assistant treasurer; George H. Tontrop, sales agent; W. J. Mackle, superintendent. Messrs. Brill, Curwen and Rawle are of Philadelphia and officers of the firm of J. G. Brill & Co., while the other officers are of St. Louis. Mr. Morsman was formerly agent for the Pacific Express Company at St. Louis. Mr. Williams was formerly secretary and treasurer of the American Brake Company, and Messrs. Tontrup and Mackle were connected with the old American Car Company. Improvements ordered by the new company are being made at the plant, which is to be practically doubled as to capacity and placed in thorough condition. A new lighting and heating plant is being installed, and 200 workmen are now employed at the works.

Wireless Clusters for Car Lighting

Wireless clusters are desirable in any class of electric wiring, but they are especially so in car work, where the tangle necessary to wire an old-style cluster fixture is to be avoided. The Benjamin wireless clusters, which are among the best known of this class, have the electrical connections as solid pieces of the fixtures. As soon as connection is made to the binding screws the cluster is ready for operation, as there are no wires save the two leads. These clusters consist primarily of an insulating base of porcelain, two one-piece contact plates attached thereto (each serving like terminals of all lamps in the cluster, and each provided with a binding screw), and a removable casing of brass or aluminum, supported and insulated by porcelain rings or bushings of special design. In eliminating wires in the cluster body by combining the necessary elements of the sockets upon one base the cost of installation is considerably reduced, and a neat, strong, durable and well-insulated cluster results. In the series clusters the contact plates are made in sections, each section, except the two carrying the binding screws, serving two adjacent lamps, so as to connect them in series. The car cluster of two lamps shown herewith is especially designed for car work and low ceilings, where opal reflectors are preferred. The reflector is firmly held between rubber rings, which protect it from the vibration of the car These clusters are made by the Benjamin Manufacturing Company, of Chicago.



CEILING CLUSTER FOR STEM



WIRELESS CAR CLUSTER WITH REFLECTOR

Litigation Over Subway Rights

An effort is being made by counsel for the Underground Railroad Company of the city of New York and the Rapid Transit Railroad Company, to secure an early hearing by the Supreme Court of the United States of the suit against the city of New York, the Rapid Transit Commissioners and the Rapid Transit Subway Construction Company. The suit was brought in the Federal Court for the Southern District of New York on July 5, 1901, by the plaintiff companies to restrain the building of the New York subway, under

claim of violation of prior rights granted by the State to those companies for its construction. The bill was dismissed from the District Court owing to lack of jurisdiction, but the question was certified to the Supreme Court in connection with the appeal taken from the decision by the lower court. The complainants aver that the case also involves the question whether the act authorizing the construction of the subway is not in contravention of the Constitution of the United States, and whether or not the act is void because it increased the debt of the city of New York beyond the limit permitted by the State Constitution. Counsel urges as reason for an early determination of the suit that the case would not in its regular order be reached and decided before the early part of 1904, whereas the defendants have announced in public prints that the operation of the underground railway will be begun during the year 1903.

Cooling Railway Motors

C. O. Mailloux and W. C. Gotshall, of New York, have obtained two patents on systems of cooling electric railway motors by means of compressed air, which, it is believed, will greatly modify the limitations that are at present encountered in electric railway practice. It is pointed out that the size and capacity of the motor is restricted by the track gage, and that the number of motors per car cannot exceed one for each axle, which gives a four-motor equipment for the ordinary double-truck car. The size of each motor depends upon the space available on the trucks, and this in turn depends upon the diameter of the wheels and on the length of the wheel base. The power limit of each motor depends upon its ability to commutate satisfactorily when carrying heavy currents, and to dissipate the heat due to motor losses and to keep its temperature below permissible limits.

In high-speed rapid transit work, especially in operating heavy trains with frequent stops and at a high-schedule speed, it has been found necessary greatly to increase the size and weight of motors, not only because of the commutation requirement, but largely on account of the temperature requirement. The high speed and the acceleration requirements tend to increase the heating of the motor, and for this reason they must be operated at a lower output than would be allowable under more favorable conditions. In some cases it has been found impossible to attain and to maintain a desired schedule speed, merely because the attempt to do so involved the running of motors at a mean rate, which caused their temperature to exceed the permissible limits. Under the circumstances it is very desirable to employ artificial means of cooling the motor, so that the heat due to copper and core losses may be more rapidly dissipated, and at the same time the output of the motor increased.

It is to meet these requirements that the system proposed by Messrs. Mailloux and Gotshall has been worked out. The motor cooling system may be supplied with compressed air from the same source as that which serves the air-brake system, or from an independent source. The air is conveyed through suitable pipes, having flexible couplings leading into the motor case, the air being distributed inside the motor frame between the field coils by means of perforated pipes. Three methods are suggested for controlling the supply of air to the motor. The first is by hand control, in which the exhaust vents of the present air-brake system are made to return the air through an exhaust pipe in such a manner that the air from the air-brake cylinders, instead of being exhausted into the outer air when the brakes are released, is sent through the cooling pipes into the motor cases. The second method consists in the use of automatic devices, whereby air is periodically allowed to flow for a determinate period of time from the air storage cylinders into the cooling pipes. The third method consists in the use of thermo-static devices, whereby air will be allowed to flow from the air storage tanks into the cooling pipes whenever a certain limiting temperature is reached.

It is claimed that the introduction of such means of artificial cooling will enable the size and the consequent cost of a motor equipment required for a given high-speed service to be materially reduced, and that in cases where a given motor equipment has reached its limitations, owing to excessive heating, the motor output may be materially increased, so as to enable the rate of acceleration and the number of accelerations in a given time to be both increased, thereby enabling a much higher schedule speed to be attained than would be possible without such means of artificial cooling. The use of artificial means of motor cooling would also permit the introduction of methods of electric braking in many cases where such methods would not now be permissible, owing to the fact that the motors are already overworked, and that the attempt to use the motors as generators in braking would heat them beyond proper temperature limits.

Chicago Union Traction Finances

Financial affairs of the Chicago Union Traction Company have been a fruitful subject of discussion the past week. The company was taxed into a deficit last year, and even higher taxes are threatened for this year. The increase in wages of conductors and motormen decided upon by the recent arbitration will cause an additional drain on the company's income. The giving of universal transfers as recently required may cut into the gross receipts, but it is too early to determine that.

General Counsel W. W. Gurley appeared before the capital stock committee of the State Board of Equalization last week at Springfield, Ill., and entered a strong protest against the way his corporation has been taxed recently.

Last year the board placed a valuation of $40,000,000 on the stock and bonds of the Union Traction. Judge Grosscup cut this to $23,000,000. Mr. Gurley said his client would be satisfied with a valuation of $23,000,000 this year, but to go above that figure would be robbery and an outrage, and the company, if the $40,000,000 assessment is made, would have to cease to exist.

"The idea that the public sales of common stock at 15 and preferred at 35 should form an estimate of the value of shares of stock is not just," said he. The uncertainty of franchise renewals renders the value of stock and bonds very precarious.

"Every one knows that the franchises will never be renewed, except upon terms much more onerous than those now enjoyed by the company, and some of the terms that will be demanded are just and right. The most conservative estimate shows that it will require from $10,000,000 to $15,000,000 to equip our property in the manner that will be demanded by the public, and in addition to this the city will undoubtedly demand some compensation for the franchise.

"With this staring us in the face, where in the world are we going to get the money if these taxing bodies continue to impose these unreasonable burdens upon us.

"I am not here," continued Mr. Gurley, "pleading for mercy. I am here for simple justice. As a matter of fact the owners of the Union Traction Company made a bad bargain when they took in these leased lines, and last year our deficit, after paying operating expenses, maintenance, and fixed charges was $247,000, not including the back taxes of $143,000 which we were compelled to pay."

The assessment of $40,000,000 placed by the board last year against the stock of the Union Traction Company and its subsidiary lines, would, the attorney repeated, ultimately drive it out of business if persisted in, he contending it was twice the real value of the property, judged from its carrying capacity.

James H. Eckles, treasurer of the Union Traction Company, in commenting on Mr. Gurley's remarks in one of the Chicago papers, says:

"What he means is that if the exorbitant taxation to which the Union Traction Company is now subjected is continued there can be but one issue in time. What he said of the Union Traction Company could be applied to other public utility and private corporations which are suffering from this unreasonable taxation. No matter how strong they are, they must succumb to it in the end. This is particularly true, however, of the traction company, because it appears to have been especially singled out as a victim of taxation.

"The assessing boards have been unreasonable with it, and Mr. Gurley simply pointed out a naked truth when he said that this course followed for some time would bring disaster."

"Where Mr. Gurley said, 'The end of the traction company is almost here, and you can touch it,' did he mean that any dissolution of the company is now contemplated?" Mr. Eckels was asked.

"Not at all," was the reply. "There is no such thing contemplated. He simply meant that such exorbitant taxes as those to which the company has been subjected recently would wreck even the strongest concern."

Casting Foundry for St. Louis Car Company

The St. Louis Malleable Casting Company, capitalized at $325,000, has been incorporated by interests identified with the St. Louis Car Company, of St. Louis, Mo., to build an immense casting foundry adjoining the works of the latter company at North Broadway. The new plant will cover about 5½ acres of ground, and will employ between 300 men and 400 men. This further development of the immense plant of the St. Louis Company shows strikingly the increased demand for the products of the company.

NEWS OF THE WEEK

Relief for Brooklyn Bridge Crush

It is understood that the American Bridge Company, which has been awarded the contract for installing four additional loops at the Manhattan terminus of the Brooklyn Bridge, so as to relieve the congestion of traffic at that point, will begin work at once. The plan will necessitate the removal of a large part of the mezzanine floor of the bridge and the cutting away of some of the stairways. All this work, however, is to be done at the expense of the Brooklyn Rapid Transit Company, and the traffic across the structure will not be interrupted while the alterations are going on. The new loops will be inside of those on which the cars run now, and there will be a distance of about 40 ft. between them. This will give additional standing room while persons are waiting for cars, and while no more cars can be run across the structure, there can be more at the terminal, and this will relieve the crush which is now caused by the crowds having to wait for the car desired.

Louisville Railway Company to Extend Lines

The Louisville Railway Company, now that the improvements in its city lines are practically completed, plans to build an extensive system of suburban lines to extend to Jeffersontown, Fishersville, West Point, Shepardsville, Worthington and Huber's. In fact, the system of lines that it is proposed to build will give Jefferson County a complete interurban system, with Louisville as a center. The first of the projected lines will extend from Louisville to Jeffersontown, a distance of 13 miles, and its construction will be begun at once. It is expected that this line will be completed by July 1. The plans of the company for building the other lines are very indefinite at this time, but preliminaries can be arranged this winter, and next year it is probable that a number of lines will be under construction. About two years ago Louisville became a mecca for electric railway promoters, but the only line that resulted from the agitation at that time is the Louisville, Anchorage & Pewee Valley Railway, which has for several months been operating successfully a line between Louisville and Anchorage, extending into the Pewee Valley.

Four-Track Line at Los Angeles

The Huntington syndicate, which, in the lines it now operates from Los Angeles to suburban points, under the name of the Los Angeles Railway and the Pacific Electric Railway, has a system of suburban electric lines that many of the large cities in the East might well be proud of, has in contemplation the construction of additional lines that, though they will not reach the total mileage of some of the systems extending from the large cities, will, in one respect, be particularly novel. The unusual feature is to be found in a belt line which the syndicate plans to build from Los Angeles to Whittier, Riverside, Redlands, San Bernardino, Ontario and Pomona, then to Los Angeles. This is not only the most extensive of the projected lines, but it will have four tracks. Two of these tracks will be used exclusively for passenger traffic and two will be used exclusively for freight traffic. From this line a branch will be constructed east of Whittier, and be extended to Fullerton, Anaheim and Santa Ana. This branch will be a double-track line, and, like the Long Beach and Alhambra lines, will act as a feeder to the system. It is understood, moreover, that a proposition is being considered for extending the Santa Ana line to San Diego, and that the construction of a line to Ventura and Santa Barbara is in contemplation. Mr. Huntington and his associates are, in the construction of this line, acting as the advance guard of the four-track electric railway. But the expectations of the projectors will probably be fully realized, as the line will extend through an agricultural district which, for the abundance and diversity of its products, is unsurpassed.

Whole Town Depended on the Power House

The recent destruction by fire of the power house of the Helena Light & Traction Company, of Helena, Mont., illustrates a condition in which many other cities of the size of Helena would probably find themselves if, for any reason, the entire power equipment of the local traction company should become disabled. As a result of the fire at the plant of the Helena company street car service was at a standstill for a week; factories were compelled to shut down, mines, mills and smelters were temporarily abandoned; newspapers were seriously hampered in their publication, as both typsetting machines and presses were run by motors. The streets were without lights, and extra precautions had to be taken to protect the public from molestation at the hands of thugs and highway robbers. Even the play at the opera house had to be postponed. Old lanterns were resurrected by citizens who wished to come down town at night, while small boys inserted candles in punctured tin cans for the purpose of providing a light. One or two business houses illuminated their entrances with Jack o'Lanterns, using pumpkins, cut in the usual manner, portraying the features of a face. An effort was made on the first day after the fire to operate the cars with horses, but the cars were found too heavy for this.

Pennsylvania Tunnel Hearing

The railroad committee of the Board of Aldermen of New York gave a public hearing on Wednesday, Nov. 21, in the matter of the Pennsylvania Railroad tunnel. The Chamber of Commerce, Merchants' Association and Realty League were among the organizations represented to urge the granting of the franchise. Several members of the Central Federated Union attended for the ostensible purpose of pleading for the inclusion of the labor clause in the contract. Abram S. Hewitt was to have been the spokesman for the Chamber of Commerce, but as he was unable to attend J. Harsen Rhoades and Gustav H. Schwab were delegated by President Jesup. Before the hearing Alderman Sullivan, representing the opposition, submitted the minority report, which objected to the granting of the franchise because the railroad company would be permitted to transport freight through the tunnel under the terms of the grant, it is claimed, and that the sum to be paid the city is insufficient. S. C. Mead, of the Merchants' Association, made a lengthy address, dwelling upon the benefit which would accrue to the city by the construction of the tunnel. The Merchants' Association committee also entered an earnest protest against the provision for an eight-hour day for laborers engaging in constructing the tunnel. Another public hearing is to be given this month.

Long Trolley Trip in Massachusetts

A novel trip was taken on Saturday, Nov. 22, by a party of street railway officials in the parlor car Concord, of the Concord, Maynard & Hudson Street Railway Company, of Concord, Mass. Starting at Maynard the car was run to Woonsocket, R. I., going over eight systems and covering 130 miles of line. With the exception of about 20 miles the entire length of Massachusetts was traversed. After leaving the lines of the Concord, Maynard & Hudson Company the car traversed the lines of the following companies: Marlboro Street Railway, Worcester Consolidated, Westboro & Hopkinton, South Middlesex, Milford & Uxbridge, Milford, Attleboro & Woonsocket and the Woonsocket Street Railway. The route extended from Maynard to Hudson, to Marlboro, to Northboro, to Westboro, to Hopkinton, to South Framingham, to Milford, to Hopedale, to Milford, thence to Woonsocket and return. The start was made from Maynard, at 7:30 a. m., and Milford was reached at 12 m. Lunch was served at Milford, the journey being begun again at 1:40 p. m. Woonsocket was reached at 3 p. m., and the return trip was begun at 3.20 p. m. Returning, Maynard was reached at 9.40 p. m. The trip was conducted under the personal supervision of John W. Ogden, superintendent of the Concord, Maynard & Hudson

Street Railway. In the party that enjoyed the hospitality of the Concord, Maynard & Hudson Street Railway were the following, all of whom hold official positions: Walter R. Dame, Henry Tower, Julius Loewe, Charles W. Shippee, William S. Reed, E. A. Onthank, Charles H. Persons, George F. Marshall, E. W. Goss, Wendell Williams, Andrew F. Mars, Edward F. Blodgett, Harry C. Garfield, Arthur M. Bridgeman, E. K. Ray, A. D. Thayer, John W. Ogden, George R. Damon, H. M. Young, D. H. Leahy, Albion R. Clapp, Carroll Z. Parker, James F. Ray, Adams Franklin Brown, J. Allen Rice, Abbot A. Jenkins, Marcus M. Wood, F. S. Ogden, E. S. Channell.

Another Court Decision in Ohio

The Supreme Court of Ohio has handed down an important decision in the case of the Hamilton, Glendale & Cincinnati Traction Company vs. O. V. Parrish. In this case Parrish sought to restrain the company from entering the heart of Hamilton, claiming that consents of certain property owners had been secured by purchase, and that, therefore, the action of the city in granting a franchise was illegal. The Common Pleas Court granted a perpetual injunction, and ordered the company to tear out its tracks in the city. The company appealed to the Circuit Court, which affirmed the finding of the lower court. The case was carried to the Supreme Court, which has reversed the decision of the lower courts, and the company will now be permitted to build into the city. The series of suits were among the important incidents in the long fight between the Pomeroy-Mandelbaum and the Widener-Elkins syndicates for control of the situation between Cincinnati and Hamilton. This fight was settled a short time ago by the "community of interests" effected by the two syndicates. However, the decision is an important one to electric railway promoters, since it decides that consents of property owners to a franchise may be purchased if necessary. The syllabus of the decision follows:

1. The consents of owners of lots abutting on a street, to the construction and operation of a street railroad on such street, are not property rights that can be appropriated under the power of eminent domain.
2. Such consents are not property rights, but rights in their nature personal to each owner of an abutting lot.
3. Such personal rights were bestowed by the General Assembly on owners of abutting lots, as a check upon the power of municipal authorities to authorize street railroads to be constructed and operated against the wishes of the owners of lots on such street.
4. The owners of abutting lots are free to give or withhold such consent, upon such terms as to them severally may seem proper, and there is no public policy in this State against giving such consent for a valuable consideration moving from the street railroad company to such lot owner.

Judgment reversed and judgment for plaintiff in error.

Chief Justice Burket formulated the opinion and it was concurred in by Judges Spear, Davis, Shauck, Price and Crew.

Report of the Twentieth Annual Meeting of the Street Railway Association of the State of New York

The New York State Street Railway Association is not only the largest of the State associations, but shares the honor with only one other, that of the Pennsylvania Street Railway Association, of publishing the proceedings of its annual conventions. These publications, in the case of the New York Association, extend back nearly two decades, and contain information in regard to operating practice and the technique of street railroading which is of the highest value. The present volume, it is needless to say, is no exception to this rule. Secretary Robinson is to be congratulated on the promptness of the publication of the report, as well as upon its attractive typographical appearance.

The Report of the Accountants' Convention

The "Report of the Sixth Annual Convention of the Street Railway Accountants' Association of America" has just come to hand, and contains 184 pages. Mr. Brockway, the energetic and efficient secretary of the association, deserves a great deal of credit for the appearance of this latest addition to the volumes containing the proceedings of the association as well as the promptness with which it has been issued. Typographically the volume makes an excellent impression, and a number of slight improvements have been introduced this year, such as printing the names of the speakers in capital letters, which make the subject matter more easily read. The volume has as a frontispiece a fine portrait of the retiring president of the association, Mr. Mackay.

The proceedings this year were unusually interesting and valuable, and their permanent record, in the form of the printed report, is one worthy of the association.

Failure of Schenectady Boycott

The boycott on the Schenectady Railway Company proved such a dismal failure that in spite of assurances of aid from the Albany labor organizations it was deemed expedient formally to rescind the action of the Trades Assembly. The order to boycott the street railway lines was never observed in Schenectady, and the folly of attempting to wage war upon the Albany railway company because of the operation of Schenectady cars over its lines was apparent even to the agitators.

The action of the Trades Assembly, however, in declaring a boycott has aroused the merchants of Schenectady, and a citizens' association has been formed to protect the city from similar experiences in the future. The association is to be non-partisan and non-political; its fundamental doctrine is freedom—political, social and industrial. It will stand for law and for an orderly respect for law. All proper aid and support will be accorded to sufferers from lawlessness of whatever nature. The objects of the association, as set forth in the constitution, are "to enable those citizens who are interested in the prosperity of Schenectady to act effectively together to a common end, the promotion of the welfare of the city; to aid in developing the material resources of the city by providing conditions that will attract and protect industries, and to support any movement calculated to encourage a good administration of municipal affairs or to prevent any improper use of public franchises to develop, sustain and make effective the best public opinion of the city."

"Noise" Suit at Boston

The full bench of the Supreme Court, last week, heard arguments in the test case of Edward F. Baker against the Boston Elevated Railway Company, which is an action to recover compensation for damages arising from the construction, maintenance, operation and location of the company's elevated system. As stated in the Street Railway Journal for Nov. 29, the case is narrowed down to the question how far, if at all, the company is to be held liable to property owners along the line of the elevated system for the noise from operation.

The petitioner contended that the statute intends that damage should be awarded for the noise from operation; that "damage from operation," which means from "systematic working," is broad enough to include damages from the noise of operation; that the building of a railroad or an elevated railway in a highway without legislative authority would be a nuisance, and, while the Legislature has power to legalize a nuisance without providing compensation to the injured party, still it can do so only to a very limited extent. The Legislature has no power to legalize a nuisance such as this, which practically ruins or confiscates the property of individuals, without providing that compensation be paid to the property owners. No previous railroad or street railway statute in the State provided damages for property owners whose property was injured by the operation of the system. The fact that the Elevated Railway Act does is entitled to great weight, particularly in view of the constant running of trains in places where the real estate is of immense value and in the heart of the city, while the noise from steam railroads is but occasional.

It is further contended that the damage from noise is a direct special damage, which is a fact found by the Superior Court, and not consequential or remote, for which compensation cannot be had. That the damage in question is in its character and extent such a nuisance as amounts to a taking of property within the constitution for which damages must be awarded.

It is further claimed that the rule of damage applicable to this case is this: Take the fair market value of the abutting real estate before the same was affected by the location, construction, maintenance or operation of the defendant's elevated railway or any apprehension of it. Take the fair market value of his estate after the location and construction and the regular running of trains, subtract the latter from the former, and the difference is clearly the actual damage which the abutter has suffered by such construction and operation unless other causes have increased the depreciation or diminished the same.

The respondent says, in substance, that the statute gives property owners only a right to compensation for direct damage to real estate, and makes the following additional contentions:

That the freedom from noises is not a property right, but a personal right.

That the damage from noise is consequential or indirect, being for the depreciation caused by the noise of passing trains.

That the personal annoyance to the plaintiff and others by the operation of the trains, while ordinarily it would be a nuisance, still the elevated railway acts have legalized it to meet public necessities, and there is no legal precedent in this State for holding such indirect damage recoverable under an eminent domain statute where no real property was taken.

That the statute means that the defendant shall pay all legal damage, which, as adjudicated by the decisions of the courts, excludes remote or consequential damages from smell, noise or soot arising from the operation of the public franchise granted by the Legislature, as in cases where a grant of rights to build and operate a canal, a railroad or an elevated railway.

That if part of the plaintiff's land is taken by the defendant he is entitled to the value of the land taken, and as regards noise only the difference between the depreciation in the value of his property which would have been caused by the noise if it existed just beyond its confines and the depreciation which is caused by the noise in its present location.

That, in estimating the damage caused by noise, the rule of law should be this: First, estimate the depreciation in the value of the plaintiff's property which would be caused by the noise if it existed just beyond the property confines; second, estimate the depreciation which is caused by the noise in its present location. The plaintiff is entitled to the difference between the two, and no more.

That the damage from noise is not in its character and extent such a nuisance as amounts to a taking of property within the meaning of the constitution for which compensation should be provided.

Comments on the Chicago Situation

Apropos of the recent vote of the Chicago City Council, which effectively threw cold water on Mayor Harrison's "wait-for-municipal-ownership" policy in regard to the renewal of street railway franchises The Record-Herald of that city states the case briefly and to the point as follows:

It is gratifying to observe that the City Council is not inclined to delay the settlement of the street car franchise problems pending the campaign for municipal ownership legislation.

All the public demands is that any negotiations entered into now shall preserve all rights which the city may avail itself of when the enabling legislation is enacted.

The obstructive attitude of the Mayor in regard to the transportation and tunnel lowering propositions is inexplicable except as accounted for by politics.

Alderman Bennett, chairman of the Council committee on transportation, is quoted by a daily newspaper as favoring early action in the franchise question, declaring that better terms can be obtained now than have ever been secured by any municipality. He is reported as saying further:

The people have declared for municipal ownership as a general proposition; but it is a question as to the best way of securing such ownership. Talk of municipal ownership at this time is childish.

Suppose we started in now to force municipal ownership. We would have to have legislation. Then we would have to condemn the properties of the traction companies, proceedings which would string out for years and be of uncertain termination.

Suppose we secured a municipal ownership enabling act from the next legislature. We would have to get a constitutional amendment to secure bonds to purchase the properties. It would take more than two years to get such an amendment.

Then suppose we went before the people with a $70,000,000 bond issue proposition, for instance. How would the people vote on such a thing?

The traction companies would grant things to-day that they would not grant years ago. The time is ripe for a settlement that would be most advantageous to the municipality. There is no use building air castles and wasting time on impossible things. The question must be met with common sense and on business lines.

All the traction franchises do not expire next year. The franchises of 6 per cent of the traction companies do not expire until after next July. Some do not expire until 1915.

I believe the people should have municipal ownership eventually. But talk of such at this time is foolish. The Mayor, in his last message to the Council, said that the Council should lay a sure foundation for municipal ownership. That is what we propose doing.

While I do not assume to speak for the committee I emphatically favor a municipal ownership clause which will give the people the right to take over the lines at the end of a specified period. How can municipal ownership be secured in an easier way?

I believe we can get the best service in the world from the companies. I believe we can secure liberal compensation. It is to the city's interest to secure these and other things, and secure them at once.

Boston Elevated Annual Report

The annual report of the Boston Elevated Railway Company for the fiscal year ended Sept. 30, 1902, has been filed with the Railroad Commissioners. The statement follows:

	1902-01	1901-00
Gross receipts	$11,321,030	$10,792,993
Operating expenses	7,862,571	7,336,597
Earnings from operation	$3,458,458	$3,456,395
Receipts from other sources	.....	76,503
Gross income, net	$3,458,458	$3,532,898
Fixed charges	2,836,560	2,896,359
Net earnings	$621,899	$636,539
Dividends	600,000	575,000
Surplus	$21,898	$61,539
Total surplus Sept. 30	483,733	463,509

Details of earnings from operation:

	1902-01	1901-00
Receipts passengers carried	$11,060,385	$10,562,533
Receipts mail carried	28,109	21,600

Traffic statistics:

	1902-01	1901-00
Number passengers carried	222,484,811	213,107,660
Number passengers carried 1 mile	617,315	590,979
Number car miles run	45,772,836	43,631,384
Average number employed	7,166	7,729
Total people killed in year	11	38
Total people wounded	2,095	1,806

Details of operating expenses:

	1902-01	1901-00
Extension and addition to rail	$326,351	$1,736,342
New electric construction	.....	187,909
Subway construction and improvements	25,207	92,269
Total addition to property account	1,949,545	4,778,203
Rental of subway	219,026	213,205

The following is the balance sheet as of Sept. 30:

ASSETS	1902	1901
Total cost of railway owned	$4,739,276	$4,412,925
Equipment	1,307,813	874,447
Cost land and buildings	4,679,548	3,514,928
Subway construction and equipment	158,269	133,061
Cash and current assets	3,788,397	1,818,123
Miscellaneous assets	3,461,168	4,733,088
Total	$18,134,470	$15,486,574

LIABILITIES	1902	1901
Capital stock	$10,000,000	$10,000,000
Subscriptions	2,346,586	.....
Current liabilities	1,346,568	1,313,246
Total accrued liabilities	2,362,843	2,386,556
Sinking and special fund	1,558,016	1,323,262
Profit and loss surplus	483,733	463,509
Total	$18,134,470	$15,486,574

Number of stockholders, 2187; number of stockholders in Massachusetts, 1851; amount of stock held in Massachusetts, $7,792,400.

Franchise Tax Appeal in New York

Argument in the appeal from the decision of Referee Robert Earl declaring constitutional the franchise tax law, passed by the Legislature of New York in 1898, was begun in the Appellate Division of the Supreme Court, Third Department, Dec. 2. Forty-seven corporations, among the largest in New York city, are parties to the controversy, but the arguments are being made on behalf of the appeals by companies whose railroad cases cover all of the points of law and fact involved in the entire controversy. Judge Earl's decision, as referee, was confirmed by Supreme Court Justice D. Cady Herrick on July 15 last. It found that the special tax law violated neither the State nor the Federal Constitutions, that the State Board of Tax Commissioners is not required, in determining the value of a special franchise, to separate the value of the tangible from the value of the intangible property constituting the franchises, and that the rate of taxation on special franchises should correspond with the rate applied in determining the value of other species of real estate in the same tax district. The amount involved aggregates $12,000,000, assessed against the corporations of the State and paid by them under protest.

PERSONAL MENTION

MR. HENRY R. NEWCOMB, chairman of the bankers' committee of the Everett-Moore syndicate, has recently returned from Europe.

MR. HENRY G. FOREMAN has been elected chairman of the board of directors of the Chicago Union Traction Company, vice Mr. Jesse Spalding.

MR. J. H. VAN BRUNT has recently been appointed general manager of the St. Joseph Railway, Light, Heat & Power Company, of St. Joseph, Mo.

MR. HENRY JAMES CROWLEY, of Lansdowne, Pa., general manager of the American Railways Company, and Miss Serena Virginia Ford, of Glenolden, Pa., were married at Sharon Hill, Pa., on Nov. 26.

MR. C. W. SIMONSON, of Dayton, has been appointed general passenger agent of the Columbus, Delaware & Marion Railway, of Columbus, Ohio. Mr. Simonson formerly held a similar position with the Dayton, Springfield & Urbana Railway.

MR. A. E. DOMVILLE, who has been connected with the St. Thomas Car Wheel Works, of St. Thomas, Ont., for eighteen years, has accepted the position of general manager of the New York Car Wheel Works, with headquarters at Buffalo.

MR. A. H. WARREN, assistant treasurer of the Houghton County Street Railway Company, of Hancock, Mich., has been appointed superintendent of the company, which place he has filled temporarily for several weeks. Mr. J. W. Payne has been appointed assistant treasurer of the company to succeed Mr. Warren.

MR. GARDNER F. WELLS has retired as general manager of the Brockton & Plymouth Street Railway Company, of Brockton, Mass., to become connected with the Terre Haute Electric Company, of Terre Haute, Ind. Mr. A. J. Bemiss will be appointed to succeed Mr. Wells at Brockton. Both companies are controlled by Stone & Webster.

MR. RICHARD EMORY, general manager of the Columbus, London & Springfield Railway, of Columbus, Ohio, has been made vice-president and a director of the Central Market Street Railway, of Columbus, vice Mr. John G. Webb, resigned. Dr. J. B. Hartman was re-elected president of the company, and Mr. Emory was made general manager.

MR. FRANK H. BROWN, who, for the last ten years, has been connected with the Worcester Consolidated Street Railway Company, of Worcester, Mass., as conductor and inspector, has been appointed superintendent of the Plainfield Division of the Elizabeth, Plainfield & Central Jersey Railway Company, of Elizabeth, N. J., of which Mr. John W. Akarman is general manager.

CONSTRUCTION NOTES

HARTFORD, CONN.—Surveys for the proposed electric railway between Hartford and Middletown are being made. The Hartford & Middletown Railway Company holds a charter for an electric railway link from the terminus of the Hartford Street Railway Company's system in Wethersfield, to Cromwell.

WILMINGTON, DEL.—The Delaware Suburban Railway Company, which plans to build an electric railway from Wilmington to Elkton, Md., a distance of 19 miles, will let the contract for materials at once. The company will do its own construction work. The plan is to use three-phase transmission at 6600 volts. The officers of the company are: George E. Schelegwich, president; John W. Schmidt, vice-president; H. R. Fothergill, secretary, manager, superintendent, purchasing agent, engineer and electrician; W. W. Hess, treasurer.

CHICAGO, ILL.—The ordinance of the Chicago, Milwaukee Avenue & Inland Lakes Traction Company that has been before the County Commissioners has been withdrawn.

QUINCY, ILL.—A committee of capitalists met a committee of the Quincy & Western Illinois Electric Railroad Nov. 24 and decided to subscribe $250,000 toward the capital stock of the company. The project, by this action, seems assured. The road is to run east to Beardstown and another branch north to Niota.

EAST ST. LOUIS, ILL.—There is a probability that the fight between the East St. Louis & Suburban Electric Railway Company and the Interstate Transit Company for the patronage of the people who ride across the Eads Bridge may lead to another electric railway being constructed between Belleville and East St. Louis. Charles E. Thomas, secretary of the Interstate Transit Company, and George Postel, of Mascoutah, have had introduced in the Mascoutah City Council an ordinance granting them or their assigns a franchise for the construction and operation of an electric railway on several designated streets of the town. Mascoutah is about 30 miles from the Eads Bridge, but the connection between the Eads Bridge fight and the Mascoutah ordinance is not hard to trace. The East St. Louis & Suburban Company operates a line between Belleville and East St. Louis. By running cars across the bridge the company has almost entirely cut off the patronage of the automobile line, because people are not unloaded at the bridge approach, which is the automobile terminal, as they were before. The Interstate Transit Company, to get even, plans to build a competing line, carrying passengers for a lower fare and unloading them where they can be carried across the bridge in automobiles. All this is made plain by the provision of the Mascoutah ordinance that the fare from Mascoutah to Belleville is to be 10 cents, and from Belleville to East St. Louis 10 cents. The present fare between Belleville and East St. Louis is 20 cents. If the ordinance is passed and accepted, a bond of $10,000 must be given to insure the construction of the line within eighteen months. The right of way for the line between Mascoutah and Belleville, Mr. Thomas says, has been partially assured. Negotiations are said to have been opened with the Southern Railway Company for its old right of way for a part of the line between Belleville and East St. Louis. If the line should be built it is said that a summer hotel will be erected on the bluffs.

EVANSVILLE, IND.—The County Commissioners of this county have granted a franchise for a right of way to the Evansville, Booneville & Rockport Electric Railway, on condition that certain alterations be made in the specifications. The right of way has already been secured through Warrick and Spencer Counties. The company has recently been granted a franchise in Booneville.

TERRE HAUTE, IND.—The County Commissioners have given a franchise to the Terre Haute Electric Company for an interurban line on the Lafayette Road from the north city limits to the boundary line of Park County. The road as surveyed runs through part of Park County to reach Clinton, in Vermillion County. No remuneration was asked for the grant.

LEBANON, IND.—Townsend, Reed & Company, of Indianapolis, who are building an electric line from Indianapolis to Frankfort by way of this city, have begun laying rails. After the line is completed to Frankfort it will be extended to Lafayette and a spur built from Lebanon to Crawfordsville.

COLUMBUS, IND.—The Indiana Central Electric Railway Company is completing arrangements for building an electric railway to connect with the Indianapolis, Greenwood & Frankfort Electric Railway in this city, to Seymour, Brownstown, French Lick and West Baden. An assessment of the stock has been ordered.

ELWOOD, IND.—The new extension of the Union Traction Company's line from Elwood to Tipton has been completed and placed in operation.

CEDAR RAPIDS, IA.—A syndicate of local capitalists headed by Orville M. Truman, of the Truman Finance Company, of Chicago, has organized a company, with headquarters at Cedar Rapids, for the purpose of introducing the hydro-carbon motors made by the Chicago Motor Vehicle Company, and also for the purpose of building interurban lines in Iowa. In the spring the company will commence the construction of an electric railway from Cedar Rapids in a northeasterly direction through Linn and Cedar Counties to Dyersville, a distance of about 40 miles.

SIOUX CITY, IA.—Improvements of the Sioux City Traction Company which will cost more than half a million dollars will be started before Jan. 1. A new car house will be constructed on the property between the present car house and the power house. This property is at present occupied by a frame building used for office purposes. This building will be dismantled and new offices will be provided on the second floor of the projected car house. The power house will be considerably enlarged. The capacity of the car shops will be doubled, and the force of this department will be worked to the limit. New cars will be built at the company's shops as fast as possible, but it is likely that some new rolling stock will have to be purchased from one of the large car works.

DES MOINES, IA.—The Interurban Railway Company has decided to extend from Colfax to Newton the line which it is now constructing from Des Moines to Colfax. The line will be completed to Colfax this month, but the extension from Colfax to Newton will not be constructed until the spring. The object of the construction of the extension is to make connection with the Iowa Central Railway at Newton, thus giving that company connection with Des Moines. The Iowa Central is the only large railway system in Iowa which does not have direct communication with Des Moines. This line extends from Watertown and Minneapolis, Minn., on the north to Albia, Ia., on the south, and Peoria, Ill., on the east. The extension will parallel the Rock Island Railroad from Colfax to Newton.

LOUISVILLE, KY.—It is said that the Louisville, Anchorage & Pewee Valley Electric Railroad is contemplating erecting elevated tracks in this city. An effort will probably be made to get a right of way into the city.

BALTIMORE, MD.—Press reports say that the Chesapeake Beach Railroad, which runs from Washington to Chesapeake Bay, will shortly be converted into an electric railway. The road is now in the hands of David H. Moffatt, of Denver, President Otto Mears and Charles W. Popper, the vice-president having retired from the management. Mr. Moffatt recently attached the company's real estate for a debt of $25,000. On the outskirts of Washington the road connects with the electric railway system, and the plan now under consideration will provide for running the trains from the Beach clear into the heart of Washington. The excursion business is to be developed for the benefit of visitors to the National Capital.

WESTFIELD, MASS.—The Westfield Valley Electric Railway Association was an organization founded to do pioneer work toward the building of an electric railway through the towns of the Westfield Valley. Its mission was to agitate, not to undertake, the construction of street railway lines. Out of it, however, has grown an organization known as the Wetsern Massachusetts Street Railway Company, which has secured franchises, and promises to commence construction next spring.