Street Railway Journal

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OPERATING METHODS OF THE COLUMBUS RAILWAY COMPANY

Columbus is practically the geographical center of Ohio; it is the greatest railroad center in the States, and is the State capital. Located here are the State House, the State penitentiary, institutions for the blind, insane and feeble-minded and deaf and dumb; there are also here United States barracks, accommodating 6000 soldiers. The city has a population of some 150,000 people, making it third in the State, and it includes within its corporation boundaries 16¼ square miles of territory. A large number of societies hold their conventions at Columbus, and, owing to its many attractions for the Ohio citizen, the number of excursionists who visit it throughout the year is very large.

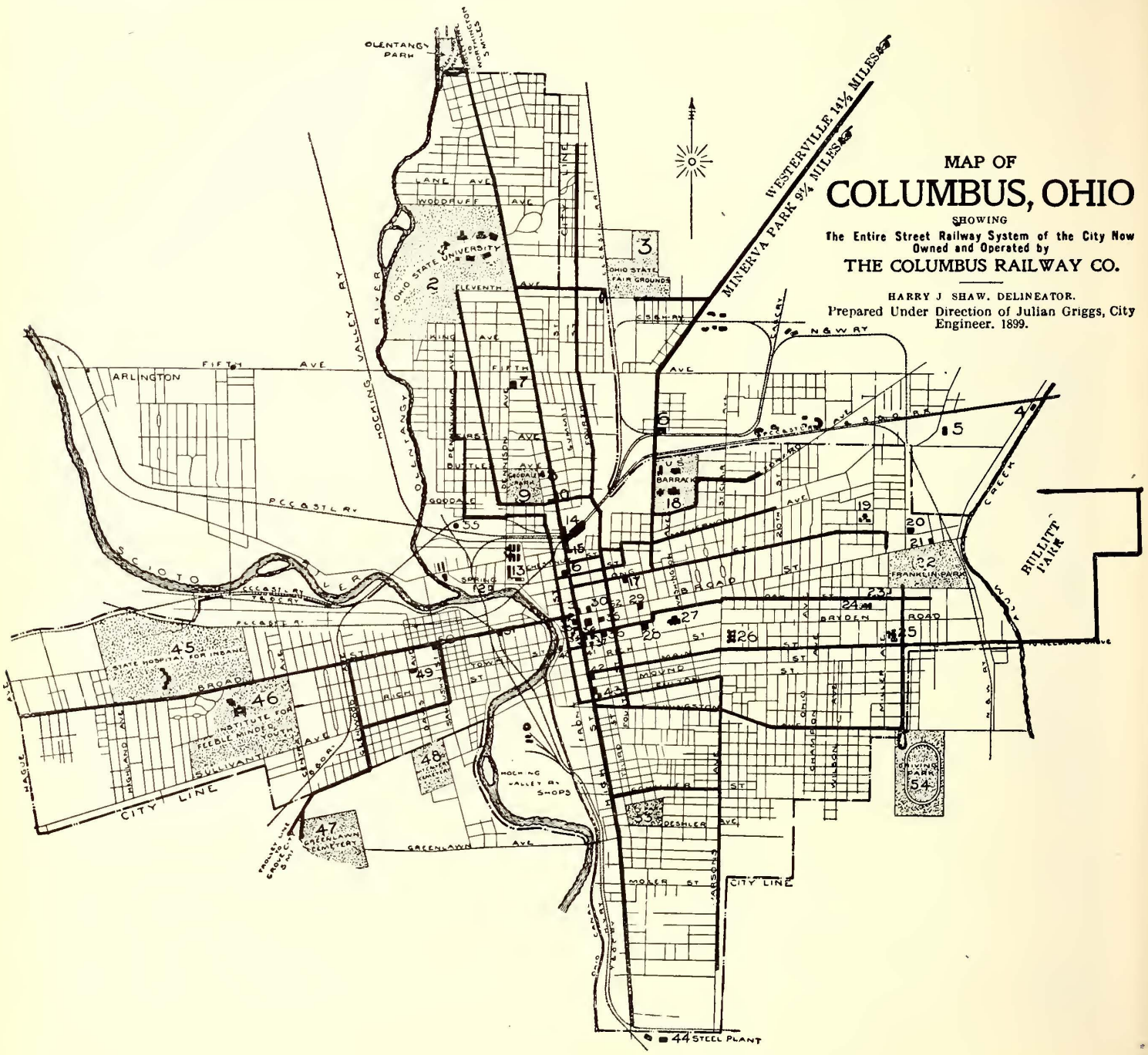
VIEW ON HIGH STREET, SHOWING METHOD OF ARCH ILLUMINATION

The engraving on this page gives a view of one of the principal thoroughfares in the city, High Street, and also illustrates the ingenious and attractive method of illuminating the street by arches. These arches are placed at intervals along High Street from the Union passenger station to Livingston Avenue, a distance of about 7400 ft., being twenty-five in number. The spacing varies somewhat, according to the length of the different squares. The arches are supported upon the steel side poles of the railway company, the support beginning at a point about 16 ft. or 17 ft. above the pavement. The center of the arch is about 26 ft. above the roadway. Each span carries fifty 16-cp incandescent lamps, the receptacles for which are wired in a hood extending beneath the arch; this hood is painted white. The current is furnished by a local electric light company, payment for which is made up by an appropriation from the city of a certain sum, and subscriptions from the various property owners and store keepers along the street. The cost has been put very low, being $19 per month per arch. The lamps are lighted every night during the year. This is in addition to the regular arc lights. The weight of the arch proper, *i. e.*, the steel work, is ap-

proximately 1000 lbs., and the cost was about $150. This does not include the wiring and the lamps. This method of street illumination has been favorably commented upon by visitors to Columbus, and is one of which the residents along the streets feel justly proud. In another section of the city, called the "Hub," located in the vicinity of Fourth and Main Streets, this arch system of lighting is also used, but upon a smaller scale.

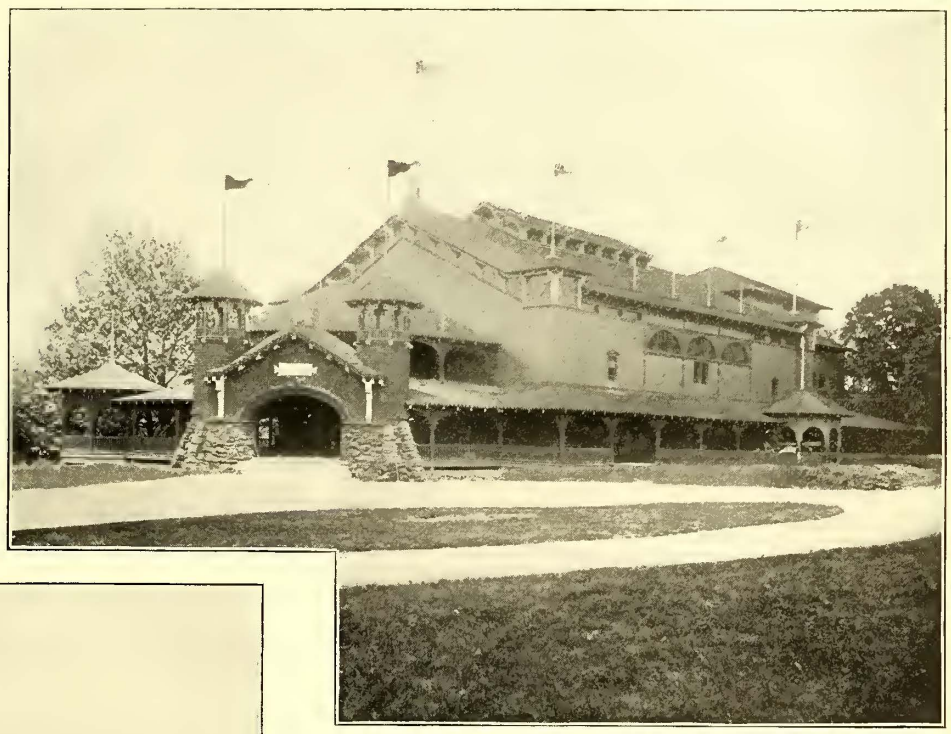
The Columbus Railway Company owns the entire street railway system, the lines of which radiate in all directions from the city's center with a total length of 98 miles. In addition to the city lines the company operates an interurban road from Columbus to Westerville.

The company, appreciating that street car riding is as much habit as necessity, encourages patronage in many ways. Visitors are informed by a sign at the entrance to the Union Railroad Station that a map of the city may be had for the asking. This is the street railway company's folder, and contains a map of the city, handsome views of the chief points of interest and comprehensive instructions for reaching them. Excursion trains are met by representatives of the company and these folders given out freely to all visitors. In this way some 60,000 have already been distributed this season. In addition to the folders the company publishes a handsome 52-page illustrated guide to the city and pleasure resorts, with map and street railway directions. These are mailed to Sunday schools, societies and others throughout the State, and assist in making up sight-seeing routes. The company believes that this advertising not only brings many people to Columbus who would not otherwise come, but by helping them to economize their time while in the city, results in their riding more often on the street cars.

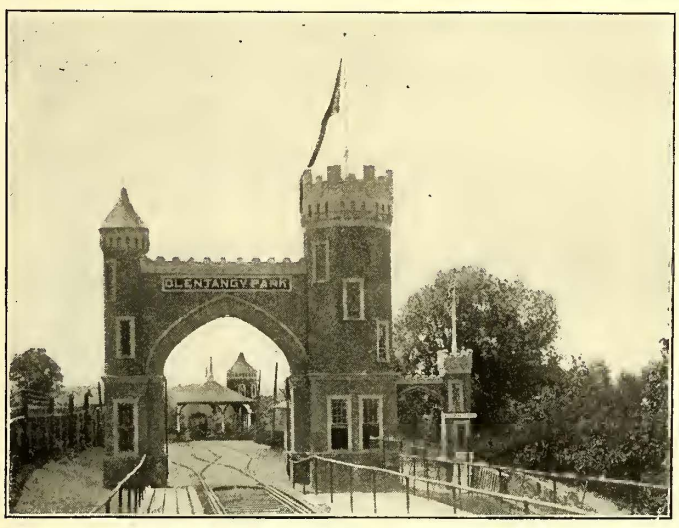


features of the resort is the toboggan slide, which is a "shoot the chutes" on a small scale. Each bather rents his own toboggan, which he must himself carry up the incline. Added to the exciting ride down the incline is the pride of sliding furthest over the water before the toboggan sinks. Although the park is thick with trees, it is well lighted at night by a multitude of incandescent lights, even the river being illuminated throughout the length of the park. Disregarding the popular notion that people who have a chance to sit down do not spend their money, the park is everywhere furnished with comfortable benches. The most prominent of the buildings is the magnificent theater, whose spacious veranda, surrounded by a dense growth of trees, overhangs the Olentangy River 50 ft. below. The theater building is 80 ft. x 250 ft.; the auditorium is large, cool and comfortable, seating 2248 people. Ice water is supplied free from suitable tanks placed at convenient points through the grounds.

Minerva Park covers 150 acres. It is not so favorably located as Olentangy, but the same care is exercised to make it a popular and pleasant pleasure ground. It has bowling alleys, scenic railway, "shoot the chutes," etc., and a theater seating 2500 persons. This



THEATER AT OLENTANGY PARK



GATEWAY TO OLENTANGY PARK

park is forty minutes out from the city, a 15-cent fare for the round trip being charged, which includes admission.

The company's rolling stock is maintained in the best possible condition, with the fact in mind, as stated above, that many people ride for pleasure or from habit, and clean, comfortable, handsome cars go far toward increasing the road's receipts. The car equipment consists mainly of double-truck cars. Owing to the wide gage (5 ft. 2 ins.), the company uses the bicycle truck under all its double-truck cars. The standard box car is 28 ft. inside, with 4-ft. 6-in. platforms, the standard open car is 36 ft. over all, with twelve seats, and vestibuled. The company much prefers the vestibuled to the ordinary type of glass front. Following what is now very general practice, the company has party cars, which are rented by the hour or evening.

The repair shops are located in a large and well equipped building. Among devices of interest is a circular crane for handling trucks, motors, etc., and fully illustrated in the accompanying engraving. It is the intention of the company to equip this circular crane—as well as the car body hoisting trolleys—with compressed air hoists. Christensen direct-connected motor compresser and air hoists are to be used. A device for making armature coils is also shown. The reducing gear is for the purpose of giving a slow speed and avoiding any back lash.

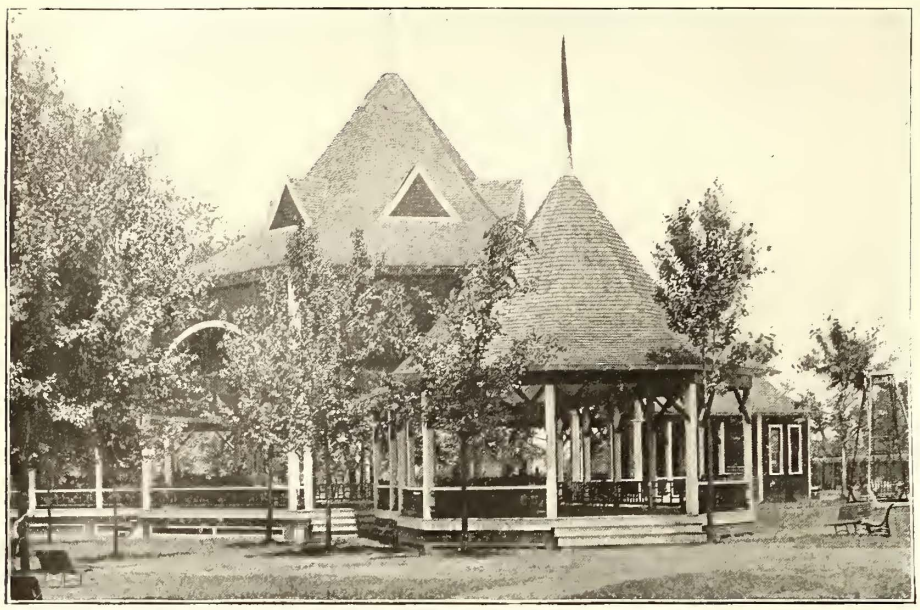
The company has had excellent success in splicing cars. Twenty of these have been in service for four years, and are apparently in as good condition as when the work was done. They are of special value, owing to their large carrying capacity and light weight. The spliced car bodies weigh a little over 9000 lbs., while new bodies of the same dimensions, which the company recently bought, weigh slightly over 14,000 lbs.; in other words, the spliced cars carry just as many people and weigh but little more when loaded than the new cars when empty. A working diagram is given, showing the general plan for splicing cars, with the arrangement of timber before covering over.

For use on interurban roads the company has spliced together two 22-ft. side seat combination cars, making a car body 42 ft. long. These cars were spliced in the same manner as shown in the accompanying plan, except that two 6-in. I-beams, filled in with oak on each side and running the full length of the car, have been added to provide for the heavy strain of interurban service. These cars have twenty-six seats upholstered in red plush, and seating fifty-two passengers. The cars are lighted by electricity and Pintsch gas. The company owns its own Pintsch gas plant, from which it supplies the gas to its interurban and private cars, and also to the steam railroad companies passing through the city, piping the gas from the plant to the Union Depot, about a mile away.

Another sketch shows the method of cleating wires under the side of the car in preference to using a cable the entire length. The wires are cleated, as shown, the full length of car underneath side seats, entering a cable at the ends which carries the wires under the platform to the con-

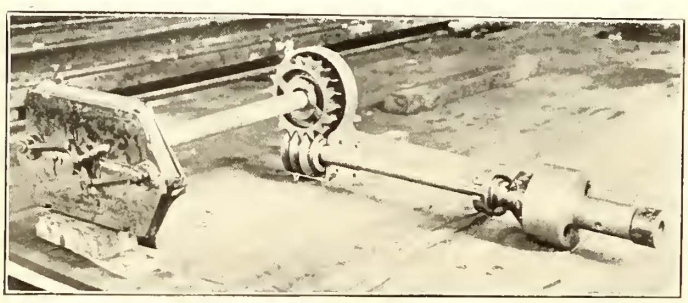
troller. All wires where passing through the floor or timbers of the car are protected by porcelain bushings. These porcelain bushings are considered a very important feature and have done much to increase the efficiency of the wiring. The total maintenance cost for all rolling stock is less than 1 cent per car mile.

Each car is fitted with an automatic fender, which costs, complete, $18. The company believes thoroughly in the use of fenders, and that they save many lives and serious accidents. One interesting case on record is that of a bicyclist who was struck by a car running at full speed. Both man and wheel were caught on the fender under the car, and when pulled out were unhurt, the man riding away on the wheel.

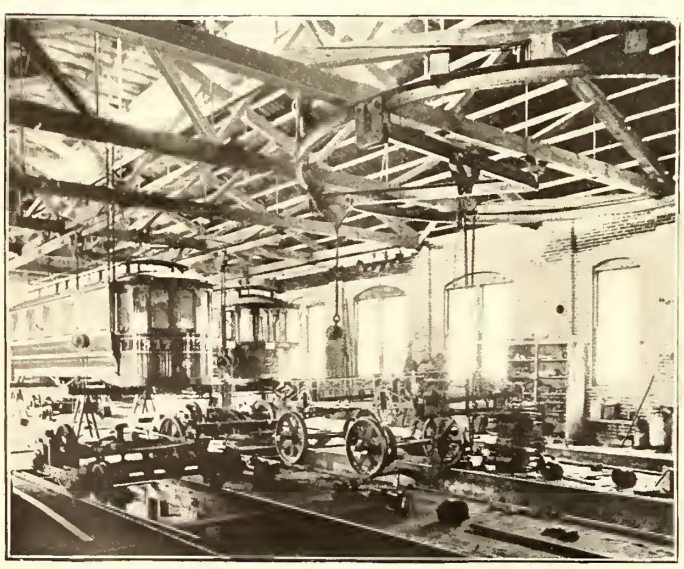


PAVILION IN MINERVA PARK

ENTRANCE TO MINERVA PARK

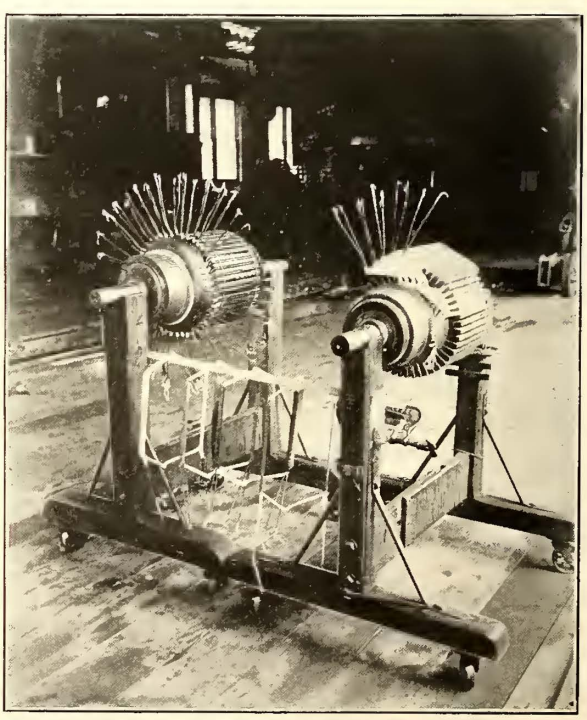


GEARING FOR WINDING ARMATURES



CIRCULAR CRANE IN ROSE AVENUE SHOPS

Trolley wheels, trolley harps and journal bearings are made in the company's own brass foundry. Trolley ears 14 ins. long cost 16½ cents apiece. Armature bearings have a composition of 80 per cent copper, 12 per cent lead, and 4 per cent each of phosphorus tin and pig tin, and show a life as high as three years. The journal bearings are bored in special design jig, which bolts on to the carriage of a lathe, using a boring bar with four cutters, viz.: A cutter at each end for facing the ends of brasses, a roughing cutter, which roughs out the work, and a finishing cutter, which sizes the brass. With this arrangement it is not necessary to caliper the brasses, except when setting the cutter; one setting of the finishing cutter will bore some-

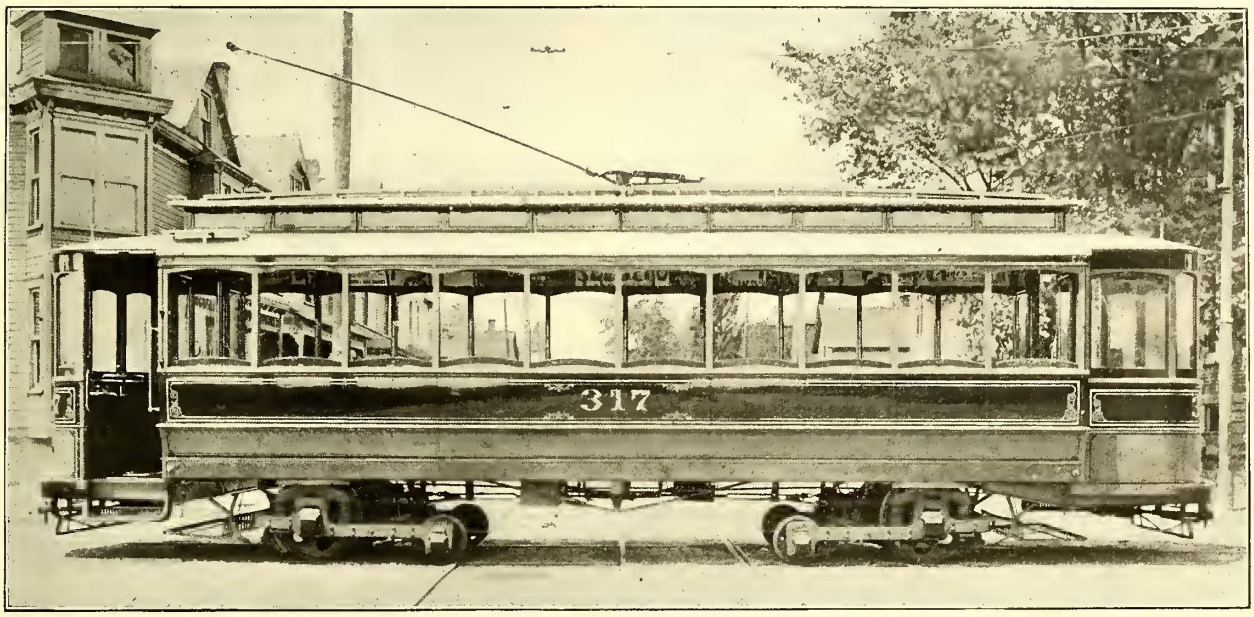


RACK FOR WINDING ARMATURES

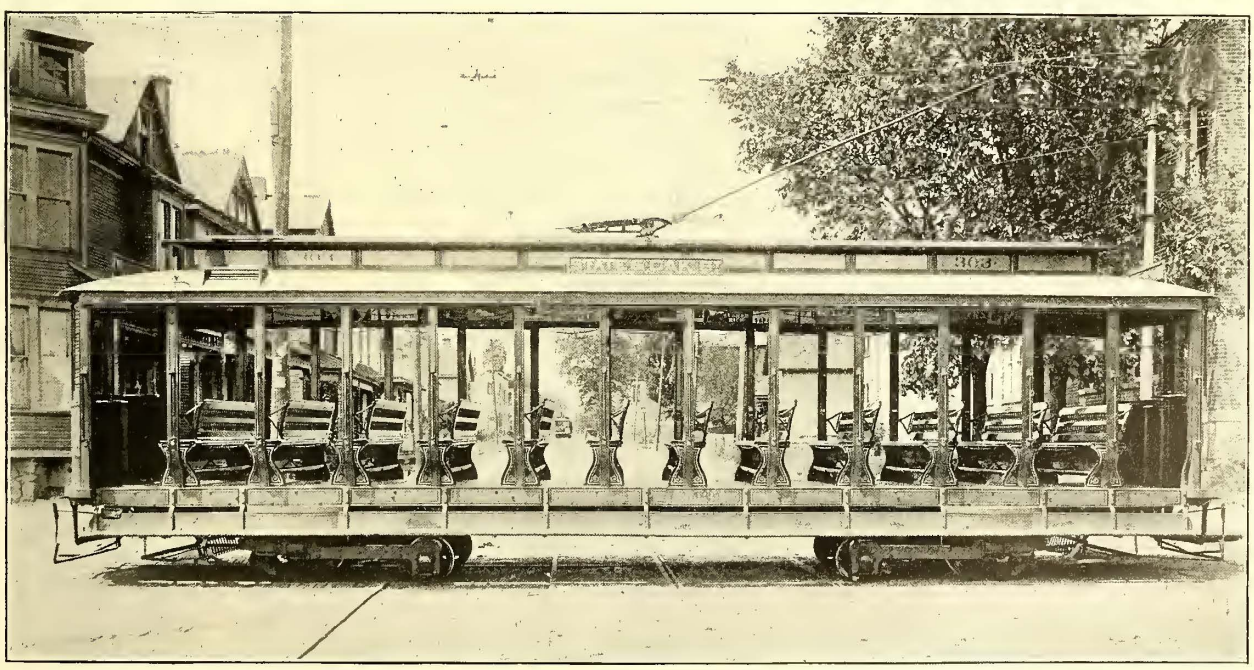
times as many as fifty bearings before needing sharpening.

The company's standard for new track and roadbed construction is 74-lb., 8-in. T-rail, laid on oak ties. The ties are laid on a bed of broken stone, which is also tamped in between up to within about 2 ins. of the tops of the ties. Then a layer of cheap concrete, flush with the tops of the ties. This is to keep the sand in which the paving blocks are imbedded from sifting down into interstices between the blocks of broken stone. This practice has greatly improved the quality and life of the pavement. The company paves to a foot outside of its rails. There are a large number of cast-welded joints on the system, and more will be put in this fall. They were put in by the Milwaukee Rail Joint & Welding Company, and the railway company itself, which now owns its own welding outfit. These joints have given excellent satisfaction.

In connection with the track work it should be stated that data relating to this department are kept in a very systematic manner. In general the idea is to get all the information which a manager would want in as concise a form as possible, and in a way which would require but a small amount of work to keep up. The record is divided into two sections: The first shows straight track, location of special work, kind of rail, pavement and joints; the second part is devoted to details of special work. Distances on straight track sheet are noted by 1000-ft. stations. Cross streets are not shown, only the exact location of the intersection of the cross street nearest each 1000-ft. station. Points of special work, curves, change of rail section and change of pavement, or a change in the kind of joints are noted in feet, counting from the preceding 1000-ft. station. In the special work record a sketch is made of each piece of work, noting joints and giving each frog and switch the same number as that in the original shop drawing from which the work was made. The connecting rails are also noted, so that special splice bars can be made at any time without disturbing the track until they are ready to be put on. Adjacent to each sketch is placed the name

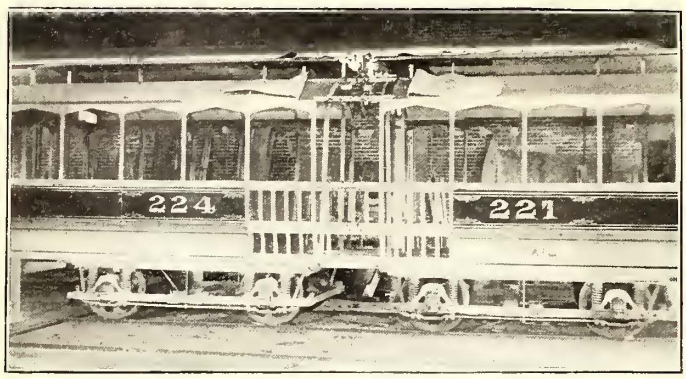


STANDARD CLOSED CAR

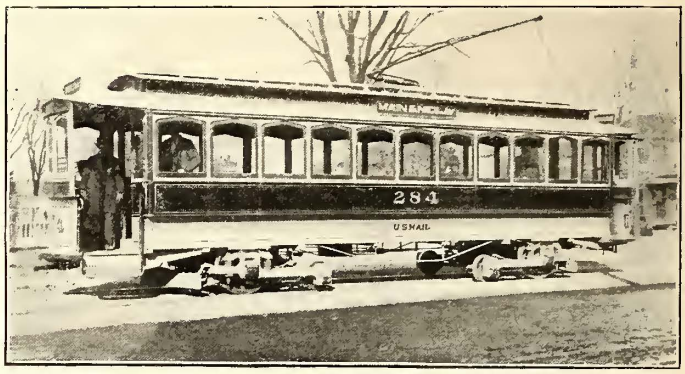


STANDARD OPEN CAR

of the company by which the work was made, height of rail, original drawing number, weight of rail and maker's section number and the time work was laid. Renewals or repairs which were made to this work are also added as made. These records are all drawn on tracing cloth, from which blue prints are made once a year, and bound in a special binding made to fit the sheets; in this way the tracings are not handled at all, and form a permanent record.



METHOD OF SPLICING TWO 16-FT. BOX CARS



CAR MADE BY SPLICING TWO 16-FT. CARS

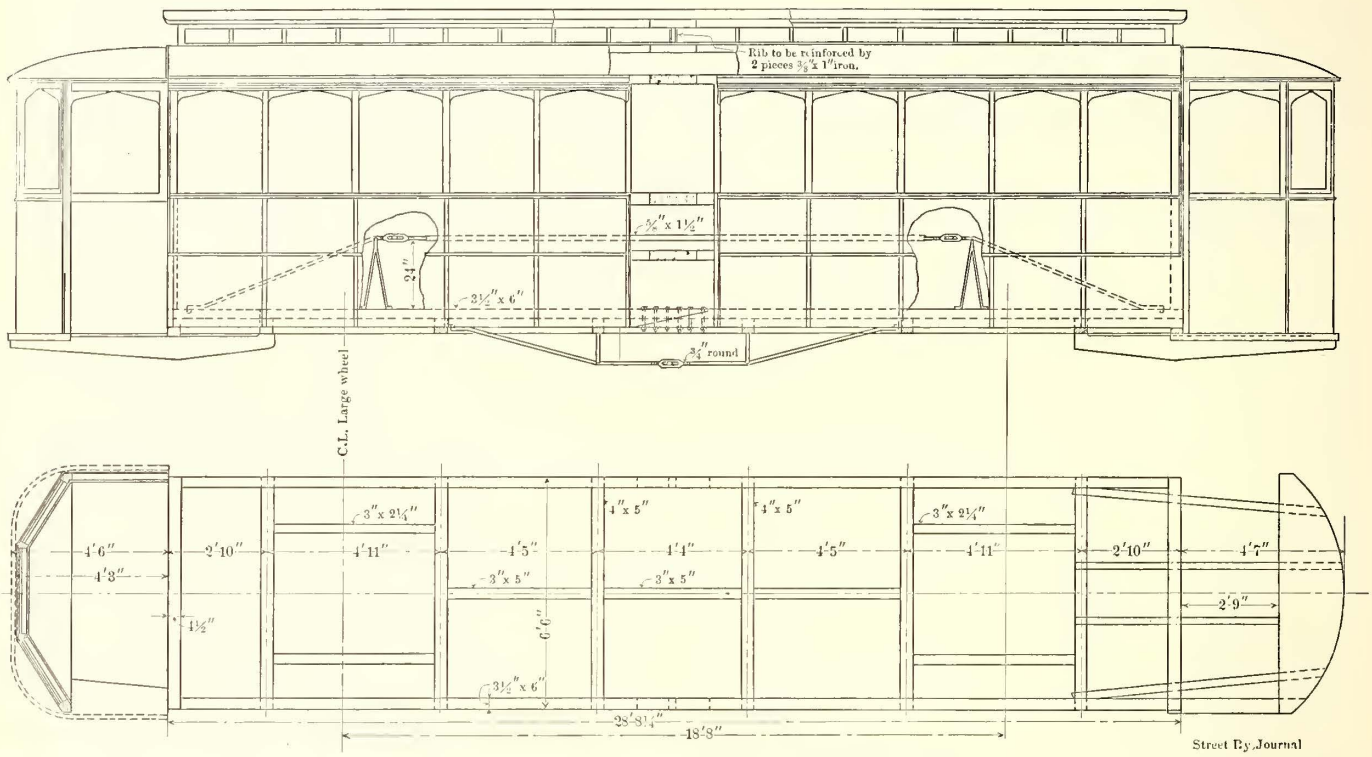
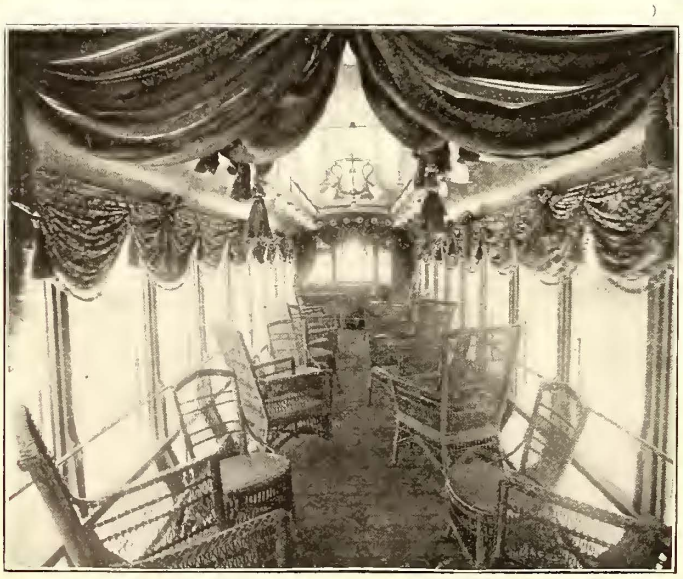


DIAGRAM SHOWING METHOD OF SPLICING CARS



INTERIOR OF TROLLEY PARTY CAR

VIEW ON NEIL AVENUE, USED LARGELY FOR EVENING PLEASURE RIDING

Changes in this record are noted upon the tracing from track foreman's report. Once a year the entire record is very carefully gone over and verified.

On the Westerville interurban line is installed an interesting automatic signal, designed for use between switches. This signal is thoroughly reliable, and a great assistance in the operation of the road. The design is somewhat crude, yet very substantial and positive. The signal arm is carried on the spindle of an ordinary bicycle wheel hub, the hub being securely fastened in the post, and the spindle to the side of the arm revolving in ball bearings on each end. This arrangement gives a very sensitive arm, and the side bearing prevents wind pressure from the side having any material effect upon its operation.

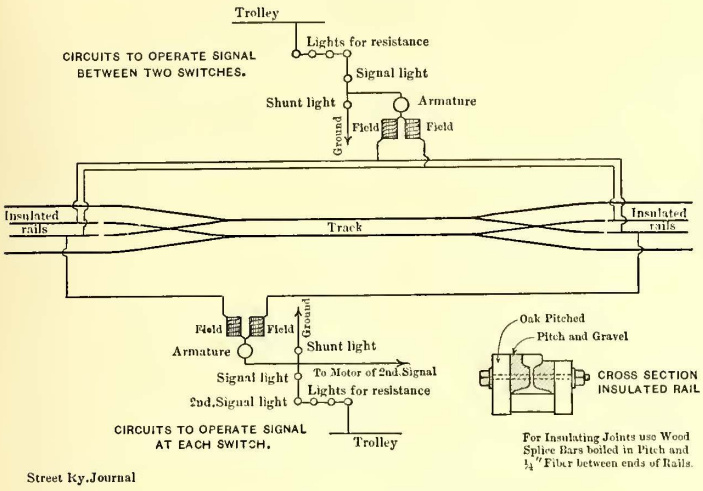
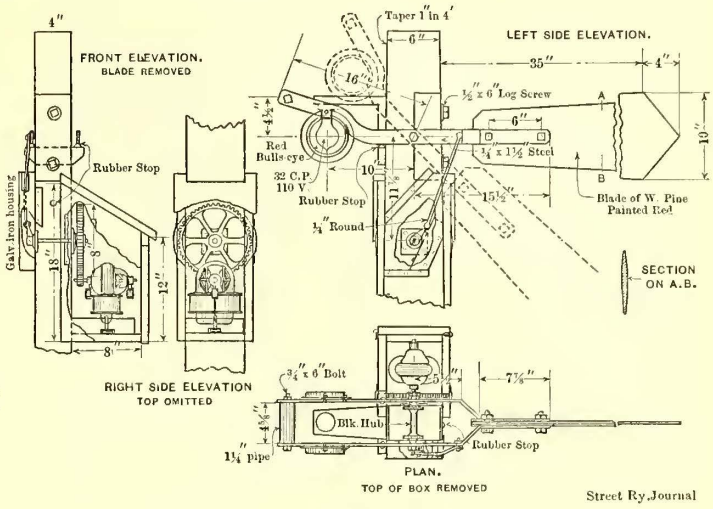


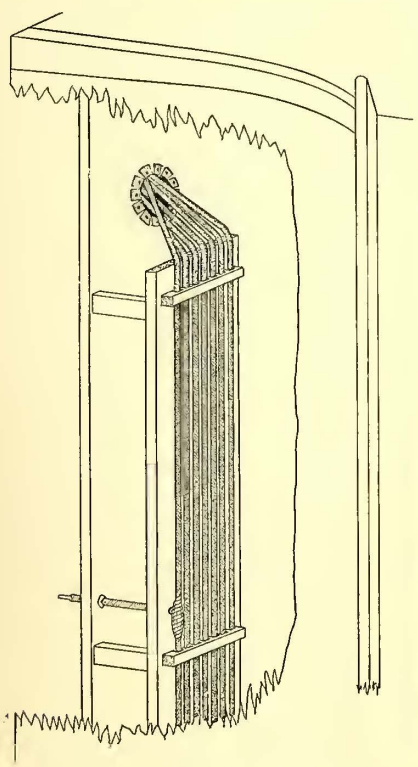
DIAGRAM SHOWING CONNECTIONS FOR SIGNAL



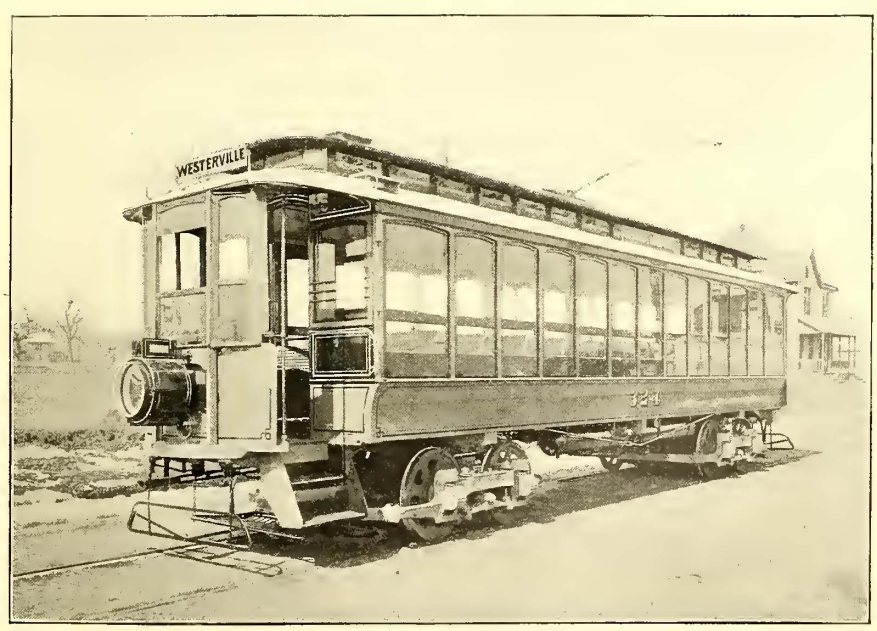
BLOCK SIGNAL

and car wheels, making the ground connections between insulated rail and ground. This circuit is clearly shown in the accompanying sketch. One field coil of the motor is used to throw target up and the other field coil so connected as to operate arm in other direction. The signal motor is shunted around a 50-volt lamp, which gives only 50 volts between insulated section of rail and the ground; in fact in actual practice the voltage is not even this high, as enough leakage will take place to reduce this voltage to about 30 volts, which is too low to be noticed by coming into contact with rail.

The company has two power houses, one of which was



METHOD OF CAR WIRING

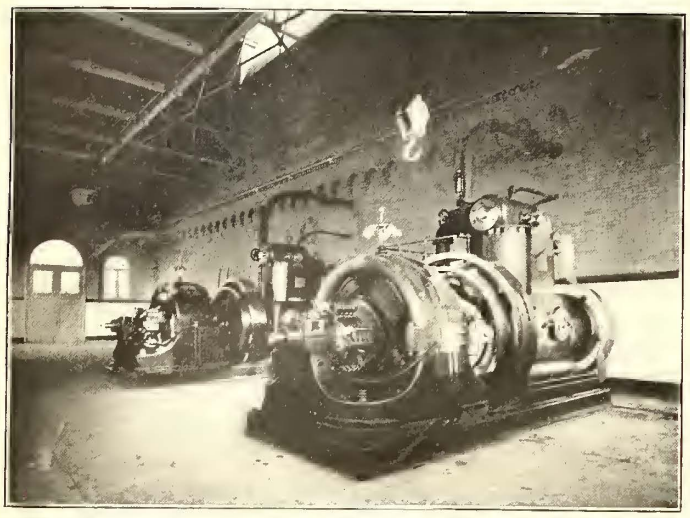


INTERURBAN CAR ON WESTERVILLE LINE

One end of the arm is made of white pine, painted red; the other end has two red bull's eye lights which cover or expose an incandescent light for night signal. The arm is operated by a Western Electric Company's 16-in. fan motor, geared to a countershaft, which is connected to the arm by a small crank and connecting rod. The crank is arranged to make a little more than half a revolution to throw the target from up to down. This signal forms a very simple locking device, and gives a maximum torque to start arm either up or down. The signal is operated by the wheels of the car passing on to an insulated rail, which rail is connected to the motor, axle

acquired by purchase, and is used largely as an auxiliary. The first, the Spring Street station, has two Buckeye tandem compound-condensing engines of 750-hp each, direct-connected to G. E. 500-kw generators. This station has also one cross-compound Green-Wheelock engine of 1200 hp, direct connected to an 850-kw G. E. generator; three McIntosh & Seymour tandem compound engines of 300

hp each, belted to G. E. generators; Wheeler surface condenser, Cockran oil separator and Babcock & Wilcox boilers. There is also an automatic gravity oiling system, which was installed several years ago, and was one of the first in the State; the drips all run back to the oil room through a waste and sand filter, and from the storage tank

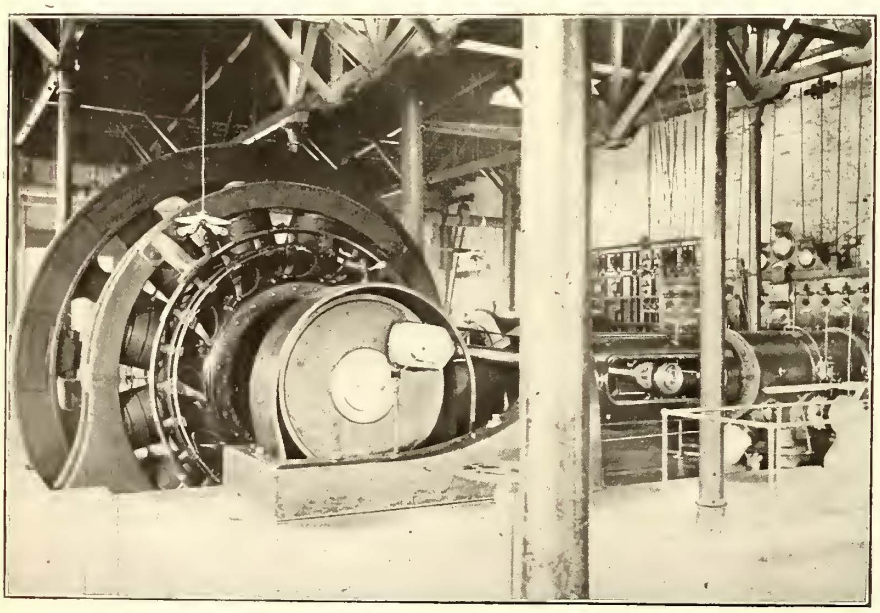


INTERIOR OF MILO POWER STATION

the oil is pumped back to the pressure tanks located in the engine room.

The Milo station is equipped with eight Stirling boilers, aggregating 2400 hp, Murphy furnaces, Green economizer and three Westinghouse engines, aggregating 1100 hp, direct-connected to Westinghouse generators. At this station there is installed a We Fu Go purifying system, which has given excellent satisfaction, having done away entirely with the necessity of cleaning the boilers.

The Columbus Railway Company has had no trouble



INTERIOR OF SPRING STREET POWER STATION

with its employees for many years. A graded schedule of wages for motormen and conductors is in force. For the first three months in the company's service the employee received 15¾ cents per hour; for the next nine months 16¼ cents per hour, and 17¼ cents per hour thereafter. Men who have been in the company's employ for six months are paid the same interest on their earnings for each six months as is paid on the preferred stock of the company. Men who have served for five years receive each year thereafter one free uniform, and as a mark of such service are allowed to wear a gold band upon the arm. After ten years of service another gold band is added on the arm and the company issues to the man without charge two uniforms per year. Fifty per cent of the company's men have one or more bands. The qualifications necessary to a successful application for the position of motorman or conductor are good health, good moral character, good eye sight without spectacles, hearing, heart and lungs sound, free use and movement of hands, arms and legs; age between twenty-three and forty years; must weigh not less than 150 lbs., if an applicant for conductor, or not less than 175 lbs., if applicant for position as motorman, and height must exceed 5 ft. 9 ins.

The Columbus Railway Company was incorporated in Aug. 18, 1889, and is a consolidation of the Columbus Street Railway Company, chartered April 25, 1892; the Crosstown Street Railway Company, chartered Feb. 24, 1893, and the Columbus Central Railway Company, chartered March 8, 1893. The company is capitalized for $7,000,000, half of which is common and half preferred stock. The property has a mortgage indebtedness of $5,086,000. The officers of the company are: President, Robert E. Sheldon; first vice-president and treasurer, Edward K. Stewart; second vice-president, Clarence M. Clark; secretary and auditor, P. V. Burington; general superintendent, M. S. Hopkins.

Trial Trips on the Wannsee Bahn

At last trial trips are being made with electric trains on the Wannsee road, near Berlin, which has been equipped by Siemens & Halske. Each train consists of nine three-axle passenger cars, each having five compartments for ten passengers each. The first and last cars have a motor on each axle, or a total of six motors. In starting, the two groups of three motors are each connected in series. As soon as a certain speed has been attained the motors on the last car are cut out. The train, which is being used for experimental purposes only, at present, is fitted with measuring instruments, which show the current consumption at all times. To compare the cost of electrical operations with steam locomotive service, the same class of measurements are made on the steam locomotive. It has been found that at the start the motors consume 200 amps., the average power at the start is 600 hp, and during the run about 300 hp is required. The time taken to get the train up to full speed (40 km per hour) from a standstill is ninety seconds, while during this time the train passes over a distance of about 500 meters. The train is completely braked in thirty seconds within a distance of 170 meters. According to this, the distance between Berlin and Zehlendorf being 12 km, the trip can be made in twenty-seven minutes, and the stops about one minute in length. This schedule must be adhered to when the train is fully loaded, *i. e.*, twenty-nine axles, 220 tons, including the weight of the 410 passengers.

M. K. McMullin, of Pittsburgh, has purchased control of the West End Traction line of that city. It is supposed that the road has been bought in the interests of the Union Traction Company.

The Metropolitan Railway of Paris

A glance at a map of Paris showing the omnibus and tramway lines of that city would appear to indicate a system of transportation so complete and so well calculated to meet every requirement that any additional facilities to this end would be unnecessary. No matter what part of the city a person may wish to visit or where the starting point may be, there is a possibility of reaching the destination with very little trouble—with or without transfer to another line—provided the traveler has an intimate acquaintance with the routes followed by the various "busses" and tramcars and understands the eccentricities of the transfer system. Every important street has, in fact, one or more lines of cars for the use of the public, and the grand boulevards are crowded during the busy hours with omnibuses from all the principal quarters of Paris. The only relief from this congestion of traffic lay in diverting a portion of it into other channels; and, since an elevated structure would be quite out of the question in a city which prides itself on the beauty of its streets, the only alternative was an underground railway. It is many years ago since such an undertaking was first considered, but really definite action was not taken until after the last Exposition. It may be that the need for better transit facilities was felt when the influx of visitors occurred at that time, but the only satisfactory solution of the problem presented itself when electric traction became a practical method for application to transportation systems, and when there was no longer any doubt as to its reliability and its many advantages for underground work

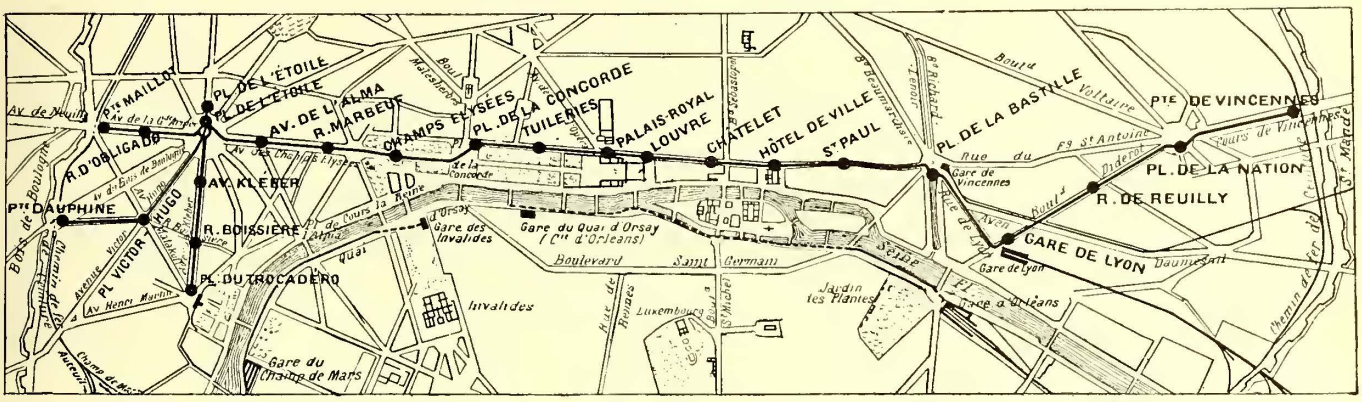


FIG. 1.—MAP OF PRESENT SECTION, PARIS METROPOLITAN UNDERGROUND RAILWAY

Four years ago the city authorities decided to build a metropolitan railway. They appeared to be particularly desirous that their road should be independent of the railroads of the State; therefore, they concluded that a narrow gage track should be used, this requirement having the additional advantage of reducing the expense of building the road. However, a State law passed in 1898 authorizing the city of Paris to build the railway, specified that the standard gage of 1.44 m should be employed. The maximum width of the cars over all was given as 7 ft. 10½ ins., and a clearance of 27 ins. was required between car and tunnel wall at a height of 6 ft. above the rails.

The Metropolitan Railway as at present projected will be remarkably comprehensive in service, and will form a network of lines almost rivaling those of the surface. The first to be constructed is one running from the Bois de Boulogne on the west to the Bois de Vincennes on the east, traversing the city through the center and following the right bank of the river for a considerable distance. Another line is to be constructed following the old boulevards and forming an irregular figure called by courtesy a circular path. This supplements the Ceinture, or Belt, Steam Railroad, which passes around the city on the inner side of and close to the fortifications. It may be compared to the inner circle of the London Underground Railway and will doubtless be of great value, passing as it does through the center of the Southern district and through the thickly populated sections in the northern part of the city. The third important line runs from east to west a little to the north of the first-mentioned line, and a fourth passes through the center of the city from north to south. Two other lines are to be built, one to provide direct communication with the different trunk railways having termini in the eastern part of the city; the other to be mostly open cut or elevated, and but little underground, connecting the Vincennes line with the belt line at its southernmost point. The three lines which pass through the city from east to west or north to south have their terminal points at the Fortifications' Belt Line, or Ceinture Railroad, which will give additional transportation facilities.

The whole network of the system is not yet under construction, as it was decided to undertake the work by sections. The most important line, especially in view of the Exposition, was that connecting the western part of the city with Vincennes, where the machinery and transportation exhibits are installed. This line, which is that shown on the map, starts at Porte Dauphine, one of the city gates leading to the Bois de Boulogne, and passes through the Place de l'Etoile, then down the Champs Elysées past the Tuileries and the Louvre, through the city to the square where once stood the Bastille, and on to the gate of Vincennes. In order to accommodate the

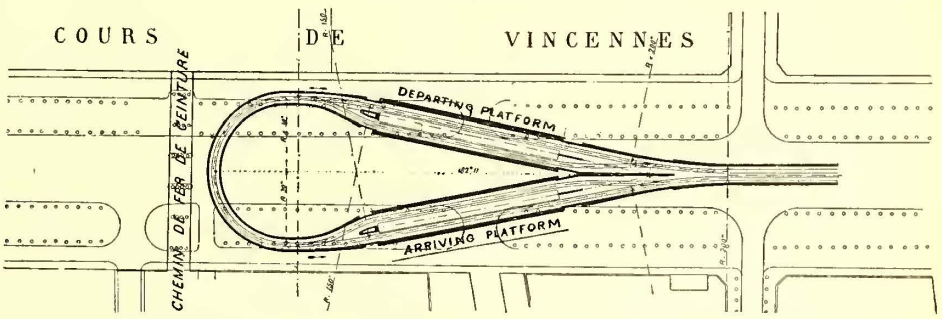


FIG. 2.—PLAN OF LYON STATION, SHOWING PLATFORMS FOR ARRIVING AND DEPARTING TRAINS

crowds of people desirous of visiting the Exposition, a branch line has also been carried to the Trocadero from the Place de l'Etoile, as shown, this forming part of a circular line to be built in its entirety only after the close of the Exposition. An extension down the Avenue de la Grande Armée to Porte Maillot has also been made. The

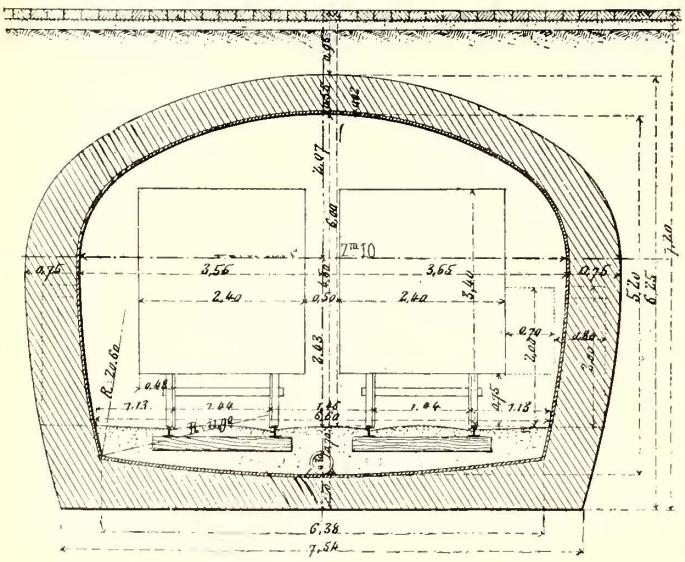


FIG 3.—SECTION OF STANDARD TUNNEL

railroad, then, from Vincennes to the Place de l'Etoile, together with the three branches to Porte Maillot, Porte Dauphine and the Trocadero, form what is called the first fraction of the underground system. It is this portion which was formally thrown open for public traffic on July 16. It was at first intended to have the opening on the 14th, which is the great national fête, corresponding to our own Fourth of July, but it was feared that the rush of people would be so great as to paralyze the road, as there would not be more than perhaps twelve trains running,

to the present time there has been no means of transportation between the two divisions of the Exposition other than that afforded by circuitous street car routes or boats on the river, excepting the use of cabs, which the general public cannot afford. The boats stop at innumerable landing places, making a very slow trip, and the steamboat

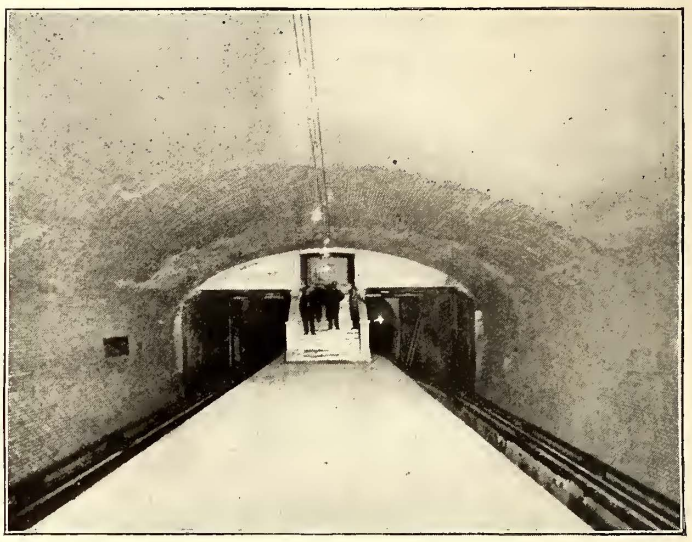


FIG. 4 —VINCENNES STATION READY FOR OPERATION

companies have not considered it worth while to put on an express service, possibly because they are satisfied it would not pay.

The length of the line at present in running order is 7 miles. The construction throughout is underground, except at the Bastille, where it was necessary to cross the St. Martin Canal, necessitating an open-air stretch which includes the station. The curves at the approaches are also exceptionally sharp, there being at one side a double curve with radii of only 165 ft. At the terminal stations

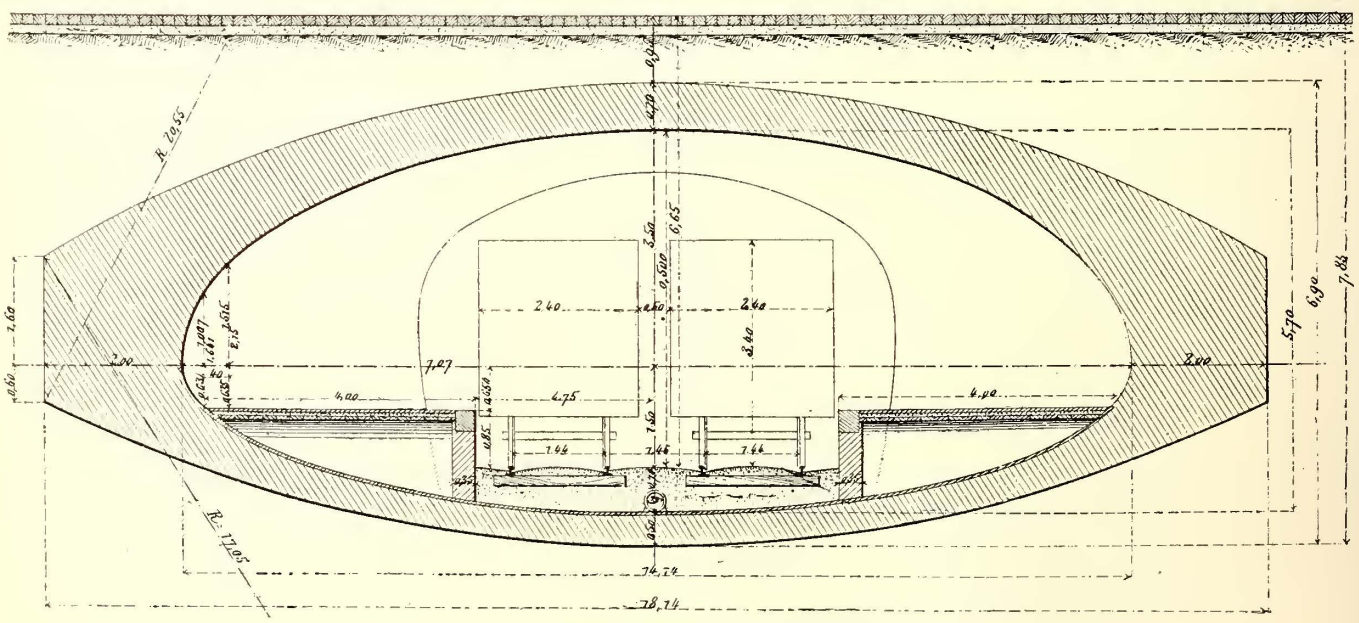


FIG. 5.—CROSS SECTION OF VAULTED STATION

and the streets of Paris are always thronged on the 14th with pleasure seekers, and immense crowds go out to the Bois de Boulogne to view the parade of the troops.

The direct connection established by the Metropolitan Railway between the main buildings of the Exposition and the far-removed annex at Vincennes should have the result of increasing the attendance at the latter place. Up

the trains are brought round a loop after discharging the passengers, this arrangement allowing of rapid handling of trains, such as would not be possible in a station of the ordinary type except by the use of a considerable number of shunting tracks. Since it is not intended to transport any heavy baggage on the Metropolitan system, hardly any greater delay may be anticipated at terminal points

than at some of the important stations in the city. As a measure of precaution, however, the terminal loops are each provided with a double-track station on one side for arrivals and one on the other side for departures (Fig. 2), thus giving plenty of time for manipulation of trains. The two stations are joined by a circular section of single track laid in a narrow tunnel, the radius being uniformly 30 m, or less than 100 ft., at all the terminals. It is to be remembered, however, that the trains are hauled around these curves unloaded. On the main line, except as noted above regarding the Bastille station, the shortest radius of curve is about 250 ft. The steepest grade is 4 per cent.

The ordinary tunnel section is shown in Fig. 3, the maximum width of the straight tunnel being nearly 23 ft. 4 ins., and the height above the rails 14 ft. 9 ins. On the sharp curves the side walls are carried out further, giving additional clearance of about 7 ins., necessitated by the regulations imposed by the government, which require a minimum clearance of 27½ ins. between the car and wall at a height of 2 m above the rails. This law also fixed the maximum allowable width of car at 7 ft. 10½ ins.

On the direct line from Porte Maillot to Vincennes there are sixteen intermediate stations, and each terminal has, as we have seen, two stations entirely independent. Three different plans of construction have been adopted. The more usual form is that of a vaulted roof with a clear height above the rails of 5 m (about 16 ft. 5 ins.) (Fig. 5); but some of the stations are built with an iron roof with brick arches between the beams, and one station—that at the Bastille—is entirely open. The iron roof has been used only in cases where, in order to avoid trouble from water, it was found expedient to keep the level of the rails as high as possible, the vaulted roof requiring a greater depth On this account the low-lying stations between the Champs Elysées and the Louvre, inclusive, as well as those at the Hotel de Ville and Gare de Lyon, are built with the iron roof—a cut and cover system (Fig. 6). The general dimensions of the stations are, for the length about 246 ft., and for the width 45 ft. or 46 ft. The platforms, raised about 3 ft. from the rails, are 13 ft. wide.

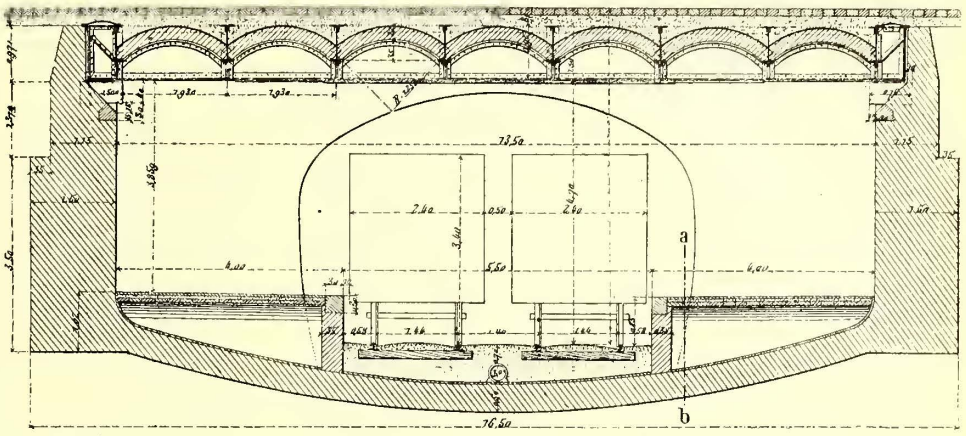


FIG. 6.—SECTION OF STATION WITH IRON ROOF

The regulations imposed by the city on the builders of the road require that no obstructions shall be placed on the streets; this means that the view across the squares or streets must not be cut off by the erection of any covered entrance to the underground stations. In consequence, the only intimation of their whereabouts is afforded by a painted board giving the name of the station, standing over the flight of stone steps, surrounded by a light railing, which lead to the passageways below. Since the depth at which the rails are laid is not more than 20 ft. to 25 ft. below the surface of the street, very little head-room is available for the building of ticket offices. Sufficient height is, however, provided for all persons, even those exceptionally tall, the lowest roof being about 6 ft. 10½ ins. At the foot of the stone stairway leading from the street is the ticket office, which may be a hall some 15 ft. square, with one side partitioned off for the ticket agents and with a counter for "gratuitous change of money." From this hall a passage conducts to the stairways communicating with the platforms, a foot-bridge being provided for crossing from one side of the station to the other. The halls and passages, as well as the more important stations, are lined with white enameled tiles, so that the rows of incandescent lamps provided for illumination are quite effective. The station of Lyon will doubtless have a large traffic from the Gare de Lyon, the terminus of the railway to the Mediterranean, which station is within a stone's throw. It will be seen that there are two platforms in the Lyon station (Fig. 8), which is built with the iron roofs supported on two rows of columns extending down the platforms, the whole interior being well illuminated by incandescent and arc lamps. The rails are laid for one double track only, which is the Porte Maillot-Vincennes line. The other platform is intended to serve the trains which will eventually run on the belt line, for it is at this point that the two lines meet, having the stations

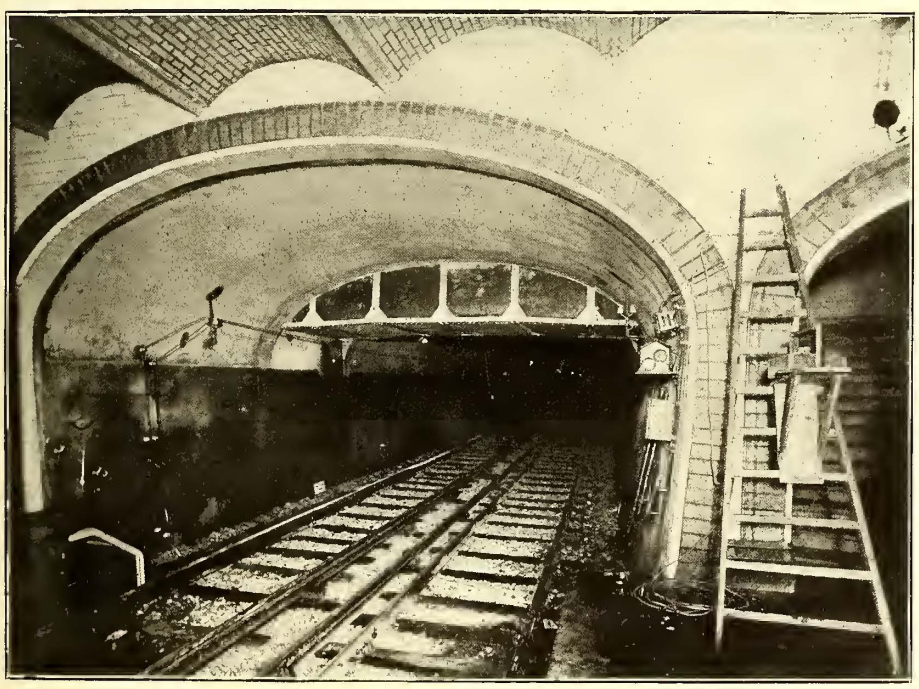


FIG. 7.—VIEW LOOKING DOWN TUNNEL FROM HOTEL DE VILLE STATION, SHOWING BLOCK SIGNAL SYSTEM

of Reuilly and Place de la Nation also in common, and separating after the latter, the belt line curving round toward the north, and the Vincennes line going east. Owing to the economy in space rendered necessary by the small amount of head-room available at some of the stations, also with a desire to avoid building long stairways to give access to the trains, the foot-bridges furnishing communication between the two sides of stations dip considerably into the tunnel cross section. In the photograph

FIG. 8.—INTERIOR OF LYON STATION

taken from the Hotel de Ville station looking down the tunnel (Fig. 7) it will be seen that the bridge is quite low, clearing the car roofs by only a small margin. This construction effectually prevents use of the railway by the

FIG. 10.—CABLE VAULTS AND GALLERIES AT PLAC DE L'ETOILE

rolling stock of the State roads, the Metropolitan cars being only about 11 ft. 2 ins. in height above the rails.

The junction of the several lines at the Place de l'Etoile has demanded a most extensive system of underground tunneling at that site, but the additional requirements of a sub-station for electric power, and large rooms for accumulators, together with elevator pits and accommodation for the necessary operating machinery and water tanks, have combined to make an elaborate honeycomb of subterranean galleries, halls and stairways, without mentioning the three immense stations. Thus the Triumphal Arch above may well be held to represent a new triumph, not of war, but of architectural and engineering skill, executed amid countless difficulties in the depths of the earth over which the stately monument is raised.

At the Etoile station one line passes beneath the others, requiring very deep excavation in order to build the lower station. For passenger service two elevators will be installed, intended principally for the lower, but available for the upper, stations. The elevator pits, solidly built with

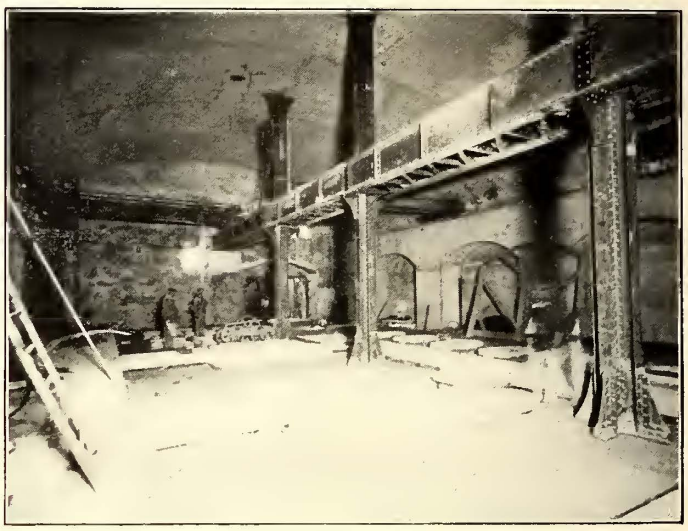


FIG. 9.—UNDERGROUND VAULT FOR TRANSFORMERS, PLACE DE L'ETOILE

masonry walls, have a depth of 57 ft. 6 ins. As yet there is no machinery installed, the walls and passages being too damp. On the lowest story a large transformer station has been built, measuring nearly 100 ft. x 50 ft., with a high vaulted roof (Fig. 9). The row of columns down the

FIG. 11.—STATION OF VINCENNES—PORTE MAILLOT LINE AT PLACE DE L'ETOILE

center are intended to support the rails for two traveling cranes by Rondet and Schorr, of 12 tons and 6 tons capacity, respectively. The foundations shown in the illustration are intended for rotary converters and static transformers, of which three sets are now to be installed. For temporary use one of these sets is placed in a shed at the opening of the eastern elevator shaft. Both the rotary and the transformers are built by Schneider & Company, Creusot. The former is supplied on the alternating side with six collector rings, and takes current at 430 volts from

three single-phase transformers fed from an incoming 5000-volt, three-phase line, giving on the direct-current side an output of 1000 kw at 600 volts.

In order to insure the service of trains at all times and to act as a regulator to the supply, two batteries of 250 Tudor accumulators are to be installed, with a capacity of 2000 amps. each for one hour. For the reception of these batteries two double rooms have been built, one above the other, with a floor area in each of the four sections of 72 ft. x 23 ft. The floor is covered with a special acid-proof bitumen, and has a gentle slope toward one end in order that any liquids spilled may run off into a drain. The ceiling of the lower rooms is formed by beams, but that of the upper rooms is carried around in a semicircle from the floor, being, therefore, 11 ft. 6 ins. in height.

The rooms which are to receive the hydraulic plant will be 40 ft. long by about 30 ft. wide, with a height of 18 ft. Here are to be three electrically operated pumps and pressure tanks for the elevator service. Connection with the sewers from this room is obtained by means of a shaft sunk 70 ft. below the floor level. Ventilation among the different chambers of this underground installation is pro-

FIG. 13.—EXIT OF CHAMPS ELYSEES STATION, SAME DESIGN AS ENTRANCE

vided by means of galleries extending in all directions, some being used to conduct the cables from the transformer room to the railway (Fig. 10). In this engraving it will be seen that a heavily insulated cable lies on the ground, this being provided temporarily to bring in the 5000-volt current from a power station at Asnières, in the northern part of the city, at present supplying the needs of the railway. The cables held in cleats are 550-volt supply wires passing up the inclined opening on the left to the railway tunnel, where connection is made to the third rail, by which power is delivered to the motors of the trains.

Returning now to the other stations along the route, Figs. 11 and 12 show two typical views, Fig. 11 being that on the through line from Vincennes to Porte Maillot. At the ends of the platforms are the stairways leading out and the foot-bridge over the railway. On the further platform is a railing surrounding a stairway which gives access to the galleries leading to the lower station. The entrance to the stairway is on the platform of the adjoining station. This adjoining station is illustrated in Fig. 12, in which a track is shown with a line of contractor's cars used in transporting earth. A good idea is obtained of the extent of these stations, the further end being lost in darkness, notwithstanding the powerful flash light used in photographing. This Trocadero branch of the Metropolitan system has not been put in service as early as the through line, although the intention was to provide special service for the Exposition. The real value of the railway, as far

FIG. 12.—INTERIOR PLACE DE L'ETOILE STATION, TROCADERO BRANCH

as it concerns the great show, lies in the facility it has provided for visiting the annex at Vincennes, an extremely interesting section, but little known by the general public.

The first stop after leaving the Porte Maillot terminal is at the Champs Elysées station, this being one of the principal entrances to the Exposition, close to the Palaces of Fine Arts and the splendid Alexander III. bridge. The illustration (Fig. 13) shows the style of entrance and exit, no structure being allowed, other than the signboard, to stand above the street level, except when the station is outside what may be called the select part of the city, as at the Bastille and beyond. The Champs Elysées station is graced on the outside by majestic lions on pedestals, but these adornments are actually part of the architectural

FIG. 14.—INTERIOR OF CHAMPS ELYSEES STATION, SHOWING EXITS

decoration of the Exposition gates leading to the two Palaces of Fine Arts, of which the larger one is visible in part. The interior of the Champs Elysées station may be seen in Fig. 14, which shows a decoration of French tricolor flags for the opening festival. In the distance the electric lights dotting the sides of the tunnel show the

curve of the line toward the Etoile, the absence of smoke allowing a clear view along the track. For the illumination of the station both arc and incandescent lamps are used, the current being taken from the power supply mains. The ticket office of this station is of the same type as those used throughout. Entrance is obtained by stone steps open to the sky, and the traveler is confronted with a notice requesting him before purchasing a ticket to get change at the bookstall, the agent being obliged to give his services in that regard free of charge. The tickets are of the ordinary size, made of pasteboard. Return tickets are issued for second-class only and are not available on the outward half after 9 a. m. The cost for single tickets is 5 cents a trip first class, 3 cents a trip second-class, and 4 cents return second class. The company operating the road under lease from the city (who builds it) does not appropriate all of this amount taken in, however, small as the fares are, but, in order to cover the interest on the city debt and other obligations, the company is required to pay 1 cent on every 3-cent or 4-cent fare and 2 cents on every 5-cent fare received, as well as a tax on the number of passengers carried beyond a total of 140,000,000 in one year.

FIG. 15.—VIEW IN TUNNEL PORTE MAILLOT—VINCENNES LINE

FIG. 19.—ENTRANCE TO BASTILLE STATION

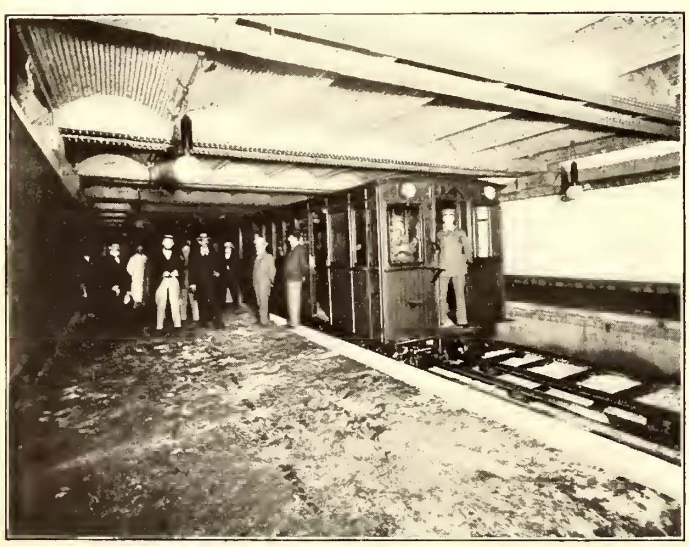


FIG. 16.—TRAIN IN HOTEL DE VILLE STATION

A view down the tunnel from this station (Fig. 15) shows well the general construction. For the track Vignole T-rails are used nearly 50 ft. long, weighing 106 lbs. per yard, and for the conductor a third rail, double headed, weighing nearly 79 lbs. The track rails are laid on metal ties 7 ft. 2½ ins. in length, spaced about 36 ins. between centers; every third or fourth tie is 6 ins. longer on the inner end, and carries the insulator for the third rail, which consists in a cast iron chair supported on two iron pins fitted to an iron base insulated by wood and protected by overhanging flanges on the chair.

The Hotel de Ville station is one of the most important, being situated within the busiest portion of the city. Fig. 16 shows a train in this station and on the platform some of the railway company's engineers. The ordinary train is composed of one motor car and two trailers, but three trailers are used when the traffic becomes heavy. The cars, to which reference will be made later, are first and second-class, and combination first and second; all the motor cars are second-class. The trains are run at intervals of a few minutes, and Dardaud's electric block system is about to be put into service, operating automatically. The signal is on the tunnel face, as seen in Fig. 7, and the wires leading to the further connections are clearly shown in the previous figures.

The Lyon station (Fig. 17), already mentioned, is likely to have extensive patronage. A desire on the part of the railway company to avoid accidents during rush hours has probably prompted the posting of the notice, "Attention aux 3 marches!"—"Look out for the three steps!"—which greets incoming passengers from the bright light of the street, who otherwise might fall in their hurry to reach the train. From the platform below there may be seen (Fig. 18) at the western end of the station a blank wall having the appearance of a tunnel bricked up and plastered alongside of the actual tunnel through which trains are continually passing. This is where the belt line will join the present line at some future day, and, making use of the same tracks for a distance of about a mile, will leave again at the station of Place de la Nation to continue a northerly course. The Lyon station has two sets of double tracks, one for each division.

The Bastille station, being of necessity built over the canal, is more in evidence than any other part of the railway system. The entrance is from the square, and the bridge over the tracks is on this level, together with the ticket office. It is a pleasing contrast to find a stopping place above the surface of the ground, and the station is decidedly airy and bright. We have already spoken of the

sharp curves rendered necessary at this point, and the photograph taken along the platform (Fig. 20) shows the bend of the tracks as they enter the tunnel. The rails also show distinctly in the bright light. It will be observed that the joints are not opposite, nor do they alternate with regularity, but they are placed nearly opposite each other. Long copper bonds ½ in. in diameter unite the track rails, passing over the fish-plates; the third rail has short, flat bonds.

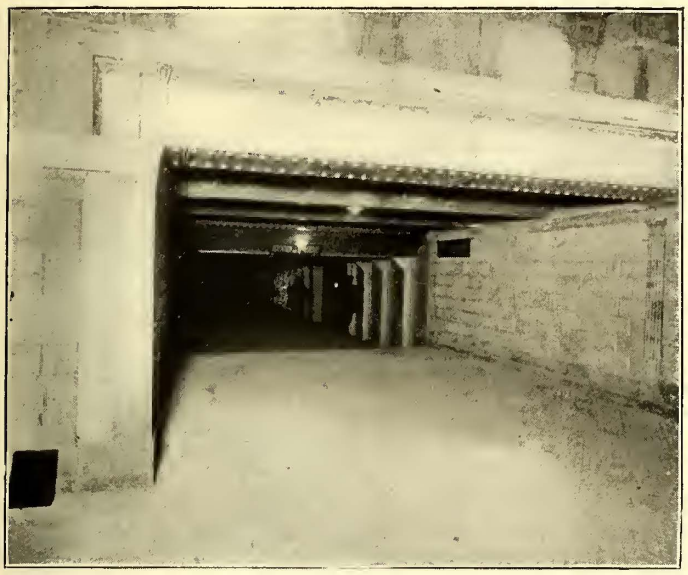


FIG. 17.—ENTRANCE TO LYON STATION

FIG. 18.—TUNNEL AT LYON STATION

The photograph of the Vincennes station (Fig. 4) is taken on the departure platform. It will be remembered that a separate station is built to receive incoming trains, two tracks being used in each case, one on either side of the platform, and the two stations are identical in design. Beyond the stairway the two tracks join and pass by way of a narrow tunnel to the other station. The platforms are of sufficient length to permit of two trains standing on each side, thus allowing of convenient storage. At this end of the line, however, there has been provided a car house, to which a branch line is run from the loop between the stations. The accompanying engraving (Fig. 21) shows the building in course of construction, and the yard outside, which will be laid with tracks, accommodating 150 motor cars and trailers for the present. The first order for motor cars called for forty-six, and at the time of starting the road there were twenty-two delivered, twelve being furnished with controllers at each end, so that they may be run in either direction, and ten having a single controller. The single-controller cars are intended for use on those sections of the road where loops are used at the terminal stations, as there is then no necessity to provide for running backward, and the double-controller cars may be used when switching is resorted to for changing the direction of travel.

One of the double-controller motor cars is shown in Fig. 22 standing in the yard of the car house. A steep incline communicates with the Ceinture Railroad above, where some car bodies may be seen on the freight cars ready for unloading. The motor cars, 29 ft. 6 ins. in length, are furnished by the Ateliers de Construction du Nord de la France, whose factories are at Blanc-Misseron (Nord). Double frames are provided, one to support the car body and one for the truck, this design allowing the removal of the upper portion without interfering with the lower. The trailers, however, supplied by the Franco-Belgian Company, of Raismes, have but one frame, painted black, while the upper frame of the motor cars is painted red, in order to make them more readily distinguished by train

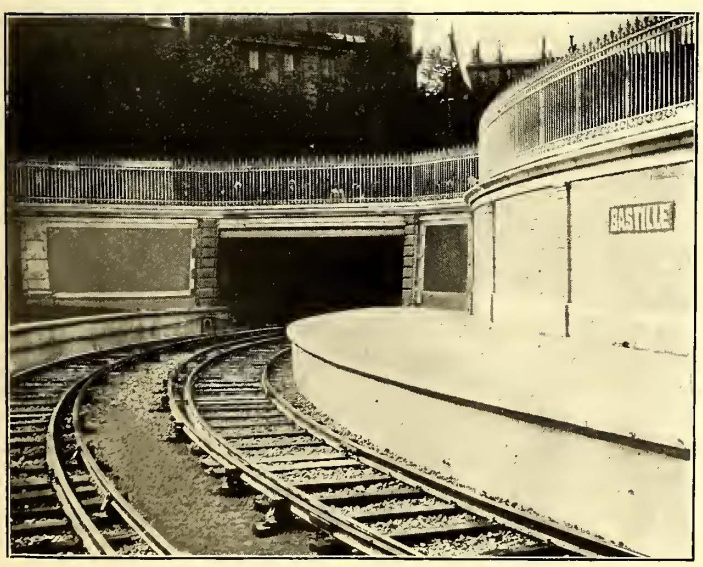


FIG. 20.—BASTILLE STATION, SHOWING THIRD RAIL

FIG. 21.—INTERIOR OF VINCENNES CAR HOUSE

hands and perhaps to give some brightness to the front of the train. Both these car factories are close to Valenciennes, in the Department Nord of France. The car

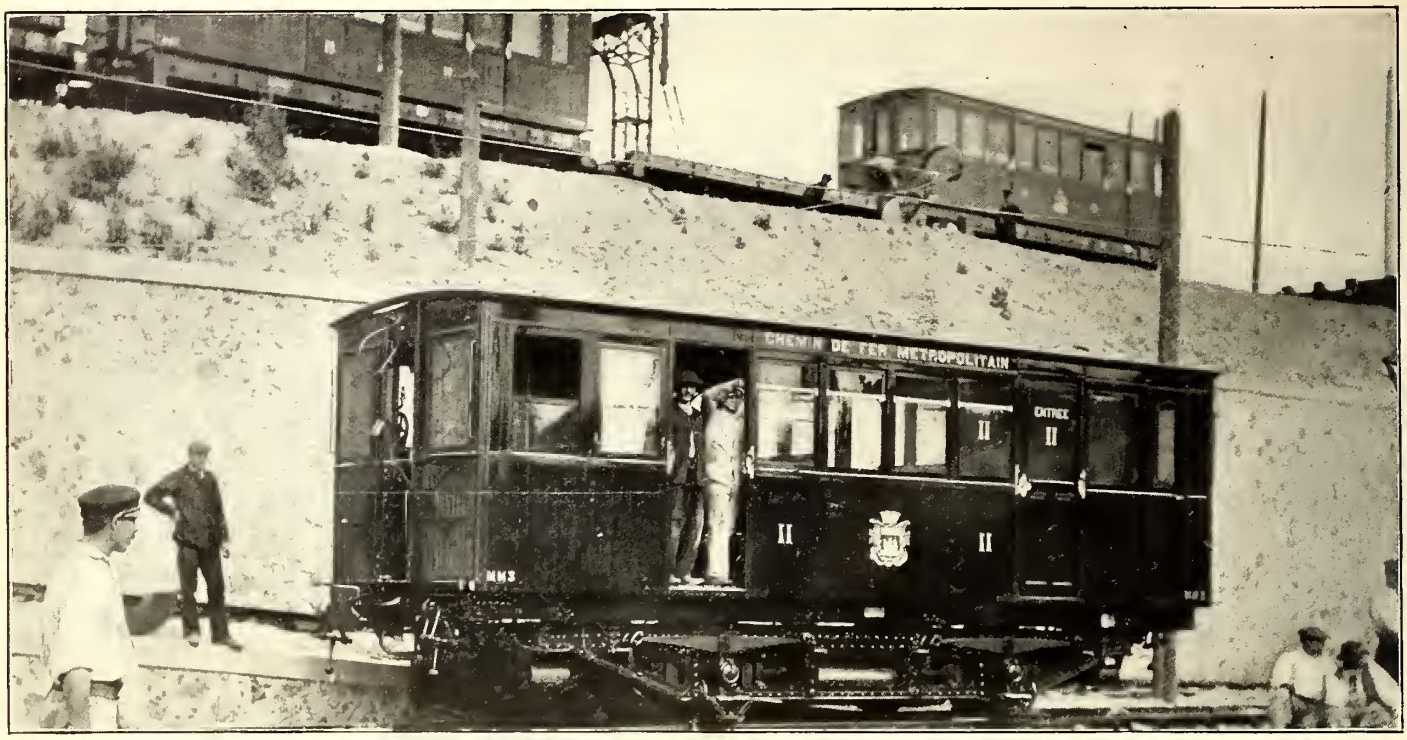


FIG. 22.—DOUBLE CONTROLLER MOTOR CAR

wheels are of forged steel, made by Baume & Marpent, and have a diameter of nearly 33½ ins.

The Metropolitan Railway Company is to be congratulated on its choice of motors, as there is no doubt that its selection of Westinghouse material in this respect has eliminated from the railway system all possibility of breakdowns, besides providing thoroughly reliable and substantial apparatus whose value will be more appreciated as repair bills are found to be low. In some other directions the railway company is perhaps not so fortunate, but is possibly desirous of assisting home enterprise.

The motors supplied by the Westinghouse Company are of 110-hp type, No. 70, two motors being provided for each motor car. In a short compartment at the end of the car is the fine large controller, of the new standard 98-A. type. In the roof above is an automatic circuit breaker, car type, and on the other side, against the partition, a toggle-joint fuse box carrying a copper wire fuse which is replaceable in a moment if burned out, and which may be easily removed if it is desired to open the circuit to prevent tampering. A Wurts lightning arrester is placed alongside the fuse box, of the ordinary form for cars.

All the above apparatus is by Westinghouse, but the air brakes are of French make. They are made by Soulerin, of Paris, and air compressors and motors are furnished by Amelin & Renaud, also of Paris. These motors, of the spherical ironclad type, are connected by gears to the compressor, which has two cylinders 90 degs. apart, and supplies air to a reservoir in which the pressure is kept at about 65 lbs. per square inch. The output of this motor is only 1½ hp, which is rather low.

Contact to the third rail is obtained by means of two shoes of the ordinary double-link form. In the car depot an overhead construction is used, and it will be observed that two wires are used, on which a four-wheeled carriage runs, passing through the loop-shaped supports. A cable from this carriage is fitted with a plug, which may be pressed into a socket on the motor car, providing by this means a connection to the controller and motors.

The motor cars are lighted by eight lamps of 16 cp, and two lamps on the outside of the cars at the head of the train. Also in the small vestibules at the end there are lamps which may be switched in, instead of one of the interior lamps. The trailers also carry ten lamps.

The start of the line was made with twelve trains of three cars each; one motor car, one first and second-class combined, and one second-class. The motor cars are all second-class, and carry twenty-eight passengers, seats being provided for twenty. The seats are back to back, some accommodating two persons, or three, and some being narrow seats for one person only. Plenty of room is provided in the middle of the car, with the object, it is

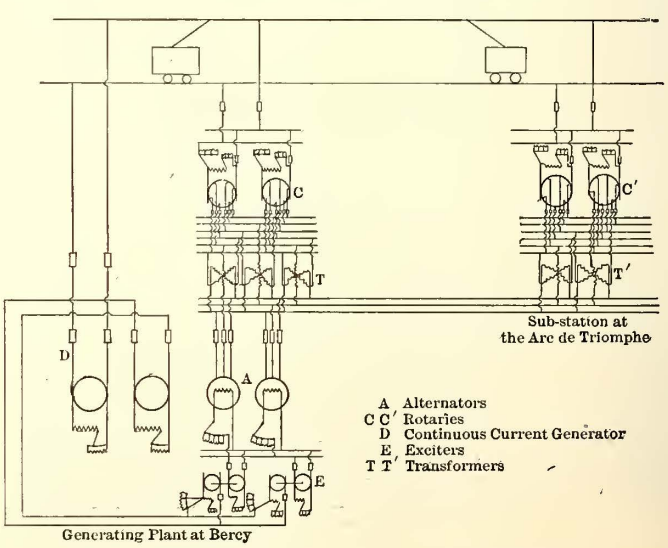


FIG. 23.—SCHEME OF ELECTRICAL DISTRIBUTION

said, of facilitating circulation. It has been said that only twenty to twenty-five seconds will be allowed for stops at stations, but, while this may seem a very short time to the French mind, it is about double the time usually required

on the London Underground Road, except on occasions of heavy traffic.

The power station which is to supply current for the Metropolitan Railway is in course of construction. The site is near the Lyon station on the banks of the Seine at Quai de la Rappé. The equipment of this station will include three batteries of six boilers each; one 1500-kw direct-current, 600-volt engine and generator; three 1500-kw three-phase, direct-connected engines and alternators delivering current at 5000 volts and 25 cycles, and rotaries, exciters, storage batteries, etc. Under ordinary circumstances the direct-current set will be used to supply the line in the immediate neighborhood of the station, but, if necessary, power can be taken from the alternating-current board. At present there are only two sub-stations. The scheme of distribution is shown in Fig. 23. The boilers at the main station are of the semi-tubular type, and will supply steam at 142 lbs. per sq. in. The engines are vertical, compound, condensing, though capable of working with free exhaust, and are fitted with Corliss valve gear. Their cylinder dimensions are 1800 mm and 1100 mm x 1500-mm stroke (70.9 ins. and 43.3 ins. x 59 ins.); each engine is fitted with a fly-wheel weighing 63,000 kg (138,600 lbs.), and operates at 70 r. p. m. The rotaries at the sub-stations are of 750 kw capacity each. A section and plan of the main station are given in Figs. 24 and 25. Fig.

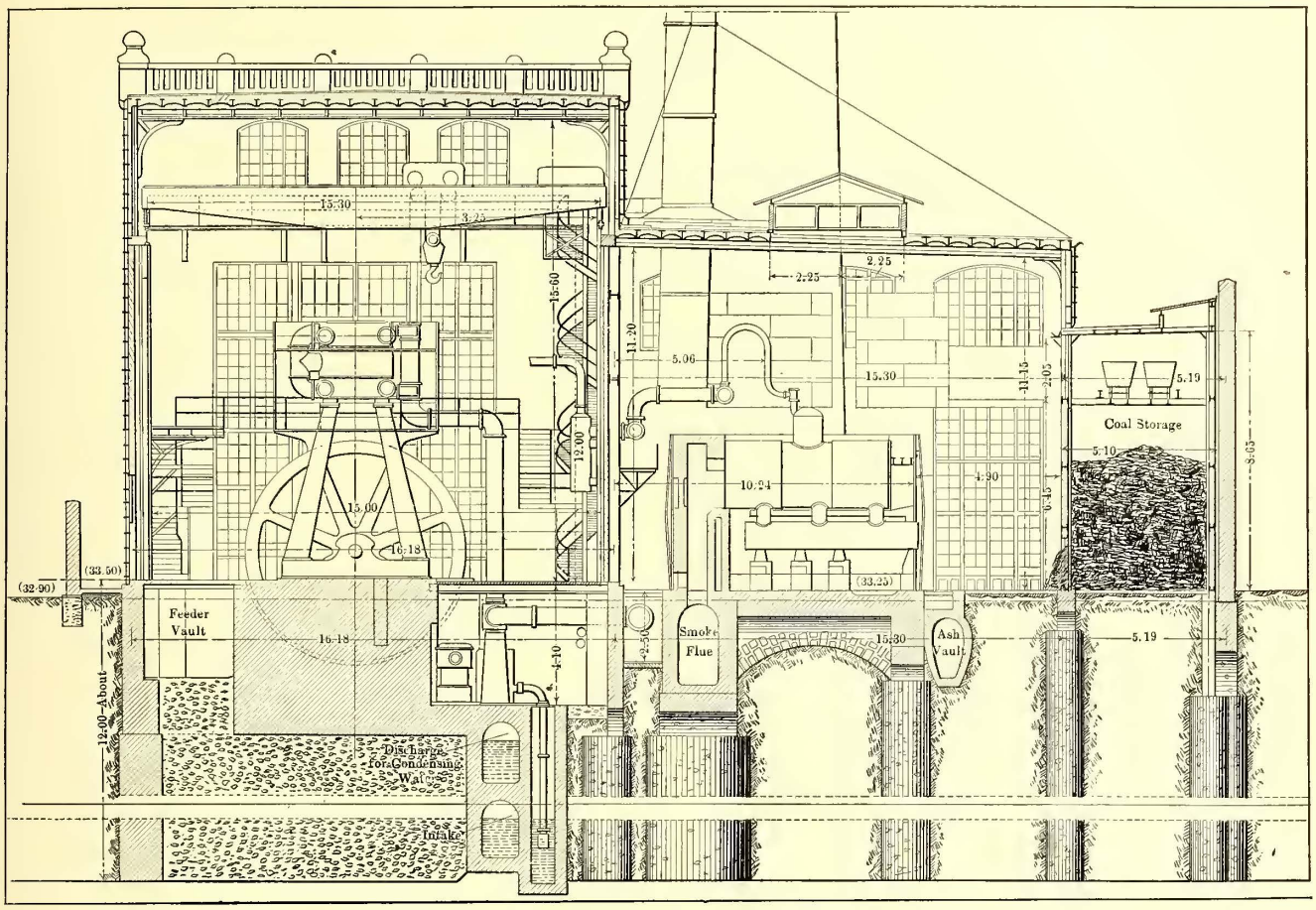


FIG. 24.—TRANSVERSE SECTION OF POWER HOUSE

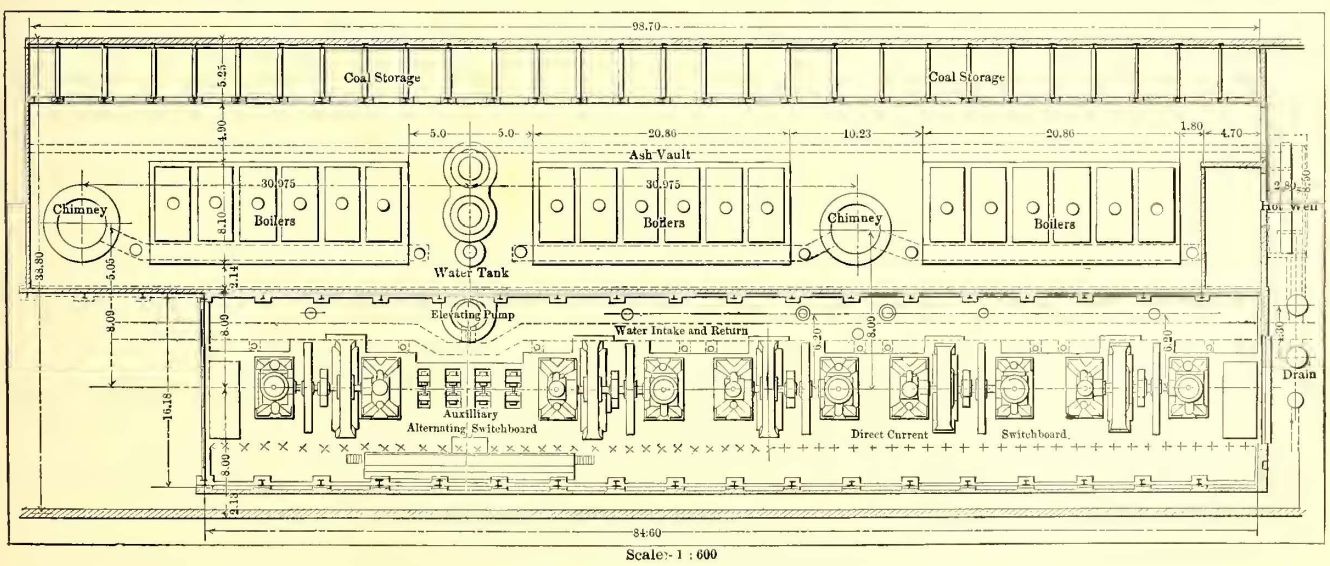


FIG. 25 —PLAN OF POWER HOUSE

26 shows the exterior of the station. The whole station outfit is to be provided by Schneider & Company, of Creusot.

One of the chief reasons that the Parisians in general were not aware of the extent of the subterranean work going on was that so little surface activity was visible. The reason for this was that arrangements were made for transporting the excavated earth by tunnels to the river. Four such tunnels were built, one at the Avenue d'Antin, above the Champs Elysées station, another at the

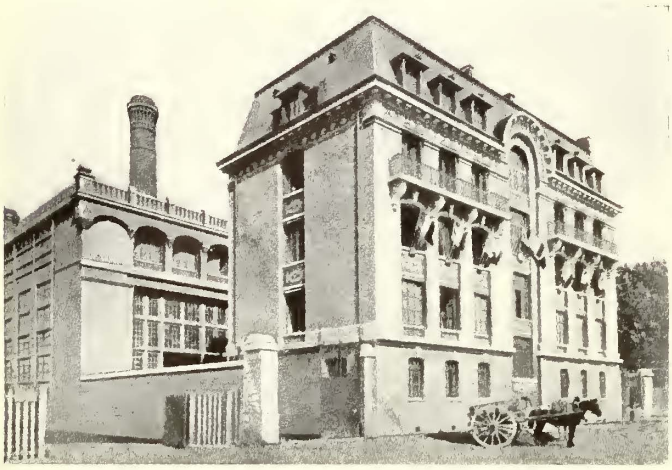


FIG. 26.—EXTERIOR VIEW OF THE POWER HOUSE

Place de la Concorde, another at the Louvre station, and another close to the Hotel de Ville station. By this means the streets were kept clear of an endless succession of carts loaded with earth, and the process of excavation could be pushed more rapidly to completion. This comprised the sections between the St. Paul station and the Champs Elysées. Near the Bastille the earth was removed by canal-boats, for the remaining sections of the line convenient points were selected, from which loaded carts could be sent to the river without seriously interfering with regular street traffic. Such points were at the terminal stations of Porte Dauphine and Porte Maillot, the Place de l'Etoile, Gare de Lyon and Place de la Nation. Nevertheless, as soon as the tunnels could be laid with rails a great part of the transportation of excavated earth was directed to the special tunnels, even from a distance.

The engineer in charge of rolling material and electrical equipment for the Metropolitan Railway Company is Henri de Grièges, who has seen a great deal of American practice in extended visits through the United States. The general director of the company is Mr. Maréchal.

The Westinghouse Company has a capable and experienced engineer in Philip Salberg, who has been superintending the setting up and operation of the material furnished by them. Mr. Cocquillot, road foreman of electrical equipment for the Metropolitan Company, has contributed largely to the initial success of the undertaking by careful and conscientious work in the important position which he has filled.

Electric Railway Possibilities in the Philippines

BY G. D. RICE

Better transportation facilities in the form of electric lines are urgently required in the first and second class cities of the Philippine Archipelago. The writer has visited most of these cities and has talked with the leading merchants of Manila and Iloilo and other cities, and the universal opinion is that such lines will pay well. American enterprise and push are securing a hold, and the largest towns, especially the two cities mentioned, are rapidly becoming Americanized. Nearly all other cities in the Orient, many of them smaller than these two cities, have already street railway lines in successful operation, and new ones are being built, and it will only be a question of time when the electric car will be as familiar a sight in the principal cities of the Philippine Islands as it is in the United States.

The conditions in the cities mentioned in these islands have greatly changed during the last few months. New business houses have opened in large numbers in the outskirts of the cities, while many private residences have been erected by persons who have been driven in from the interior by the recent wars of the guerilla bands. The territory covered by Manila and Iloilo, which, like other Oriental towns, is very large, has become greater than ever before, and the indications are that the expansion will be greatly increased before the close of the present year, for there are many contracting firms at work putting up business houses, factories and private dwellings. At the present time the working classes are obliged to walk or hire carremettas or bull cars, and as most of the workers get only about 20 cents a day, it will be seen that they cannot afford to hire expensive traveling outfits. The only street car line in Manila now is operated by animal power, the stunted native horse being employed. Only a few cars are run, and these at long intervals. These cars, however, are filled to the point of overflowing by the natives, so there is no chance for the ordinary traveler to get on. The road need not be considered as a factor in the traffic of the city, although it might be used as a basis upon which to establish a modern form of railway line. In Iloilo there is no street car line, but instead there are lines of busses and carremettas. These do a good business, but cannot begin to accommodate the people who desire to travel.

Owing to the fact that most of the streets in Manila are very narrow, special plans in the establishment of an electric system would have to be adopted. There are a few main thoroughfares which are broad enough for all practical purposes, but such streets are few compared with the narrow ones. These narrow streets are going to interfere with the improvement of the cities of the Philippines for many years, and possibly until the streets are widened by tearing out alternate blocks. Only the shortest cars can be employed in these narrow streets, and probably a narrow gage would have to be adopted, as in many of the European cities. The sidewalks are also narrow, and in many cases the span wires will have to be attached to the buildings on each side of the streets. In Iloilo a standard gage road can be used, and the suburbs of Manila are also suitable for standard gage tracks. The streets in both cities are crowded not only with vehicles, but with pedestrians, who walk in the streets. This would interfere to a considerable extent with the speed attainable, but it seems to be the general opinion that if an electric line were built much of this traffic would be diverted to it, and that the effect would be to reduce considerably the street congestion.

An advantageous condition for the construction of lines in these islands is the fact that stone for ballast can be secured very cheaply. There is found here in the mountainous sections of Luzon and Panay vast quantities of so-called sandstone, which not only makes a good ballast, but is an excellent building stone. Many of the churches and bridges in the islands have been constructed of this stone, and it has been found very desirable. Taken altogether the outlook for electric traction in the Philippines is exceedingly good.

The First Five Years' Experience in Maintaining the Niagara Gorge Railroad

BY GEORGE A. RICKER

Some æsthetic souls, whose observations concerning Niagara Falls Mr. Slicer has compiled in "The Niagara Book," doubtless held up their hands in horror at the mere suggestion of building a railroad in the Gorge of the Niagara, but I do not believe they can harbor resentment against us, for the tracks hugging the shelf at the foot of the great cliffs and winding their way beside the waters look for all the world like toy tracks that embryo engineers in their childhood build, with cars running slowly up and down, seeming no larger than the plaything trains they used to wind and watch with breathless interest in their perilous career across the floor. These good people failed to appreciate the depth of the canyon, and rightly feared the destruction of its beauty. It was indeed inevitable that the appearance of the Gorge should, for a time, suffer by the operations of building, as displacing the foot of the slope in excavating for the roadbed meant that its equilibrium would be disturbed, that slides would take place and carry with them some of the vegetation which covered the talus. A year or two sufficed to re-cover these bare spots with shrubs and vines, that, growing in such luxuriance, when viewed from the highlands above seem like landscape gardens, blending with their varied foliage the deep tranquil blue of the skies with the snowy white and brilliant greens of the rapids below. All lovers of Niagara, and surely those who entertain feelings of special admiration for the Whirlpool Rapids, must, it seems to me, take pleasure in the keen delight of the eager throngs that view the splendid panorama of the Gorge from the vantage ground of the new road. Before the railroad was built but little could really be seen of this wondrous spectacle. At a few points only visitors could get narrow glimpses of the tumbling waters, from stairways and crevices in the cliffs; now the whole river from the Falls to the silent depths at Lewiston can be seen and enjoyed.

While it is not known who first conceived the idea of building the railroad in the Gorge, it is certain that two well known Buffalo men, Benjamin Fenton and Ensign Bennett, were the first to actually undertake the difficult work. It was their intention to build a road from the Maid of the Mist Landing in Prospect Park to the Whirlpool, with narrow-gage tracks, to be operated by steam, for it must be borne in mind that even so recently as 1886 an electric railroad was not practicable. The opposition met by these gentlemen from vested interests was so great that they finally abandoned the work.

In 1889 another prominent Buffalonian, Captain J. M. Brinker, purchased the franchise of the Whirlpool Company, and reorganized the enterprise under the name of The Niagara Falls & Lewiston Railroad Company. The line was continued beyond the Whirlpool through the Gorge to the village of Lewiston, where connection was made with the New York Central Railroad and with the steamers for Toronto. At the Niagara Falls end of the line the location was changed to ascend the talus, and by climbing the high bank the city of Niagara Falls was reached, where connection was had with the other railroads reaching that point. The courts sustained the new company, as they had failed to do the Whirlpool Company, granting to it the right of eminent domain. From this time rapid progress was made in securing the necessary right of way, either by purchase or by condemnation.

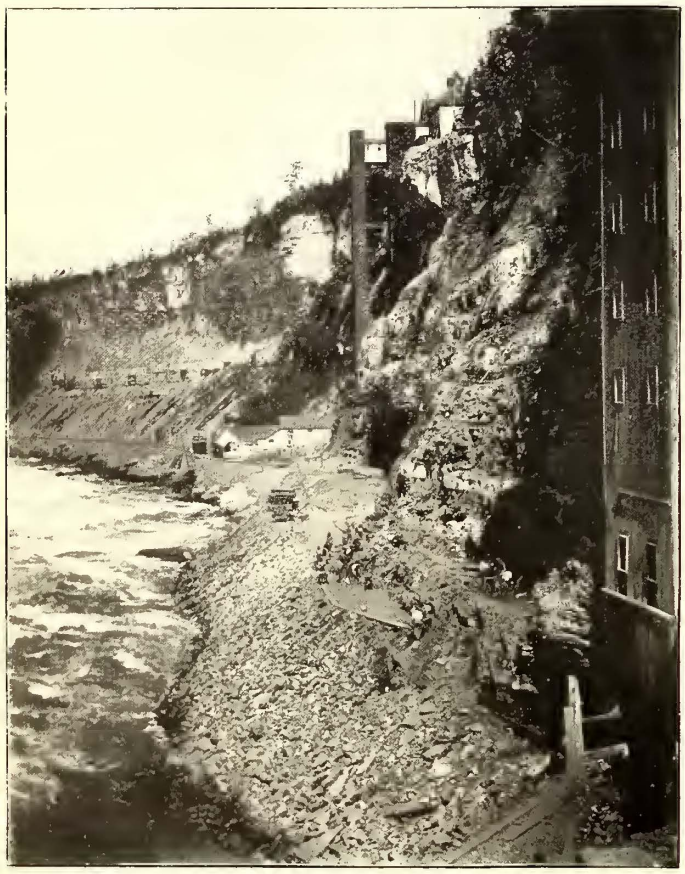
Probably no more difficult railroad survey was ever attempted than this. The slopes, which from the uplands seem to be covered with soft verdure, and to present no great obstacles to progress, were found to be at close range almost impenetrable jungles of underbrush. Shrubs and trees in countless varieties were intertwined and bound together by the wild grape vines, grown to such density and strength as only the wild grape can, when undisturbed for many years. Much trouble was experienced in the insecure footing, as nicely balanced rocks of great size would roll down the slopes, crushing everything before, from the weight of a man climbing over them. The work of the survey was hazardous in the extreme, for not only was the vegetation dense and the footing insecure on the talus, but for a distance of about one-half mile below the railroad bridges, nearly vertical cliffs extended from the Highlands to the rapids below. At several points in this section men from the engineer corps were lowered over the cliffs and flags placed on projecting ledges where they might be seen from the top of the bank on the Canadian side. Base lines were established on Canada's side of the river, from which the flags were located by triangulation. Beyond this section, and continuing to Lewiston, the line was run following the curving bank of the river, and as nearly as possible 20 ft. above the average water level. Just before undertaking this survey I had returned from railroad location in the Rocky Mountains, and was imbued with the idea

BEGINNING WORK ON TALUS NEAR LEWISTON

that nothing in this part of the world could equal the difficulties I had met in the canyons of the Rockies. After locating the Gorge road my views have been substantially modified, for, although the cliffs of the Western canyons exceed many times in height the walls of the Niagara, nowhere are there to be met the difficulties inseparable from the tremendous forces working in the Niagara rapids.

Construction of the road was begun on April 11, 1895, by Crage & Tench, contractors, of Buffalo, who furnished men and tools and their services, for 10 per cent of the force account. Beyond a profile, which it was found impracticable to follow, no detailed plans had been made since the survey. The method adopted in building was aptly described by one of my rodmen, when he said, "It was by main strength and awkwardness." My orders were to build a railroad in this unpromising place, and I proceeded forthwith to obey. Had classification been attempted, two kinds of material would have been named: loose and solid rocks, as the talus is made up of large and small stones with not enough earth to fill the interstices, and no cementing material, although the roots of dense vegetation helped to hold in place and maintain a much steeper slope than would otherwise have been possible. The deep channel of the river afforded the very best place for wasting the material excavated, and work proceeded rapidly. From 600 to 1000 men were employed, and the

first 5 miles roughly completed; one track laid, and the work train reached the southern terminus Aug. 25 of the same year. On the inner side of the roadbed a slope was formed that would stand for the time being, which meant that heavy rains and the frost in the coming spring would bring down large quantities of material left on the steps above. Crossovers were placed at such point as seemed to threaten, and from time to time as slides occurred the road was operated with single track in section, and large numbers of men quickly removed the encroaching talus.



THE OLD BUTTERY ELEVATORS AND CLIFFS WHERE VERTICAL ROCK CUT OF 100 FT. WAS MADE. LOOSE ROCK, SHOWN BY SLOPE, WASHED AWAY NOW

Several large slides took place in the early part of 1896 and again in 1897, but the quantity decreased each year until the spring of 1899, when but trifling amounts of earth and stone were found after the frost had come out of the ground, indicating that a condition of stable equilibrium had been reached. The slopes are now fully covered again with vegetation, and have taken on their former appearance of stability and beauty. Many culverts were necessary in this lower section of the road, but fortunately few bridges were required. Near the village of Lewiston a small stream in a deep gully, running into the river from the foot of the Lewiston escarpment, is crossed by a timber trestle 124 ft. in length, and 42 ft. high. Two miles further up the line is a 70-ft. decked span latticed girder over a gully, formed by another lateral stream, into which for years the New York Central Railroad, which is located about 150 ft. above us, has wasted its surplus earth and rock. These two bridges are the only structures in the lower 5 miles of the road, and the wooden trestle will be replaced in the coming winter by a steel viaduct. The latticed girder bridge put in last summer replaced the earlier wooden structure. The tracks for the entire length of the road are ballasted with rock borrowed from the talus; no crushing was necessary, as in many places clear slides of small stone, not much larger than ordinary broken stone ballast, was found, furnishing an almost unlimited supply of excellent ballast. The ties are of cedar, except on the steep grades, where oak was used, and all are of the standard steam railroad sizes and spacing. The rails were rolled by the Carnegie Steel Company, weigh 60 lbs. to the yard, and are of the "American Society" section, No. 110. No attempt was made at mathematical alignment, as the roadbed followed the irregular outline of the natural slope. None of the curves is at all sharp for the slow rate of speed required by the schedule, and all that are less than

ONGIARA POINT, VIEW TAKEN DURING SURVEY

300 ft. radius are protected with guard rails. A timber guard extends the entire length of the road outside of the outer rail.

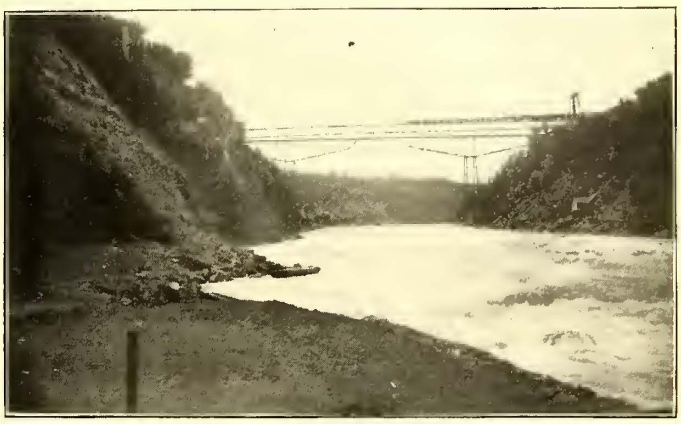
Construction of the upper section of this railroad, beside the rapids and to the top of the high bank in Niagara Falls, was much more difficult and tedious. South of the old Buttery Elevator, at the terminus of the first year's work, began almost vertical cliffs, extending from the top of the escarpment to the seething rapids below. Drills and men were lowered over the cliffs to the first ledge, about 100 ft. above the grade line, and blasting operations carried on mostly by hand. The blasts were fired usually at noon, when hugh quantities of rock were thrown into

ONGIARA POINT, VIEW TAKEN AFTER COMPLETION OF ROAD

the river, disappearing beneath the tumbling waters of the rapids, without seeming in any way to obstruct the stream or to change in the slightest degree the curve of the waves. The vertical cutting averaged nearly 100 ft., and estimated roughly, 100,000 cubic yards of rock were thrown into the river from this one-half mile of line. At the site of the old Van Horn elevator, about one-fourth of a mile below the railroad bridges, in a deep recess in the cliff, an attempt was made to construct the roadbed in the swift current of the rapids. This experiment I believed would be futile, as a powerful stream of water was constantly discharged

upon the new embankment, diverted from the main current by a large boulder, about 50 ft. from the cliff. It was evident that this bed had been excavated by the same powerful agency, and it was but waste of time and money to attempt to place in its way any structure less substantial than the cliff, which it had cut out. I speak in some detail on this point, as it has since proved to be one of the most difficult parts of the roadbed to maintain. During a period of high water in the spring of 1897, when the river rose 19 ft.

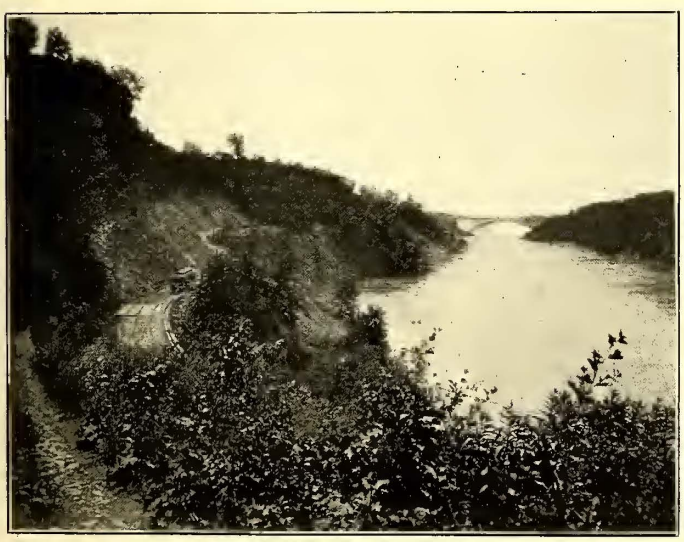
GIANT ROCK ON LEFT, DEVIL'S HOLE RAPIDS ON RIGHT. VIEW TAKEN DURING CONSTRUCTION



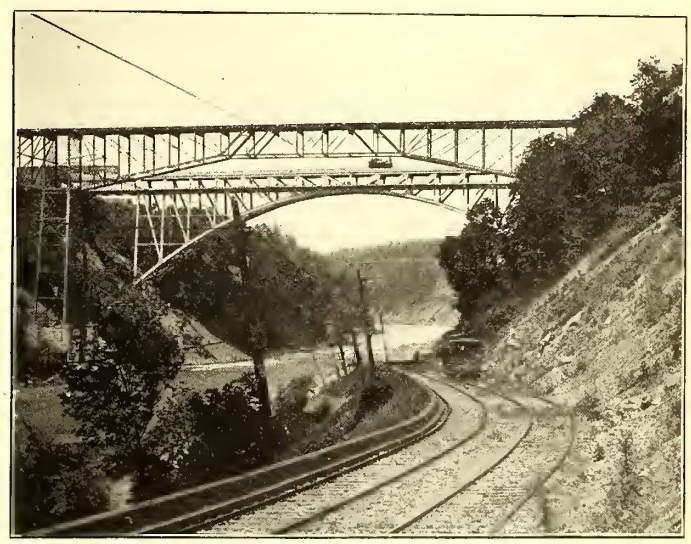
ALMOST VERTICAL CLIFFS, MOST DIFFICULT PART OF SURVEY. VIEW TAKEN JULY, 1886

above its ordinary level, some of this embankment was carried away. A substantial crib of large timber, which replaced the embankment, was in turn washed out in 1898, after which the company determined to do what it might profitably have done at first, and the cliff was blasted away and a shelf made of sufficient width for a single track.

During the early part of the summer of 1899 the old Niagara Falls & Lewiston Railroad Company became seriously embarrassed, and its property passed into the hands



THE LONG GRADE. FALLS IN THE DISTANCE. VIEW TAKEN AUGUST, 1899



FINISHED ROAD, CANTILEVER AND NEW STEEL ARCH BRIDGE VIEW TAKEN AUGUST, 1899

of a new corporation, at the head of which, as president, is General Francis V. Greene, of New York, and as vice-president, Herbert P. Bissell, of Buffalo. These gentlemen and their associates, after thoroughly reorganizing the enterprise and placing it upon the most substantial financial basis, proceeded to the practical reconstruction of the entire road. Operation in 1899 was not begun until July, when most of the work was finished. The talus having, as I have already said, been reduced to a condition of stability, the greater part of the work consisted in protecting the embankment from erosion by the rapids. The general method followed is best described as "enrockment." This consists in riprapping or paving the slopes with very large stones. To accomplish this a specially constructed flat car, carrying an electric derrick, was built, and has been in constant use for several months. Two men operate this car, and as many additional as are necessary assist in taking out the stone and replacing them in strengthening the embankment. Long stretches of the outer slope have been thus protected, and this work will proceed until all exposed surfaces will be entirely covered in the manner described. At the bay referred to, where the original embankment was washed away, the river from the ledge or shelf on which the inner track rests as before described, has been filled with large stones out to the great boulder of Niagara limestone, and these stones are so arranged on the outer side as to present the appearance of being carefully paved. Protection for the second track has thus been provided, and the substantial character of this enrockment is such as to resist for all time, in my opinion, erosive action of the waters. Beneath the cantilever steel arch bridge the tracks are gauntleted, passing over two latticed girder spans in front of the bridge piers. The total width between the faces of the cantilever footings and the deep waters of the river was but 13 ft., and a single track was therefore unavoidable. This is the only point upon the line where the road is so contracted and operation is carefully guarded by stopping approaching cars by the use of suitable signals, and a watchman constantly on duty.

From the bridges to the top of the high cliff, a distance

of nearly a mile, the average gradient is 4.7 per cent, the maximum 6.4 per cent, and the total elevation overcome is just 200 ft. Continuing beneath the New York Central's five tracks the line sweeps sharply to the right on a curve of 50 ft. radius, the sharpest on the line, and from thence parallels the Central for a few hundred feet, reaching Second Street in Niagara Falls, where connection is made with the tracks of the Niagara Falls Street Railway. The views herewith show stages in the progress of the work, and were taken by Mr. Arnold.

Operation of the Niagara Gorge Railway is continued from the first of May of each year to the first of March of the following year. March and April, I may state positively, are the only months when the loose material from the cliffs falls upon the slopes of the talus. This is, of course, when the frost is coming out, and small stones which have been wedged out by the ice are loosened. Since beginning operation of the road in 1895 to the present time, no passenger or employee has ever received injury from falling rocks. I was daily over the road during its construction, and have many times since passed from the Falls to Lewiston and return on cars or on foot, and have never seen a rock fall. It is my opinion that with due care, and such is most certainly maintained by the present management, the maintenance of this railroad need not be excessively expensive, and that the same safety of operation can be obtained as is secured on any mountain railroad.

Since the acquisition of the railroad at the top of the bank on the Canadian side by the International Traction Company and the reconstruction of the Suspension Bridge at Lewiston, a belt line has been in operation, over which cars of the Niagara Gorge Railroad Company pass, starting from Niagara Falls, and going to Lewiston by both railroads, making the trip down the Canadian side across the Suspension Bridge and up the Gorge; and also in the reverse direction. The extraordinary beauty of the scenery from the commanding heights on her Majesty's side of the river, combined with the grandeur and wondrous effects of the rapids, which Hawthorne describes as "an impetuous river of snow," affords to the traveler an experience which is at once unique and impressive beyond power of words to describe. The river is itself so fascinating that I am loath to leave it for other scenes, but that the public appreciates the belt line is shown by its generous patronage.

The report of the passenger department of the Gorge route for the month of July, just passed, shows an increase of 35 per cent in passengers carried over the corresponding month in 1899 and this, in spite of the recognized fact that this year at Niagara Falls has been so far a dull one. The managers of all other attractions complain of the scarcity of people at the Falls this year, but the Gorge route is prosperous, and its management well satisfied with the showing of the road.

A new feature has been added to the attractions of the Gorge by illumination of the rapids at night. Trains are made up at the Falls, and run to the rapids, where an hour or more can be spent in contemplation of the beautiful spectacle, the lamps are hidden from view, and their rays projected over the waves by reflectors, so arranged that the illumination is most effective. In addition to the arcs, a large searchlight, mounted on a flat car, takes position some distance below the observation platforms, while its powerful beams are thrown against the waters and screens of green and yellow interposed, producing most beautiful effects. The roar of the waters against the walls of the Gorge, the depth of the canyon in the darkness of the night and the frowning cliffs above produce upon the onlooker a feeling of awe and fascination. I am bound again to refer to Mr. Howell's eloquent tribute to the rapids, whether viewed by the light of day or the moonlike glow of the artificial illumination, I must agree with him that "I had schooled myself for great impressions * * * but I had not thought of the rapids taking me by the throat, as it were, and making my heart stop. I still think that above and below the Falls the rapids are the most striking feature of the spectacle."

The Early Wichita Electric Railway, Built in 1887

BY T. C. HUGHES

During the summer of 1885 the writer became acquainted with Dr. A. W. Adams, of St. Louis, Mo., who was at that time making some experiments in the propulsion of cars by means of electricity. His efforts had resulted in the production of a design which was considered by the parties interested therein to have met all difficulties in motor mounting. The method adopted in mounting the motor on the car is clearly shown in Fig. 1. Making arrangements to acquire a territorial right in the invention I started out to find a place and the capital to equip a full sized road with the system.

This quest landed me, during the summer of 1887, in Wichita, Kan., where I obtained the ear of J. O. Davidson, then president of the Citizens' Bank of Wichita. With him

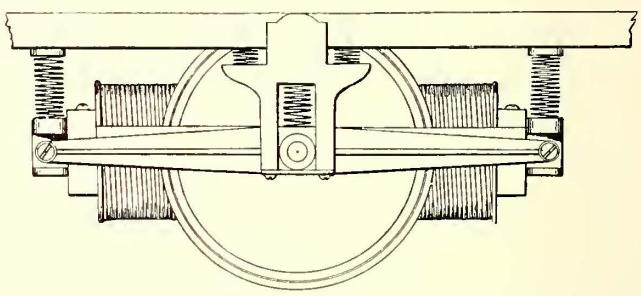


FIG. 1.—METHOD OF MOTOR SUSPENSION

and his associates I made a contract to build and equip with three cars some 5 or 6 miles of single track and switches, over a route commencing at Market and Douglass Avenue, then running north on Market to Riverside, thence west across the little Arkansas River to Riverside Addition and the Wichita Driving Tracks. From here the road extended north and west 3 or 4 miles through several new additions.

The work was commenced and carried forward both at St. Louis and in Wichita. The track was of 40-lb. Johnson girder rail, laid on ties and ballasted in the down-town portion.

A frame boiler and engine house, 40 ft. x 60 ft., contained two horizontal tubular boilers of 100 hp capacity each, a horizontal high-speed Smith, Beggs & Rankine engine of 100-hp rating, and a Brush generator, having an output of 60 amps. at 1000 volts approximately. The construction of the balance of the apparatus for the electrical equipment was in charge of W. L. Seddon, of St. Louis. The track work, power plant, etc., which was directly under my charge, progressed much faster than the manufacture of the electric machinery, and as the Wichita owners were pushing us for completion of the road within the time limit of the contract, many changes were made in the plans to procure the electrical machinery on time.

As many features of the construction were rather novel, and as no description has ever been given of them, I hope the following particulars relating to the details of this en-

terprise will prove both profitable and interesting history to the readers of the STREET RAILWAY JOURNAL.

The trolley wire was a hollow copper tube, $\frac{7}{8}$ in. in diameter and about 1-32 in. in thickness, made in lengths of 18 ft. Every 18 ft., or at the ends of each section of the trolley tube, an overhead switch was located, as shown in Fig. 2. The function of this switch was to cut out of circuit the section of live trolley wire directly over the car.

Two trolleys, pulled by a flexible cord, were attached to the roof of the car with spring clamps, one trolley being at the front, the other at the rear end of the car.

The distance between the trolleys was greater than the distance between the overhead switches, by probably 4 ft.

When, therefore, the front trolley opened the overhead switch the current would pass down to the motor through the rear trolley, and after traversing the motor would reach the overhead line again by the front trolley, the front trolley breaking all switches and the rear trolley closing all open switches, see Fig. 3. The current then reached the generator station by an independent pole line. In the overhead construction the trolley wire and switches were suspended from longitudinal cables attached to, but insulated from, cross suspension wires, fastened to wooden poles located on each side of the street. The trolley wire was suspended every 5 ft. from this longitudinal cable, each suspension wire being insulated therefrom, the return wire being carried on poles at one side of the street. At the generator station the return circuit was carried to a carbon-point automatic rheostat intended to throw in and out the field coils of generator, and thereby control the output of the latter.

The cars were of the Brill make, and were, if I correctly remember, 28 ft. over all, mounted on four-wheel trucks. The motors were mounted in a rigid frame, journaled at four points on the axles and geared to one axle with coil-wire belts. While this design of motor mounting did not conform to our ideas, we were forced to its use by stress of time to meet our contract requirements with the Wichita Company.

The trolley consisted of a frame carrying five wheels, as shown in Fig. 4. The under wheel would engage the switch points extending below the under surface of the trolley tube, and turn the wheel in the switch one-eighth of the way around, making or breaking the circuit as the case might be. Quite complicated overhead switches were designed for the turn-outs, but never erected. Instead, two wires were put up for that part of the line which extended from the power house to Douglass Avenue, with a single wire extending over the balance of the track.

In the operation of this line after construction, many difficulties were encountered, as I presume will be apparent to all electrical men, but which rather surprised the projectors at that time. Nevertheless enough experience was gained in the trial to enable the engineers to make a success out of it, except for financial difficulties in which the enterprise at that time became involved. It was then decided to abandon the series system and re-equip the road with a parallel system and to mount the motors as originally intended. This proposition was submitted to the St. Louis stockholders, but was rejected. Thus ended the first St. Louis effort to equip a practical street railway line with electricity.

The St. Louis company undertaking the work was known as the Advance Electric Construction Company, and the principal stockholders were A. W. Adams, W. L. Seddon, H. L. McPheeters, Seth W. Cobb, D. R. Francis, Charles Hoyle and Ewing Hill.

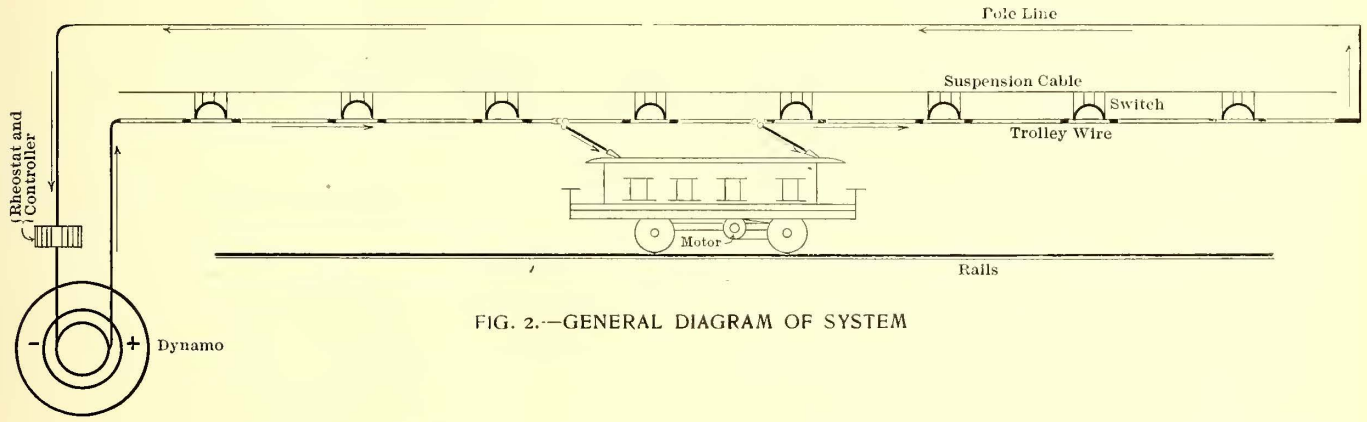


FIG. 2.—GENERAL DIAGRAM OF SYSTEM

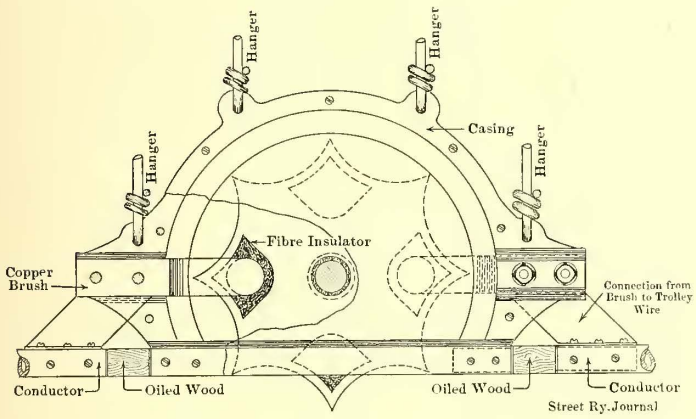


FIG. 3.—MAKE AND BREAK SECTION INSULATOR

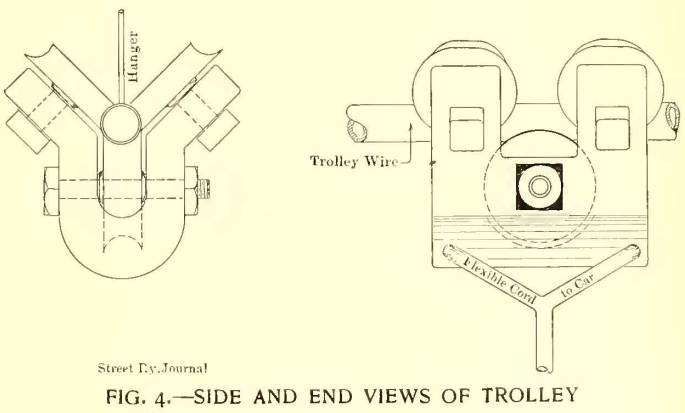


FIG. 4.—SIDE AND END VIEWS OF TROLLEY

A concession for an underground electric line in Buenos-Aires, Argentina, has been granted to Carlos Bright, an American engineer, having an office at 874 Cuyo Street, Buenos-Aires.

A railroad known as the Anglo-Argentino Tramway Company, having offices at 3583 Rivadavia Street, Buenos-Aires, has made application for permission to change its traction over to an electric system.

Can Small Electric Roads be Operated at a Profit? II and Conclusion

BY JAMES BLAKE CAHOON

An important consideration for a road operating in a small town is that of the track, for it may be taken for granted that this class of roads cannot afford, and in fact, it is not necessary for their moderate traffic to put in, as expensive a track as is necessary for the larger cities. Still, it must be amply heavy for the work to which it will be subjected, and must be so built that the repair account will be as light as possible. The City Councils are sometimes inflated with their own importance to such an extent that they fully believe that they know more about the construction of the roadbed than the railway people do themselves, and where this occurs, they are very apt to impose restrictions and specifications such as are only justly applicable to the larger cities. As a general rule, these specify that the road must lay a deep girder rail, not less than 6 ins. in depth, with a flange not less than $2\frac{1}{2}$ ins. in width, through the main streets of the city, and they often compel the laying of this class of rail everywhere inside the city limits; they also impose the paving of the road between the rails and for a distance of 2 ft. outside, when, as a matter of fact, about the only paving in the city is that on the main business thoroughfare, yet they will permit a steam road to lay T rails, and often without any restrictions as to paving.

This is presumably on account of the general feeling that the electric road is going to be the most profitable enterprise that has ever been in the city. This idea is well illustrated by an actual fact that came under my own observation in an accident case that was being tried some time ago. The gist of the matter was that a man went out from his house to get a car, which was an open one, and without waiting for the car to stop, reached out for one of the handles with the intention of jumping on, but missed his grip with one hand, and was dragged for a few feet alongside the car. When the car was stopped, he recovered himself, jumped on and went on down town about his business. The conductor at the time asked him if he were hurt, and he answered in the negative. About a year afterward he brought suit against the road for $10,000 damages, on the ground that this accident was the cause of a double hernia. The evidence was practically all in favor of the road—the jury were unable to agree, and it cropped out later that the point of disagreement was solely on whether they should give the man $1,000 or $4,000, the argument in favor of giving him damages being that the road was a rich corporation, and the man was poor and ought to have something, anyway. This case was subsequently settled, in view of this fact which was brought out, for $400 in preference to letting it go to trial again. As a matter of fact, this road was only just about earning its operating expenses, and the prospect of paying any dividend was far in the dim future, yet the general feeling among people was that the road was earning a large amount of money.

Coming back to the question of track—it seems to be generally conceded that for this class of roads T rail construction is the best, and the nearer it comes to steam road construction, the better. I believe if this class of roads could build their roads with 70-lb. T rails, placed on a subfoundation of 6 ins. of broken stone, ballast them up even with the surface of the ties with the same material, fill them up practically level with the surface of the rail with ordinary dirt, or, preferably, gravel, use a long, heavy splice bar, and place ties every 2 ft., using for the latter a tie having not less than 7-in. face, 6 ins. in depth, and 8 ft. long, that the track could be maintained with a minimum amount of repairs. Even with this construction, I consider it necessary to maintain a small track gang, and keep them going over the road the year round, and this work should be done systematically and thoroughly, and not have the road gone over in a general way in the spring and again in the fall, and left to take care of itself the rest of the year. I have tried both methods, and am satisfied that the cheapest method is to keep a small gang at work continually. For the ordinary ten to fifteen car road, with a mileage of from 15 to 20 miles, three men will take care of a road built as above, and keep it in good shape without any difficulty. If, however, the road is built, as probably the majority of roads are, on the ordinary dirt foundation, there will be more or less heaving in the spring, and it will be necessary to supplement this gang at that time.

The question of paving is an especially sore point with the small railway. John W. Boyle, president of the Utica Belt Line Street Railway Company, in an article in the Utica *Herald* March 23, 1899, treated the subject of paving from a railway standpoint in a most admirable manner, and brought out very clearly the point that the street railway is not benefited in the least by paving. He states that pavements are built only at the request of abutting property owners. They secure the pavement and pay for it for their individual convenience and benefit, and this is so well recognized that the law compels them to pay two-thirds of the cost of the pavement and the city one-third, on the ground that the abutting property owner is the person most benefited. The street car is the only vehicle in the street which furnishes and keeps in repair at its own expense that portion of the street on which its wheels revolve; it is the only vehicle which neither wears out nor litters the pavement. He further makes the point that after a pavement is laid, it becomes a constant source of inconvenience and expense whenever work is necessary upon the tracks, and the railway company is expected to, and does bear this increased expense for an improvement which is made for the benefit of everyone in the city except itself.

If people want rapid transit in the small cities, the fact is beginning to force itself home that they must either lighten the burden imposed upon the railway corporations, and work with them and assist them in every way possible, or else this class of railway will be obliged to retire from business. Financial men are not, as a rule, putting their money into enterprises from motives of pure philanthropy, but do want to see and expect to receive a fair return for the money invested. If onerous laws are enacted, and penalties in the shape of paving and expensive track construction imposed, rendering it impossible for these roads to pay any return on the investment, capitalists are going to withdraw from this class of investment, which will result in either the abandonment of this class of roads or shifting the burden upon the local people. Some years ago it was not a difficult matter to float bonds to build a road in a city of any fair size, but a letter which I received only the other day in regard to financing a projected road well illustrates the feeling which bankers have in regard to these propositions at the present time. Quoting from a letter dated July 17, 1900, they say, "We regret to state that it is unlikely that we shall be interested in the way indicated, as we do not undertake the financing of companies except with a record *behind them*." Another firm of bankers, referring to the same proposition, says, "We are not financing uncompleted roads." These quotations in general illustrate the feeling among the banking element in regard to furnishing the funds for building roads at the present time. The numerous railway laws that have been passed in most of the States impose the same restrictions upon the

small road as upon the large, making no attempt to distinguish between the two, although common sense shows that a provision which might be a minor charge against a big road would be a crushing burden on a small road; it is high time that the small road, as well as the people, recognize this fact, and take the necessary steps to secure the repeal, and readjust the railway laws so that the burden, be it in the form of taxes, construction or paving imposed, shall not be more onerous to the small road than it is to the large.

I think it would be fair to assume that the majority of the small roads have been built by contract, and where this occurs, invariably the repair account is a large one; this is particularly true of the overhead line, largely due to the fact that when the roads were built the idea of calling in a consulting engineer to draw up specifications and supervise the work was not in vogue, and the result is that the line was put up in a slipshod way, with cheap materials, and has been giving out ever since. There is no part of the road where it pays to do as good work and put in the best of materials as in the line, one reason being that the pressure is on the line for about eighteen hours a day, and if the line is not well insulated there is a constant loss owing to leaks, and this loss represents coal at about $2 per ton usually. In this connection, I wonder how many of the small railways in the country make a thorough and systematic test of their lines to determine whether they are properly insulated or not. I will wager to say that not one in ten do it, the general rule being to let the line take care of itself until a break occurs in the line or an insulator gives out; they then send out and fix that particular break, return the tower wagon to its shed, and wait for another break. It is not a difficult matter to test the line out for grounds and leaky insulators, nor does it cost very much to do it, and as a matter not only of precaution but of good horse sense, it ought to be done at least once a week where there is reason to suspect that the class of insulators is not of the best; where the line is built of first-class materials, it still should be subjected to tests for grounds at least once a month. There is no better criterion of the management of a road than the general appearance of the overhead line as one goes over the town. If it has a slipshod appearance, poles out of line, the line itself baggy in one place and too taut in another, insulators with fur on them, line out of center, etc., it is pretty safe to conjecture that the road is not paying. It is not the great big things that conduce so much to economy and rendering the road a profitable investment, as it is the little things, and of these little things a general air of neatness is the chief.

The next subject that demands our attention is that of the car houses and repair shops, and how they should be taken care of to secure the best results at the least cost. The car houses of many of our small roads remind one of a junk dealer's, largely because of the small force employed and the little if any attempt made to keep things clean and in order. Gears, pinions, parts of motors, trolleys, and even cars themselves become worn out, and are thrown to one side in the corner of the car house and left to take care of themselves. Repairs are usually made wherever the car happens to be in the car house, and everything is left lying around in a perfect hodge-podge of disorder. There is really no necessity for this, and it leads to slipshod methods in the care of the cars and everything else. There is even more necessity for order and method on the small road than on the large, and the car houses should be laid out particularly to facilitate work. The car house should not be a machine shop, or a carpenter shop, or a paint shop—there should be the car house proper, in which the cars are housed, and at the rear end there should be provided separate rooms, preferably arranged as follows: Facing the car house, at the rear end and on the right half, place the wash room for washing cars, in rear of this the machine shop; on the left, the carpenter shop, and in rear of this the paint shop. Many roads wash their cars at night wherever they happen to stand on the tracks in the car house, and the result is that the car house is always damp, and consequently when a car is allowed to stand in there for any length of time, moisture gathers on the fields and armatures of the motors; after this has been repeated a few times an armature or a field burns out, and then the apparatus is blamed.

As a matter of economy, it is much better to have a separate wash room with proper drainage, wherein the cars can be washed. In this connection the care of the cars comes up, and after trying various methods, I am thoroughly convinced that the best is to provide a sufficient number of cars so that every car may be thoroughly washed, cleaned and given a brief overhauling every other day, doing this in the daytime, and not at night. Night inspection of car equipments and washing of cars do not accomplish the best results. When the cars come in after the day's run, half of them should be run on a track so that they can be taken care of in the manner indicated on the following day; the other half should be gone over to see that the grease cups are full, and brushes and brake mechanism in good working order. This small amount of inspection can be done by the night fireman of the power house, assuming that the car houses are situated as they should be, alongside of the power house. In addition to the inspection mentioned above, motors should be dropped from the cars periodically and thoroughly overhauled in the machine shop, commutators turned down, new bearings put in, and any general repairs needed to the motor equipment done at this time. In regard to the car bodies themselves, the utmost care should be taken to see that these are kept up in a cleanly condition and looking reasonably bright. Under ordinary conditions of operation, cars will need revarnishing once a year for two years, and the third year they should go into the paint shop and have the paint removed down to the wood, being repainted afresh. Many roads make a contract with some local painter to do this, while other roads, operating ten to twenty cars, find that they have work enough to keep a painter busy the year round. I believe the latter plan to be the better one.

The ordinary working force required to take care of cars of this size road under these conditions are a good machinist and helper, a carpenter who is also a blacksmith and general allround handy man, a painter, and a lineman who is also an armature winder and can take care of repairs to the armatures and fields, in addition to looking after the line and acting as starter to get the cars out in the morning. To keep things looking somewhere near decent, it is advisable to have the car houses and all shops thoroughly cleaned and inspected once a week, the rule I followed being to have the men clean up Saturday afternoon, then I would thoroughly inspect all buildings on Sunday afternoon. We built a bin in the rear of the machine shop, into which all broken gears, pinions and scrap of all kinds were thrown, and a junk dealer came regularly the first of each month and cleared this out. There were no excuses taken for the buildings not being thoroughly clean and in good order at the times mentioned—they simply had to be, and once the men understood this, there was no further trouble. One result of this was to make the men careful in their work, and to overcome the natural tendency to waste things, and the consequence was a marked decrease in our repair account. In the power house, where there was little

necessity for disorder or dirt, everything was required to be clean and in good order by 10 o'clock daily. There was very little trouble about this, as engineers are usually proud of their machines and take good care of them.

After all that has been said in regard to the property itself, when we come right down to the meat of the matter, the success or failure of a road depends very largely on three factors: First, the manager; second, the employees, and third, the cordial co-operation of the two preceding. As a rule, the class of men making up the employees of the small roads are drawn from the town itself, usually born and brought up there, and on the great majority of roads more or less difficulty is encountered in keeping the same men in the service continuously, due largely to the fact that the young fellows in the course of two to five years want to get into something that will pay better, and incidentally take them more out of the public gaze, many of them being inclined to look on the occupation of conductor of a street railway as pretty near the next thing to working on the street with pick and shovel. Hence it is that the younger element do not make as good conductors as the married men with a few years added to their age. This does not seem to be true of the motormen, and it is hard to discover a reason for it. I remember at one time a bright young fellow, who had been a conductor for some three years, and who, during this time, had an almost perfect record, came into the office one day and said that he had decided that he wanted to leave our employ. I sounded him a long time as to cause, and finally elicited the fact that he was engaged to be married, and the young lady to whom he was engaged did not like the idea of his working any longer as a conductor, and much preferred that he seek some other work. I asked him what he had in mind, and he said that he had been offered the position of brakeman on one of the steam roads. I told him I would give him a vacation for three months, and if at the end of that time he still entertained the same feelings in the matter, I would accept his resignation; if he did not, he could continue with the company. At the end of two months he came to me and said that he and the young lady had come to the conclusion that after all it was better for him to stay in the employ of the company, and so far as I know, he is there to this day.

It is often remarked that the discipline on this class of roads is not as good as on the larger, yet I see no reason why the discipline should not be better, provided the characteristics of the men are carefully studied. There is, of course, a tendency among them to be more or less hail-fellow-well-met with all their friends, and as they do not have to be as much on the alert, and look after things as sharply as on the large road, there is a tendency to chat with the patrons of the road and take life as easily as possible, but this can be counteracted through the cultivation of a proper esprit de corps, and infusing into the men the idea that on their efforts largely depends the financial success of the road. The manager comes more into contact with each individual than can possibly be the case on the large road, and hence has a chance to instill much of his individuality and methods into their minds and lead them in such a way that they are glad to work for the interests of the company. Many roads do practically nothing for their men, and when the advisability of establishing a club room for their employees is mentioned, they dismiss it with the single remark, "Oh, we cannot afford to do that." As a matter of fact, they are the very people who should afford to do it.

It does not cost very much to fit up a waiting or club room for the employees, with a billiard and pool table and the current literature, with a few good books of reference and some of the standard games. I believe I was the first manager of a small road to do this, as also to introduce the longevity system of paying the men and giving them service stripes in accordance with the number of years of service, and certainly I did not, and I know the men never regretted the taking of this step. Prior to this the men had no place to wait for cars whose men they were to relieve, and consequently drifted into saloons. In this particular town, all cars came into a common center, and the relief was made there. The car houses were situated nearly 2 miles from this point, so that it was practically impossible for the men to have any headquarters there. At first I took one fairly good-sized room on the second floor of a block on the corner of the main business street, at a point where the road turned the corner. From this the men could see their cars coming, and be ready to meet them promptly.

In fitting up this room, it not being large enough for a billiard room, and I being at the time unable to get other quarters, I carpeted the room, heated it, and provided card tables and several of the common games, like backgammon and cards, and the daily papers, including a New York paper, the weekly illustrated papers and half a dozen of the illustrated monthly magazines; there were also provided enough chairs and odd tables to take care of the average number of men who would find their way in there, as well as a clock and a telephone. This worked so well and showed such good results, that by renting the whole of the second floor of this block, I was able to secure a large room adjoining the former one, which we fitted up as a billiard room, putting in the tables and paraphernalia at the expense of the company. The question that came up in my mind at this time was how to handle the billiard tables—if the men were allowed to use them haphazard and just as they pleased, without being held responsible in any way, the chances were that they would be knocked to pieces in a very short time, and the thought occurred to me, "Why not treat this as we would in a private club? Whoever uses the table pays for it." There was this difference, however, that we could not afford to keep anyone to look after the tables and collect the payments. I believed that the men could be trusted in the matter, and therefore had some little printed slips made up in pads of one hundred, and instructions were issued that for every game the man who used the tables was to fill in his name on the slip and deposit it in the box provided for that purpose. These slips were collected once a week, and deductions made from the men's pay at the rate of 2 cents for each game, the loser of the game paying for the game. The revenue derived from this source was kept separately, and used for the maintenance of the tables, and anything in excess applied to the reduction of the rent of the rooms.

The balance of the rooms on this floor were rented for a sufficient rental, such that taken in connection with the receipts from the billiard tables, the rooms practically cost the company not over $10 per month, and I have always considered this as one of the best investments the company ever made. It did much to get the men together and keep them out of saloons and from hanging around street corners, and acted as a leaven to materially raise the esprit de corps, with the result that the men felt that they were not working for a soulless corporation, who did not care a continental whether they were taken care of or not, or whether their work was made easy or light, but they did feel that the company had their interests at stake, and we frankly told them that we were doing all we could afford to do and a little more. We did not hide our receipts nor our expenses from them, but told them frankly what they were and just how we came out year by year, and as times picked up and the receipts increased, we were able to do a little more for them, and did not hesitate to do it. The men, feeling that the interest of the company was their in-

terest, worked to further that—they were polite and attentive to passengers, took care of ladies and children, helping them on and off the cars, and in fact worked as though they really did have a financial interest in the success of the company.

Another thing which we did was to help the men in the matter of uniforms. When I took hold of the company, the men wore about anything they pleased in the way of uniforms, the principal thing being a blue coat and cap, with the word "Conductor" on the latter, and as each man had his own ideas on the subject, the styles were anywhere from a steam road conductor to a farmer. Having been brought up myself to see men in the neat uniform of the navy, it certainly grated to see this slipshod condition. Feeling that it would be a hardship to the men to force them to buy a new uniform at once, I suggested that they appoint a committee of five to select cloth and style of uniform, and told them that I would get bids from the different tailors, and that they could select the tailor and I would have him make the bid on a cash basis, the company paying for the uniforms and the men paying the company at the rate of $1 a week for the men having full pay, and a proportionately less amount for those receiving partial pay. In this way the men were able to get the benefit of a spot cash payment, which saved them about $2 on the cost of a uniform.

I found this committee to work well in the matter, and suggested to the men that they keep this committee or elect another to confer at any time when any points came up that seemed to need talking over. The only point that ever came up subsequently on which the committee needed to act was when the men in the winter time wanted to give a ball, and wanted to know what could be done in the way of taking their guests home when the ball was over, this being about 3 o'clock in the morning, after the cars had stopped running. This we readily fixed by telling the men that if they were willing to run the cars, the engines would be started up in the power house in time for them, and they could take their guests home without charge. In the summer time we also gave the men an outing, in the shape of a trolley ride with decorated cars, and let them invite their wives and sweethearts. After some two or three years union men from other cities came to our road and tried to interest our men in forming a union. The men promptly told these emissaries that there was no need of their joining anything of the kind, that they had all the union they wanted in their own club room, free, and I rather gathered from what leaked out subsequently that these representatives thought it advisable to leave the city on the first train, and it did not matter particularly where that train was going.

Too much care cannot be used in the selection of employees for this class of road; for the manager, it is almost like taking a man into his own family. Good men can be obtained, and therefore it is poor policy to take anyone who comes along and applies for a place. There is no point on which a manager needs to exercise more strictness than on this. Reference should not only be required, but should be examined into carefully, not necessarily by the manager himself, but by one of his aids, who reports on what he finds out of the man's past career, his habits, manners and customs, and the reasons why he is out of a place, or wants to leave his present place. We made it a rule never to take a man over thirty-five years of age, and for a motorman one of the requirements was that he should be a good mechanic or stationary engineer, and as vacancies were of infrequent occurrence on our road, we were able to hold to these requirements very strictly. When men were selected they were put through a course of training, motormen being sent for two weeks to work in the power house, followed by two weeks in the repair shops, then a week's instruction in operating cars, after which they were required to pass a written examination.

The training of the conductor, while not so thorough as this, was still sufficient to ground him in his duties before he was allowed to take a car, and he also was required to pass a written examination before he was accepted. Men coming in in this way were placed on the extra list, and were given a regular run in order of seniority.

Finally, I believe this class of roads can be made to pay if they are treated as has been indicated in this article. Each individual problem must be worked out, but in general it may be said that, given good equipment and good track kept up in first-class condition, a good manager who will show people that it is working not only for the interests of the company, but for their interests, and who can secure the co-operation of the employees, will make a road of this class pay.

Extension of the Plant of the Worcester Consolidated Street Railway

The Worcester Consolidated Street Railway is located in a thriving business town where the opportunities for a successful street railway are unusually good. Not only is the local traffic considerable and uniform, the cars being well filled on all the lines at all hours of the day, but connections are made with a large number of suburban lines. Among these are the Worcester & Webster, Worcester, Boylston & Clinton, Worcester & Leicester, and a half dozen other roads which connect with Fitchburg, Hudson, Leominster, Grafton, Oxford, Webster, Leicester and most of the principal towns and villages of Central New England. Through transfer systems and arrangements for joint use of tracks the road has been placed in a unique position, practically controlling the largest mileage, without exception, in New England, although its own tracks cover only about 65 miles.

Several of the neighboring roads have recently been acquired by a syndicate, and the question of consolidating the different suburban power stations has arisen, with the result that in the immediate necessary extension of the Worcester plant provision is being made for such additional equipment as may be needed to operate not only the Worcester street railway lines, but all the combined suburban roads. The power plant necessary for this immense system will be, with the exception of those controlled by the Boston Elevated Railway Company, the largest in New England.

The Worcester roads are all practically concentrated within the city limits, with the exception of the Worcester, Grafton Center and North Grafton line, which is also a part of the consolidated system. An average load of seventy double-truck cars is carried for about eighteen hours summer and winter, and the power-station output, under the same conditions, amounts to about 1250 hp. This is increased somewhat in the early morning and late afternoon hours, but the daily load factor is very high. The maximum current (exclusive of snow storms, etc.) is on a summer afternoon, say during a ball game, and sometimes rises to 3600 amps.

The power plant is located in the southern part of the city, near Webster Square, within 100 ft. of the Blackstone River, which furnishes an ample supply of excellent water the year round for both boiler feed and condensing purposes. A side track from the Boston & Albany Railroad leads to sheds alongside the boiler room, where capacity

for a month's supply of coal is provided. The building is of steel construction throughout, with light brick walls, the shaft center lines and boiler fronts being parallel and at right angles to the roof trusses, which are parallel with the gable ends. The extension, which is at the southern end, is being built without disturbing any of the existing construction. The present plant is 100 ft. wide and 120 ft. long, divided near the middle of its length by a 12-in. brick wall with only two doors, one at the end and one between the two batteries of boilers. The west wall abuts on the sidewalk, but there is ample room in every other direction, there being five acres of land in the property. At the northwest end of the engine room is the office of the superintendent, which is elevated about 12 ft. above the floor, giving a good view from the desk of every engine and generator. There are two monitors extending the entire length of the roof, one over the center of the engine room and one over the steam leaders above the boilers. The stack is steel, 100 ft. high, and rises from within the boiler room. The engine room floor is of latticed iron bars 10 ft. above the basement floor, so that the heating and condensing apparatus, piping, etc., are constantly in sight of the engineers. Each valve on the basement piping is connected with stands and rods, so as to be operated from the engine room floor.

The equipment consists of twelve horizontal, tubular boilers of 200 hp each, set in two batteries of nine and three units each; four 500-kw and one 850-kw generating sets, the four being belted, and the larger set direct coupled. The engines are all vertical, cross-compound condensing, built by the Lake Erie Engineering Works. The generators are of General Electric make. Most of this equipment was installed about seven years ago, and the generators especially are somewhat antiquated. In spite of this fact, however, the plant has run continuously for the seven years without a breakdown, and during that time has not been operating non-condensing for a single hour. The 850-kw unit has been running practically without a stop twenty-four hours daily for two years.

The condensing plant consists of a 500-hp Goubert feedwater heater and Worthington horizontal duplex independent jet condenser. A box crane rated at 8 tons, but frequently used for 30,000 lbs., and operated by hand, runs over the engine room. A 118-hp General Electric booster outfit, direct connected, is used for the "Lake line," raising the potential to about 650 volts, for transmission to the furthest distant point of the whole system, at Lake Quinsigamond, which is about 9½ miles from the plant.

The piping is arranged in duplicate for security against breakdown. Each of the first nine boilers is connected through a square bend to a T looking upward. From the run of the T a straight pipe leads to one header, and the other header is connected to the outlet of the T by a U bend having a valve at its highest point. The boiler mains are 6 ins., the two headers 12 ins. The last three boilers, which have only recently been installed, are each connected through a 6-in. long bend to an 8-in. header, from which two 8-in. U bends lead, one to each of the main headers. Steam to the engines is taken from Ts on the header through long sweep bends to the engines. No separators are used. The drips from the steam mains and headers are returned through traps to the boilers. These will eventually be superseded by some form of gravity return system. The engines exhaust into one 16-in. main, to which the condensers are connected, so that any condenser may be used on any engine. Neither mechanical draft nor economizers are used. The efficiency of the station as a whole has been moderately high, as compared with that of similar plants with more modern apparatus, but the operating expense per car mile has been low, and an average evaporation by the boilers of nearly 10 lbs. of water per pound of coal, with 170 degs. as the temperature of feed, is often reached, although they have been driven beyond their rated capacity.

The addition to the station will be 100 ft. in width and 90 ft. long, and will be of the same general construction as the existing portion. A broad monitor roof will be built over the engine room, which will consist of two bays 30 ft. and 16 ft. wide, respectively. The center bay, which is to contain the main engine, will measure 43 ft. from floor to bottom of roof girders, and will be surmounted by a 23-ton crane built by the Wrought Iron Bridge Company of Canton, Ohio. The smaller bay will have a 5-ton crane under a pitch roof. The boiler room, on the eastern side of the addition, will be an extension of the existing boiler room, and will permit of the installation of nine new boilers, making twenty-one in all. This room is 44 ft. wide and 16 ft. high to the lowest portion of the trusses. The roof is pitched up to a height of 38 ft. at the 12-in. dividing wall between boiler and engine rooms. The side walls of the addition are merely for filling in the steel work and are 12 ins. thick. The roofing is the H. W. Johns Manufacturing Company's asbestos paper; the flooring, granolithic on I beams and brick arches. There will be no basement, properly speaking, the condensers, etc., being planned to rest on the main floor, while the engine cylinders will be reached from this floor by a winding staircase. There will be a low, studded basement room under the westerly bay of the engine room, the purpose of which will be mentioned later. The main engine bay will be of sufficient size to contain two units of the size of the one now being installed. There will be space also for an additional 150-kw, direct-connected booster, which will become necessary if the plant is used to operate distant suburban lines.

The main floor of the smaller bay in the engine room is strengthened to support several three-phase rotary converters, which would in this case be required. The basement under would be ventilated by cone fans for the proper reception of step-up transformers. The rotaries would then take direct current at 550 volts from the main generators and deliver alternating current probably at not over 500 volts to the transformers. Here it would be raised to something above 2000 volts, the precise potential not having yet been calculated, and transmitted to various outlying sub-stations, where other rotaries would transform it to direct current for street railway use. All this is, of course, a matter of future probability, no transmission apparatus having been contemplated in the present stage of equipment.

The immediate extension for which the building has been thus enlarged consists of a 1600-kw, direct-connected generating set, which will be erected in October. The engine, which is being built by the International Power Company, of Providence, R. I., is a vertical cross compound, running at 100 r. p. m. The cylinder diameters are 32 ins. and 66 ins. respectively; the stroke, 48 ins. It will be the largest engine of its type in the country, with the exception of that recently purchased by the Boston Elevated Railway Company. It is of special design throughout, the novel features originating both with the builders and the railway company, many of the points being specified by Mr. McKee, the chief engineer of the plant. The high-pressure cylinder will be steam jacketed over the whole of its surface, the low-pressure cylinder on the heads only. A live steam reheater will be used between the cylinders. Lever throttles and lever by-pass valves will be used throughout, the general construction being closely in accordance with marine practice. A by-pass from the

main steam supply will be run to both sides of the low-pressure cylinder beneath the inlet valve.

The foundation for the engine will measure 35 ft. 8 ins. x 22 ft. at the top, and will be 13 ft. deep. The sub-soil is of first-rate quality for a footing, and the exposed work will be of Portland cement and broken stone concrete. The fly-wheel is 18 ft. in diameter and weighs 60 tons. The height from floor line to top of engine is 27 ft. 2 ins., so that a man standing on top of one of the cylinders could almost reach the roof girders. The shaft is of steel, solid, 20 ins. in diameter. The low-pressure cylinder is cast by a new method, which has been entirely successful. The shell and chest were made in three parts, the dividing lines being near the heads. The faces of these three parts were then machined, packed with very thin copper gaskets and securely bolted together. They have not been taken apart since, nor is it expected that they will be. The machining, including boring, facing and drilling, has been done on the three castings at once. The reason for so casting the cylinder was to provide for repairing a possible breakdown without getting a new cylinder. Should a head blow out taking a piece of the body flange with it, as it sometimes does in the power plants, the broken casting could be replaced in a short time by a new one made from the same pattern and machined to templates, and the new piece could be bolted in while the engine was in place on its frame.

Another unique feature is the valve motion. This, instead of being operated from spur gearing, as is usual in this class of engines, is actuated from two eccentrics set on the main shaft, one on the center and one on the quarter. The eccentrics transmit the motion to an auxiliary shaft, to which the rods are connected as in ordinary practice. As the rods are of extreme length, there will be no trouble occasioned by their angular displacement during rotation. The valves are of the endwise gridiron type, conforming in general design to the standard form of the old Green-Wheelock engines, and the clearance has been reduced by their use to less than 3 per cent. The main bearings are 20 ins. x 36 ins., and the generator outboard bearing 16 ins. x 32 ins. These are of the shell type, with water jackets. A small steam pump will maintain a gravity tank flow, or forced flow, if necessary, around each bearing piece. The bearing caps, instead of being fastened to the bases with stud bolts, will be connected with long T end bolts, the Ts setting in slots in the bases, which can be reached from the outside. This will render it quite easy to remove and replace the caps and fill the shells. The oiling will all be done mechanically, as it is in the present station. A supply tank will be located near the roof and a receiving tank in the basement. The oil will flow from the supply tank to the bearings, the regulation being by hand, and thence to the receiving tank. A small pump will take it from the receiving tank through a filter and force it to the supply tank again. A connection from a supply barrel will be made to the pipe between the pump and the filter. A Holly gravity drip system, soon to be installed, will carry all the live steam drips to a receiving tank, into which the low pressure drains from heaters, etc., will be brought. A small reducing valve blowing high-pressure steam into the heaters will give the required upward velocity to the condensation, which will thus be carried above the water level in the boilers to a supply tank, from which the return boiler feed will be through check valves to the blow-off pipes inside the cocks. This system will be entirely automatic and will be in continual operation except when a boiler is being blown off.

The exhaust from this engine will be carried to a 2000-hp Wainwright vertical heater of the "easy flow" type, especially designed for this plant. The heater body, which is 40 ins. in diameter, will be divided longitudinally into three compartments at the top and four at the bottom by webs, or fins, cast in one piece with the shell. The length of the body of the heater is 16 ft.; that of the tubes 124 ins. One hundred and fourteen $1\frac{1}{2}$-in. tubes are used, the total tube heating surface being 671 sq. ft., making a ratio of a little less than 3 hp to the square foot of heating surface. From the heater the exhaust will pass to the condenser, which is also of special design. This is a twin simplex beam vertical air pump and jet condenser, built by the Geo. F. Blake Manufacturing Company. The steam cylinder is 14 ins. in diameter; the water cylinder 35 ins. The stroke of both pistons is 21 ins. The floor space occupied is 7 ft. 4 ins. square, and the total height of the condenser from floor line to beams is 11 ft. 7 ins. The outfit is designed to give an even vacuum of $29\frac{1}{4}$ ins. of mercury with injection water at 70 degs. F. The water of the Blackstone River, which is to be used, will rarely rise more than 10 degs. above this temperature on the hottest days of summer. The vacuum maintained will, of course, have an important bearing on the economy of the engine as guaranteed by the builders. The contract calls for a steam consumption of the main engine, when operating at 125 lbs. steam pressure, not greater than $12\frac{1}{2}$ lbs. (dry) per i. h. p. per hour for any range of load between 1800 and 2500 hp. The vacuum under which this economy must be made has not been stated. With any practicable vacuum, however, so low a steam consumption at 125 lbs. steam pressure is almost unprecedented, and the result of the tests when they are made will be received with general interest. As the contract contains a forfeiture clause involving a heavy penalty for every 1/10 lb. of steam consumed in excess of the guaranteed rate, the engine will no doubt be a record breaker in its class. If the tests are made by weighing the exhaust steam condensed in a surface condenser and the indicators are accurate, the results ought to be authoritative.

The generator is one of the General Electric Company's multipolar railway type, running nominally at 550 volts at 100 r. p. m., and 10 per cent over compound. The machine has twenty-two poles. The distance across the field ring is 21 ft.; the armature is 164 ins. in diameter and the commutator 120 ins. The normal rating is 1600 kw, but provision is made for 25 per cent overload. The floor space occupied is 6 ft. x 21 ft., and the total height from base of bed to ring is 22 ft. The height from the top of the base is 14 ft. 6 ins. The machine will form a decided contrast to the old-fashioned octagonal field-ring generators now in the station. It will do well if it makes a better record. One of the commutators on a 500-kw generator which has been running steadily for seven years has only been turned off once in that time, and is to-day in almost perfect condition. The worst commutator of the lot is on a machine just opposite a doorway leading to the street. This has been turned down three times—about $\frac{1}{8}$ in. in all. All of this old equipment is working daily, the only perceptible defect being a slight weakening of the insulation.

The General Electric Company is building a switchboard for the new plant, which will take the place of the one now in use. Several of the present instruments will be utilized. The board will be constructed of black slate, in twenty panels; two for the boosters, six for the machines and twelve for the circuits. Should the developments already mentioned take place there will have to be added one machine panel, two or three feeder panels and several for the rotaries.

Instead of having connections separately from the positive, negative and equalizing wires to the board, a main negative bus is used, into which the negative wires of all

the machines are connected. By putting in the negative switch first the generators can be coupled in multiple. In other respects the board and wiring system will conform closely to standard railway practice.

Mention has been made of the rotaries and static transformers which may have to be installed very soon. The system will in this case be unique. The ordinary transmission plant uses alternating-current generators with step-up transformers if necessary and rotaries at the sub-station In this plant only direct-current machines will be used, and there will be four transformations: from direct to alternating current, then to high potential, then to low potential, and finally back to direct current. The reason for adopting such a system lies in the fact that a large amount of the equipment is already in place and that for best economy the large units must be used on the city lines. To fill these conditions direct current is a necessity and the loss by transformation through rotaries unavoidable.

Paris Exposition Notes

[*From Our Regular Correspondent.*]

It would be impossible to give in the pages of the Street Railway Journal, which it is possible to devote to the subject, even the briefest description of all the street railway exhibits at the Paris Exposition. The most important exhibits, however, have been mentioned, and readers of the paper may be certain that they have been able to acquire a knowledge of the street railway exhibits at the Exposition in this way much more readily and systematically, even if not so much in detail, than would have been possible by a visit to the Exposition itself. As already stated, the street railway exhibits are distributed around the Exposition in a dozen different places, so that it is almost impossible to locate them, and one would hardly be surprised at coming across some tramway exhibit in almost any section. Again, the delay, attributable principally to the Exposition authorities, in getting the exhibits in shape and under way, has added very much to the general confusion, and many exhibitors were glad to accept almost any space rather than to wait indefinitely until the space previously assigned them was ready for occupancy. This has added very much to the difficulty of locating many of the exhibits.

Mention has already been made that among the street railway exhibits American apparatus is predominant. Among those not previously described is that of the Lorain Steel Company, of Johnstown, Pa., and the Bullock Company, of Cincinnati, Ohio, who have a joint exhibit in the Electricity Building. Here the former company shows a number of Dupont trucks for single and double-truck cars, equipped with standard Steel motors. These motors range in size from 25 hp to 50 hp. A number of controllers, trolley poles, rheostats, etc., complete the exhibit. The Bullock space is devoted largely to Bullock generators. These are necessarily of the smaller sizes, but views are shown of 800-kw railway and power generators manufactured by the company. The American Steel & Wire Company has its largest exhibit in the mining section, where are shown samples of ore mined by the company, wires of steel, iron, brass, copper, aluminum, etc., varying in size, rail-bonds, etc. The Roebling Company has exhibits in both Electricity Building and in the Mining Building; the most conspicuous object in the former is a model of a conduit electric railway system, to show the method of connecting the feeders to the conductors; in the latter is shown a handsome model of the Brooklyn Bridge. The General Electric Company, in addition to the elaborate exhibits made by its representatives in Europe, and particularly by the French Thomson-Houston Company, has also an exhibit of its own in the Electricity Building. The feature of this exhibit is an elaborate model of its three factories made to the scale of 20 ft. to the inch. These models are constructed of sheet zinc and copper and beautifully colored, and every detail is reproduced. In addition, the company shows photographic views of its works and of some of the most important installations made in America and abroad. The Triumph Electric Company is making a joint exhibit with the Fay & Egan Company, of Cincinnati, Ohio. Part of this exhibit is located in the Electricity Building and part in Vincennes. The Triumph exhibit is of motors which run the woodworking machinery shown by the Fay & Egan Company. Among the other exhibits in the Electricity Building the visitor sees the switchboard appliances and overhead line material of the A. & J. M. Anderson Company, the commutator bars of the Billings & Spencer Company, the Van Wagoner & Williams Hardware Company, the Eureka Tempered Copper Works and the Forest City Electrical Company, the fuses of the Chase-Shawmut Company, the switchboard appliances of the Crouse-Hinds Company, the General Equipment Company, Zindars & Hunt and the Cutter Electric Manufacturing Company, the trolley appliances of the Central Union Brass Company, graphite brushes made by Joseph Dixon, Jersey City, N. J., specialties of the Creaghead Engineering Company, switches of the Falk Company, lightning arresters of the Garton-Daniels Company, fuses, overhead line appliances and heaters of the H. W. Johns Company, insulators of Fred. M. Locke, mica and micanite made by Eugene Munsell & Company, brushes of the Ohio Electric Specialty Company, New Process Rawhide pinions, fans of D. L. Bates & Brother, carbon brushes made by the Speer Carbon Company and the Partridge Carbon Company, raw hide pinions of Horsburgh & Scott, conduits of the Sprague Electric Company and American Vitrified Conduit Company, mica of the W. H. Sills Mica Company, Ward Leonard controllers, motors of the Jeffrey Manufacturing Company and the Crocker-Wheeler Electric Company, and wire of the Hazard Manufacturing Company and the Okonite Company.

In Class 27 of miscellaneous exhibits, in Electricity Building, are shown electric heaters made by the Consolidated Car Heating Company, Gold Car Heating Company and the American Electric Heating Corporation, and the measuring instruments of the Bristol Company, the Weston Electrical Instrument Company and Queen & Company.

Many of the American exhibitors in the tramway department have limited themselves to photographs or drawings of the apparatus made by them. This is particularly the case with the E. P. Allis Company, the American Car Sprinkler Company, the American Car Company, Babcock & Wilcox, Berlin Iron Bridge Company, Harold P. Brown, Chisholm & Moore Manufacturing Company, Christensen Engineering Company, Consolidated Car Fender Company, Hipwood-Barrett Car & Vehicle Fender Company, Leonhardt Wagon Manufacturing Company, Link Belt Engineering Company, J. R. McCardell Company, New York Car Wheel Works and Taunton Locomotive Manufacturing Company. Others, however, show models of their apparatus or samples. Among these, American rail-joints of different kinds are particularly prominent, especially those of the Continuous Rail Joint Company, the Weber Railway Joint Manufacturing Company and the Diamond State Steel Company. The Charles Scott Spring Company and the A. French Spring

Company both show sets of locomotive springs, while the Peckham Truck Company exhibits a beautiful set of models of the different types of Peckham truck. The American Street Railway Association has on exhibition a complete file of its transactions. McKee, Fuller & Company show a set of car wheels and axles, the Pressed Steel Car Company shows samples of its cars, trucks and bolsters, the Q. & C. Company of its tie plates, and the Safety Car Heating & Lighting Company is exhibiting its method of gas lighting.

Group IV. at the Paris Exposition comprises machinery, and, as is well known, the American exhibits in this department attracted widespread attention abroad, owing to the handsome showing made by American manufacturers. In this group are included steam appliances, prominent among which are engines of the E. P. Allis Company and of the Ball Engine Company, boilers of the Babcock & Wilcox Company and of the Clonbrock Steam Boiler Company, valves and pressure gages of the Crosby Steam Gage & Valve Company, injectors of the American Injector Company and Penberthy Injector Company, purifiers and filters of the Burt Manufacturing Company, steam separators of Joseph De-Rycke, lubricating graphite of the Joseph Dixon Crucible Company, governing and reducing valves of the Locke Regulating Company, valves, gages, injectors and lubricating devices of the Lunkenheimer Company, a feed-water heater of the Taunton Locomotive Manufacturing Company, valves, piping, etc., of the Walworth Manufacturing Company and of the Crane Company, feed-water heaters, pumps and condensers of the Wheeler Condenser & Engineering Company, pressure gages of the Bristol Company, valves and pumps of the Chapman Valve Manufacturing Company, a portable, automatic air compressor of the Christensen Engineering Company, conveying machinery of the Jeffrey Manufacturing Company, pumps and condensers of the Stilwell-Bierce & Smith-Vaile Company, flexible shaft appliances of the Stowe Manufacturing Company, exhaust fans and blowers of B. F. Sturtevant & Company, hydraulic jacks of the Watson-Stillman Company, pneumatic tools of the Chicago Pneumatic Tool Company and of the Q. & C. Company, corundum wheels of the Hamden Corundum Wheel Company, and machine tools of the Niles Tool Works Company and the Pond Machine Tool Company.

One of the most prominent electric railway exhibits at the Paris Exposition is the large electric locomotive, manufactured by the Allgemeine Elektricitäts Gesellschaft, of Berlin, and designed for hauling passengers and freight cars, as well as for switching purposes on heavy-service roads. It is constructed for a standard gage of 4 ft. 8½ ins. (1435 mm). The trolley and fixtures above the locomotive may be removed without trouble in case it is desired to use the locomotive as a car of a train. In that case the gears are also removed from the axles, so that the armatures do not revolve. The locomotive is capable of pulling a 300-ton train at a speed of 19 miles an hour, or 30 km per hour, on a level. The weight available for traction, which is equal to the total weight of the locomotive, is 24 tons; the maximum draw-bar pull at the start is 7900 lbs. (3600 kg). With the exception of the roof of the motorman's cab, the floor and the inner facing, the locomotive is constructed entirely of iron and steel. The wheel base is 8 ft. 2½ ins. (2500 mm), so that the locomotive can traverse the sharpest curves met with on railways. The wheels are 39.4 ins. (1000 mm) in diameter, and have wrought iron centers, with steel tires. The weight of the locomotive is carried on the two axles by means of elliptical springs.

The locomotive is equipped with a Westinghouse air brake, with independent motor compressor, and with hand brakes. Air whistles are used. The front and rear of the locomotives are made low, with sloping tops, to give an unobstructed view of the track from the cab, according to standard practice.

The trolley base extends along the entire length of the roof of the cab. The current is taken off by means of four sliding trolleys of special construction, which are pressed against the trolley wires by means of heavy springs. The style of trolley was adopted on account of the frequent changes of direction of travel which might be expected. In order to insure sufficient contact the manufacturers recommend a number of No. 0 (8 mm) trolley wires. The locomotive at Paris is fitted with three.

The locomotive is equipped with two type 800 V. B. (150 hp) motors, each geared to an axle at a 1 to 3 ratio.

In addition, this German company has on exhibition a three-phase 3000-kw generator with direct-coupled exciter, a pavilion lighted by Nernst lamps, a complete assortment of commutators, transformers, wattmeters, arc lamps, tramway equipment parts, photographs of installations, etc.

The German exhibits, on the whole, are exceedingly complete and elaborate, and reflect great credit on the German manufacturer. Among those which I have not previously described the exhibit of Felten & Guilleaume, of Carlswerk, deserves notice. In addition to the full line of bare and insulated wires, which this company shows, for electric light, power and miscellaneous electric service, the company is making quite an elaborate exhibit of copper rail-bonds. Both the Electricitäts Actiengesellschaft, formerly Schuckert & Company, of Nuremburg, and the Helios Company, of Cologne, make elaborate exhibits. The latter shows quite an amount of tramway apparatus including railway motors of different sizes. Outside of Germany, the principal Continental firms exhibiting tramway apparatus are Ganz & Company, of Buda-Pest, and the Société Anonyme d'Electricité & Hydraulique, of Charlevoix, both of whom have elaborate exhibits. The latter shows direct-connected units of 1000-hp three-phase, 500-hp monophase, 200-hp direct-current motors, etc., in addition to its standard street railway equipment.

Most of the English exhibits which are of interest to tramway managers will be found in the Electricity Building, although there are a few in Vincennes. Among the latter are the Westinghouse exhibits, already mentioned in previous issues. The Mossberg Roller Bearings Company shows journals fitted with its well known bearings. In the Electricity Building, however, will be found the greater part of the British exhibits, including those of the British Insulated Wire Company, Callender's Cable & Construction Company and W. T. Glover, showing cables and wires for electrical transmission purposes. British industries are also well represented by the exhibit of Mather & Platt, who have a direct-current unit in the Exposition power station; the Chloride Electrical Storage Syndicate and the Electrical Power Storage Company both showing accumulators, and James White, of Glasgow, who is exhibiting a fine line of scientific and measuring instruments. R. W. Blackwell & Company, Ltd., also exhibit a full line of the many devices and appliances for which they are selling agents, and supplied a large proportion of the material for the third-rail Exposition Railway. In the Suffren power station of the Exposition one of the largest engines was supplied by Willans & Robinson. This engine is of the well-known Willans type, is of 2400 rated hp, and is direct connected to a 1340-kw direct-current 500-volt generator, built by Siemens Bros. With the possible exception of one German engine, which is of about equal capacity, it is the largest engine in either of the two electrical stations at the Exposition.

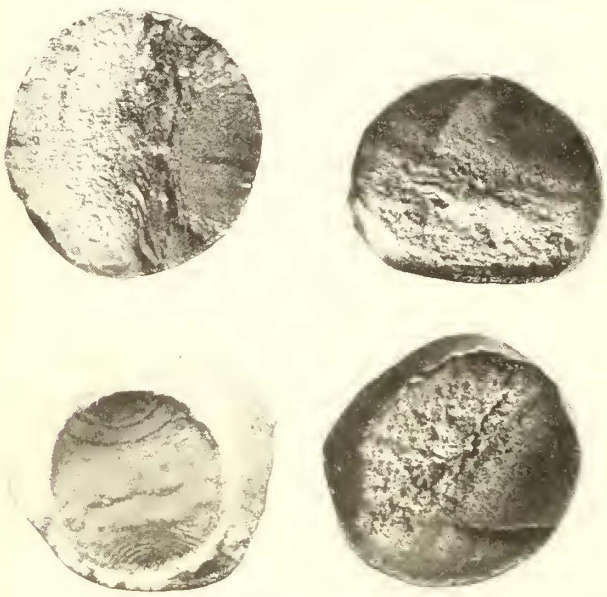
CORRESPONDENCE

Breaking of Copper Trolley Wire

Societa Generale Italiana Edison di Elettricita,
Milan, Italy, July 11, 1900.

Editors Street Railway Journal:

Where the copper trolley wire on our system has broken we have noticed the constancy of certain marked characteristics that we think may be of some interest to your readers. The broken surface is never homogeneous, but consists of one part showing a fresh break, and one or two other parts showing a series of concentric zones of brown



SECTIONS OF TROLLEY WIRE

(Enlarged about five times actual size)

oxide. The photographs annexed represent some of these surfaces.

It would seem from these sections that the breaking is not due to a sudden strain or to a reduction of the area, but occurs gradually and during a comparatively long space of time.

It would be interesting to know if other observations of this kind have been made on other roads, and if any investigations have been made to determine the cause of this initial weakening of the wire. Guido Semenza.

Polyphase Distribution for Electric Railways

Denver, Col., Aug. 10, 1900.

Editors Street Railway Journal:

Dr. Louis Bell has, in this month's Street Railway Journal, what appears to me to be a very timely word of caution against the extravagant application of the three-phase method of distribution for railways. To be in fashion some railway companies are evidently using it when the ordinary well known and much cheaper methods are available. Electrical distribution for railways with direct current and the ordinary standard machinery has by no means reached its limit, and although railway companies are generally suffering for higher voltage, their engineers appear to have overlooked the fact that they all have it within easy reach.

The present and almost universally used method of distribution *is all wrong*. High voltage in the congested districts and low in the suburbs is the rule. It should be the reverse. Running motors down town in series is poor practice. It heats them, while running the cars in the suburbs under low voltage is very expensive. The heavy current used also heats the motors and is a severe drain on the supply. The time of the motorman and conductor is also squandered wastefully. On more than one road with which I am acquainted the total operating expenses could readily be reduced 20 per cent by changes in the circuit arrangements. The method I advocate is a three-wire compensating system. The ordinary generators are used, but coupled in Edison's three-wire way. Those on one side, which are to supply the congested districts, are arranged for, say 450 volts, while the other side, which supply the outskirts, are arranged for, say 650 volts. Such an arrangement would effect a great saving in copper and would come pretty near eliminating that great source of trouble—electrolysis. By speeding up in the suburbs four cars may take the place of five now running, and in some cases one-half of the number could be dispensed with. People living in the outskirts would probably be as well accommodated with a forty-minute service done in twenty minutes as with a half-hourly service, which requires thirty minutes to take them to business or home.

If it is desired to extend the roads to other towns, for instance, the ordinary motors may be used safely and have all of the advantages of a distribution at 1100 volts. This would require a double trolley, each to be in connection with the outside terminals of the three-wire system. The motors would be run in series. John C. Henry.

The Characteristics of a Successful Street Railway Manager

Neck o'Woods, N. Y., Aug. 11, 1900.

Editors Street Railway Journal:

I know that it is great temerity on my part to try to add to the words of yourself, Mr. Vreeland and John Smith, but "fools rush in, etc.," and this is my rush. I read your article on "Successful Managers" in the June number, because I always find something good in that department; I read Mr. Vreeland's article because he always says something worth listening to and has the happy faculty of winnowing the wheat from the chaff and baking it into good, plain, everyday bread (I hasten to say that this last sentence has no reference to *your* article!), and I read Mr. Smith's article because he seems to voice the opinions of that large portion of the human race that bears the same name, and therefore his article *ought* to carry weight.

When I had read and digested the three, I put all the qualifications into one pan of a scale and jumped into the other pan myself, and—like Mr. Smith—I *just* balanced them! That showed at once that there was something wrong somewhere, as I am *not* a "successful" manager; there was certainly short weight or count on the part of the qualifications, so I hunted for the missing ones, and found them as Paddy found the cellar door—"by their *not* being there."

You have all three missed two important qualifications of a "successful" manager—the available opportunity to display his ability and the power to grasp it. You see, it is not given to all of us to have the opportunity to take our little candle out from under the bushel and wave it in the sight of bankers and syndicates; with some of us blind fate sits on top of the basket with all her heft, and our little taper burns on—and out—in "innocuous desuetude"; then again there are times when she will kick the bushel over, yank out the light and wave it so high and wide that all plutocracy shall see it—and thus is made another success-

ful manager! No—the most important of the qualifications is the opportunity—the available opportunity. Shorn of this, the manager may be *capable*, but he will not be "successful" in the full meaning of the term. He may be all that you three artists have painted him; he may be capable in each and every one of the seven ways (Mr. Smith seems to think that there are only six), he may have proved those qualifications one by one and over and over, but until he gets the *opportunity* to *display* those seven managerial virtues, what shall it profit him? And Echo answers: "From twelve to eighteen hundred per year with a week's vacation to attend the A. S. R. A. convention, if it happens to be held near his town"! And Mr. Smith indorses every word that Echo says, and to prove it plays a sample tune on his own horn! This is a bad example, and—while I know that "comparisons are odious"—I am going to do the same thing—in another key.

You—Mr. Editor—have known me a long time and are pretty well acquainted with my railway career; you know that I have had a succession of small successes without a single failure to mar the dread monotony since my unhappy fate dumped me into the street railway business. You know that I can plead guilty to all of Mr. Vreeland's "seven virtues," even to "honesty," "diplomacy" and "horse sense"; you know that I know the street railway business from top to bottom and am still willing to learn, and yet I would hardly call myself a "successful" manager, because I have never had the opportunity to display these qualifications in any field large enough to attract attention to my work nor to redound very greatly to my credit or my financial benefit.

Now, I know that someone will say "Pshaw! The successful man—or manager—*makes* his opportunity." That is not true, and what is worse, it is not good sense. Opportunities are like poets, they are born and not made. It takes three things to make a successful manager; the capable man, the available opportunity and the ability to grasp it, and if they do not all come—and come together at the same time—well, there is "another good man gone wrong"!

So, Mr. Editor, if you do not feel convinced that I am right in both my arguments and my "terrible example," just you get some of those bankers and syndicates to turn loose a few fine, large opportunities and send them down this way, and I will soon prove to you and Mr. Vreeland (Mr. Smith does not need any proof on this point) that you both left out two very important qualifications!

Yours hopefully

BROWN, JONES AND ROBINSON.

The Car Hour Unit in Milwaukee

It will be remembered that at the last convention of the Street Railway Accountants' Association of America, H. C. Mackay, auditor of the Milwaukee Electric Railway & Light Company, made an able argument in favor of the use of the "car hour" instead of the "car mile" as a unit for comparing the results of operation. The "car hour" unit has also the indorsement of John I. Beggs, general manager of the company, and has been adopted by the company, as shown by the reproduction herewith of the company's daily earnings sheet. In this sheet the names of several of the divisions have been omitted to reduce the space required for the form.

This statement, as will be seen, gives a comparison of earnings by lines, together with a comparison of the service given to secure such earnings, and the effect of that service, and keeps the management thoroughly posted as to the service required.

An example is given in the form below, showing an increase in service of forty-five car hours, which has produced an excess revenue of $54. It has, however, reduced

THE MILWAUKEE ELECTRIC RAILWAY AND LIGHT COMPANY

Report of Passenger Earnings

For _____ } _____

Tickets Collected,
25 for $1.00
6 for .25

Comparison Made with Same Day of the Week	Car Hours		Earnings				
			Car Hour				
	1900	1899	1900	1899	1900	1899	Increase or Decrease
Wells St.,—Farwell Av	450	405	2.10	3.20	945.00	891.00	54.00
Fond du Lac Av.,—National Av							
Walnut St.,—National Av							
Sixth Av.,—Third St							
Greenfield Av.,—Third St							
Oakland Av.,—Russell Av							
Holton St.,—Mitchell St							
Muskego Av.,—Eighth St							
Clybourn St.,—Grand Av							
Private Cars							
Miscellaneous							
Total							

Year	Comparison Made With Current Date	Mileage			Earnings		
		Day	Month to Date	Year to Date	Car Hour	Month to Date	Year to Date
1900							
1899							
Increase or Decrease							

MILWAUKEE LIGHT, HEAT AND TRACTION COMPANY

Comparison Made with Same Day of the Week	Car Hours		Earnings				
			Car Hour				
	1900	1899	1900	1899	1900	1899	Increase or Decrease
West Park,—Wauwatosa							
Hawley Road,—N. Greenfield							
N. Greenfield,—Waukesha							
Racine,—Kenosha							
Kenosha City							
N. Milwaukee							
S. Milwaukee,—Racine							
Private Cars							
Miscellaneous							
Total							

Year	Comparison Made With Current Date	Mileage			Earnings		
		Day	Month to Date	Year to Date	Car Hour	Month to Date	Year to Date
1900							
1899							
Increase or Decrease							

the earnings per car hour from $2.20 to $2.10. Assuming the cost of operation to be $1.20 per hour, the result would be:

Year	Car Hours	Net Earnings
1900	450	$405.00
1899	405	405.00

Indicating that while the increased service has reduced the earnings per hour, the profit on the increased hours has made the net earnings equal.

Electric Express Company at Dayton

The Southern Ohio Express & Freight Company is now being organized at Dayton, Ohio, for the purpose of conducting the freight and express business on the electric lines centering at Dayton. The officials of the different electric railways centering at Dayton will be interested in the company, and it is said that James M. Randall, at present with Wells, Fargo & Company, will be general manager of the company. The capital stock of the company will be $100,000.

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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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Experience from visiting a large number of railway systems has shown that a pretty fair index of the care exercised in the maintenance of the entire road can be gained from the condition of the car house. While this is not always true, it is generally safe to conclude that where the car house is kept clean and light, and where the corners are not made the depository of worn-out parts and scrap, the line, as a whole, is kept in pretty fair condition. On the other hand, if the reverse is the case, slackness in management is generally present in other parts of the system. This is true not only because one part of the system is not likely to be better than the rest, but because the car house is to a certain extent the center of the maintenance department, and the microbes of trouble which develop outside on the road very often have their origin there. For instance, if a slovenly use of grease is permitted in the car house the repair men there soon look more like coal heavers than like mechanics, whose business it is to handle electrical machinery, and it is not strange if they should lack a certain pride in the maintenance in a cleanly condition of the apparatus under their care. Again, if dust and dirt are allowed to accumulate in the corners, they soon extend to the controllers and motors, and where there are miscellaneous piles of scrap and broken parts on the floor they often hide new supply parts and the tools used in car repairs. As a result the workman fails to find the tool he requires for the repair which he wishes to make, and often either neglects to make the repair entirely or uses an inferior substitute for the right article to save time. The ideal car house should not only be kept in good condition, but it should be so located that there is plenty of light from above and on the sides, and the light should enter the building in such a way that it is not cut off by a line of cars standing on the tracks. Where the structure is in the center of a crowded city, where natural light is not available, it is the best economy to use artificial illumination freely, as it is almost impossible to keep a dark car house in tidy condition. Eternal vigilance is the price of a low maintenance account, and a car house in good order is one of the most important factors in securing it.

* * * *

Another factor, however, is order and arrangement in the repair shop, and here also can often be found causes for a high repair bill. One of the most conspicuous of these causes is that there is no one person responsible for the tools used and there is no place to keep them when not in service. The time lost by workmen in searching for misplaced or lost tools will usually more than pay for a tool room and attendance to insure the return to the storeroom and keeping in proper order of the necessary tools used in repairs. Tools are lost and broken, and in order to save the first cost of the proper tools resort is made to all sorts of makeshifts, which involve loss in labor and the waste of good material. While it is true that a good workman does not blame poor work on the tools he employs, yet it is certain that better work can be produced where well kept tools suitable for their purposes are supplied. The large roads have learned by experience that these elements are vitally important essentials in bringing down the cost of repairs and in increasing the life of the equipment. In the smaller roads these matters are not so readily determined, but the cost of equipment repairs is high, and where the tool investment is small, the supply and labor investment is large for a given number of equipments maintained.

It has been found by several roads operating suburban and interurban lines that the powerful search-light beam from an arc headlight is of great benefit in running the cars at high speeds after dark. Such arcs are always supplied directly from the 500-volt circuits, by far the greater part of the power taken from the line for this purpose being wasted in dead resistance. By the use of the enclosed type of arc lamps from 80 volts to 100 volts can be usefully expended between the carbons. Enclosed arc lamps are

made for even higher voltages, some lamps used on 220-volt lighting circuits being designed to operate with as high as 150 volts or 160 volts between the carbons. It is difficult, however, to adjust the lamps so that they will operate successfully with such long arcs under the vibrations of car service, so that about 100 volts is all that can be usefully expended in the arc, the other 400, 450 or 500 volts, as the case may be, being wasted in the resistance. In an arc taking 6 amps. this means a waste of about 2½ kw or 3 kw, and any means of preventing this waste would remove a serious objection to the arc headlight. While this power can during a part of the year, be used to assist in heating the car by putting the headlight resistance in the car during the winter and outside of it in the summer, obviously the most useful application would be in the lighting of the car, as car lights and headlights are desired at the same time, summer or winter. If the car lights were wired in series with the arc headlight, in place of the usual resistance, they would be subjected to the fluctuations of the arc, and particularly to the jump of the current when the arc is struck by the closing of the carbons together on starting. The fluctuations of the enclosed arc are slight, and their effect upon a circuit with a large fall of voltage in series with the arc is still less, so that this factor would disturb the steadiness of the light of incandescent lamps less than the usual variations of trolley voltage. The jump of the current on striking the arc might, at first sight, appear to be a serious objection, but it must be remembered that even if the arc is short-circuited the lamps, normally burned at 450 volts, would only be getting 550 volts, not enough to burn them out very soon if of good quality and of low efficiency.

About two years ago one of the large Edison companies operating 80-volt enclosed arc lamps on its 115-volt mains tried the experiment of putting in incandescent lamps for the series resistance to absorb the 30 volts or 35 volts difference between the line voltage and that of the arc. These lamps, of course, got a tremendous rise of voltage when the arc was momentarily short-circuited by the closing together of the carbons. They operated satisfactorily, however, for some time; but, being simply used to illuminate a street corner sign, the arc itself giving all the light that was wanted, their value was small and their use was not extended. In street railway work, however, the 2500 watts or 3000 watts thrown away in series with an arc headlight would serve to light thirty or forty 16-cp lamps, enough to make even the longest double-truck car a blaze of illumination. This could be done without taking any current for the incandescent lamps, the waste of the headlight being used solely for this purpose. The wiring could easily be arranged to substitute a resistance for the arc light during those times when it is desirable to shut off the arc on meeting other cars, etc. It would be interesting to know whether this experiment has been tried, and if so, with what results.

Street Railway Consolidation.

Some time since we gave a brief investigation of the advantages to be derived from consolidating small roads into connecting systems, viewing the matter mainly from the operating side. The advantages gained in the way of cheaper motive power, increased traffic from other connections, and the possible advantage to be gained from consolidating power systems—all these causes operate to insure very material economies. There is, however, another side to the matter, viz: The gains to be made from consolidation in the matter of more general expenses than those to which we previously referred. Whatever views may be held with respect to the effect of consolidations broadly considered in the public interest, all political economists seem to be pretty well united for once upon the following proposition: That human energy misapplied, or applied at an economic disadvantage, is a loss to the community. Consequently there seems to be a general concurrence of opinion that as regards consolidations, viewed in their most general aspect, those changes due to consolidation which avoid needless expense and apply, on the whole, the energy of the organization more efficiently thereby, are, to both public and private interests, thoroughly beneficial.

A very brief investigation of the facts regarding the small street railways of the country will show that not only can consolidation improve their condition in the ways heretofore described, but more particularly by means of lessening unnecessary and wasteful expenditures, and enabling the general business of the consolidated companies to be carried on more economcially than would otherwise be the case.

Without endeavoring to analyze too closely the nature of these affairs, there are three directions in which consolidations are able to make a very remarkable improvement in the economic conditions surrounding such enterprises. These three are, economy in fixed charges, economy in administration, and economy in maintenance and repairs. Taking these up in order, an item which is apparent at the first glance is the advantage of large consolidated interests in the matter of funded indebtedness. When a group of roads pools its issues, and comes under a consolidated management, there is, in nearly every case, back of the enterprise financial support of the most solid character. Now, *per se*, such a backing may be no more responsible or of any higher integrity than the interests back of the small individual enterprises; but, nevertheless, it is a fact that the large interests represented in the case of consolidation can and do secure funds at a very materially lower interest rate than could possibly be obtained by the component parts of the enterprise.

There are still a good many small roads whose funded debt bears 6 per cent interest. They may be perfectly solvent and well administered, but under such general conditions that any further issue of bonds, for purposes the most legitimate, would practically have to be made at the same rate. A very large number of roads have of late been able to secure funds at 5 per cent, but below this rate only the biggest and solidest enterprises have, as yet, been able to go. Once let a group of small roads be consolidated or put into a single coherent solidly backed enterprise, and it becomes possible to secure further capital for proper administration, at a rate ½ per cent to 1 per cent better than could possibly be realized by the roads independently.

Now, street railways at the present time are operated on an average margin of profit so small, that saving of interest on funded debt is an advantage not lightly to be put aside. The last report of the Railroad Commissioners of

Massachusetts gives a vast amount of detailed information regarding the financial status of the various roads throughout the State. The average street railway in Massachusetts is, from necessity, rather conservatively capitalized and rather economically managed. Yet the report of the Railroad Commissioners shows that out of 116 companies doing business in the State, only fifty-four last year paid dividends; while the remaining sixty-two, of which thirty-eight had been in operation more than a full year, had paid no dividends whatever. This indicates that not a few roads, even in a time of more than average prosperity, are staggering along under the unpleasant burden of funded indebtedness.

For example, one small road which carried last year more than three-quarters of a million passengers, came out of the game $2.51 to the bad. Even a small saving in interest on its funded debt would have made a much pleasanter looking balance sheet, although it might not, and would not, have justified the payment of a dividend. Another road that shall be nameless here paid a dividend out of a surplus providentially secured the previous year, although it was blessed during the current twelve months with a visible net income of only $152.34. This statement is merely given to indicate that not all even of the fifty-four companies in Massachusetts which paid dividends had actually earned them during the current year. The long and short of it is that the margin of profit is so small in the operation of the average—not the favored—street railway, that the saving to be secured from the better financial standing, which, on the whole, comes from wise consolidation, is really a very valuable asset. The investor has a feeling of security in a carefully consolidated system that he never has with respect to most of the individual parts of which it is composed.

If this were the only gain to be secured by consolidating there might not be, in many cases, sufficient reason for such a step. But in the general administration of small roads there are necessary expenses which may be materially diminished when a group of roads is put under a united management. For instance, the items of superintendence and clerk hire, in other words, the general office expenses, are very materially reduced by a consolidation of management. In many cases the possible saving might only be 1 or 2 per cent of the operating expenses, but, such as it is, the economy is clear gain. With one set of general officers and an economically administered clerical department, a group of roads can generally be assured of enough saving to make a very perceptible change in the balance sheet.

But this is by no means the most important gain in administration which can be thus effected. Two of the items of general expense in street railway operations, not always appreciated by the general public but painfully evident to those in the business, are legal expenses and insurance. A strong consolidation gains in the former item, not only directly, but indirectly, on account of the considerably smaller probability of a certain class of legal actions being brought to a damaging termination. Every one engaged in the business of transportation sooner or later runs across litigious individuals who succeed in making themselves very disagreeable and sometimes very expensive to the enterprise in which he is concerned.

The general legal department can take care of such cases more cheaply and efficiently than is possible in the case of the small individual road, operating only in the district in which the action may chance to be brought. Legal expense is, however, as a rule, not a considerable portion of the operating expenses; although it not infrequently rises to half a per cent or more. A much more serious matter is the insurance, which is more or less involved in the question of legal expense in very many cases, inasmuch as a large part of the insurance expense is due to accident and liability insurance of one kind or another. A glance through the report just referred to shows that it is not uncommon to find as high as 5 or 6 per cent of the total operating expense charged to insurance. This is a very considerable amount and one in which a material saving would be highly desirable. Of course it is an open question as to how far it is economical for street railways to carry all or a part of their legitimate insurance charges, but the policy of at least partial self insurance is one often carried out successfully, and, in the case of large consolidated enterprises, a chance for gain of this kind is much greater than among roads considered individually.

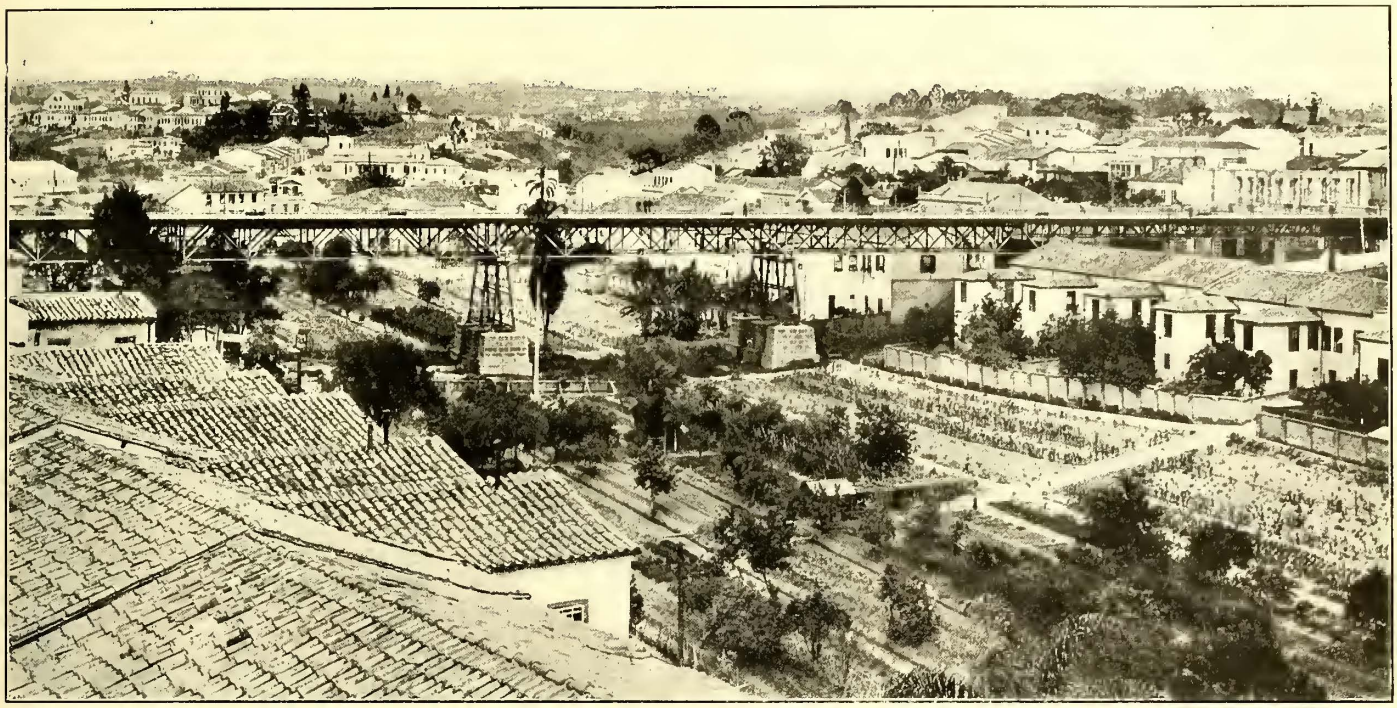
Closely allied to the question of general expense, yet in some features related to operating cost, is the matter of such organization as will secure economical buying, and careful and searching book-keeping. It is rather difficult for a small road in which one or two men are charged with a great variety of duties by way of superintendence, either to keep as close track of the books or to buy as advantageously as is easily possible when there is a regular accounting, auditing and purchasing department. Much of the advantage in consolidation as respects funded indebtedness also applies to the uniting of current purchases of material. On the whole, a large and solidly backed organization can buy cheaper and on better terms, and with more effective competition, than a small road operated as an individual and with comparatively limited resources. It will be very difficult indeed to estimate the amount of possible or probable saving due to this cause, but those practically in the business not infrequently have occasion to realize it.

In the department of operation and maintenance there is likewise a chance for very material economy. As a rule, large roads own and operate their own repair shops, and do much other miscellaneous work of a similar character, for which the necessary equipment is a considerable item of expense. Small roads, as a rule, have not this advantage, and consequently many items of maintenance fall most heavily upon those least able to bear them. The moment a consolidation takes place all the parties to it have the advantage of the aggregated facilities for repairs and maintenance.

The sum total of the items which we have enumerated as favorably affected by a union of roads under a single, strong management, is of amount not easy to estimate exactly on account of the varying conditions. It will generally, however, be as much as 10 per cent of the total operating expense, sometimes as high as 15 per cent. The possible savings from this amount are certainly large enough to make an essential difference in the year's balance sheet of the average road. It is worth noting that the savings here enumerated are practically dependent upon organic consolidation, while those to which we directed attention a few months ago can be, in part at least, secured through friendly affiliation.

The Sao Paulo Tramway, Light and Power Company

In the issue of July, 1899, the STREET RAILWAY JOURNAL announced the formation of the Sao Paulo Tramway, Light & Power Company, Ltd., and gave a short description of its plans. Recent reports from Brazil show that the undertaking is progressing very favorably. This company, it will be remembered, was organized under the laws of the Dominion of Canada, early in the year 1899, for the purpose of constructing and operating a combined electric light, power and street railway system in the city of Sao Paulo, State of Sao Paulo, Brazil, the concessions granted to F. A. Gualco and A. de Souza for these purposes having been assigned to the company. The construction work was commenced about the 1st of July, 1899.



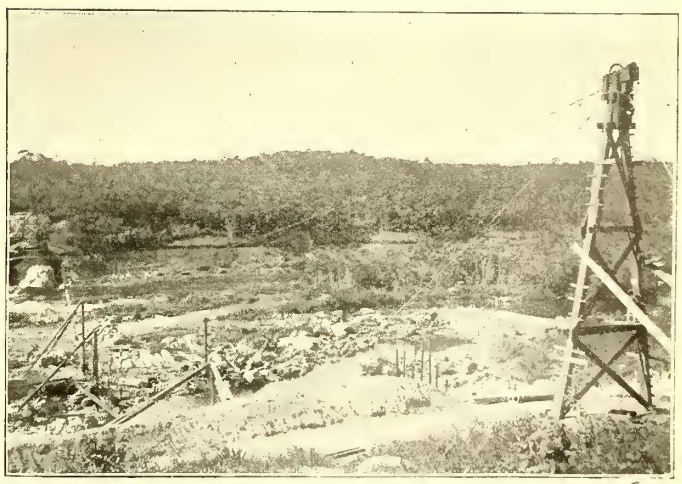
GENERAL VIEW OF SAO PAULO

The city of Sao Paulo has 260,000 inhabitants according to a census just completed. In addition to a large area of the city proper, there are several suburbs to which the company proposes to extend its lines. The city is substantially constructed, possessing many fine buildings, and is well provided with schools for general education, as well as for higher college work, including normal and law schools. The streets are well paved, a very large amount of money having been expended for this purpose within the last few years. A first-class waterworks system supplies all portions of the city, and all sections are well provided with sewers. The city is lighted with gas at the present time, and in a manner fully as satisfactory as that of any city of Europe or in this country, where gas lighting is still in vogue. The street lighting, waterworks and sewers are under the control of the State authorities.

The city of Sao Paulo is located upon a high plateau, about 2300 ft. above the sea level, and on account of climatic conditions, is noted for its healthfulness as compared with other Brazilian cities. The infectious diseases which are so prevalent in the seacoast cities are practically unknown at Sao Paulo, and it is very rare indeed that an isolated case is brought into the city from the seacoast. In consequence of its healthfulness the city of Sao Paulo is the manufacturing center of Southern Brazil, and one of the most important cities in the Republic in this respect. The manufactures are very diversified, consisting of bags, shoes, sugar, beer, cotton and woolen cloths, sacking for coffee bags, flour, brick, tile, coffee, machinery and other products.

A large amount of power is used in the city, now produced by steam, aggregating at least 4000 hp. The power plants are of various sizes, from 500 hp down, of which 1000 hp consists of motors, ranging from 5 hp to 25 hp. On account of the price of coal, the cost of steam power is quite high, and the consumers are very generally pleased at the prospect of securing a cheaper and better form of motive power.

The hydraulic plant is situated at Parnahyba, 21 miles from Sao Paulo, on the River Tiete. The initial installation will consist of three turbines of about 2000-hp capacity, directly connected to alternating-current generators of the three-phase type, with necessary step-up transformers, and high and low-tension switchboards. The building is being constructed so that a fourth turbine and generator can be installed at a later date if desired. As shown by the dotted lines on the general plan of power development the capacity can be doubled should occasion



VIEW OF DAM IN COURSE OF CONSTRUCTION

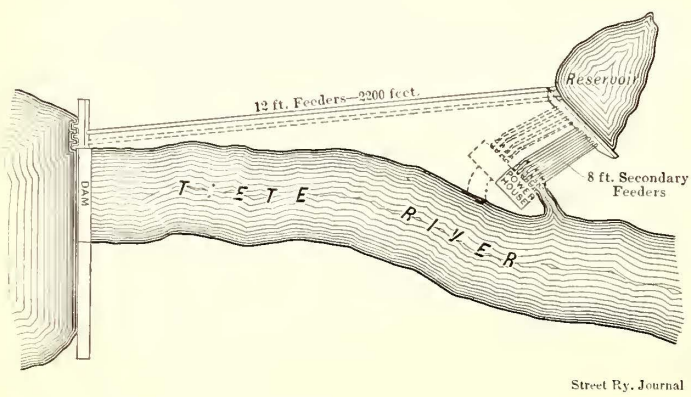
arise. The hydraulic plant consists of two dams, the larger crossing the River Tiete about 35 ft. in the clear height, and about 750 ft. long on the crest, constructed of rubble granite masonry, founded on solid ledge. The illustration shows the dam in course of construction. It will form a large storage reservoir of an average width of 660 ft., and a length of 4 miles to 5 miles in the main course of the river. In addition to this, there are several lateral branches, following up the course of streams emptying into the main river for long distances, and covering large areas, so that the combined surface area of the reservoir will probably exceed 600 acres, thus affording enormous storage capacity. The water will be conveyed from the dam to a small reservoir through a steel tube 12 ft. in diameter, by 2200 ft. in length. This tube will be supported every 10 ft. by steel saddles, similar to the one shown in the illustration. The irregularities in the surface of the ground are overcome by lengthening the uprights of these saddles, and making cuts through the hills. The view of the masonry foundations—which are made of granite rubble, capped with cement—shows the large amount of work required on this main feeder construction. To provide for changes in temperature three expansion joints of the type shown will be placed in this tube. These joints will allow quite a change of length in the pipe, the rubber gaskets effectually preventing leakage. The small reservoir, at a distance of 2200 ft. from the main dam, is formed by a small dam about 165 ft. long by 50 ft. high, across a ravine. The water is led to the turbines from this small dam through steel feeder-tubes, about 8 ft. in diameter and 178 ft. in length. Two small feeders, of about 3 ft. diameter, are provided for operating the exciter turbines. The head of water at the turbines will be about 75 ft.

MASONRY FOUNDATION FOR MAIN FEEDER TUBE

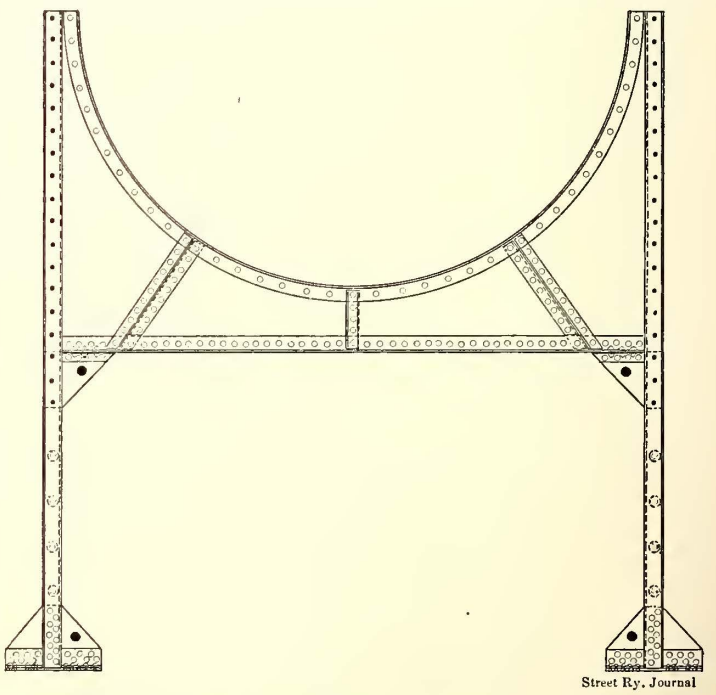
When completed there will be installed in the power house four horizontal twin turbines of a rated capacity of 1800 hp, direct connected to alternating-current generators; and two 150-hp turbines, connected to 100-kw exciters. The hydraulic apparatus is of the Victor type, from the Stilwell-Bierce and Smith-Vaile Company, and the electrical equipment is furnished by the General Electric Company. The alternating current is transformed by twelve step-up transformers of a total maximum capacity of 5600 kw to the line potential of 25,000 volts. The transformers are of the air blast type, the ventilating fans being made by the Buffalo Forge Company. For the operation of the apparatus and the control of the current, an extensive switchboard is provided, consisting of two high-tension line panels, one ground detector panel, four generator panels, two exciter panels, four high-tension and four low-tension transformer panels, and two totalizing panels. In both the main power station at Parnahyba and the sub-station in Sao Paulo the high-tension switchboards are placed on a gallery near the entrance for the transmission line. The other switchboards are placed on the main floor. All high-tension wiring is thus kept away from the low-tension circuits, the latter being, in general, placed under the floor in terra cotta ducts. The power station building is fireproof, built of concrete and iron, provided with traveling cranes, and machine shop for the repair of apparatus.

A substantial and comfortable dwelling house has been constructed, near the power station, for the accommodation of the employees of the company, who are to be stationed at Parnahyba. A telephone system connecting the Parnahyba station with the central one in Sao Paulo, and also connecting the various car houses, shops and offices of the company in the city, will be installed.

From careful measurements of the flow of water made last summer at the low water season, it was found that



GENERAL PLAN OF POWER DEVELOPMENT

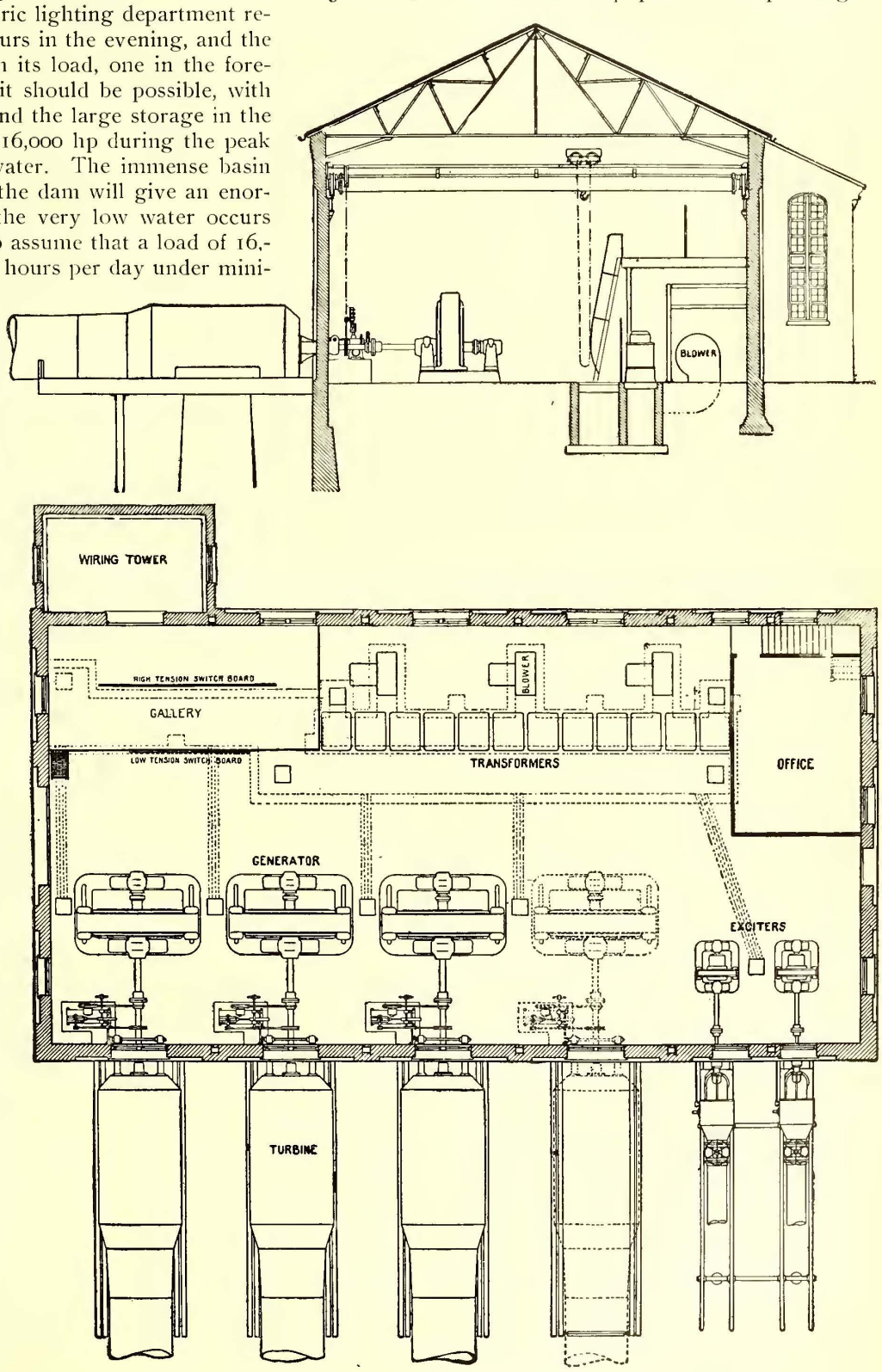


SADDLE FOR SUPPORTING MAIN FEEDER TUBE

there was a minimum of at least 6500 hp flowing through the twenty-four hours of the day. This was based upon accurate measurements, and on an assumption of a much lower water level than was actually found at any time during the summer or as stated by the old residents of Parnahyba. Inasmuch as the electric lighting department requires the power only a few hours in the evening, and the street railway has two peaks in its load, one in the forenoon and one in the evening, it should be possible, with this amount of water flowing and the large storage in the dam, to operate the station at 16,000 hp during the peak of load at the season of low water. The immense basin formed by the construction of the dam will give an enormous storage capacity. As the very low water occurs for a few days only, it is safe to assume that a load of 16,000 hp could be carried for ten hours per day under minimum conditions. With the exception of these few days there will always be at least double this amount, and during the high water season there is at least 140,000 hp available. The rise of water is very gradual, and there are never any sudden freshets in the river; there is also an absence of ice, consequently the troubles and dangers due to cold weather, connected with the operation of the hydraulic plants in the north, are absent. The work on the hydraulic power station is progressing rapidly, and it is hoped that the first power can be obtained from there about the first of next year.

The transmission line from Parnahyba to Sao Paulo will consist of two independent three-phase circuits, designed to operate at 25,000 volts. These circuits consist of No. 0 bare copper wire, and each is of sufficient size to transmit 2200 kw with a loss of about 10 per cent. Octagonal wooden poles are used, 34 ft. long, on which are supported two cross-arms, the braces and other pole fittings being of galvanized iron.

All of the current required for lighting power and street railway purposes will be distributed from a central step-down sub-station, in which the high-tension current at 23,000 volts will be reduced to 2300 volts, and where will also be located motor-generators, for the conversion of the alternating current to a 500-volt direct current for street railway use. This station will consist of a fireproof building, equipped with traveling crane. The electrical installation will consist of three 500-kw induction motors, direct-connected to 575-volt direct-current railway generators, and a synchronous motor set will probably be added. The motor-generators have been used instead of rotary converters, as it is claimed that they will give better regulation on the periodicity adopted, 60 cycles per second. There is also 600 arc lamp capacity of constant current transformers, ten 400-kw potential regulators for lighting circuits, twelve step-down transformers of total maximum capacity of 5600 kw, and switchboard equipments for operating the

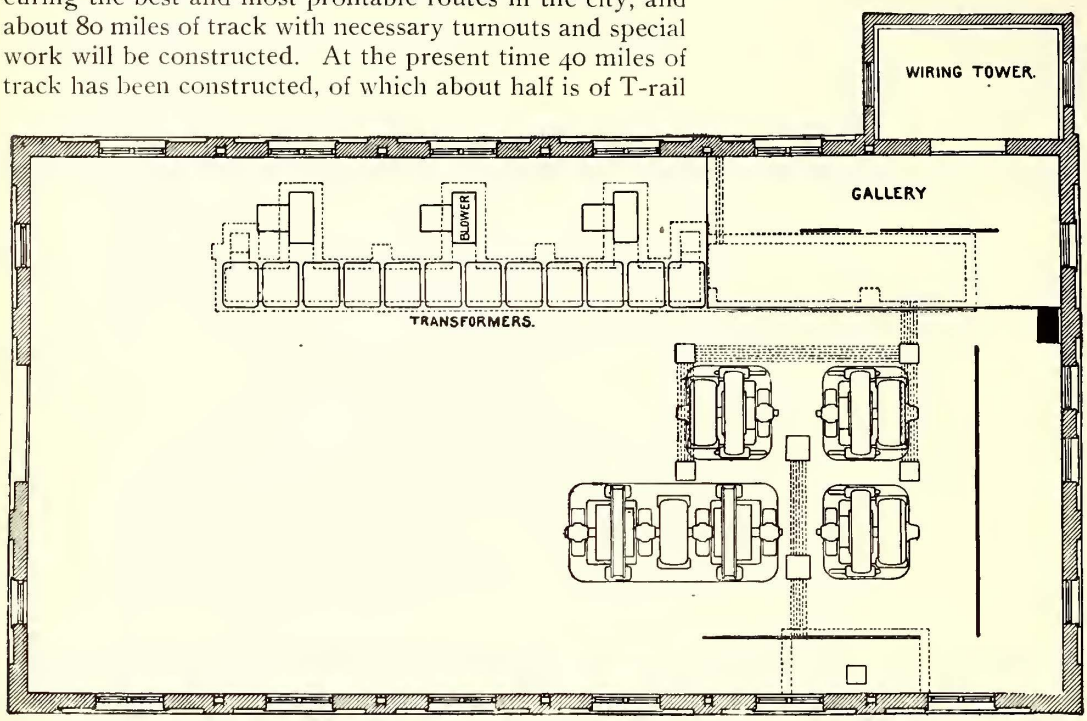


ELEVATION AND PLAN OF POWER HOUSE—PARNAHYBA

high and low-tension circuits, and for connecting the electrical apparatus above enumerated. These boards are very complete, and are equipped with the latest type of apparatus, consisting of two high-tension line panels, ground detector panel, four high-tension transformer panels, four low-tension transformer panels, one totalizing lighting panel, four motor panels, four railway generator panels, ten power-circuit panels, arc light circuit

panels for twelve 50-light circuits, and ten railway feeder panels.

The railway lines have been laid out with the view of securing the best and most profitable routes in the city, and about 80 miles of track with necessary turnouts and special work will be constructed. At the present time 40 miles of track has been constructed, of which about half is of T-rail and half of girder rail, Pennsylvania Steel Company's sections, No. 242 and No. 243 respectively.



PLAN OF SUB-STATION—SAO PAULO

The girder rail used is 7 ins. high, weighing 90 lbs. per yard, having a lip inside of the groove, which is on the level with the tread of the rail, for the purpose of preserving the pavement. The rails have a 6-in. base, resting on concrete stringers, with steel ties placed 10 ft. apart. These steel ties are made of 7-in. channels, and are 5 ft. 9 ins. long, imbedded in concrete. Drop forged brackets are used, four to each tie, for the purpose of bracing the rail.

STREET SCENE IN SAO PAULO—LAYING TRACK

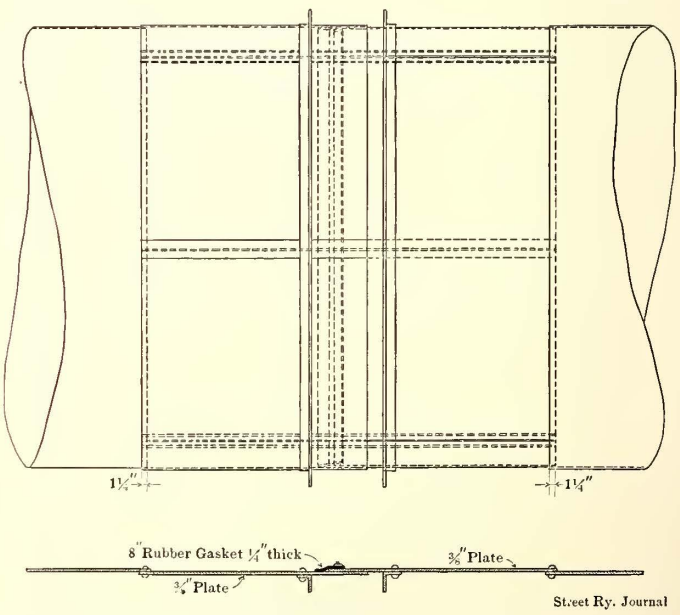
The whole surface is covered over to a distance of 2 ft. outside of each rail with a 4-in. layer of concrete, and to 5 ins. below the tread of the rail to allow for paving blocks. The T rails are 6 ins. high, weighing 62 lbs. per yard. The rails are placed on wooden ties, spaced 2 ft. apart, with four brackets to each tie, through which the rails are spiked to the ties, the whole lying on a layer of concrete 4 ins. thick.

On part of the line steel ties are used in place of the wooden ties. Both the T rail and girder rails are bonded with the West End type of bond.

The single pole overhead construction is illustrated in the engraving. This form is used in many places, but in the center of the city span wires are stretched from poles at the curbs.

The company is operating at the present time fifteen nine-bench open cars of the J. G. Brill Company's make. The cars are 29 ft. 8⅜ ins. in length over the crown pieces, and have a seating capacity of forty-five. They are mounted on Brill 21-E trucks, having a wheel base of 8 ft., and wheels 30 ins. in diameter. The cars are finished in cherry and ash, with a ceiling of three-ply birch veneer, neatly decorated. The cars are equipped with the Neal electric headlights and the Millen illuminated signs. Orders have just been placed with the St. Louis Car Company for fifty additional cars, to be of the same general design and finish as those now in use, and fitted with the same style trucks.

The motor equipments consist of General Electric Type 58 motors. These are rated at 37 hp each, and there are two motors per car.

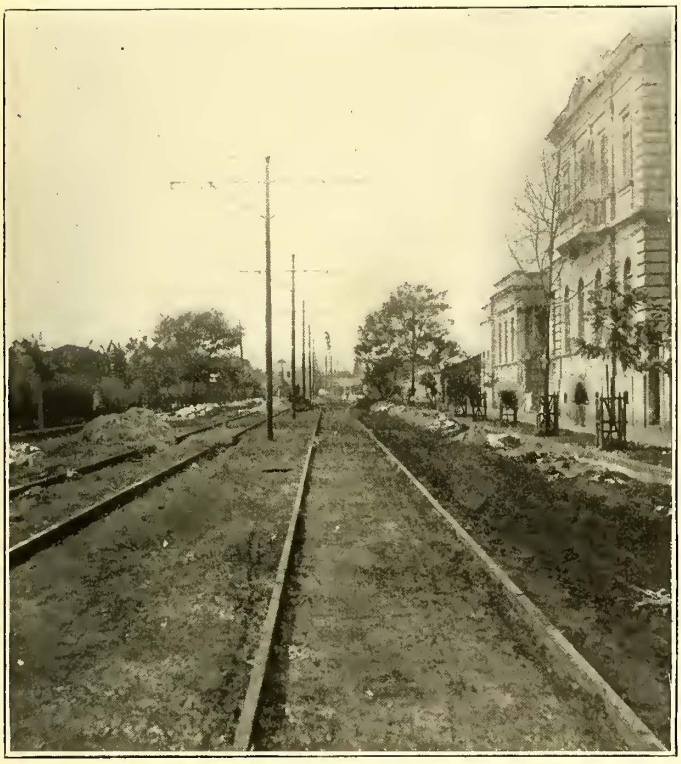


DETAILS OF EXPANSION JOINT IN MAIN FEEDER TUBE

The electric light system will consist of an underground installation for the center of the city, of a capacity sufficient to supply 10,000 16-cp incandescent lamps and 200 arc lamps. The remainder of the city and the suburbs will be supplied by an overhead system completely covering the entire territory, so that the current can be supplied in any street of the city or suburbs where there is a demand.

On account of the extremely high price of gas, due to the excessive cost of coal, and the great cost of kerosene

oil and other illuminants, the use of electric light will be almost universal, as already indicated by applications to the company, and the electric light system will need to be as extensive and general as the distributing system of a



T RAIL AND CENTER POLE CONSTRUCTION

gas company ordinarily is in a large city. The total capacity of the electric light system in wiring and transformers will be sufficient to supply 50,000 16-cp lamps and 800 arc lamps.

The system of distribution adopted is a single-phase alternating circuit, 2300-volt, 2-wire primary, with a network system of 3-wire secondary mains, at 115 volts. By means of a proper arrangement of feeders and location of transformers, a uniform potential will be maintained in the secondary network. It is proposed to operate from this system all the small motors and fans, for which there is a large demand, as well as to supply current for heating and cooking purposes.

In addition there will be installed a complete system of circuits for power distribution, reaching all sections of the city where power is used. In the central section of the city the motors will be supplied from a three-phase 430-volt underground circuit, the circuit being supplied from transformers situated in the lighting transformer vaults. The remainder of the city will be supplied by a three-phase 2300-volt overhead circuit.

It was very important to commence the operation of the company's lines in Sao Paulo at as early a date as possible, and as the hydraulic plant could not be built within eighteen months, it was deemed best to order a small temporary steam plant for the operation of the first electric lines. This plant, which is now in operation, consists of two 350-hp engines, built by the Robb Engineering Company, of Amherst, N. S., directly connected to 225-kw generators. This plant will operate about twenty cars. As already mentioned, fifteen cars only are now in operation, for which a small car house has been erected.

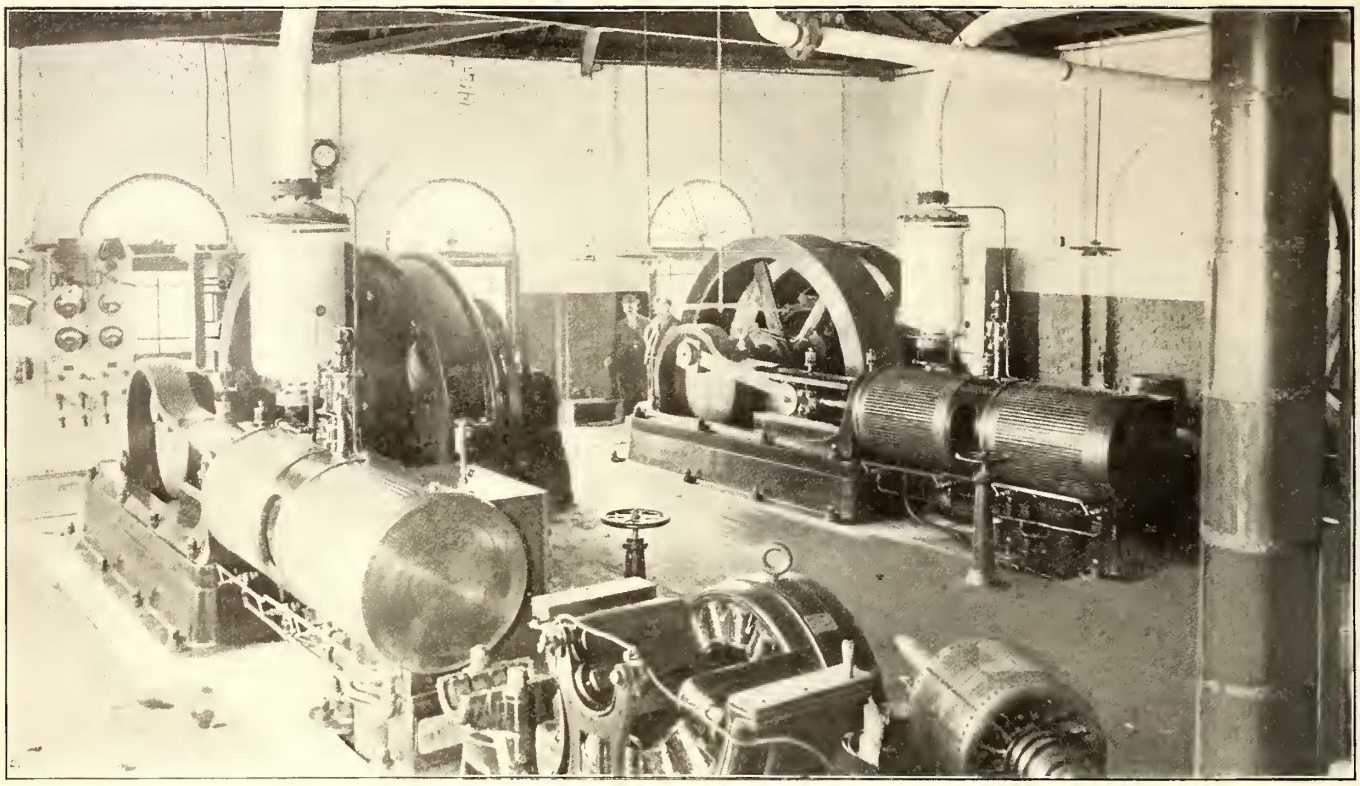
When the power is supplied by the hydraulic power station at Parnahyba, the cost of operating the tramway lines will be low, as open cars only are required, and there will be no snow expenses, while the wages of all classes of labor are very much lower than the ruling wages in this country. The cost of operating the plant at Parnahyba and the distribution of the current in Sao Paulo for lighting and for manufacturing purposes will also be very low. The men required for the direct operation of the plant will be experienced and well paid, but few of this class are needed, and the great body of employees required for the maintenance of the transmission lines in the city and the general conduct of the business will be of the ordinary laboring classes, so that the cost of producing and distributing the power will be fully as low, and probably less, than with any hydraulic power station in this country. Under these conditions it is believed that the ratio of net to gross income will be very high.

The contracts for the track materials, electrical and hydraulic equipment were placed a year ago at prices much less than those prevailing at the present time, and the cost of construction is being carried out well within the amounts estimated by the company's engineers.

At the time of the organization of the Sao Paulo Company and the commencement of the work there were two rival companies engaged in business in the city, one the Viacao Paulista, with about 57 miles of track, doing a street railway business with animal traction, the other the Agua Luz, operating an electric light business and supplying about 5000 incandescent lamps and 100 arc lamps. Negotiations are under way for the absorption of these two companies by the Sao Paulo Tramway, Light & Power Company, Ltd. The Viacao Paulista owns and operates two independent railway systems, one situated in the city of Sao Paulo and the other in Santos, a city of 60,000 inhabitants, about 50 miles distant from Sao Paulo, and one of the most important ports in Brazil. The plant and equipment of the Viacao Paulista includes about 57 miles

STREET SCENE IN SAO PAULO, SHOWING ONE OF THE OLD CARS

of track in Sao Paulo, 153 passenger cars, with an average seating capacity of twenty-three, twenty-six freight cars, two locomotives, 2300 mules, and ten car shops and stables.



INTERIOR OF STEAM POWER STATION, SAO PAULO

The company has in its employ in charge of the work at Parnahyba H. L. Cooper, one of the best known hydraulic engineers in this country. The general business of the company in Brazil is under the charge of Robert C. Brown, formerly electrical engineer of the West End Street Railway, of Boston, afterwards chief engineer of the Montreal Street Railway Company, and later general manager of the Halifax Electric Tramway Company, of Halifax, N. S. A. Mackenzie, of the firm of Blake, Lash & Cassels, of Toronto, is in charge of the legal interests of the company.

Changing the Broadway Road From Cable to Electric Power

The Metropolitan Street Railway Company, of New York, is utilizing the usually slack traffic months of July and August to make the necessary changes in the conduit of the Broadway cable railway to fit it for electric traction. This work is in line with the policy of the company, announced some time ago by President Vreeland, to change over all of its cable lines to the underground trolley system. The work is being carried on in sections of three or four blocks in length, so as not to obstruct the street to any greater extent than is necessary, and a section is completed and paved in before the adjoining section is opened. The reconstruction is being carried on without interfering with the operation of the cable cars, and as these cars run under a thirty-second headway during the greater portion of the day, and as the reconstruction not only involves radical changes in the conduit itself, but renewal of all tie-rods and track rails, it will readily be seen that the task is one of no small engineering difficulty. It is done by keeping the men at work as long as possible between bunches of three or four cars, then having them suspend operations until these cars have passed, then beginning their work again quickly. Of course at night the headway is much longer, and this allows the men to work under much more advantageous conditions.

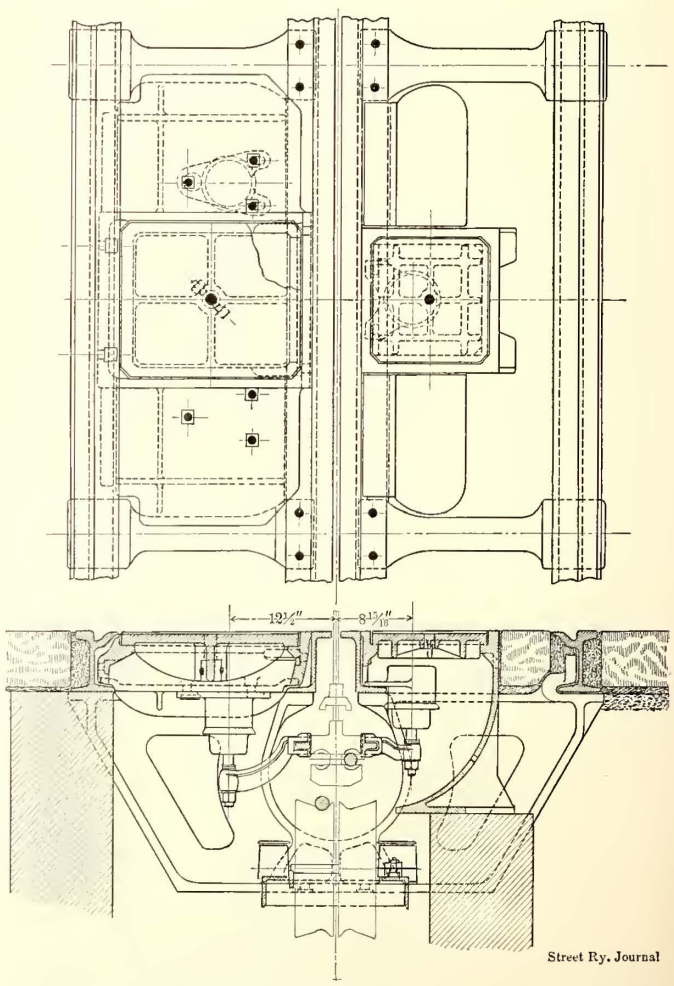
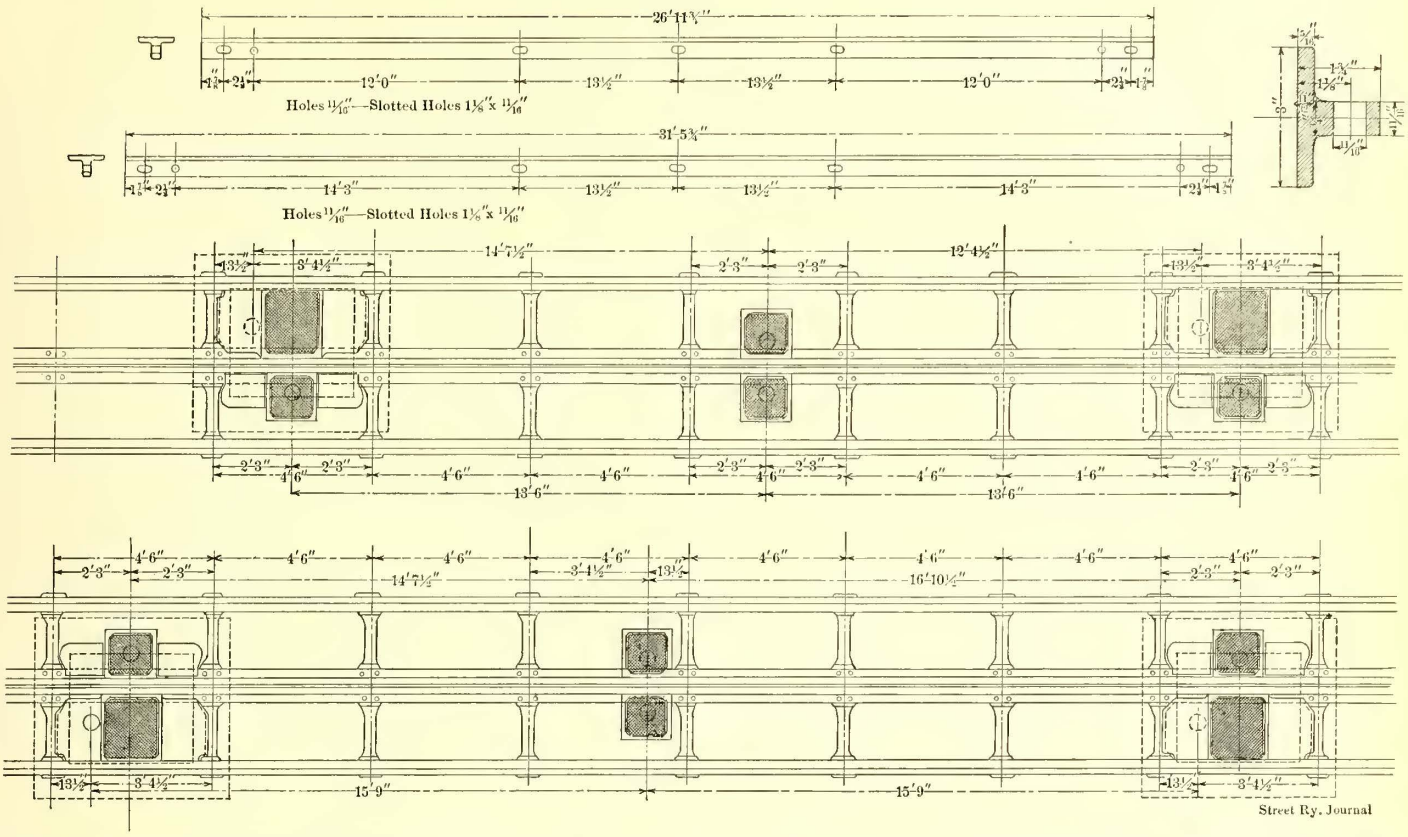


FIG 1.—SECTION AND PLAN, SHOWING BROADWAY CONDUIT, ELECTRICALLY EQUIPPED

The accompanying diagram, Fig. 1, shows a cross sec-

tion and plan of the Broadway conduit, as adapted for electric traction. For convenience of reference the existing cable sheaves and grip are superimposed on the section in light lines in their correct position. In the present work the insulators, brackets and conductors are not being installed, this being left for a later date, when they can be put in place through the hand-holes and grip hatches without disturbing the pavement.



GENERAL PLAN OF BROADWAY CONDUIT, SHOWING THE TWO STANDARD SPACINGS OF HAND-HOLES, ALSO CONDUCTOR BARS

The principal work now being done on the conduit itself is the cutting of the concrete for, and the setting in place of, the hand-hole curbs. In the original Broadway conduit the yokes were 4 ft. 6 ins. apart, and the carrier pulley vaults were spaced either 27 ft. or 31 ft. 6 ins. apart, depending upon local conditions. As shown in the plan, Fig. 1, which is of the conduit at such a vault, the old manhole cover was on one side of the slot rails only. This cover will not be interfered with, but the insulator for that side of the conduit will be supported on either one side or the other of the cover, depending on the spacing. Directly opposite each of these covers, however, a special hand-hole curb is being installed, as shown. This curb is of cast iron, rests on a concrete base, and is grouted in place. Midway between each manhole, also, similar hand-holes are being installed for insulators, so that the latter will be located either 13 ft. 6 ins. or 15 ft. 9 ins. apart. The original conduit was lined with sheet iron. This necessarily had to be cut away at the hand-holes, but is being left in position between the hand-holes. The form of conductor bars and insulators to be used is the same as on the rest of the system, and is shown in both engravings.

The method to be followed when the insulators and conductors are introduced in the conduit has not yet been announced, and this forms a very interesting problem. As will be seen from the section, if these conductors are placed in position while the cable is in use, the grip will be apt to collide with the conductors, and break the insulators. On the other hand, if cable operation is stopped during the considerably long process of introducing the insulators and conductors, the financial loss, owing to a suspension of traffic, would be considerable. It will be remembered that in the conversion of the Third Avenue Railroad the insulators were mounted on rods, so that they could be slid to the side of the conduit and equipped. When the company was ready to make the change to electricity, the cable was stopped and all the insulators in a section were slid forward into position together, taking a much shorter time than if all the work of placing them in position had to be done when cable operation was suspended. On the other hand the Capital Traction Company, of Washington, D. C., in altering over its Pennsylvania Avenue cable line to electricity, ran horse cars during the interruption.

Street Car Building

(Stephenson Practice)

BY CHARLES HENRY DAVIS, C. E.

VIII.—Assembling—(Continued)

In the August issue of the STREET RAILWAY JOURNAL we gave the details of the roofs for our two standard cars, namely, the Boston (closed) and the Brooklyn (open). Tables Nos. 37 and 38 give respectively the details of platforms for the standard cars, while Plates IX. and X. illustrate the various parts. As in tables Nos. 31, 32, 33, 34, 35 and 36, each distinct part of the platforms is described, giving the material, the general dimensions, how made, on what tools and how assembled, all in consecutive order as each car is built in the shop. In using these tables they are to be read across the page, line by line, as in the case of any book. In column 1 the numerals indicate, in consecutive order, the number of distinctive pieces; where a letter follows the numeral it indicates another operation, but not another distinctive piece. Letters in column 4 are the same abbreviations of woodwork and metal work as used on Plates I. and II. These tables are given on the following pages.

Table No. 37

Detail of Platforms of Boston Closed Car, in the Order of Assembling

(25 ft. Body; Car No. 2; Fig. 3; Plates I. and IX.)

Consecutive Number	Quantity	Name of Piece	Piece Number Plates I. and IX.	Material See Plates I. and II.	Details: Quantity	Details: Name	Details: Reference Letter Plate IX.	Dimensions	Observations and Particulars of How Used	Tools Usually Employed (Others can be used if convenience or necessity requires)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10) The various pieces of which the platforms are composed are assembled independently of all others, as was seen to be the case with the roofs, etc., and when completed they are attached to the car. These pieces are —	(11)
166	2	**Crown-pieces** (Fig. 296)	3003	O.	--	----------	--	6 ft. 1¾ in. x 14½ in. x 2¾ in.	Each having:—	
					2	Holes	a	9-16 in. diam.	For platform outer-sill (3001) bolts	Borer
					4	Holes	b	9-16 in. diam.	For platform inner-sill (3002) bolts	Borer
					2	Holes	c	13-16 in. diam.	For dasher short-end-posts (3504)	Borer
					2	Holes	d	13-16 in. diam.	For dasher center-posts (3505)	Borer
					2	Holes	e	13-16 in. diam.	For dasher intermediate-posts (3506) through platform outer-sills	Borer
					1	Hole	f	9-16 in. diam.	For pedal alarm-gong pin (3564)	Borer
					1	Hole	g	7-16 in. diam.	For brake-shaft pawl-pin (3527)	Borer
					1	Hole	h	4 in. x 1⅝ in.	For wiring	Borer
					2	Holes	i	9-16 in. diam.	For bolts for brake-shaft lower-bearing (3517) Fig. 331	Borer
					2	Holes	k	9-16 in. diam.	For bolts for platform step-hanger (3531)	Borer
167	4	**Platform outer-sills** (Fig. 294)	3001	A.	--	----------	--	6 ft. 8 in. x 7½ in. x 3 in.	Each having:—	
					1	Gain	a	10¾ in. x 2¾ in.	For crown-piece to rest on	Band saw or shaper
					2	Chamfers	b	----------	To round off the sharp edges	Chamfering machine
					1	Hole	c	9-16 in. diam.	For 7 in. x ½ in. round-head bolts to secure the crown-piece through holes (a) of the crown-piece	Borer
					1	Hole	d	13-16 in. diam.	For securing crown-piece by means of intermediate-post through hole (e of crown-piece	Borer
					1	Tie-bolt	e	6 in. x ½ in.	To prevent the sill from splitting at (f)	
					2	Holes	g	11-16 in. diam.	On the underside for bolts to secure the sills to the side-sills through holes (m) Fig. 33, Plate IV.	Borer
168	4	**Platform inner-sills** (Fig. 295)	3002	A.	--	----------	--	5 ft. 11 in. x 7 in. x 2¾ in.	Each having:—	
					1	Gain	a	14 in. x 2½ in.	For crown-piece to rest on	Band saw or shaper
					1	Gain	b	4½ in. x ½ in.	For iron buffer. These are on the underside of this part, but not seen	Band saw or shaper
					2	Holes	--	9-16 in. diam.	For 7 in. and 6⅜ in. x ½ in. round-head bolts to secure crown-piece through holes (b) of the crown-piece	Borer
					1	Tie-bolt	c	6 in. x ½ in.	To prevent the sills from splitting at (d)	
					1	Hole	e	13-16 in. diam.	On underside, for bolts to secure the sills to the intermediate cross-sill (6) Fig. 38, Plate IV. (*see Con. No. 6, Table No. 31*), through hole (h)	Borer
					1	Hole	f	13-16 in. diam.	On underside, for bolts to secure the sills to the end-sills (2) through hole (e) Fig. 36, Plate IV. (*See Con. No. 10, Table No. 31.*)	Borer
					2	Chamfers	g	----------	To round off the sharp edges	Chamfering machine
169	8	**Platform flooring-boards** (Figs. 297, 298)	3004	Y. P.	--	----------	--	4 in. wide, 1 in. thick	Having:—	
					2	Gains	a	----------	Next the car body to allow rain water on the platform to fall through to the ground. They are screwed to the sills with 128 No. 12 in. x 1¾ in. steel screws	Shaper
170	4	**Crown-piece corner-irons** (Fig. 307)	3501	W. I.	--	----------	--	17 in. x 2¾ in. x ⅛ in.	Each having:—	
					1	Hole	a	----------	For No. 12 in. x 1½ in. steel screws to secure it to the crown-piece	Power punch
					1	Hole	b	----------	For 2½ in. x ½ in. lag screws to secure it to the crown-piece	Power punch
					4	Holes	k	----------	For bolts, same as shown at (k) Fig. 296, for platform step-hangers	Power punch
171	4	**Dasher short-end-posts** (Fig. 312)	3504	W. I.	--	----------	--	2 ft. 11-16 in. x 1½ in. x ⅞ in.	Are now inserted in holes (c) Fig. 296, of the crown-piece, the	
172	4	**Dasher-post washers** (Fig. 317)	3507	C. I.	--	----------	--	3½ in. x 1¼ in.	Being first slipped over the end of the post; they are then tightened up with the flat washer and nut under the crown-piece	
173	4	**Dasher center-posts** (Fig. 313)	3505	W. I.	--	----------	--	2 ft. 8¼ in. x 1½ in. x ⅞ in.	Inserted in holes (d) of the crown-piece, and with	
173a	4	**Dasher-post washers** (Fig. 317)	3507	C. I.	--	----------	--	3½ in. x 1¼ in.	Are tightened up with the flat washer and nut under the crown-piece	
174	4	**Dasher intermediate-posts** (Fig. 314)	3506	W. I.	--	----------	--	2 ft. 8¼ in. x 1½ in. x ⅞ in.	Inserted in holes (e) of the crown-piece, and through holes (d) of the platform outer-sills, and with	
174a	4	**Dasher-post washers** (Fig. 317)	3507	C. I.	--	----------	--	3½ in. x 1¼ in.	Are tightened up with the flat washer and nut under the crown-piece	
175	2	**Dashers** (Fig. 299)	3511	S.S.	--	----------	--	2 ft. 8 in. x 5 ft. 10 in.	No. 14 gage, bent to fit around the crown-piece, to which they are secured with 20 No. 12 x 1 in. blued steel screws through holes (a), they are fastened to the dasher short-end-posts with	
176	12	**Dasher end-posts straps** (Fig. 311)	3508	W. I.	--	----------	--	1 in. wide	Slid over the end-posts and bolted to the dashers through holes (b) with 24 round-head ¼-in. stove bolts	
177	8	**Dasher-post top-clips** (Fig. 315)	3509	W. I.	--	----------	--	1 in. wide	Bolted round the center and intermediate-posts to the dashers through holes (c) with 16 round-head ¼-in. stove bolts	
178	8	**Dasher-post bottom-clips** (Fig. 316)	3510	W. I.	--	----------	--	1 in. wide	Bolted round the center and intermediate-posts to the dashers through holes (d) with 16 round-head ¼-in. stove bolts	
179	2	**Iron-buffers** (Fig. 334)	3530	M. I.	--	----------	--	22 in. x 5 in.	Are now bolted to the crown-piece with two bolts, 4¼ in. x ½ in., and to the crown-piece through the platform inner-sills with 4 bolts, 5¾ in. x ½ in., countersunk round heads, and screwed to the crown-piece through holes (a) with 4 lag screws, 3½ in. x ½ in. The undersides of the platforms now receive 2 coats of lead paint mixed in oil, after which they are attached to the car body, the platform outer-sills being secured with 4 bolts 12½ in. x ⅝ in. and 4 bolts 15¼ in. x ⅝ in. through holes (g) of the outer-sills and the holes (m) of the side-sills, Fig. 33, Plate IV. Further, 4 bolts 16½ in. x ¾ in. and 4 bolts 20 in. x ¾ in. are passed through the holes in	
180	4	**Platform-sill clamps** (Fig. 304)	3502	W. I.	--	----------	--	----------	Which are placed under the part (h) of the outer-sills, then the 16½ in. bolts are passed through holes (d) in the end-sills, and the 20 in. bolts through holes (l) in the side-sills, Fig. 33, Plate IV., and holes (b) in the end-sills, Fig. 36, Plate IV., and are well screwed up	
181	4	**Sill-bolt beveled-washers** (Fig. 305)	3503	C. I.	--	----------	--	----------	Are inserted under the bolt nuts on the sloping underside of the outer-sills to give a firm bearing. The platform inner-sills are then secured with 4 bolts, 9 in. x ¾ in. through holes (e) of the inner-sills and the holes (h) of the intermediate cross-sills, Fig. 38, Plate IV., and 4 bolts, 16½ in. x ¾ in. through holes (f) of the inner-sills, and the holes (e) of the end-sills, Fig. 36, Plate IV., there being used	
181a	4	**Sill-bolt beveled-washers** (Fig. 306)	3503	C. I.	--	----------	--	----------	For the holes (e) of the inner-sills	
									The following are now adjusted and secured, to a large extent in the order given, though for convenience or other reasons this may be sometimes departed from.	

182	8	**Platform step-hangers** (Fig. 308)	3531	S. S.	--	----------	--	3-16 in. thick	In pairs, are now bolted to the platform step-hanger brackets (1512), Fig. 123, Plate V. (*see Con. No. 85, Table No. 33*, with 8 bolts, 1½ in. x ⅜ in., clearly shown in Fig. 351, and to the crown-piece through holes (k), Fig. 296, with 4 6 in. and 4 7 in. x ½ in. bolts. They are further secured with
183	4	**Platform-step hook-bolts** (Fig. 320)	3581	W. I.	--	----------	--	4 in. x ⅜ in.	Bolted through the platform outer-sills, and hooked to the step-hanger as shown in Fig. 359
184	4	**Platform-step tread-boards** (Fig. 310)	3005	A.	--	----------	--	2 ft. 8 in. x 12 in. x 1 in.	Bolted to platform step-hangers with 32 countersunk bolts 1½ in. x 5-16 in. through holes (a)
185	4	**Platform step-fenders** (Fig. 309)	3534	M. I.	--	----------	--	2 ft. 9 in. x 7⅛ in. x 4¾ in. x ¼"	Screwed to the front of the tread-boards and outer-sills with 40 No. 12 x 1 in. steel screws
186	4	**Platform-step tread-board facing-irons** (Not Ill.)	3533	W. I.	--	----------	--	⅞ in. half-round	Screwed to the front of the tread-boards with 36 No. 14 x 1 in. steel screws
187	2	**Switch-stick rings** (Fig. 318)	3560	M. I.	--	----------	--	----------	Placed on the left-hand dasher intermediate-posts, resting on the dashers
188	2	**Trolley-cord rings and snaps** (Fig. 319)	3561-2	M. I.	--	----------	--	----------	Placed on the left-hand dasher center-posts, resting on the dashers
189	2	**Dasher-rails** (Fig. 302)	3512	W. S.	--	----------	--	5 ft. 5½ in. x 1¼ in. x ⅜ in.	Is adjusted to the dasher-posts by the 4 holes (a) and secured by the nuts shown; there are further in each rail:—
					5	Holes	b	5-16 in. diam.	For bolts to hold the dasher rail-caps (3513), Fig. 303 — Drill press
					2	Holes	c	5-16 in. diam.	For bolts to secure the dasher-rail grab-handle (3514), Fig. 300 — Drill press
					2	Holes	d	⅜ in. diam.	For bolts to secure the brake-shaft upper-bearing (3516), Fig. 328 — Drill press
190	2	**Dasher-rail caps** (Fig. 303)	3513	Bz.	--	----------	--	5 ft. 7 in x 2 in. x ⅞ in.	Bolted to the dasher rails with 10 square-head bolts, 1¼ in. x ¼ in. through holes (b)
191	4	**Dasher-rail grab-handles** (Fig. 300)	3514	Bz.	--	----------	--	----------	Adjusted to the dasher intermediate and short end-posts and secured to the dasher-rails with 4 round head bolts, 1 in. x ¼ in., through holes (c) and with the bolts going through holes (b) of the dasher-rail. They are secured to the short end-posts with
192	4	**Dasher-rail grab-handle nuts** (Fig. 301)	3515	Bz.	--	----------	--	----------	Screwed to the short end posts
193	--	**Brake-shafts complete** (Fig. 321)	3519	----	--	----------	--	----------	Consisting of:
193a	2	**Brake-shafts** (Fig. 321)	3520	W. I.	--	----------	--	1½ in. diam.	With
194	2	**Brake ratchet-handles** (Figs. 321, 322)	3521	Bz.	--	----------	--	----------	In which are
195	2	**Brake ratchet-handle upper-ratchets** (Fig. 323)	3522	M. I.	--	----------	--	----------	With
196	2	**Brake ratchet-handle springs** (Fig. 324)	3524	W. S.	--	----------	--	----------	While to the top of the brake-shafts are secured
197	2	**Brake ratchet-handle lower-ratchets** (Fig. 321)	3521	M. I.	--	----------	--	----------	Which interlock with the upper-ratchets
198	2	**Brake-shaft upper-bearings** (Fig. 328)	3516	M. I.	--	----------	--	----------	Bolted to dasher-rail through holes (d), Fig. 302, with 4 bolts 1¼ in x 5-16 in.
199	2	**Brake-shaft lower-bearings** (Fig. 331)	3517	M. I.	--	----------	--	----------	Bolted to the crown-piece through holes (i), Fig. 296, with 4 bolts 14 in. x ½ in.; the cut-outs (e), Fig. 299, at the bottom of the dasher fit round these pieces and also make room for
200	2	**Brake-shaft ratchets** (Fig. 329)	3525	C. I.	--	----------	--	----------	Fitted tight to the brake-shaft and keyed
201	2	**Brake-shaft pawls** (Fig. 326)	3526	M. I.	--	----------	--	----------	Are secured to the crown-piece by means of
202	2	**Brake-shaft pawl-pins** (Fig. 325)	3527	W. I.	--	----------	--	----------	Which are bolted through
203	2	**Brake-shaft pawl-washers** (Fig. 327)	3528	M. I.	--	----------	--	----------	The brake-shaft pawl and hole (g) in the crown-piece, Fig. 296
204	2	**Brake-chains** (Fig. 332)	3529	W. I.	--	----------	--	⅜ in., 30 in. long	Are bolted to the brake-shaft through the hole (a) below the ratchet, Fig. 321
205	2	**Brake-shaft steps** (Fig. 330)	3518	C. I.	--	----------	--	----------	Are bolted later to the drawbar-rest (3007), Fig. 348, through the holes (c) with 4 bolts 3¼ in. x 5-16 in.
206	--	**Drawbar spring-castings complete** (Fig. 335)	3535	----	--	----------	--	----------	Composed of:—
206a	2	**Drawbar spring-castings** (Fig. 336)	3536	M. I.	--	----------	--	----------	Bolted under the platform to the platform inner-sills with 4 bolts 9½ in. x ⅝ in. and 8 bolts 9 in. x ⅝ in. through holes (a)
207	2	**Drawbar springs** (Fig. 339)	3537	W. S.	--	----------	--	----------	Fitting inside the casting, while going through it and the ends of the casting are
208	2	**Drawbar-heads** (Fig. 341)	3539	M. I.	--	----------	--	----------	Upon which at each end of the springs fit
209	2	**Drawbar spring-plates** (Figs. 337, 338)	3538	M. I.	--	----------	--	----------	The heads are held in the castings by means of
210	2	**Drawbar-head keys** (Fig. 335)	3549	W. I.	--	----------	--	----------	Inserted in the end of the heads, through the slot (a), Fig. 341. When the car is to draw a trailer
211	2	**Drawbar plain radial-bars** (Fig. 349)	3544	W. I.	--	----------	--	4 ft. 2 in x 2¼ in. x 1⅛ in.	Are inserted between the jaws (b) of the head (3539) and secured by
212	2	**Drawbar coupling-pins** (Fig. 340)	3540	W. I.	--	----------	--	----------	Which are prevented from being jolted out by
213	2	**Drawbar coupling-pin cotters** (Fig. 335)	3541	W. S.	--	----------	--	----------	Inserted in holes in the pins. To complete the outfit for trailers
214	1	**Drawbar coupling-link** (Fig. 344)	3546	M. I.	--	----------	--	----------	Is secured by one of its
215	2	**Drawbar coupling-link pins and chains** (Fig. 344)	3547	W. I.	--	----------	--	----------	To the other end of the drawbar radial-bar (3544), the other end being similarly coupled to the trailing car
216	1	**Drawbar coupling-link box** (Fig. 343)	3008	W. P.	--	----------	--	----------	For stowing away the coupling-link when not in use, is secured to the underside of the car bottom by
217	2	**Drawbar coupling-link box-straps** (Fig. 342)	3559	W. I.	--	----------	--	----------	Secured to the link-box with 12 No. 14 x 1 in. steel screws, and to the car bottom with 4 No. 14 x 1¼ in. steel screws
218	--	**Drawbar supporting-frames complete** (Fig. 359)	----	----	--	----------	--	----------	Composed of
218a	2	**Drawbar-rests** (Fig. 348)	3007	A.	--	----------	--	6 ft. 0 in. x 3 in. x 1½ in.	With
219	2	**Drawbar-rest wearing-plates** (Fig. 350)	3550	W. I.	--	----------	--	----------	Screwed to the rests with 20 No. 14 x 1 in. steel screws. To these rests are secured one end of each of the following supporting pieces, the other ends of same being secured to the platform:—
220	4	**Drawbar-rest hangers** (Fig. 352)	3552	W. I.	--	----------	--	1 ft. 5 in. x 1½ in. x ½ in.	Bolted to the drawbar-rests through holes (b) with 4 bolts, 3¼ in. x ½ in. and to the crown-pieces with 4 bolts 3¾ in. x ½ in. countersunk heads
221	4	**Drawbar-rest hangers** (Fig. 353)	3552	W. I.	--	----------	--	1 ft. 5½ in. x 1½ in. x ½ in.	Bolted to the drawbar-rests through holes (a) with 4 bolts 3¼ in. x ½ in., and to the crown-pieces with the dasher short-end-posts (3504)
222	4	**Drawbar-rest braces** (Fig. 358)	3553	W. I.	--	----------	--	1½ in. x ⅛ in.	Bolted to the drawbar-rests through holes (b) with the same bolts as used for the hangers, Fig. 352, and to the platform outer-sills with 4 bolts 3¾ in. x ½ in.
223	20	**Drawbar-rest toe-guards** (Fig. 354)	3554	W. I.	--	----------	--	½ in. diam.	Screwed to the drawbar-rests with 20 No. 12 x 1 in. steel-screws, and to the crown-pieces with 20 No. 12 x 1 in. steel screws
224	2	**Drawbar-guards** (Fig. 347)	3006	A.	--	----------	--	4 ft. 4 in. x 3 in. x ¾ in.	Bolted to the drawbar-rest hangers, Fig. 352, through holes (a) with 4 bolts, 1½ in. x ⅜ in.
225	4	**Fender-sildes** (Fig. 357)	3555	M. I.	--	----------	--	----------	In pairs, bolted through holes (a) to the drawbar-rest through holes (a) with the same bolts as used for the hangers, Fig. 353, and through holes (b) to the drawbar-rests through holes (e) with 8 bolts, 3¾ in. x 5-16 in.
226	4	**Fender adjusting brackets** (Fig. 355)	3556	M. I.	--	----------	--	----------	Bolted to the platform-step tread-boards, Fig. 310, through holes (b) with 8 bolts 2 in. x ½ in.
227	2	**Fender holding-sockets** (Fig. 356)	3557	M. I.	--	----------	--	----------	With
228	2	**Fender holding-pins** (Fig. 356)	3558	W. I.	--	----------	--	----------	Bolted to the drawbar rests through holes (d) with 4 bolts 2¾ in. x ½ in.
229	2	**Upper-deck grab-handles** (Fig. 342a)	2504	W. I.	--	----------	--	----------	Seen in Fig. 359, screwed to the upper-deck roof with 4 No. 14 x 1½ in. and 4 No. 12 x 1½ in. steel screws
230	2	**Pedal alarm-gongs** (Fig. 345)	3563	S.	--	----------	--	----------	With
231	2	**Pedal alarm-gong castings and hammer** (Fig. 345)	3565	M. I.	--	----------	--	----------	Are secured to the underside of the platform with 2 bolts 5½ in. x ¾ in. and 2 bolts 3⅜ in. x ⅜ in
232	1	**Pedal alarm-gong pin** (Fig. 346)	3564	W. I.	--	----------	--	----------	Passes through hole (f) in the crown-piece, and is detachable for use on either platform
233	4	**Platform-gates and fixtures** (Fig. 333)	3566	W. I.	--	----------	--	Wood's make	Screwed to the ends of the car with 12 No. 15 x 1¼ in., 24 No. 16 x 2 in., 8 No. 20 x 2 in. and 8 No. 20 x 1¼ in. steel screws

Number of Distinctive Pieces ..... 67 (Column 1)
Total Number of Pieces ..... 235 (" 2)
Number of Bolts ..... 244 (" 6 and 10)
Number of Screws, about ..... 372 (" 6 and 10)
Number of Nails ..... (?)

Total ..... 851 +

Nearly all the pieces and means of attachment described in this table can be clearly seen in Figs. 351 and 359. During the erection of the pieces enumerated in this table, work has been progressing in the interior of the car. (*See Table No. 39 and Plate XI.*)

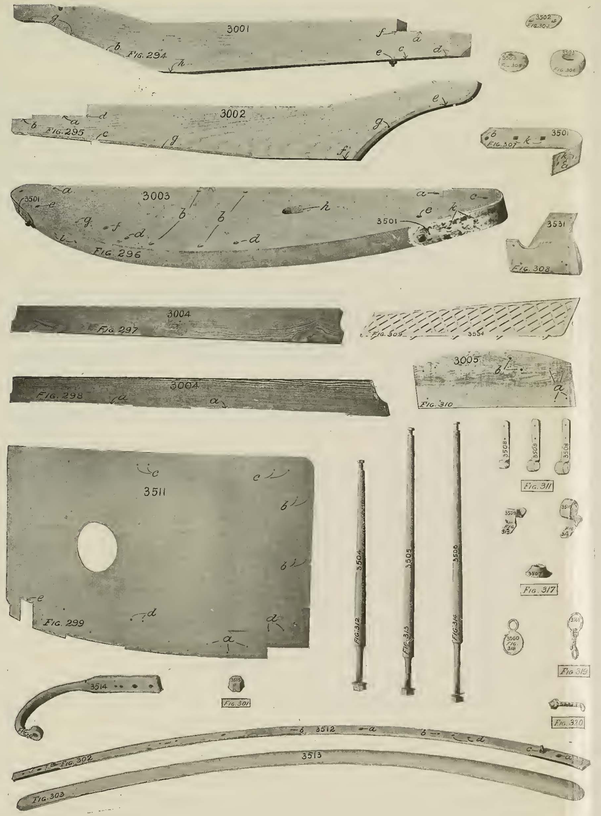
Table No. 38

Detail of Platforms of Brooklyn Open Car, in the Order of Assembling

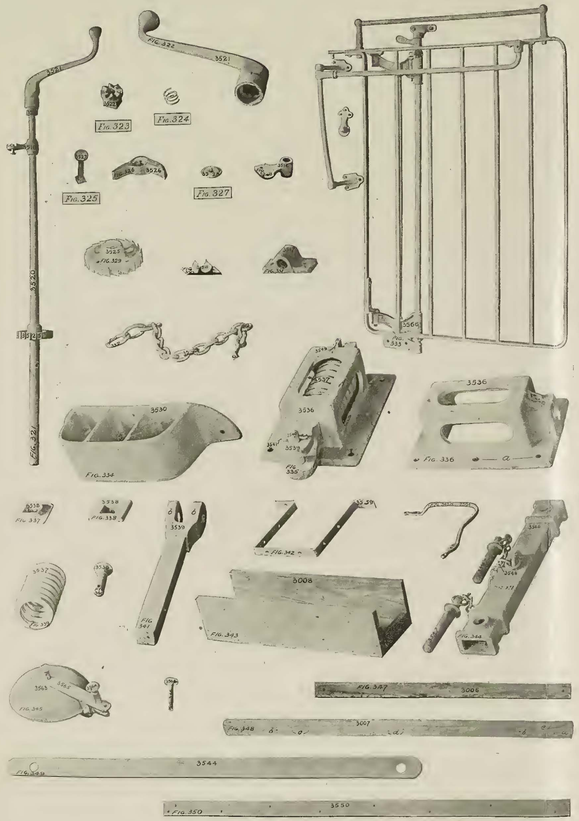
(12 Benches; Car No. 4; Fig. 5; Plates II. and X.)

Consecutive Number	Quantity	Name of Piece	Piece Number Plates II. and X.	Material See Plates I. and II.	Details: Quantity	Details: Name	Details: Reference Letter Plate X.	Dimensions	Observations and Particulars of How Used	Tools Usually Employed (Others can be used if convenience or necessity requires)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
106	4	**Dasher center-posts** (Fig. 363)	8504	W. I.	--	----------	--	41 in. x 1 in.	Are inserted in holes (c) of the crown-piece (5028) Fig. 62, Plate IV., passing through holes (c) of the platform inner-sills (8018) Fig. 61, and bolted underneath	
107	4	**Dasher intermediate-posts** (Fig. 362)	8505	W. I.	--	----------	--	36½ in. x 1 in.	Are inserted in holes (d) of the crown-piece (5028) and bolted underneath	
108	8	**Dasher-post washers** (Figs. 362, 363)	8506	C. I.	--	----------	--	----------	Are passed over the bottom ends of the posts before being inserted in the crown-piece holes	
109	2	**Dashers** (Fig. 360)	8501	S. I.	--	----------	--	No. 16. 6 ft. 6 in. x 2 ft. 8 in.	With hole 9⅝ in. diameter in center for electric headlights, screwed to crown-pieces through holes (●) with 48 No. 12 x 1 in. blued steel screws, round heads	
110	8	**Dasher-post bottom-clips** (Not Ill.)	8509	S. I.	--	----------	--	1⅛ in. wide, ⅛ in. thick	Bolted round the center and intermediate-posts to the dashers through holes (b) with 16 round-head ½ in. x 3-16 in. stove-bolts	
111	2	**Dasher-moldings** (Fig. 383)	8003	A.	--	----------	--	6 ft. 6 in. x 1¼ in. x ⅞ in.	Screwed to dasher through holes (c) with 46 No. 9 x ¾ steel screws	
112	8	**Dasher-post top-clips** (Not Ill.)	8508	S. I.	--	----------	--	1⅛ in. wide, ⅛ in. thick	Bolted round the center and intermediate-posts to the dashers through holes (d) with 16 round-head 1¼ in. x 3-16 in. stove-bolts	
113	4	**Dasher end-moldings** (Not Ill.)	8523	W. I.	--	----------	--	2 ft. 5¾ in. x ¾ in. x ¼ in.	Half-oval, riveted to the end of the dashers through holes (e) with 40 round-head rivets, 7-16 in. x ⅛ in.; the clips 8508 and 8509 are shown by Figs. 315, 316, Plate IX.	
114	2	**Dasher-rails** (Fig. 382)	8510	W. I.	--	----------	--	1¼ in. x ⅜ in.	Are adjusted to the dasher center and intermediate-posts by the holes (a) and secured by the top nuts shown in Figs. 362, 363. There are further in each rail:—	
					6	Holes	h	----------	For screws to secure the dasher-rail caps (8004) Fig. 384	Drill press
					2	Holes	c	5-16 diam.	For bolts to secure the dasher-post pipe-commode-handle (8514) Fig. 364 to the dasher-rail	Drill press
					1	Hole	d	7-16 diam.	For bolt to secure the brake-shaft upper-bearing (8528) Fig. 371 to the dasher-rail	Power punch
					1	Hole	e	7-16 diam.	For bolt to secure the switch-stick top-holder (8518) Fig. 385 to the dasher-rail	Power punch
					1	Hole	f	⅜ in.	For bolt to secure the fender hold-up eye (8522) Fig. 382, to the dasher rail	Power punch
115	2	**Switch-stick top-holders** (Fig. 385)	8518	M. I.	--	----------	--	----------	Bolted to the dasher-rail through holes (e) with 2 bolts, 1⅜ in. x ⅜ in.	
116	2	**Switch-stick bottom-holders** (Fig. 386)	8519	M. I.	--	----------	--	----------	Bolted to the crown-piece with 4 bolts 3½ in. x ⅜ in.	
117	2	**Fender hold-up eyes** (Fig. 382)	8522	M. I.	--	----------	--	⅜ in. diam.	Bolted to the dasher-rail through holes (f) with 2 stove-bolts, 1⅛ in. x 5-16 in.	
118	4	**Platform-hood supports** (Fig. 361)	8503	W. I.	--	----------	--	1¼ in. diam.	Inserted in holes (e) of the crown-piece (5028) Fig. 62, Plate IV., and bolted underneath	
119	4	**Dasher-post washers** (Fig. 361)	8506	C. I.	--	----------	--	----------	Are passed over the bottom ends of the hood-supports before being inserted in the holes in the crown-piece	
120	4	**Dasher-post pipe commode handles** (Fig. 364)	8514	Bz.	--	----------	--	12 in. long	Are passed over the top of the platform-hood supports, and bolted through holes (a) to the dasher-rail through hole (c) with 4 round-head bolts 1⅛ in. x ½ in.	
121	4	**Platform-hood-support brackets** (Fig. 366)	8515	Bz.	--	----------	--	----------	Are adjusted to the top of the platform-hood supports and screwed to the platform-hood bows with 16 No. 12 x 1¼ in. steel screws	
122	2	**Brake-shaft lower-bearings** (Fig. 369)	8529	M. I.	--	----------	--	----------	Fitted in hole (h) of the crown-piece	
123	--	**Brake-shafts complete** (Fig. 365)	8526	----	--	----------	--	----------	Composed of:—	
123a	2	**Brake-shafts** (Fig. 365)	8527	W. I.	--	----------	--	1 15-16 in. diam.	Are adjusted to	
124	2	**Brake-shaft upper-bearings** (Fig. 371)	8528	M. I.	--	----------	--	----------	Which are bolted to the dasher-rails through holes (d) with 2 bolts 1⅜ in. x ⅜ in. There are also	
125	2	**Brake ratchet-handles** (Figs. 367, 368)	8532	Bz.	--	----------	--	----------	Burns & Silver's pattern with ratchet, Fig. 368, pawl and spring, welded to the top of the brake-shaft	
126	2	**Brake-shaft ratchets** (Fig. 365)	8536	C. I.	--	----------	--	----------	Fitted tight to the brake-shaft and keyed	
127	2	**Brake-shaft pawls** (Fig. 372)	8547	C. I.	--	----------	--	----------	Are secured to the crown-piece by means of	
128	2	**Brake-shaft pawl-sleeves** (Fig. 374)	8540	C. I.	--	----------	--	----------	Upon the upper portion of which the pawl turns, and the lower portion of which is secured to the crown-piece by	
129	2	**Brake-shaft pawl-bolts and nuts** (Fig. 373)	8541	----	--	----------	--	----------	Bolted to the crown-piece	
130	2	**Brake-chains** (Not Ill.)	8542	W. I.	--	----------	--	----------	Are bolted to the brake-shaft below the ratchet	
131	2	**Brake-shaft stays** (Fig. 370)	8531	W. I.	--	----------	--	----------	Bolted to the platform inner-sills (8018) Fig. 61, Plate IV., with 4 bolts 8¼ in. x 7-16 in.	
132	1	**Center-brake-lever carrier** (Fig. 407)	8544	W. I.	--	----------	--	----------	Bolted to the center-brake-lever carrier-beam (5025) Fig. 63, Plate IV., with 4 bolts 8¼ in. x ½ in., round heads	
133	1	**Center-brake-lever** (Fig. 408)	8545	W. I.	--	----------	--	----------	Bolted to the carrier with	
134	1	**Center-brake-lever bolt** (Fig. 406)	8546	W. I.	--	----------	--	----------	And secured with the nut and cotter	
135	1	**Brake-chain connecting-rod** (Not Ill.)	8543	W. I.	--	----------	--	----------	Attached to center-brake-lever and brake-chain	
136	2	**Rigid drawbars** (Fig. 375)	8551	W. I.	--	----------	--	----------	With	
137	2	**Drawbar coupling-pins** (Fig. 377)	8559	W. I.	--	----------	--	----------	Which also passes through hole (c) of the buffer (8590) Fig. 390, and	
138	2	**Drawbar coupling-pin chains and eyes** (Fig. 377)	8561	W. I.	--	----------	--	----------	Bolted to crown-piece through holes (g) with 6 bolts 4¼ in. x ½ in., the eyes being secured with one of the buffer-bolts. (*See Con. No. 140, also Fig. 390*). The bolt also passes through one of the holes (a) of the buffer	
139	4	**Buffer-blocks** (Fig. 379)	8006	A.	--	----------	--	6⅝ in. x 3½ in. x 2¾ in.	And	
	4	**Buffer-blocks** (Fig. 379)	8006	A.	--	----------	--	6⅝ in. x 3¼ in. x 2¾ in.	Screwed to the projecting ends of the platform inner and outer-sills with 8 No. 20 x 4 in. steel screws	
140	2	**Angle-buffers** (Fig. 390)	8590	W. S.	--	----------	--	----------	Bolted through holes (a) to the platform inner and outer-sills through holes (d) and (c) Figs. 60, 61, Plate IV., with 8 bolts, 8 1-16 in. x 7-16 in.; the bolts also pass through the buffer-blocks, and the platform-hood supports pass through holes (b)	
141	4	**King-bolt-casting beams** (Figs. 391, 392)	8010	O.	--	----------	--	3 ft. 9¼ in. x 13¾ in. x 3¼ in.	Of which two are cut out at (d) to make room for the pedal alarm-gong, are bolted to the crown-pieces through holes (f) Fig. 62, Plate IV., with 4 bolts 8 in., 4 bolts 8¼ and 4 bolts 8½ in. x ½ in., countersunk heads	
142	2	**King-bolt bottom-castings** (Fig. 402)	8595	M. I.	--	----------	--	----------	Bolted to the king-bolt casting beams through holes (b) with 8 bolts, 10¾ in. x ½ in., and to the king-bolt-casting beams through holes (c) and the king-bolt beams through holes (f) Fig. 53, Plate IV., with 4 bolts 16¾ in. x ½ in.	
143	2	**King-bolt top-castings** (Fig. 404)	8594	M. I.	--	----------	--	----------	Bolted to the king-bolt beams through holes (d) with 4 bolts 5¼ in. x ⅝ in.	
144	2	**King-bolts** (Fig. 404)	8593	W. S.	--	----------	--	----------	Adjusted to the top and bottom castings	
145	2	**Spring-compressor channels** (Fig. 398)	8599	W. S.	--	----------	--	6 ft. 2½ in. x 6 in.	To which is fitted	
146	2	**Spring-compressor wearing-plate beams** (Fig. 399)	8005	O.	--	----------	--	6 ft. 7 in. x 5½ in. x 3 in.	Both being then bolted together to the side-sills through holes (j) Fig. 48, Plate IV., with 8 bolts 8¼ in. x ⅝ in.	
147	2	**Spring-compressor wear-plates** (Fig. 405)	8600	W. S.	--	----------	--	----------	Screwed to the wearing-plate beams with 28 No. 16 x 2 in. steel screws, countersunk heads	
148	4	**Truck check-chain hooks** (Fig. 403)	8619	W. I.	--	----------	--	----------	Secured with bolts of the spring-compressor wearing plate beams (8005) Con. No. 146	
149	4	**Angle truck-bearing plates** (Fig. 400)	8597	W. S.	--	----------	--	----------	With	

BOSTON CLOSED CAR. (Table No. 37.)



BOSTON CLOSED CAR. (Table No. 37.)



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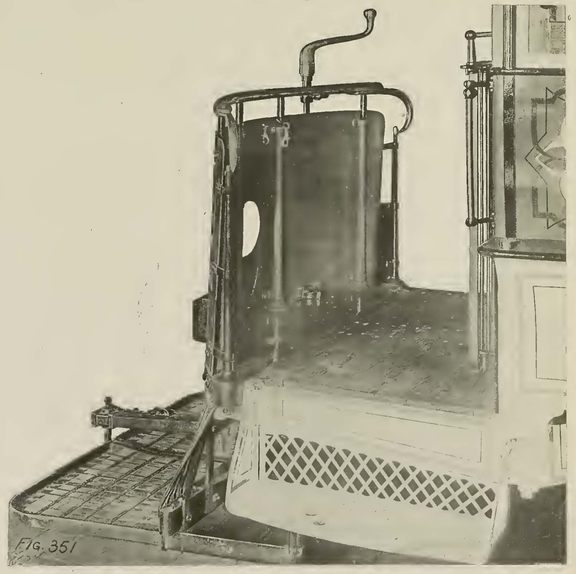


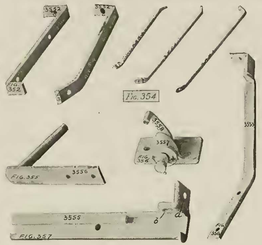


PLATE IX. [Figs. 294 to 359]

DETAILS OF PLATFORMS OF

BOSTON CLOSED STANDARD CAR

BOSTON CLOSED CAR. (Table No. 37.)

ILLUSTRATING

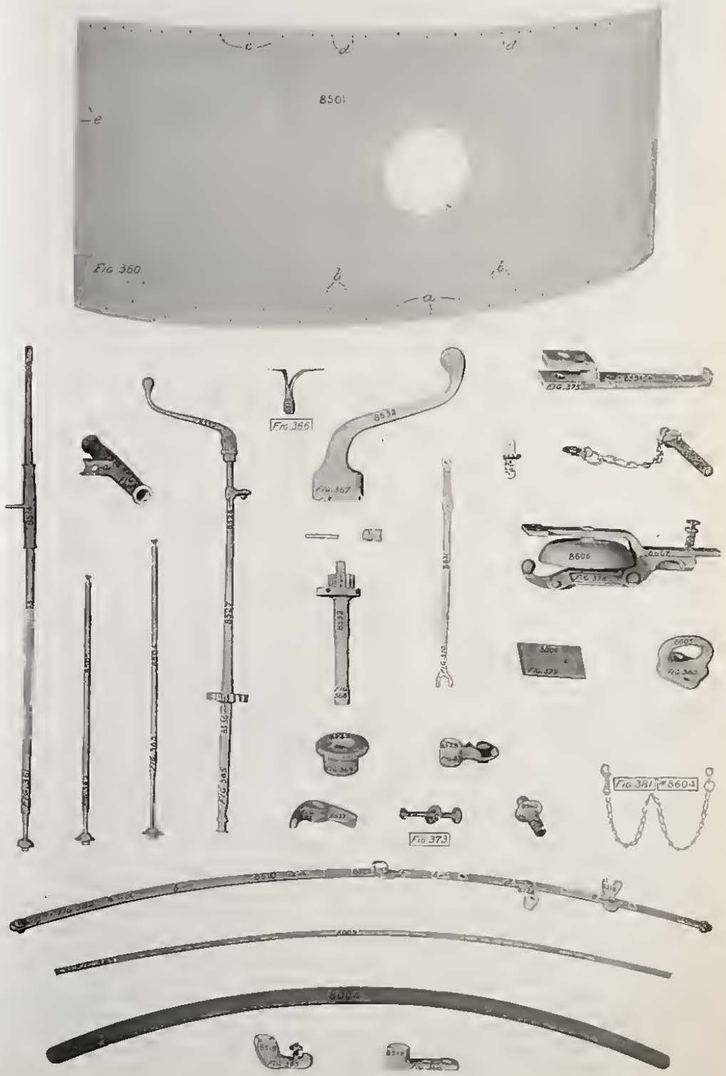
STREET CAR BUILDING

(Stephenson Practice)

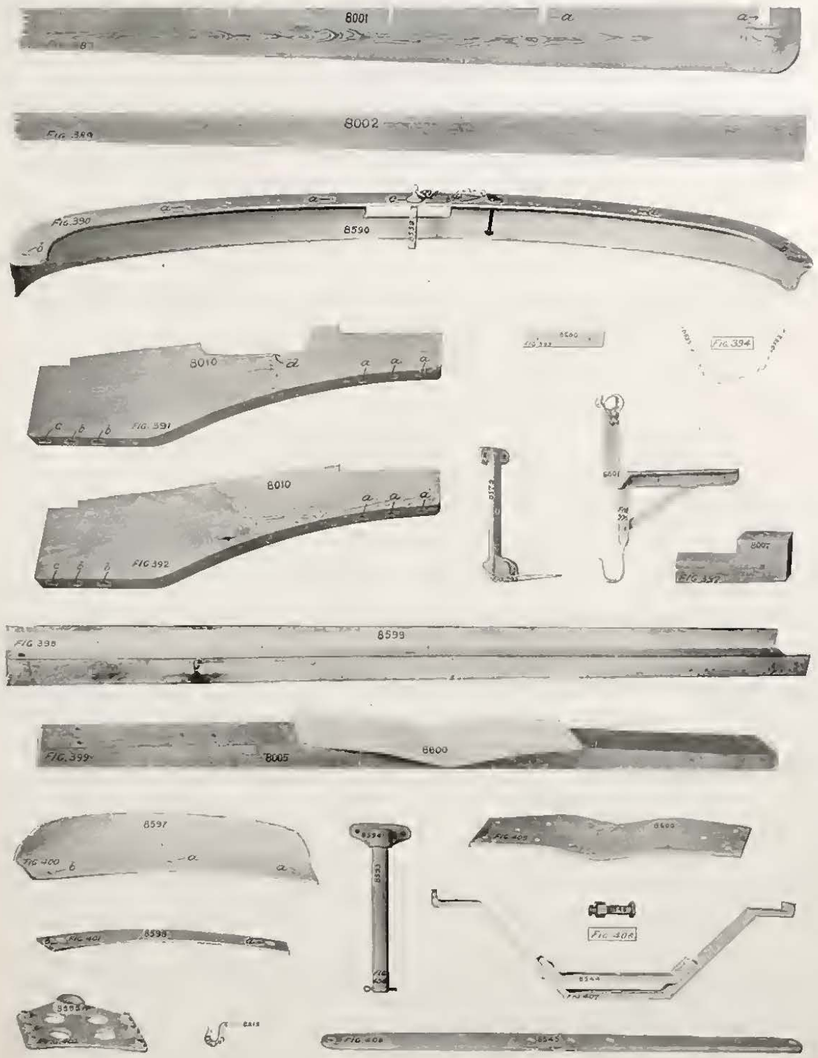
By

Charles Henry Davis, C. E.

BROOKLYN OPEN CAR. (Table No. 38.)



BROOKLYN OPEN CAR. (Table No. 38.)



BROOKLYN OPEN CAR. (Table No. 38.)

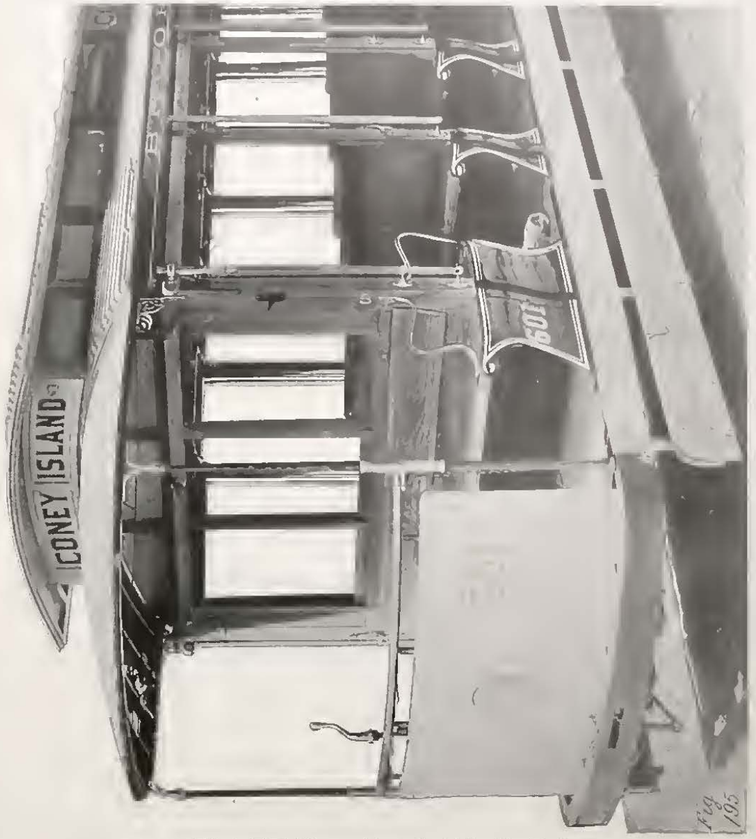


PLATE X. [Figs. 360 to 408.]

DETAILS OF PLATFORMS OF

BROOKLYN OPEN STANDARD CAR

ILLUSTRATING

STREET CAR BUILDING

(Stephenson Practice)

By

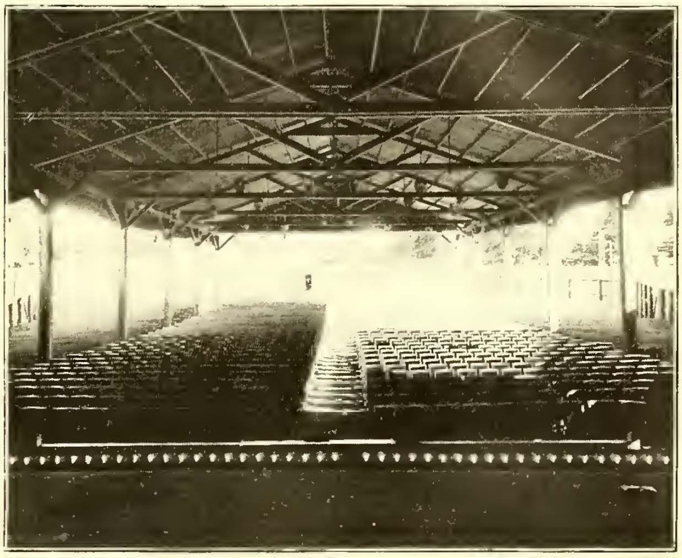
Charles Henry Davis, C. E.

150	4	**Truck rub-plates** (Fig. 401)	8558	W. S.				Bolted to side-sills and rubbing-plate beams (5026) Fig. 58, Plate IV., with 8 bolts, 8¾ in. x ⅝ in., through holes (a) and 4 bolts 7⅜ in. x ⅝ in., countersunk heads, through holes (b) Note.—All the pieces described under Con. Nos. 141 to 150 are for use with Brill's Maximum Traction Truck
151	22	**Side-step hangers** (Fig. 395)	8579	W. I.				Bolted to the side-sills through holes (g) with 28 round-head bolts 5⅞ in. x ½ in. and 16 round-head bolts 6⅜ in. x ½ in.
152	2	**Side-step tread-boards** (Fig. 387)	8001	Y. P.			32 ft. 5 in. x 9⅜ in. x 1⅝ in.	In 2 pieces, joined together with
153	2	**Side-step splice-plates** (Fig. 393)	8580	S. S.				Are now bolted to the step-hanger feet at the notches (a) with 22 round-head bolts 2¾ in. and 22 round-head bolts 2½ in. x 5-16 in.
154	2	**Side-step tread-board facing-irons** (Not Ill)	8581	W. I.			33 ft. 0 in. x 1 in. half-oval	Are screwed to the front edge of the tread-boards with 144 No. 14 x 1¼ in. and 4 No. 20 x 4 in. steel screws
155	2	**Side-step toe-guards** (Fig. 389)	8002	Y. P.			32 ft. 5 in. x 9⅜ in. x 1⅜ in.	Bolted to the legs of the step-hangers with 44 round-head bolts 1 13-16 in. x ¼ in.
156	4	**Side-step hold-up chain and snap** (Fig. 394)	8582	W. I.				Screwed to the side-sills with 8 No. 14 x 1 in. steel screws, and
157	4	**Side-step hold-up chain eye** (Fig. 394)	3583	W. I.				Bolted to the side-step tread-boards with 8 round-head bolts, 1½ in. x ¼ in.
158	4	**Gooseneck fender-hanger blocks** (Fig. 397)	8007	A.			1 ft. 3¼ in. x 6 in. x 3¾ in.	With
159	4	**Gooseneck fender-hangers** (Fig. 396)	8601	W. I.				Bolted to crown-piece with 4 cheese-headed bolts 6¾ in. x ½ in. and through the buffer to the platform sills with 4 round-headed bolts, 7¼ in. x ½ in.
160	2	**Dasher-rail caps** (Fig. 384)	8004	C.			6 ft. 7½ in. x 2¼ in. x 1 in.	Screwed to the dasher-rails through holes (b) with 12 No. 12 x 1 in. steel screws
161	4	**Platform guard-chains and snaps** (Fig. 381)	8604	W. I.				Secured by the eye to the dasher-rails by means of the bolts in holes (c), Fig. 382
162	4	**Platform guard-chain eyes** (Fig. 380)	8605	Bz.				Secured to the corner-posts with 8 No. 16 x 1½ in. bronze screws
163	2	**Pedal alarm gongs** (Fig. 378)	8606	S.				With
164	2	**Pedal alarm-gong castings and hammer** (Fig. 378)	8607	M. I.				Are secured to the floor with 4 bolts 2¼ in. x 7-16 in. and to the crown-piece with 2 bolts 4 in. x 7-16 in.
165	1	**Pedal alarm-gong pin** (Fig. 378)	8608	W. I.				Is inserted in hole in nose-piece to operate same Assembling has now progressed so far that cabinet work, trimmings, etc., can be next taken up. (*See Table 40, Plate XII.*) Fig. 195 is reproduced on Plate X., as it shows in position many of the pieces described in this table

Number of Distinctive Pieces	60	(Column 1)
Total Number of Pieces	189	(" 2)
Number of Bolts	310	(" 6 and 10)
Number of Screws (about)	322	(" 6 and 10)
Number of Nails	?	
Total	821 +	

Summer Theater at Syracuse, N. Y.

At some of the recent national and State street railway conventions some doubt has been expressed by certain street railway managers as to the profit of engaging theatrical troupes as attractions to summer railway parks. That this is not the sentiment of all managers, however, is shown by the number of very tasteful and commodious summer theaters which have been built and operated at



INTERIOR OF THEATER

many railway parks throughout the country during the past season. A number of these have been illustrated in recent issues of this paper, and below will be found several views of the theater built this season by the Syracuse Rapid Transit Railway Company.

The theater was opened July 2 and contains about 1000

VIEW OF VALLEY THEATER AFTER PERFORMANCE, JULY 28

seats. It is provided with a roof, so that the entertainment can be given rain or shine. A stock opera company of twenty-seven people was engaged through a musical bureau in New York, and repertoire opera is given, the bill being changed every week. The opera for the first week was the "Mikado."

Conductors sell tickets for 25 cents, including the round-trip car fare and admission to the opera. Persons who do not ride on the cars to the theater have to pay

25 cents admission. The best seats, which consist of 400 opera chairs, are sold at 25 cents extra. Matinee performances are given on Wednesday and Saturday afternoons, when the general admission is 10 cents. During the first two or three weeks in July the weather was very much against open-air performances on account of rain nearly every day and cold nights, but still with the inclement weather the attendance was good. The business, however, steadily increased, and during the last part of July and the first two weeks in August the gate receipts of the show paid the expenses of the theater, making the car fares clear profit.

The plan was a new one for Syracuse, but it has fully established itself in the minds of the people and the very best people in the city are regular attendants. The park is run in a very high-class manner; no intoxicating drinks are sold within the inclosure, and the managers of the company have now no doubt as to the success of the venture. Besides the direct return from the investment there is also no doubt but that the high character of the performances and the splendid car service to and from the show have been the means of improving the standing of the street railway company with the public and making it more popular.

Important Work in Northern New Jersey

The New Jersey & Hudson River Railway & Ferry Company, which operates an electric line from Hackensack and Englewood to Edgewater, N. J., and a ferry between Edgewater and West 130th Street, New York, has been engaged during the last year upon important extensions to its line. A full description of the Hackensack division, about 3 miles in length, was published in the Street Railway Journal of February, 1900. This section has recently been completed by the opening of a large swing-draw across the Hackensack River, giving an entrance to Hackensack. As this bridge is one of the largest, if not the largest drawbridge in the country, used exclusively for electric railway service, it is worthy of more than passing notice. It was built by F. R. Long & Company, contractors, under the supervision of Ford, Bacon & Davis, consulting engineers of the Railway & Ferry Company.

The approaches to the draw are over trestles at each end. The west side trestle is 915 ft. in length, consisting of sixty-one bents of 15 ft. each. The eastern trestle is 285 ft. in length, and consists of nineteen 15-ft. bents. A standard bent is shown in Fig. 1. The piles, of which there are six in each bent, are all of selected white oak, from 30 ft. to 45 ft. in length. The framing is of long leaf yellow pine, and consists of caps 12 ins. x 12 ins.; girders, of which there are four underneath the track, 8 ins. x 12 ins., and cross and longitudinal bracing, which is 3 ins. x 10 ins. The bracing is bolted and the caps are fastened to the piles by iron dowels. These dowels are 1 in. in diameter, and average from 18 ins. to 24 ins. in length. The holes to receive them were bored 1-16th in. smaller than the dowels, which were covered with white lead and then driven into the hole.

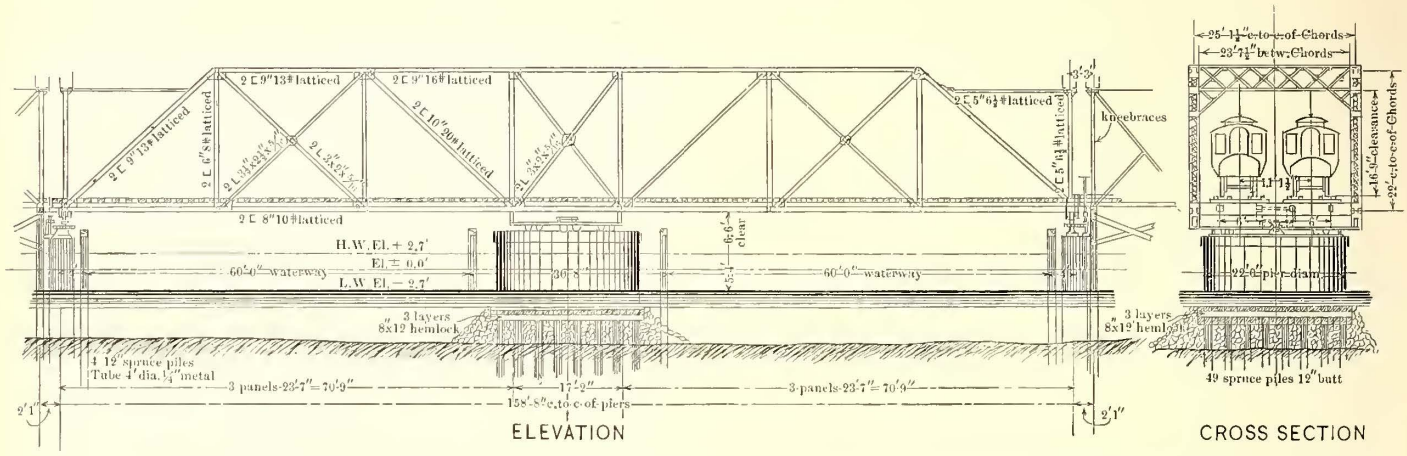


FIG. 2.—SIDE ELEVATION AND CROSS SECTION OF BRIDGE ACROSS THE HACKENSACK RIVER

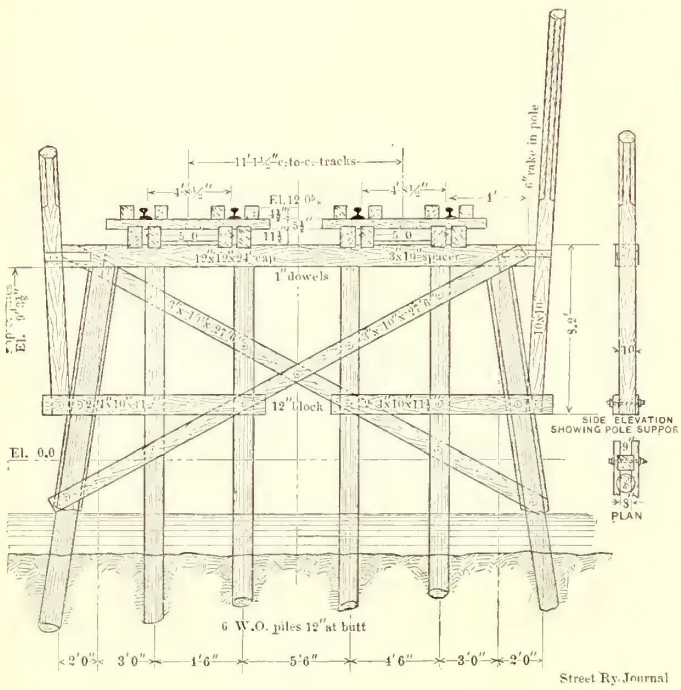


FIG. 1.—STANDARD BENT IN TRESTLE

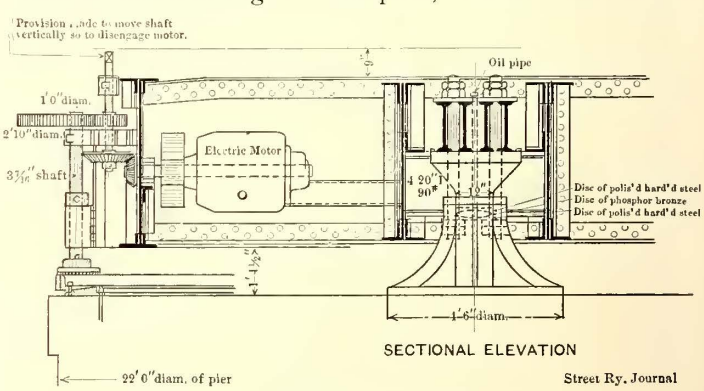


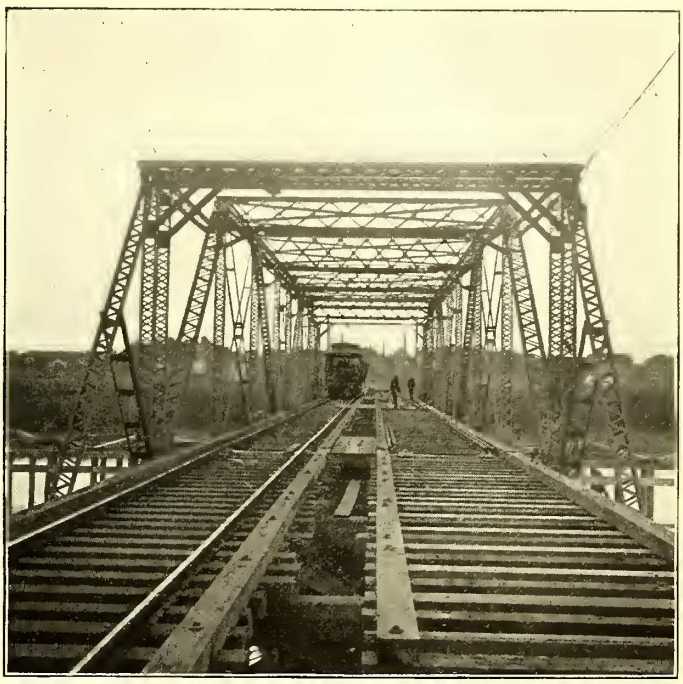
FIG. 3.—ELECTRIC ATTACHMENT FOR OPENING DRAW

The ties and wooden guard stringers are also of yellow pine, the ties being 6 ins. x 8 ins. x 9 ft., and placed 18 ins center to center. The rail is a 60-lb. T. A. S. C. E. standard, with six-bolt joints. The joints are bonded under the fish-plates, and the rails are cross-bonded every six joints. The bridge itself is of the riveted truss type, 160 ft. long, with pivot draw. The center pier consists of piling, on which is a grillage, surmounted by heavy first-class masonry. The end piers are formed by clusters of four piles, each surrounded by a steel casing, 4 ft. in diameter, and filled with best quality concrete. The cross section of the bridge shows the spacing of the tracks, which, as will be seen, is very liberal, to accommodate the extremely wide cars used. The track centers are 11 ft. 1½ ins. apart, permitting two 9-ft.-6-in. cars to pass.

To keep the bridge in line there are four end rests, two on each side; these rests are adjustable from above. In addition, the alignment of the track is kept perfect by the use of four shoes at each end, one of which slides under the ends of each rail, thus holding the latter in line. There are also the usual spring latches. The bridge can be opened by hand or electric power, which is the usual method. For the latter a G. E. 800 motor, with a train of gearing, is used, as shown in Fig. 2, and by it the bridge can be opened and closed in one and one-half minutes. The motor receives its power from a cable connecting the railway feeders with the center pier. The bridge is designed to carry a full load of 30-ton cars on each track.

Special attention was given to the construction of the overhead trolley line on the bridge. As will be seen, the end supports at both the bridge portals and at the shore ends are extremely heavy, being built up of angles, latticed and braced. On the overhead framing, which supports the drawbridge frogs, is attached a short wooden plank, which is backed with an asbestos sheet; the plank was then painted with fireproof and insulating paint. As the frogs which are attached to this board are insulated, a triple insulation is thus secured between the frogs and the iron work of their supports. This substantial construction allows the trolley wire to be kept taut.

Mention should also be made of the safety devices.

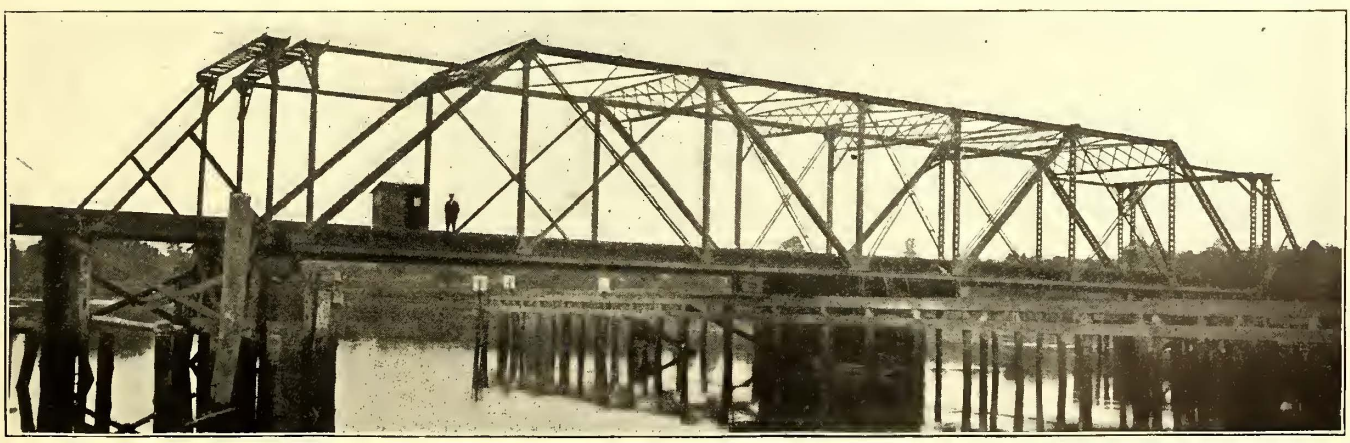


END VIEW OF BRIDGE

River, the company has been carrying on other important construction, notably that on the edge of the Palisades, and in the power house, where a 500-kw unit has been installed. A more extended description of these improvements will be published later. The company has also entirely renewed its rolling stock. The closed cars have not yet been delivered, but the open cars have been in use all summer, and are as large and fine as any in use in or near New York. They were designed by Ford, Bacon & Davis, and were built by the American Car Company.

The main dimensions of the open car are as follows: Length over corner posts, 32 ft.; length over dashers, 40 ft.; length over bumpers, 41 ft. 6 ins.; total width over sills, 7 ft. 5⅝ ins.; total width with steps down, 9 ft. 6 ins. The side sills are of long leaf yellow pine, 5 ins. x 7 ins., and each is faced with a ¾-in. x 8-in. continuous steel plate. There is also a regular truss rod for supporting each side sill. The corner posts are of white ash, 4½ ins. x 2½ ins., and all roof rafters are re-enforced with steel.

The interior finish of the car is of white ash, and it is fitted with ten reversible and four stationary benches, each seating six passengers. At the ends of the car are two large windows, the advertising racks over which are reserved exclusively for the notices of the company. The

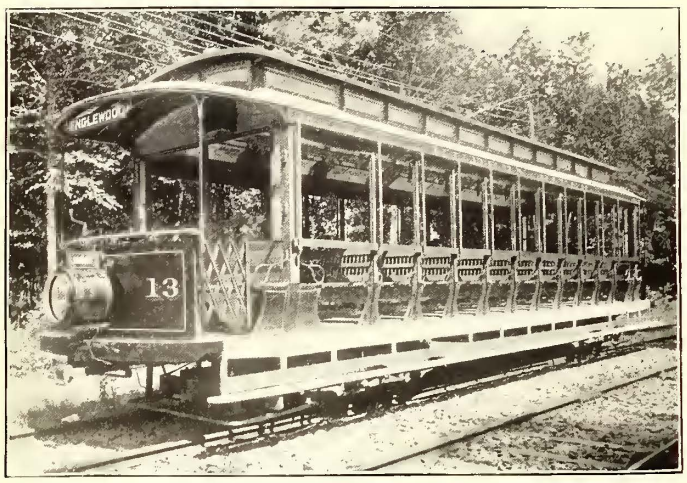


SIDE VIEW OF 160-FT. SWING BRIDGE

Eight hundred ft. from each end of the bridge a cluster of five green lamps, furnished with a reflector, have been installed in a signal box. In addition there are four red lights at a distance of 150 ft. from each bridge portal. Both lamp circuits are closed by the bridge tender just before opening the draw, the lamp near the switch being for the purpose of showing to the tender that the circuits are in working condition. The cars are run over the bridge at full speed.

In addition to the improvements at the Hackensack

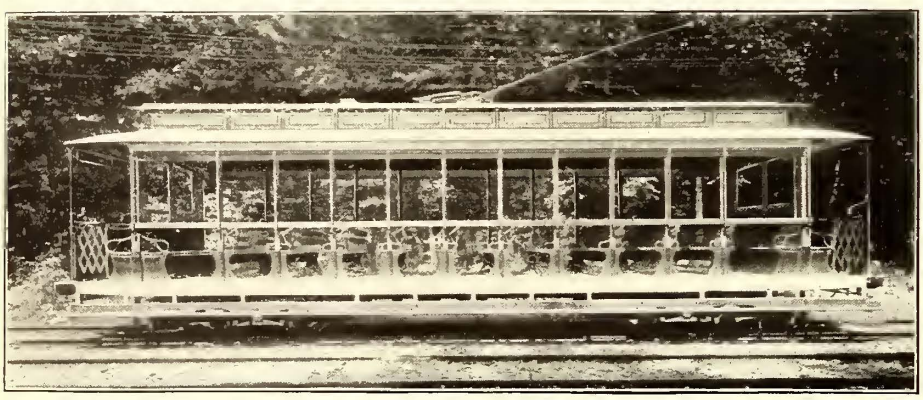
ceilings are of bird's-eye maple. A novelty has been introduced in the electroliers, which are not of metal, but consist of an ornamental wooden cone, carrying sockets in which the lamps are set. This eliminates all danger of crosses, and the cone is much easier to keep in good condition than a metal electrolier. There are three clusters of five lamps each for interior illumination. The bumper is



END VIEW OF CAR

of solid white oak, faced with a ½-in. x 6-in. steel plate. On the roof of the car is a tool box, in which all miscellaneous repair parts are kept, and between the trolley boards is an extra trolley pole. This precaution has been found useful on more than one occasion. The cars are furnished with arc electric headlights, and are also equipped with Vandorn draw-bars, Sterling fenders and registers, Wilson trolley catchers, De Witt sand boxes and the Price momentum brake, manufactured by the Peckham Truck Company.

The subject of braking is a very important one upon this line, as the cars have carried as many as 160 passengers



SIDE VIEW OF CAR

each, and would weigh, when loaded with 200 passengers, 30 tons each. At the same time the line is almost a succession of grades, some of which are as high as 10 per cent, with sharp curves at the base. The managers of the road state that the brakes have given great satisfaction, and are very easy to operate and keep in repair.

Each car is mounted on two 14 B 3 Peckham trucks, with 4-ft. wheel base. Double plate wheels, supplied by the New York Car Wheel Works, are used; they are 30 ins. in diameter, with 3¼-in. tread and 1-in. flange. The motor equipment consists of four G. E. 67 motors, which have a rating of 38 hp each. These motors have no difficulty in carrying the car up the grades, and as an instance of the load which comes upon them, it might be stated that it is not an uncommon thing for one car to draw more than 350 amps. from the line.

Owing to the fact that the cars are wider than those which had previously been used on the line and the fact that in the summer large loads are often carried, it was considered advisable to run a car over the line early in the season, with different loadings, to determine the compression at the different loads, together with the permanent set. The load was secured by filling large paper bags with sand. These bags weighed 81 1-3 lbs. apiece, and with the full loading, eight bags were placed in each seat. The test was a severe one, being more than a car would actually carry in passengers, and the load being more dead than a human load would be. Some of the results of this test, which was made by F. W. Bacon, general superintendent of the Railway & Ferry Company, are given in the following figures:

AVERAGE COMPRESSIONS
(All measurements made from bottom of sills.)

Car Body

Load, 10,000 lbs. compression	17/32 ins.
" 20,000 " "	1 9/16 "
" 25,000 " "	2 3/8 "
Permanent set	7/32 "

Journal Springs

Load, 20,000 lbs. compression	3/16 ins.
" 25,000 " "	10/32 "
Permanent set	1/32 "

(Not including journal spring, that came up ⅛ in.)

Average rise of bolster from 25,000 lbs. to no load.... 1 7/32 ins.

Storage Battery Cars in New York

The Metropolitan Street Railway Company, New York, is now operating four storage battery cars on its Thirty-Fourth Street crosstown line. There are several quite severe grades on this line, but the cars are giving perfect satisfaction, and as fast as more can be secured they will be used to replace the horse cars still in use. The cars are of a large closed type, similar to that of the Broadway cars, room being found for the batteries beneath the seats. The motors and controllers, furnished by the General Electric Company, differ somewhat from those used on the other cars of the Metropolitan electric lines. The type of motor is G. E. 72, and of controller, S-7. A complete charging station has been fitted up at the car house in Forty-Second Street, and the system is expected to satisfactorily supply the needs of crosstown traffic in that section of the city.

The date of opening the entire Broadway line with electric power has not yet been announced, although Mr. Vreeland has stated that the line as far south as the postoffice would be completed, so far as street excavation is concerned, about Sept. 1. All of the Lexington and Columbus Avenues cable lines have been altered. On the latter lines the existing track rails were not changed, but the joints were cast-welded by the Falk process.

The rearrangement of the transfer system in Washington, D. C., and the curtailment of its privileges has met with some opposition from the residents of the city. The inauguration of a double fare on one of the lines of the system has also met with a storm of protests. However, the opposition comes mainly from those who "kick for the sake of kicking." President Stevens, of the company, has given ear to all with supposed grievances, and has convinced the general public of the merits of the new system.

LEGAL NOTES AND COMMENTS

EDITED BY J. ASPINWALL HODGE, JR., OF THE NEW YORK BAR*

Conflicting Decisions on a Question of Contributory Negligence

A New York Appellate Court has just passed upon a legal proposition never before decided in this State, and in doing so has followed a decision in Iowa, which it cites, and decisions in Virginia and Ohio which it does not cite. It expressly repudiates the reasoning by which the courts of Tennessee, Illinois, Missouri, Maryland and Texas have reached an opposite conclusion.—*(Lewin vs. Lehigh Valley Railroad, 52 App. Div., 69.)*

The court holds that, in an action brought by an administrator to receive damages for the next of kin caused by the negligence of the defendant, the negligence of the administrator, who was the father of the infant intestate, contributing to the fatal injuries is not a defense; and that this is so, although the administrator is the sole next of kin and under the statute entitled to the entire proceeds of the action. The court cites the case of *Wymore vs. Mahaska Co., 78 Iowa 396.* The same doctrine is held in *Norfolk R. R. vs. Groseclose, 88 Va., 267,* and in *Cleveland R. R. vs. Crawford, 24 Ohio St., 631,* and *Davis vs. Guarmieri, 45 Ohio St., 470.*

The theory of these cases cannot be defended on the ground that exact or even approximate justice is done, but only on the ground that the action, being created by a statute, the question is not what is justice and right between the parties—the answer to which solves most questions of common law when unaltered by statute—but rather what is the wording of the legislative enactment. Where that says that the administrator shall recover in all cases where the intestate could have recovered had he survived, it must mean that this defense, involving the negligence of a third party—although the party benefiting by a recovery—cannot be successfully interposed. Practical difficulties the court sees, which would arise under any other construction, and which are wholly unprovided for by the statute. For example, if there were several beneficiaries, some of whom were negligent and some were not, how would the fund awarded be distributed?

But the court had difficulties to meet, on the other hand, when confronted with the proposition that its decision was allowing one to profit by his own wrong, a result repugnant to the law. The court only half answers that objection by saying that that proposition applies only to cases where the party's wrong is *wilful*, as where one murdered his grandfather and was not allowed to take under his will. But suppose the act of the father administrator which contributed to the accident was a wilful one, or suppose the act was a joint assault upon the intestate. All the reasons deduced from the wording of the statute for holding that the plaintiff administrator could recover would hold good, including the dreaded complications in distributing the fund, if there were innocent, as well as guilty, next of kin. The court probably felt that this effort to reason away the strength of this maxim prohibiting a profiting from one's own wrongdoing was only partially successful, for it immediately makes the bolder and the safer statement that the court is not concerned with the final disposition of the fund—that is not a part of the proceedings prior to judgment.

There can be no question, whatever view we take of the decisions in the above mentioned States, that the statutes which necessitate or allow them need revision. In the January and February numbers of the STREET RAILWAY JOURNAL we pointed out other analogous evils, and injustices which are the progeny of the carelessly constructed statutes governing this form of action by an administrator for the next of kin.

All the courts of other States which have passed upon this question have taken the opposite view, and held that the negligence of the next of kin who could benefit by the recovery may be proved as a defense to the action.—*(Bamberger vs. R. R., 95, Tenn., 18; City of Pekin vs. McMahon, 154 Ill., 141; Koons vs. R. R., 65 Mo., 592; B. & O. R. R. vs. State, 30 Md., 47; T. M. R. & M. N. Co. vs. Herbeck, 60 Tex., 602.)*

It will be noticed that this question is not one like that which is still waged about the doctrine of imputed negligence. There is involved simply a difference of opinion upon a question of abstract justice, to wit: Shall the negligence of a parent be visited upon the head of an innocent child where such negligence has contributed to the accident to the child damaged? New York was the first to say "Yes" *(Hartfield vs. Ropes, 21 Wend., 615)*, and was followed by Massachusetts, Maine, California, Minnesota, Maryland and Indiana, and withstood and contradicted by the courts in nearly all the other States and in England. There the difference of opinion is in the answers to the question, what is just? But in the case we have been discussing the courts do not disagree upon that question at all. They, none of them, hold that it is just that next of kin whose negligence has contributed to the death of the intestate should recover, but some of them hold that the statute compels them to decide contrary to the justice of the matter.

Where a father brings an action for the loss of services of an infant the courts all agree that if his negligence contributed to the accident caused by the negligence of the defendant, he cannot recover.—*Smith vs. Hestonville R. R., 92 Penn St., 450; Metcalf vs. Rochester R. R., 12 App. Div., 147, 158.* This illustrates curiously the injustice of New York, Iowa, Virginia and Ohio (whether necessary under the statutes or not), in the cases brought by administrators.

A father with his child in a carriage is run into by a train and his carelessness is a contributing cause of injuries sustained by the child. The injuries seriously threaten the child's life. They are certain to incapacitate it for work. Whether the child shortly dies as the result of the injuries or lives, incapable, the father has lost the child's services during its minority. If the child dies he can recover damages for such loss (and other damages as well) under the doctrine in *Lewin vs. R. R., supra;* but if it lives he cannot recover under the doctrine in *Metcalfe vs. R. R. supra*—as he should not in either case—because he brought the damage upon himself by his own carelessness, which may have been almost criminal. H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

CONNECTICUT.—Injunction—Franchises—Power to Lease—Damages—Legal Action.

1. Where defendant's answer, in an injunction proceeding to restrain it from trimming certain trees, alleged that such trimming would not materially injure the trees, a demurrer by plaintiff to such answer admitted the truth of its allegations, and was decisive against plaintiff, since an injunction does not issue to prevent immaterial injury.

2. 5 Sp. Laws, 619, 10 Sp. Laws, 69, 11 Sp. Laws, 1082, and 12 Sp. Laws, 208, 682, authorizing defendant company to take leases of the property and franchises of any other street railway companies with which its tracks may connect, imply power in the latter to give such lease; and, where defendant was a lawful lessee of a franchise to construct and operate a street railway, averments in its answer that it had a right to lay and operate such railway were sufficient statements of its power to do so.

*Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

3. Where a bill for injunction is based on a threatened injury to trees, and no case is made justifying the issuance of the writ, plaintiff cannot recover damages in lieu thereof before the injury is done.—(Huntington vs. Hartford St. Ry. Co., 46 Atl. Rep., 824.)

ILLINOIS.—Charter Powers—Method of Operating—Changes—Parties Entitled to Question. A declaration charged that defendant was authorized by its charter and a municipal ordinance to operate its street cars in a city by means of animal power only; that one of defendant's cars, while being operated by cable power, collided with one of plaintiff's cars, and injured it. It was not alleged that the collision was occasioned by the negligence of defendant's employees in charge of such car. Held, since the question of whether the propulsion of defendant's cars by cable power was an abuse of its charter powers can only be determined in direct proceedings instituted by the State or city, the adoption and use of such power cannot, in an action between individuals, be adjudged of itself to make defendant a trespasser in the street so as to make it liable for injuries not occasioned by its negligence.—(Chicago Gen. Ry. Co. vs. Chicago City Ry. Co., 57 N. E. Rep., 822.)

ILLINOIS.—Eminent Domain—License—Res Judicata.

1. Rev. St. c. 24, art. 5, sec. 1, par. 25, provides that City Councils shall have the power to establish and change the location of any railway within the city. Chap. 131a, sec 2, declares that, when it is necessary for the construction, maintenance, or operation of any street railway to take or damage private property, such taking may be accomplished as exercise of right of eminent domain. Held, that where a city passed an ordinance which claimed to be by authority of chap. 24, and which declared that a certain street railway should locate its line in certain streets and on certain private property, the ordinance was a nullity so far as establishing a route for the railway was concerned, as the taking of private property is authorized only in case of necessity, under the statute, and not upon the judgment of a City Council.

2. Rev. St. c. 24, art. 5, sec. 1, par. 25, provides that City Councils shall have the power to establish the location of any railway within the city. Chap. 131a, sec. 2, declares that, when it is necessary for the construction or operation of any street railway to take or damage private property, such taking may be accomplished as exercise of the right of eminent domain. Held, where a city ordinance declared where the lines of a street railway might be located, and provided it should be located on no private property without the consent of the owner, the ordinance was a nullity as a location, since the railway company was not authorized to adopt the location by virtue of the ordinance, or upon proof of the necessity contemplated by the statute.

3. Where an ordinance declared that a street railway might locate its lines on certain streets and over certain property, and then provided that the location was to be made subject to such further conditions as might be imposed by ordinance when the railway company should adopt the route, and that the ordinance was not to be construed as a grant of rights in any street, but that the determination whether such right should be granted was reserved until a petition for the same should be presented by the railway company, the ordinance was a nullity as a location, in that there was no grant of a right to go upon or along the streets on which the ordinance professed to provide for location.

4. Rev. St. c. 24, art. 5, sec. 1, par. 25, provides that City Councils have the power to establish the location of any railway within the City. Chap. 131a, sec. 3, relative to street railways, provides that no assent shall be granted of the location of the line of the street railway until public notice of the road's petition for a location shall be first given by ten days' publication in some newspaper. Held, that where a city passed an ordinance which declared that a street railway company might locate its line on certain streets without there having been a petition or publication of the notice thereof, the ordinance was a nullity as a location.

5. Where a city gave to a street railway company the right to use certain streets on the condition that the road should grade and gravel the street, and pay $100 a year for a term of years, and the road accepted the burdens and expended $3500 in complying with the conditions, and built its road in the street, an ordinance thereafter passed, prohibiting the occupation of part of the streets occupied, was a nullity, since the license having been acted on, and a substantial consideration received by the city, the license became a binding contract.

6. Where, on proceedings by a street railway company to condemn private property, owners of such property contested the company's right to condemn the same, and the questions raised were taken to the court of last resort, the decision of that court concerning the company's right to take the property settled every objection which might have been raised, whether then raised or not, since the doctrine of *res judicata* embraces, not only what has been actually determined, but extends to any other matter which might have been determined.

7. It is not necessary, as a condition precedent to the location by a street railway company of such portions of its line as are not within, upon, or across a street, nor to the exercise of the power to condemn private property for purposes of its construction, that the consent of the city be obtained, as that may be secured subsequently.—(Harvey et al. vs. Aurora & G. Ry. Co., 57 N. E. Rep., 857.)

KANSAS (United States Circuit Court of Appeals).

1. Appeal—Formal Error as to Parties—Amendment. The fact alone that an action was brought in the name of the wrong party as plaintiff is not ground for reversal, but the Appellate Court will direct the substitution of the proper party.

2. Private Nuisance—Use of Street by Railways—Legislative Authority. Neither by legislative enactment nor by ordinance of a city can the use of a public street be granted to a private corporation for uses which constitute a private nuisance, and result in special injury to the owners of property abutting on the street, except upon making compensation for such injury.

3. Railroads—Grant of Right to Use Street—Construction. A grant to a railway company of the right to "operate and maintain a railway" on a public street does not carry by implication the right to erect and maintain a water tank in the street.

4. Private Nuisance—Use of Property by Railway Company. A railway company has no more right than an individual to so use its property as to unreasonably interfere with the peaceable and comfortable enjoyment by others of their property, or to cause special injury to particular property, without making compensation for the injury.

5. Same—Location of Railway Station Adjacent to Church—Liability for Damages. The erection by a railway company of a water hydrant in a street immediately opposite the center of a church, and only 35 ft. distant, and of a station on property on the opposite side of the street, so that the noises and odors and the dust and smoke incident to the stopping and starting of trains at both station and hydrant interfere with services in the church, and render the building unfit for the uses for which it was built, constitutes a private nuisance, which amounts, in legal effect, to a taking of the church property to the extent of the injury done thereto, for which the company may be required to make compensation; and it is no defense to an action for the recovery of such compensation that the structures built by the company are necessary for the operation of its road, or that its trains are operated in a careful and proper manner.—(Chicago G. W. Ry. Co. vs. First Methodist Episcopal Church of Leavenworth City, Kan., 102 Fed. Rep., 85.)

LIABILITY FOR NEGLIGENCE

ALABAMA.—Personal Injuries—Collision with Hose Cart—Contributory Negligence—Right of Way—Ordinance—Evidence—Instructions—Appeal and Error—Record—Recitals—Assignments of Error—Issues—Waiver.

1. Where the record shows no judgment on either the demurrer to the complaint or the demurrer to the pleas, a statement that a demurrer to each count of the complaint was overruled by the court, and demurrers to pleas Nos. 4, 5, 6, 7 and 8 sustained by the court, is nothing but a memorandum of the clerk, and assignments of error based thereon will not be considered.

2. Where pleas were filed to the complaint, and demurrers were interposed to a part of them, the record failing to show any judgment on the demurrers, they will be regarded as waived; and the judgment entry reciting that "issue being joined," without specifying particular pleas, on appeal it will be considered that issue was joined on all the pleas.

2. Plaintiff, a fireman, was riding on a hose cart driven by the chief driver. The horses were being driven as fast as they could run, and while crossing defendant's tracks collided with a car standing thereon, and plaintiff was injured. There was a car track on the street on which the hose cart was being driven, and crossing the defendant's track. There was a space of about 8 ft. between such track and defendant's car. No effort was made to check the speed of the hose cart as it approached defendant's track. Held, that the manner of driving the hose cart across defendant's track was negligent.

4. In an action by a fireman against a street railway company for injuries received in a collision between a hose cart on which he was riding and one of defendant's cars, an ordinance of the city giving the hose cart the right of way in the street was irrelevant, since having the right would not exempt the driver of the hose cart from the duty of exercising care in driving across defendant's track.

5. Where, in an action for personal injuries, evidence, without conflict, sustained the plea of contributory negligence, it was error to refuse an instruction that, if the jury believed the evidence, they should find for the defendant.

6. In an action by a fireman for personal injuries received in a collision between a hose cart on which he was riding and one of

defendant's cars, an instruction that it did not make any difference in that action whether the driver of the hose cart was negligent or not, unless his negligence was the sole cause of the accident, was erroneous.—(Birmingham Ry. & Elec. Co. vs. Baker, 28 So. Rep., 87.)

CONNECTICUT.—Negligence—Riding on Footboard—Judgment by Default—Nominal Damages. Where a street railway was built along a causeway, which necessitated placing the trolley poles near the track, and defendant, who had knowledge of the situation, was riding on the footboard next to the trolley poles, and refused to step up on the platform at the invitation of the conductor, but leaned back to allow him to pass by, and struck his head against a trolley pole, plaintiff was entitled to nominal damages only on default, since he was guilty of contributory negligence.—(Nugent vs. Fair Haven & W. St. Ry. Co., 46 Atl. Rep., 875.)

ILLINOIS.—Jumping on Moving Car—Proof of Custom—Encouragement of Custom—Negligence *per se*—Circumstances—Instruction—Province of Jury.

1. Where, at the transfer station from defendant's electric line to their cable cars, the latter were started by the car-house cable, and were carried by their own momentum a distance of 50 ft., to where the down-town cable was picked up, and the plaintiff, who had run after a car while it was moving slowly of its own momentum, and stepped on the platform, was thrown and injured by the sudden jerk occasioned by the picking up of the down-town cable, evidence that passengers during the crowded travel of the morning hours were in the habit of running after the cars and jumping on them at that point was incompetent for the purpose of establishing a standard of ordinary care.

2. Evidence that it was the custom of passengers during the crowded travel of the morning hours, to so run after and jump on the cars, and that the defendant's conductors encouraged them in so doing, by assisting them on the car and telling them to come on, was competent to show negligence on the part of the defendant.

3. An instruction that the court did not mean to give an opinion as to what were or were not the facts in the case, but that it was solely and exclusively for the jury to determine from the evidence, and having done so to apply to them the law as stated in the instructions, was not objectionable as giving the jury to understand they were independent of the law.—(North Chicago St. Ry. Co. vs. Kaspers, 57 N. E. Rep., 849.)

MINNESOTA.—Collision with Traveler—Contributory Negligence.

1. The reciprocal relations of the public and a street railway company vary according to circumstances and conditions. Distinction made as to their relative rights and duties in the populous and in the sparsely settled parts of a city. Held, that the driver of a vehicle who drove upon a street railway track in the suburban, thinly settled district of a city, where the public use of the street was limited, without looking for approaching cars, was guilty of negligence.

2. One who, under such conditions, is riding in a rear seat, and who has no direct control over the horses at the time, but who is a joint contributor to the hire of the team for the occasion, is guilty of negligence if he does not look for approaching cars upon crossing a street car track.

3. Under the circumstances of this case, a mere passenger, who has no control over the team, was not guilty of negligence in failing to look out for cars when crossing the track.

4. Certain assignments of error examined and held to be not sustained.—(Wosika vs. St. Paul City Ry. Co.; Shindelus vs. Same, 83 N. W. Rep. 386.)

MINNESOTA.—Injury to Person on Track—Question for Jury.

1. As a general rule, it is a question of fact for the jury, to be determined from all the circumstances of each case, whether a party is guilty of negligence in attempting to cross a street railway track without first looking and listening for approaching cars.

2. Rule applied, and held, that the question of the plaintiff's contributory negligence in this case was one of fact and not of law.—(Riley vs. Minneapolis St. Ry. Co., 83 N. W. Rep., 376.)

MINNESOTA.—Accident to Person on Track—Evidence. This is a personal injury action. The plaintiff, in the nighttime, was thrown from his bicycle upon the street car tracks of defendant, and thereby rendered unconscious. While in this condition he was struck and injured by one of the defendant's cars. One of his specifications of negligence was that the defendant permitted the headlight of the car to become defective, dirty and grimy, so that it did not sufficiently light its tracks. A witness who was present at the time of the accident was permitted to testify that subsequent thereto, and for a year, he observed the headlights on other cars of the defendant at different times and under different conditions, and that they gave a better light, and showed further on the tracks, than did the one in question on the night of the accident. Held, prejudicial error.—(Moldenhaur vs. Minneapolis St. Ry. Co., 83 N. W. Rep., 381.)

MINNESOTA.—Collision with Wagon—Evidence—Damages. These are personal injury actions. Held, in each case:

1. That the finding of the jury to the effect that the defendant was guilty of negligence, and the plaintiff was not chargeable with contributory negligence, is sustained by the evidence.

2. That the amount of damages in one of the cases is excessive.—(Durose vs. St. Paul City Ry. Co. [three cases], 83 N. W. Rep., 397.)

MISSOURI.—Injury to Pedestrian—Contributory Negligence—Violation of Ordinances—Civil Liability—New Trial.

1. A decedent's contributory negligence will bar a recovery of damages for causing his death, in the absence of allegations and proof of wantonness or wilfulness in causing the injury, though defendant may have been negligent.

2. Where a verdict is in accordance with the law, the granting of a new trial is error, though the court committed error in refusing instructions.

3. The violation of a city ordinance requiring a motorman to keep a vigilant watch for persons on or moving toward the track, and on the first appearance of danger to stop the car in the shortest time possible, and prescribing a penalty for failure to comply therewith, will not authorize a recovery against the company for causing the death of a person on the track, without proof that such company had agreed to or contracted to be bound by such ordinance, since the city cannot by ordinance create a right of action between third persons, nor enlarge the common-law liability of citizens between themselves.

4. Where a city ordinance regulating the operation of street cars is not enacted for the special benefit of any person or class of persons, but simply pertains to the conduct of the companies to the community as a whole, no other liability follows a violation than the penalty imposed by the ordinance itself, and hence its violation confers no right of action by third persons.—(Holwerson vs. St. Louis & S. Ry. Co., 57 S. W. Rep., 770.)

NEW JERSEY.—Appeal — Review — Conflicting Evidence—Comments by Court.

1. When the evidence of witnesses in a cause on trial is in conflict, it is the province of the jury to determine which of it is to be taken as true—to determine the credibility of the witnesses, and in which direction the weight of evidence exists; and the verdict will not be set aside unless it be against the clear weight of evidence, or is found to be the result of the feeling, bias or prejudice of the jurors.

2. Comments of the trial court upon the evidence, fairly made, and which do not mislead the jury, if the facts be left to the jury to determine for themselves, will not be cause for setting aside a verdict.—(Faulkner vs. Paterson Ry. Co., 46 Atl. Rep., 765.)

NEW JERSEY.—Collision—Injuries—Negligence of Motorman—Verdict—Evidence. Where it appeared that, when plaintiff drove onto defendant's street car track, its car was several hundred feet away, and nothing prevented the motorman from seeing him, though the track was slippery, a verdict in his favor for injuries sustained in a collision with the car will not be set aside.—(Sickler vs. North Jersey St. Ry. Co., 46 Atl. Rep., 779.)

NEW JERSEY.—Injury to Driver of Wagon—Contributory Negligence. One who, while driving on a street in front of an approaching street car, turns his team onto the track in front of the car without turning around to see whether or not a car is approaching, and is struck by the car for the reason that it is too near him to be stopped after his intention to drive onto the track becomes apparent, is guilty of contributory negligence.—(McHugh vs. North Jersey St. Ry. Co., 46 Atl. Rep., 782.)

NEW JERSEY.—Injury to Child on Track—Contributory Negligence.

1. The rule of duty which requires the ordinary traveler in crossing a street railway to use his powers of observation to discover approaching vehicles, and his judgment how and when to cross without collision, is also binding upon a child who is *sui juris*.

2. In actions for injury to a child of that degree of responsibility when so crossing a street railway, the question of contributory negligence is generally one for the jury; but where it appears beyond dispute that the child, in its attempt to cross, acted in entire disregard of the degree of prudence which may be reasonably expected from one of his years, and has thereby contributed to the collision that caused the injury, then the question, contrary to the usual rule, becomes one for the court to determine.

3. In the present case the plaintiff was a girl nine years of age, who was in the act of crossing a trolley track in a city street, and was injured by collision with an approaching car. Under the circumstances, as developed by the plaintiff's evidence at the trial, a nonsuit was granted. On error, held, that the nonsuit should be

sustained on the ground of contributory negligence.—(Fitzhenry vs. Consolidated Traction Co., 46 Atl. Rep., 698.)

NEW JERSEY.—Assault on Passenger—Damages. Plaintiff, while a passenger on a street car, was assaulted by the conductor and thrown from the car. After the assault he was not able to work for eight weeks, and since then only able to work eight hours a day, and earn $8 a week. Before he was assaulted he worked from twelve to fourteen hours a day and earned from $10 to $18 a week. He received a slight scalp wound, had a rib fractured, spit a little blood, and suffered a great deal of pain. His physician stated that thirty-three days after the injury he was apparently cured, and that his bill was $62. The jury awarded plaintiff $2500. Held, that the damages were excessive and should be reduced to $1200.—(Fohrman vs. Consolidated Traction Co., 46 Atl. Rep., 783.)

NEW JERSEY.—Carriers—Degree of Care—Crowding Trolley Car.

1. A common carrier of passengers must use a high degree of care to protect them from dangers that foresight can anticipate.

2. By "foresight" is meant not foreknowledge absolute, nor that exactly such an accident as has happened was expected or apprehended, but, rather, that the characteristics of the accident are such that it can be classified among events that, without due care, are likely to occur, and that due care would prevent.

3. The crowding of a trolley car, and especially of those parts of it that are used for entrance and exit, is attended with a liability to danger that the carrier should anticipate and employ care to avert.—(Hansen vs. North Jersey St. Ry. Co., 46 Atl. Rep., 718.)

NEW YORK.—Injury—Conflicting Evidence. In an action for injuries caused by being thrown from a moving street car, where the evidence of plaintiff and defendant was conflicting, a nonsuit was properly denied.—(Kelly vs. Brooklyn Heights R. Co., 64 N. Y. Suppl., 64.)

NEW YORK.—Liability for Injuries—Streets—Contract to Maintain.

1. Where a street railway company contracted with a township to keep the streets and highways in a safe and passable condition, while constructing its road, an action for an injury resulting from the dangerous condition of the highway, may be maintained against the company by the person injured.

2. Same—Sufficiency of Evidence. A street railway company had contracted with a township to keep the streets and highways in a safe condition while constructing its road therein. Plaintiff was injured by reason of the unsafe condition of such road. The evidence for the plaintiff showed that the company had not worked on the line for two months, while defendant's witnesses testified that it had been completed for six months. Held, insufficient to support a finding that the road was being constructed at the time of the accident, so as to entitle plaintiff to recover against the company.

3. Motion to Dismiss—Waiver. Where defendant moved to dismiss the complaint for insufficiency of evidence, at the close of plaintiff's case, and stated wherein the evidence was insufficient, and such deficiencies were not supplied, defendant did not waive the right to insist that the cause should not be submitted to the jury by failing to again specifically set out the grounds of the objection in a motion to dismiss, which was made after the evidence was closed.—(Sullivan vs. Staten Island Elec. R. Co., 64 N. Y. Suppl., 91.)

NEW YORK.—Evidence—Speed of Car—Competency of Witness.

1. A witness who has driven wagons for twenty years, and who testifies that he is familiar with the speed of wagons, is competent to testify as to the rate of speed at which a street car was running at a particular time, and which he had a chance to observe.

2. Same. It is not error, in an action for injuries sustained by collision with a street car, to refuse to permit a witness to state whether a car was running fast or slow, where he states that he did not notice its speed.—(Garduhn vs. Union Ry. Co., of New York City, 64 N. Y. Suppl., 210.)

NEW YORK.—Review—Sufficiency of Evidence.

1. Where there is evidence in the record sufficient to sustain the judgment of the trial court, it will not be reversed on appeal as against the weight of the evidence.

2. Permanent Injuries—Damages—Instructions. Where, in an action for injuries resulting from defendant's negligence, plaintiff testified that his memory had been impaired by the injury, and a physician testified that loss of memory was a reasonably certain result of such injury, it was not error to refuse to instruct that no damages could be had for permanent injuries.—(Jena vs. Third Ave. R. Co., 64 N. Y. Suppl., 88.)

NEW YORK.—Negligence of Independent Contractor—Liability—Joint Tort Feasors.

1. Plaintiff was injured by the upsetting of a carriage caused by an embankment from 4 ft. to 7 ft. high, which had been thrown up in the public highway by the defendant contractors under a contract with the defendant railway company, preparatory to building an elevated roadway over the defendant company's track. On the night of the accident there was no light to warn travelers of the presence of the embankment. The Supreme Court had authorized the railway company to build the roadway, and also ordered the company to comply with the requirements of General Railroad Law, sec. 11, which authorizes railway companies to excavate, fill in, or change the grade of a highway when necessary to carry its line across the roadway. Held, that the defendant railway company was liable for the injury, as a joint tort feasor, and could not escape liability under the rule that exempts a party from damages for the negligent act or omission of an independent contractor, who has undertaken work for the benefit and at the instance of the party with whom he contracts; since the railroad company, having interfered with the highway under the permission of a statute, had imposed on it the implied obligation to protect the public from accidents by reason of such interference.

2. Same—Excessive Damages. Where plaintiff was thrown from a carriage and seriously injured, by reason of which she was confined to her bed for many weeks, and used crutches for three months after the accident, and eighteen months thereafter had not fully recovered, and probably never would be completely restored to health, a verdict of $8000 was not excessive.

3. Instructions—Co-Defendants. Where a requested instruction related wholly to the respective rights of the co-defendants, and had no bearing on the rights of the plaintiff, a judgment in favor of the plaintiff will not be reversed because of the refusal to give such instruction.—(Deming vs. Terminal Ry. of Buffalo et al., 63 N. Y. Suppl., 615.)

NEW YORK.—Collision with Team—Negligence. A finding that a collision of street car with a wagon at the intersection of two streets was caused by negligence of the motoneer, without contributory negligence of the driver, is warranted by evidence that the driver, on coming east from a point 10 ft. from the west crossing, saw the car coming south 100 ft. from the north crossing; that while driving the team at a "moderate trot," without lessening his speed as he approached the track, and "looking for other vehicles and pedestrians that might be on the other crossing," the wagon was struck on the hind wheel by the car; and that the motorman gave no warning of the car's approach, and made no effort to check its speed, though he saw the team as he approached the northerly crossing, and could have stopped the car within 12 ft.—(Piercy et al. vs. Metropolitan St. Ry. Co., 62 N. Y. Suppl., 867.)

NEW YORK.—Credibility of Witness—Hostility.

1. In an action against a railway company for injuries, the fact that a witness for plaintiff, who was also her attorney, had, as an attorney, brought other actions against defendant, is not sufficient to show that, as a necessary consequence, he must entertain malice against defendant sufficient to affect his credibility as a witness.

2. Same—Appeal—Harmless Error. The sustaining of objections to questions put to a witness introduced by plaintiff, who was also plaintiff's attorney, tending to elicit evidence of his hostility to defendant from the fact that as attorney he had prosecuted other actions against defendant, if error, was not prejudicial, where the witness' hostility was made manifest by other evidence.—(Franklin vs. Third Ave. R. Co., 65 N. Y. Suppl., 434.)

WISCONSIN.—Judgments—Verdict—Contributory Negligence—Duty to Look and Listen.

1. A decision of the Supreme Court in an action by a wife alone for personal injuries will, under the rule of stare decisis, control a subsequent action of the husband to recover for the same injuries, in so far as there is a substantial identity in each case.

2. It is not error to direct a verdict for defendant in an action against an electric street railway company to recover for injuries sustained by one of defendant's cars, where there is no direct evidence of defendant's negligence, but there is evidence showing plaintiff to be guilty of contributory negligence.

3. A motorman on an electric street car may presume that one driving a carriage in front of his approaching car, and who he sees is about to turn upon the track in front of his car, will desist from so doing when he sounds the gong of his car; and he is only bound, as an ordinarily careful man, to exert efforts to stop his car after he sees that his warning is unheeded.

4. A driver of a buggy, whose ears are muffled in a seal-skin cap and coat, is guilty of contributory negligence in driving on an electric street car track without looking any considerable distance up or down the track to see if a car is approaching, since in such case she is deprived of a warning through the sense of hearing.—(Cawley vs. La Crosse City Ry. Co., 82 N. W. Rep., 197.)

A Large Convertible Car

The engravings which accompany this article show two views of a double-truck, twelve-bench, convertible car recently built for the New Castle Traction Company, of New Castle, Pa. This car is one of a lot supplied this company by the J. G. Brill Company, and is the largest of the kind yet turned out. The idea of the convertible car is one which is receiving much attention from street railway men at the present time. The public are everywhere, even in our northern cities, clamoring for an open car during the warmer weather. They are equally clamorous to have these cars taken off whenever a cold wave interrupts the pleasant weather, and they object, very rightly, to the use of them during chilly weather late in the fall or early in the spring, yet throughout the year, even in winter, there are days when the use of such cars materially increases the traffic of a street railway. Boards of Health in some cities where open cars are extensively used have found it necessary to interfere and demand that a certain proportion of closed cars be run the whole year round. The railway manager at the present time is confronted with the problem of a double equipment, half of which only can be used at any one time. This, of course, means double storage capacity, with all the attendant expenses, and it also means, if the public are to be thoroughly accommodated, the storage shall be arranged in such a manner as to make it possible to change from one to the other kind of car at the shortest possible notice. Actual practice succeeds only in using a double equipment, and keeping the open car in service as long as possible. It is put on weeks before the proper time in the spring in order to take advantage of any stray warm days which might occur, and it is often kept on in the fall a month longer than is comfortable for many of the traveling public.

The aim in designing the Brill convertible car was to have a single equipment which could at all times give the railway manager the car he mosts needs at the required time. Furthermore, it provides a car which is entirely self-contained, and is at all times ready to be changed from one type to another without going to the shops or car houses, and without further labor than that which can be given by the motorman and conductor in a few minutes. With an equipment of this character the storage capacity of the car houses is reduced practically one-half; there is a corresponding diminution in the sizes of buildings, the quantity of land required, attendance necessary and capital invested.

How perfectly the Brill car has answered the requirements can be judged from the engravings and from the accompanying description. Fig. 1 shows the car open for summer use. It is in all respects a standard cross seat, center aisle open car. From a layman's point of view it is identical with the usual type. The expert notices, perhaps, the panels in the corner and certain minor details of construction, as for example the form of grab handles and positions of the panels. Fig. 2 shows the car closed, the steps folded up ready for winter use. It is practically a standard box car on double trucks. It is true there is a folding step and grab handles at each window post, but the arrangement of the windows and panels is similar to that of the ordinary car. With the exception of the fact that the windows rise instead of drop, the car is, as far as the passengers are concerned, the same in operation and arrangement as a closed car. The curtains operate in the same way—when closed they come to the window rail; when open they come all the way to the floor. These New Castle cars have twenty-four benches and seat forty-six persons, one of the stationary seats at each end of the car accommodating one person only. The open car has the Brill round-corner seat end panels, which give great ease of entrance from the sides.

The cross-seat car is being looked upon with more and more favor by street railway men, and several large companies are ordering them extensively. The idea is that there is a profit in carrying seated passengers, and that when seated people are more comfortable if they face in the direction in which they are moving.

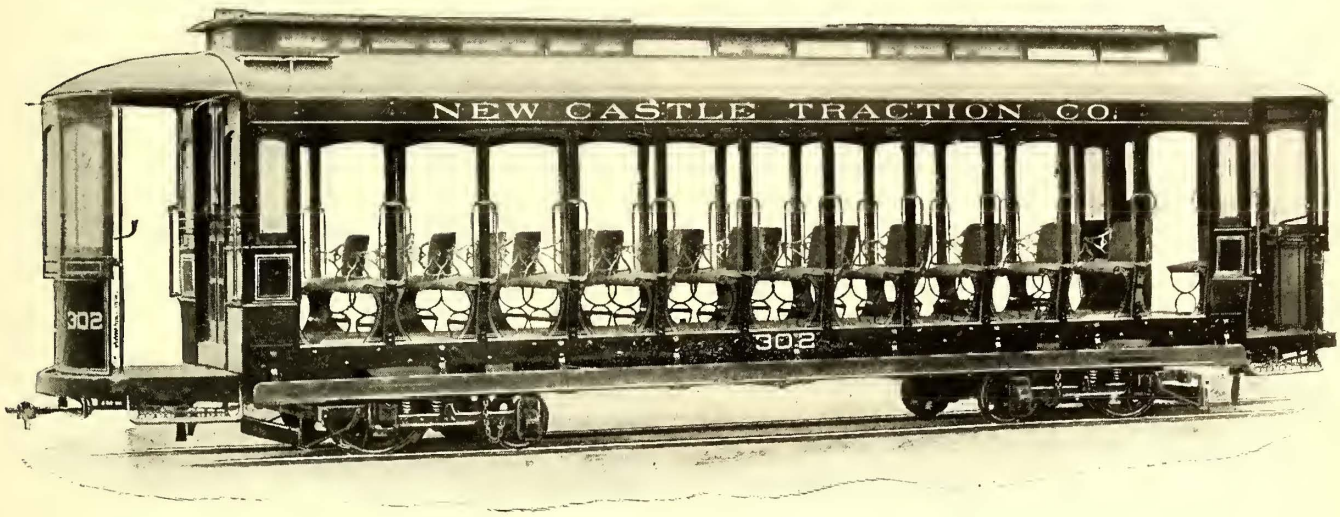


FIG. 1—CONVERTIBLE CAR FOR NEW CASTLE, OPEN

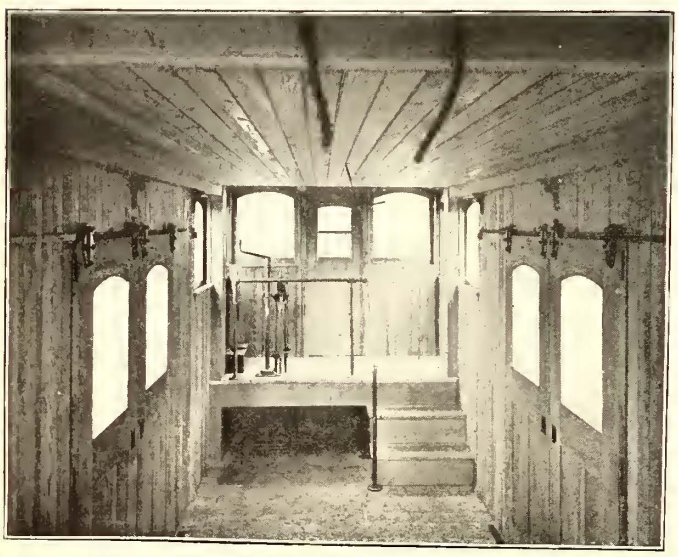
FIG. 2—CONVERTIBLE CAR FOR NEW CASTLE, CLOSED

The following are the principal dimensions and details of these cars: The length over end panels, 30 ft. 8 ins.; length of platform, 4 ft.; length over dasher, 38 ft. 8 ins.; width at the sills, 6 ft. 8¾ ins.; width over the posts, 7 ft. 5½ ins. The extreme width of the car when the steps are down is 8 ft. 8 ins.; when they are up the extreme width is 7 ft. 8 ins. The height of the platform steps is 14 ins. from the head of the rail; the riser is 13 ins. The long step or running-board is 19 ins. from the track and 15 ½ ins. from the step to the floor of the car. The width of the car inside at the center is 8 ft. 2½ ins., and the body is 9 ft. 3½ ins. from the bottom of the sill over the trolley board. These cars were mounted on maximum traction trucks, with driving wheels 33 ins. in diameter, 2-in. tread and ⅝-in. flange. They were fitted with electric brakes, Brill angle-iron buffers, Brill portable vestibules, radial draw-bars, two sand-boxes, two Dedenda gongs. The General Electric Company furnished cables, controllers and resistances. The side panels are of the new type, having metal on both sides of the slats, making a very warm car side, and, being flexible, they fill the groove completely. The interior of the car is so nearly identical with those ordinarily used that even an experienced railroad man would not be likely to note the fact that there was anything unusual in the construction. The center of the car, perhaps, appears a little more lofty than usual. The ventilators and monitor deck are the same. The construction of the roof is such as to give this car an unusual amount of stiffness and strength. The letter board and panels are made from a single piece, and are halved upon the posts and carlines. The necessary interior furring strips also anchor each of the carlines, while the carlines being wider than usual at the foot and made up as part of the posts are much stronger than those of any ordinary car. Although this design has been in use long enough to have made its weak points visible, no faults of any consequence have appeared. Cars of this type have been in a number of accidents which have demonstrated their unusual strength.

Electric Freight Locomotive at Whitinsville, Mass.

The use of electric locomotives is increasing, not only for passenger but also for freight transportation. Several recent electric freight locomotives have been described in these pages, and views of a recent machine of this class, built by the Taunton Locomotive Manufacturing Company for the Whitin Machine Works, of Whitinsville, Mass., are given herewith.

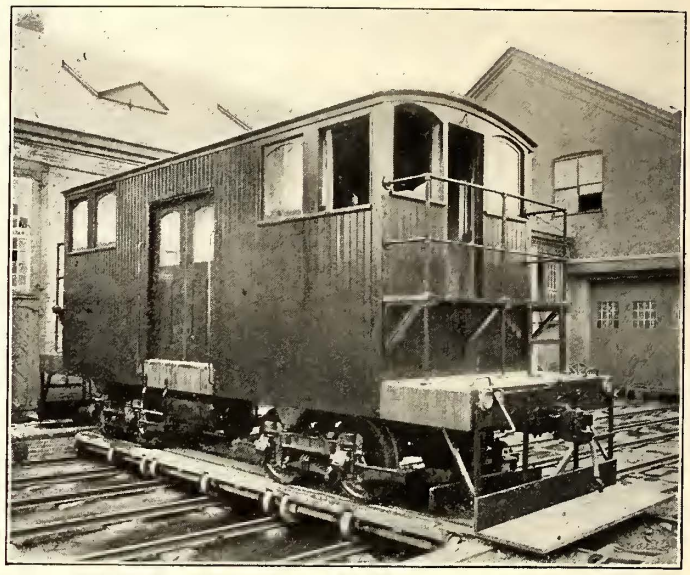
The main frame of the locomotive body consists of two end



INTERIOR OF CAB

sills of 8-in. x 12-in. oak, eight longitudinal sills of 4⅝-in. x 11-in. yellow pine, and two bolsters of 8-in. x 11-in. yellow pine. On this frame is laid a flooring of 1¾-in. spruce. The cab, which is built on this frame, is constructed of four corner posts of 6-in. x 6-in. yellow pine, and belt rails, door framing and side braces of 2¾-in. x 4-in. yellow pine. The end roof carline is of 2½-in. x 3-in. white pine curved, and the other roof carlines are 1¼-in. x 9½-in. yellow pine. The outside roofing and sheathing is of ⅞-in. North Carolina pine, and the inside roofing and sheathing is of ⅞-in. North Carolina pine, except for about 4 ft. at each end, where the roof carlines were made circular on the under side, as well as the top, so as to allow the platform to be placed as high as possible, and the sheathing was reduced to ⅜ in.

The locomotive is mounted on Peckham No. 14 B-3 double trucks, fitted with 33-in. wheels on 4½-in. axles. The electrical equipment consists of four G. E. 57 railway motors, whose armatures are wound for slow speed, each coil containing six turns. Series parallel controllers allow the operation of the locomotive at a speed of 5 to 6 miles per hour on the series slow running point, and 9 to 12 miles per hour on the multiple point. The



GENERAL VIEW OF LOCOMOTIVE

six-panel resistances are under the cab platforms, with the idea of utilizing their heat in the winter time to warm the cab.

The automatic air-brake apparatus with which the locomotive is equipped was supplied by the Christensen Engineering Company, and will operate in connection with any of the standard automatic brakes. The locomotive is accordingly supplied with coupling hose in order that the air brakes may be used on any freight car which it has to handle.

The motor compressor is situated underneath the engineer's platform at one end of the car, and has a capacity of compressing 20 cu. ft. of free air per minute to 100 lbs. pressure. The main storage reservoir is placed beneath the car, as are the brake cylinder and the auxiliary reservoir, and is connected by piping to the compressor and to the engineer's valves at the ends of the locomotive. The auxiliary reservoir is piped to the triple valve on the tail of the brake cylinder, which is in turn connected to the engineer's valves. The locomotive is supplied with whistles, one at each end, which are blown by compressed air.

Reduced Tariff on Electrical Machinery in Italy

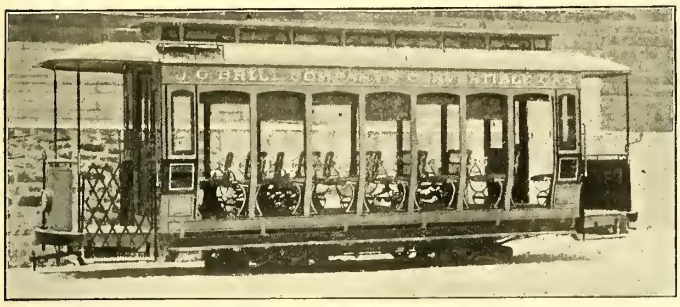
The United States State Department has made public the text of the new reciprocity treaty with the Kingdom of Italy. In consideration of reductions in the United States tariff upon certain Italian products, chiefly wines, the Italian government proposes to lower its duties on some six or seven articles of American manufacture, among them scientific apparatus, dynamo-electric machinery and varnish. Under the agreement the Italian import duties on these manufactures will not exceed the following figures:

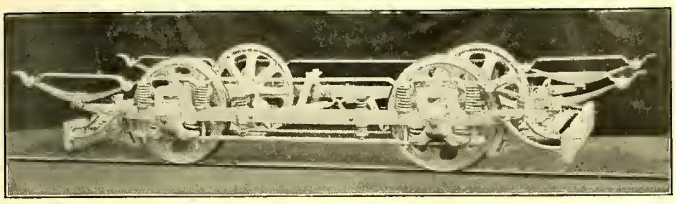
Articles	Rate in Lire Per Quintal
Scientific instruments:	
(a) Of copper, bronze, brass, or steel.	
(1) With spy-glasses or microscopes, or graduated scales or circles, spy-glasses for use on land, monocles, binocles, lenses, detached and mounted	30.00
(2) Not provided with any optical instrument nor with graduated scales or circles	30.00
(b) Of all kinds, in the construction of which iron is evidently predominant	30.00
Upon dynamo-electrical machines:	
Upon varnishes, not containing spirits nor mineral oils	20.00
(1) The weight of which exceeds 1000 kg	16.00
(2) Weighing 1000 kg or less	25.00
Upon detached parts of dynamo-electrical machines	25.00

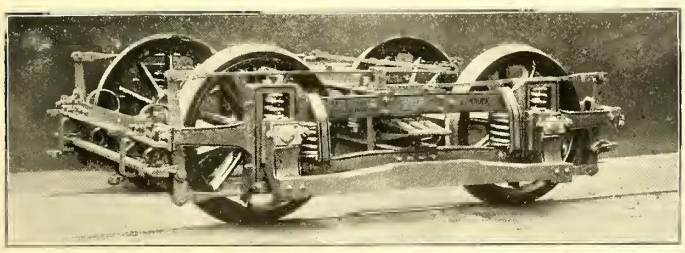
The treaty, which must first be approved by the Italian Parliament, will continue in force until the expiration of the year 1903, and if not denounced by either party one year in advance of the expiration of said term, it will continue in force until one year from the time when one of the high contracting parties shall have given notice to the other of its intention to arrest the operation thereof.

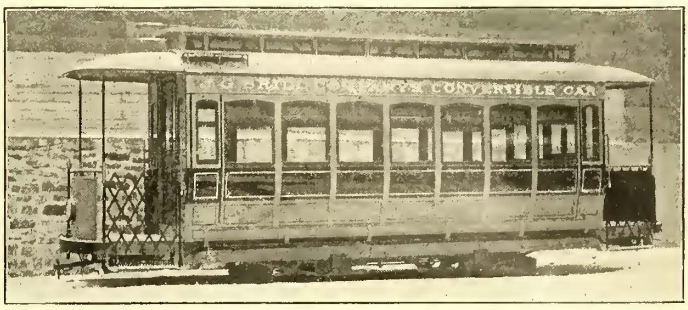
The Brill Exhibit at the Paris Exposition

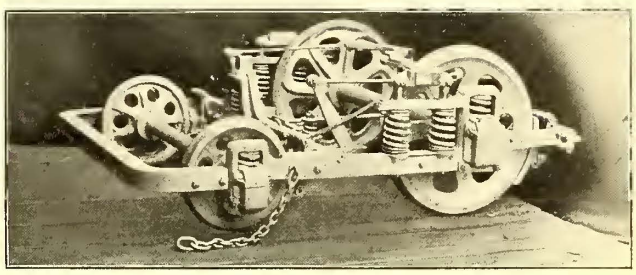
Reference was made in the last issue to the exhibit at the Paris Exposition of the J. G. Brill Company. The principal objects shown are illustrated herewith. As with most of the transportation exhibits, part of the apparatus shown is in the Champs de Mars section and part in the Transportation Building at Vincennes.

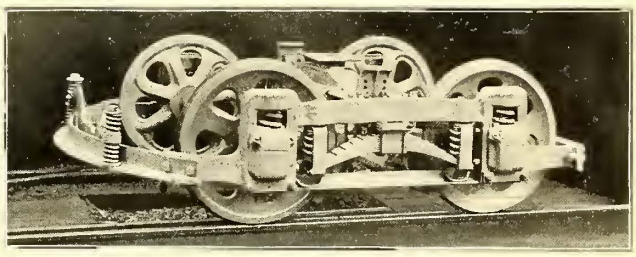












BRILL CARS AND TRUCKS AT THE PARIS EXPOSITION

The exhibit in the former comprises four quarter size truck models showing respectively: A model of the 27-G, of the 21-E, of the Maximum Traction and No. 27 trucks. The chief exhibit of the Brill Company, however, is at the Vincennes annex. The most conspicuous objects here are the snow sweeper, illustrated in July, and a Brill convertible car complete, mounted on a 21-E truck. This convertible car, which is illustrated herewith, was constructed to meet the requirements and restrictions imposed by French government officials relating to tramway rolling stock.

There is also shown one 27-G bogie truck, similar to other trucks of this same type which the company has furnished for use on French tramways; also one maximum traction truck of the same construction, as are now being furnished for use under French cars.

The maximum traction truck exhibited is fitted with solid forged wrought iron side-bars, this being one of the latest improvements in double-truck construction. The 21-E truck is also fitted with these solid forged iron side-bars, according to the Brill practice for several years past. The company also exhibits here one of its No. 27 high-speed trucks.

To show the other patterns of cars manufactured by it the Brill Company has out a large stand containing quite a number of miscellaneous photographs of cars and trucks, the stand being arranged for easy access in order that the public may examine the different types of rolling stock which the company has recently furnished throughout the world. The whole exhibit, which is one of the largest of the American exhibits at the Paris Exposition, covers a space 100 ft. x 10 ft.

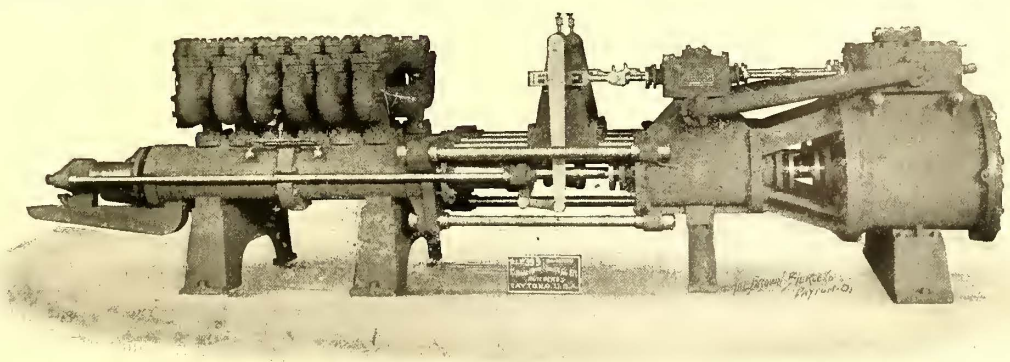
As this issue goes to press a cable dispatch states that the Brill Company was awarded, by the official jury, two grand prizes, one for its system of trucks, the other for its convertible cars. These are said to have been the only grand prizes awarded for electric trucks or convertible cars.

A New Design for a Compound Duplex Pressure Pump

The accompanying illustration shows a new compound duplex pressure pump to develop a maximum pressure of 700 lbs. per sq. in. manufactured by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio.

The liquid end is of the end-packed trombone style. The cylinders are made of special metal; mounted thereupon are separate chambers for the location of the valves. The chambers are also constructed of special metal and designed with a view of facilitating quick access for the inspection of the valves.

The valves are of the hydraulic pattern, made of steel, and guided from below. An extension piece is provided for supporting the water plunger, and an approved adjustment device provided therefor.

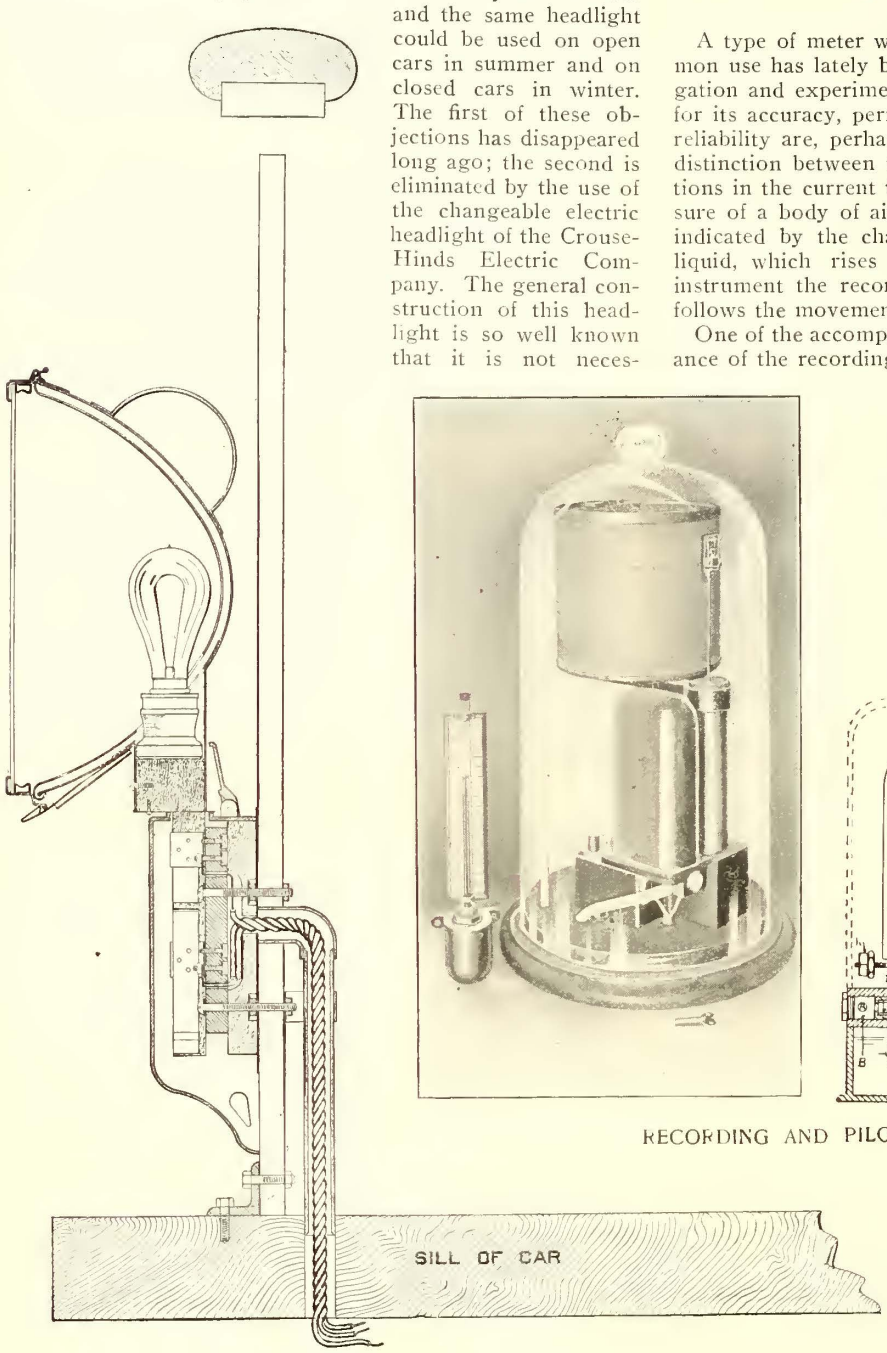


COMPOUND DUPLEX PRESSURE PUMP

The water end is mounted on heavy supporting columns. An engine of the transposed cylinder type is furnished, giving free access to all steam pistons without dismantling the pump. The outside valve adjustment is a feature of this design.

Changeable Electric Headlight

When electric cars were first introduced, electric lamps were, of course, used for the interior illumination of the car, but oil was employed exclusively for headlight purposes. The reason for this was probably two-fold; one was that the electric light was not considered reliable enough for headlight service, where the safety of the passengers, as well as that of persons crossing the track, is dependent to such a great extent upon the burning of the headlight at all times; the other reason was undoubtedly the fact that the oil headlight could be changed from one end of the car to the other so that a double equipment was not necessary for each car and the same headlight could be used on open cars in summer and on closed cars in winter. The first of these objections has disappeared long ago; the second is eliminated by the use of the changeable electric headlight of the Crouse-Hinds Electric Company. The general construction of this headlight is so well known that it is not necessary to discuss it here. The company has made a few changes in detail, however, during the last year, which have increased the convenience and reliability of the device. A section of the headlight, showing the construction of the receptacle as now built, is shown herewith. The receptacle, of course, is attached to each dasher, and the contacts form part of the light circuit of the car. One headlight only is required for each car in operation, and by placing this light in one of the receptacles, the lamp is automatically thrown into circuit, cutting out the lamp over the front platform. When the headlight is changed to the other platform the lamp cut out is thrown into circuit again, and the other platform light is cut out.



SECTION SHOWING HEADLIGHT AND RECEPTACLE

The contact stem of the headlight is made of second-growth hickory, kiln-dried and boiled in paraffin to make it thoroughly waterproof; the receptacles, which are mounted at each end of the car, are made with a kiln-dried oak back, having mounted thereon a ½-in. slate block. The brass connections of the receptacles are mounted on this base, and the contact springs are made of phosphor bronze. The receptacle is encased in a cast-iron backing 10 ins. high x 4 ins. wide. The wires are carried through the dasher in a small iron pipe. The opening of the receptacle not in use is protected by a cast-iron lid, which drops in place when the headlight is removed, making it water-tight.

A New Recording Meter

A type of meter which differs greatly from those now in common use has lately been brought out. Much painstaking investigation and experiment have been expended on it, and the claims for its accuracy, permanence, compactness, legibility and general reliability are, perhaps, not too strongly expressed. The radical distinction between this and the ordinary type is that the variations in the current to be measured control the variation in pressure of a body of air in a closed vessel. This latter variation is indicated by the change in height of a column of non-volatile liquid, which rises and falls in a tube. In the recording instrument the record is traced by a float-supported pen which follows the movements of the liquid's surface.

One of the accompanying illustrations shows the general appearance of the recording meter, and a small "pilot" indicator, which

RECORDING AND PILOT INSTRUMENT

can be placed in any desired position. The other illustration gives a section of the apparatus showing its operation. Air is supplied either from a small air pump furnished with the instrument, or from some other source, at a pressure of about 1¾ lbs. per square inch to the orifice, *A*, in the chamber, *B*. The air then flows through a series of porous diaphragms made of filter paper, whose prime function is to serve as an air resistance, but incidentally remove any dust particles and serve to make the instrument dead beat, and then enters the passage, *D*, into which is drilled the opening, *E*, which is capped by the valve, *F*. The valve itself consists simply of a small flat disc of non-oxidizable metal, *F*, resting on a circular seat with escape ports, *G*, below it, and a pin, *H*, resting on top. On the pin rests a spool, *J*, carried by one end of the lever, *I*, on the other end of which is a counter-weight, *K*, by means of which the effective weight on the pin, *H*, can be adjusted. The spool is wound with wire through which the current to be measured is passed, this being done by means of the two short thin copper ligaments, *L*, which support and form the fulcrum about which the lever can oscillate. A magnet, *M*, furnishes a field of force such that the reaction between it and the current forces the

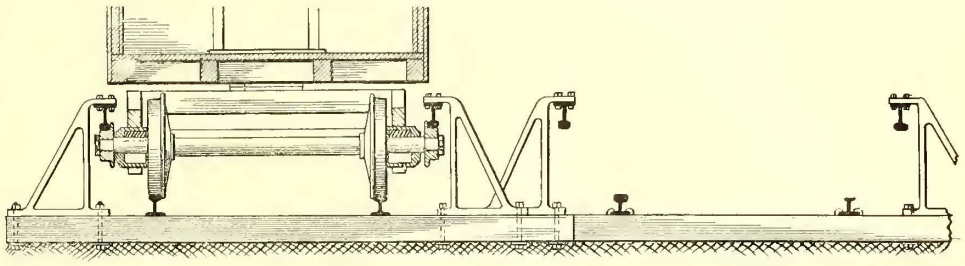
spool down with a force increasing as the current increases. The valve, *F*, is thus a variably loaded safety-valve, whose blowing-off point is constantly and proportionately varied by the current variation. The counter-weight, *K*, on the lever is so adjusted that when no current is passing through the spool the weight on the valve-pin is such that the blowing-off pressure in *D* is one sufficient to force the liquid in the closed chamber to such a height that the pin will register zero and the liquid in *U* will be forced to the zero position on the scale. The pressure cannot go above this when no current is on, as any tendency to increase simply results in lifting the valve slightly higher, whereupon more air escapes and the pressure falls back; nor can it go lower, as if there were this tendency the valve would partially close because of the spool weight, and the less rapid escape of air through it would cause the pressure to build up again because of the constant flow of air from the high-pressure supply at *A* through the air resistance, *C*. It is thus seen that the air pump must not necessarily keep a constant pressure on the opening, *A*. Exactly the same thing holds good when the weight on the valve is that due to the non-counterbalanced portion of the spool weight plus the downward thrust caused by a given current through it. This gives what is practically a heavier loaded safety-valve, so that the blowing-off pressure in *N* is higher, and this higher pressure, of course, forces the liquid up further, thus showing the presence of a current. The height to which the liquid rises is directly a measure of that current, because the extra downward thrust on the spool is, from the magnetic field and spool design, proportionate to the current.

It should be noted that the only work that the varying current has to perform is to *control* the air pressure, the actual energy required to move the liquid, and so show the variation, being supplied by an independent source, whose power is, comparatively speaking, unlimited.

The "column" instruments, described above, are being manufactured by the Whitney Electrical Instrument Company, and introduced by Machado & Roller, of 203 Broadway, New York City. A plain indicating instrument having a vertical scale like the pilot indicator, but extending 18 ins. between the zero and maximum readings, as well as a type of meters to be used on alternating currents, are also constructed.

A Device to Prevent Derailment

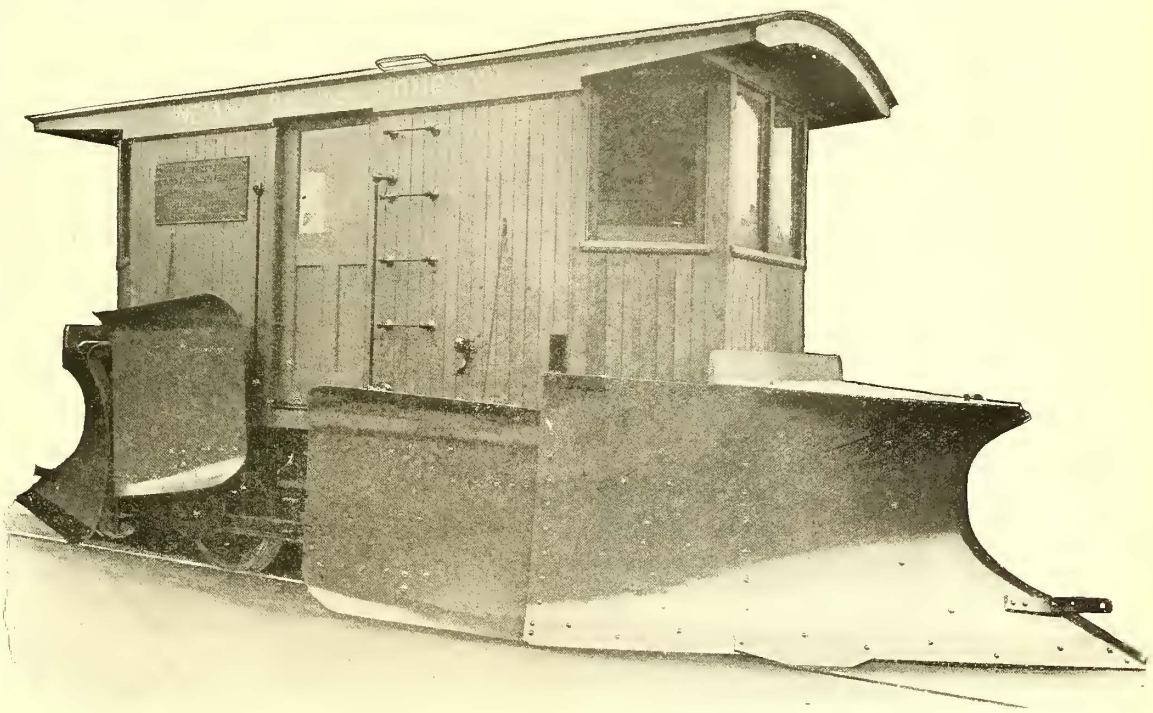
The accompanying illustration gives a good idea of a new system of track construction whereby it is claimed high speeds may be obtained without fear of derailing the cars. As seen from the figure, there is no material variation from the standard roadbed and rolling stock of the present day. The only difference in the roadbed is that for about every fourth tie one somewhat longer is substituted, on which to fasten the brackets for the support of the safety rails. These consist of ordinary T-rails turned upside down and bolted securely to the brackets, thus, if anything, increasing the stiffness of the roadbed. The car axles, instead of terminating in the grease-box, are extended until they project out under the inverted safety rails, and are provided with a small anti-friction roller at their extremities, which travels along those rails. By having this roller insulated from the axle and using a contact shoe on each side of the car, the safety rails may be insulated and used as the two sides of a trolley circuit, and the cars run electrically. This would be, of course, the probable form of power for high-speed service. The inventor of the system is W. T. Van Dorn, of Chicago, manufacturer of the Van Dorn automatic car coupler.



DEVICE FOR PREVENTING DERAILMENT

A Powerful Snow Plow

The new 1901 snow plow of the Taunton Locomotive Manufacturing Company differs in a number of particulars from the company's 1900 model. It weighs 5 tons without motors, and is thus somewhat lighter than the Taunton standard plow of last year. This reduction in weight has been secured entirely by dispensing with cast iron, especially in the shape of the two heavy counterbalance weights. The manufacturers have also substituted wrought iron and timbering for a large amount of cast iron used in last year's plow, and the noses are now raised and lowered by a chain, operated by worm and gear mechanism. The whole weight of the nose rests on the rail, although the height of the nose can be adjusted to suit any condition. This renders the plow especially valuable in light snows, and guarantees a clean rail under these circumstances. At the same time the shape of the nose and heavy oaken backing give sufficient strength for heavy drift work.



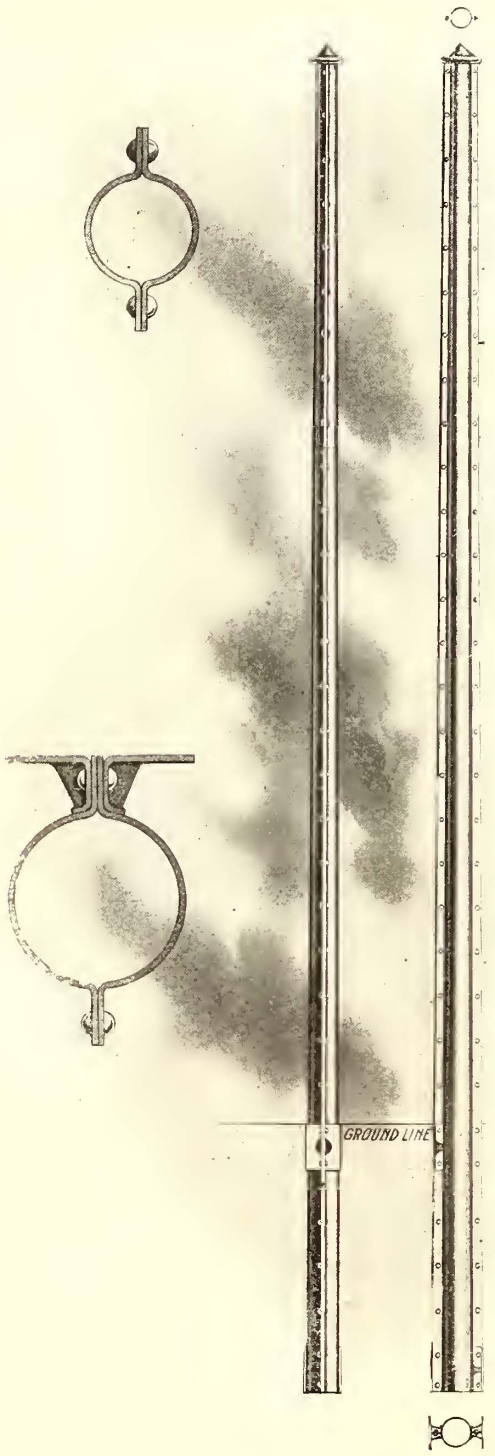
A POWERFUL SNOW PLOW

The wings are also a departure from former Taunton practice, and are believed to be an improvement, inasmuch as they dispense with the wing hinge pin, always difficult to keep in shape, when the plow is sent against frozen ground or hummocks of ice. The nose is carried so far back on each side that the wheels are thoroughly protected, and the sides of the plow are also protected from snow without in the least interfering with accessibility to the running gear. The hood or overhang part of the roof has been practically taken away to make perfectly easy the manipulation of the trolley rope. The effective Taunton digger is applied to this plow, and, as now built, the manufacturers, who have had many years of experience in electric plow building, state that they can see no opportunity for further improvement in a plow for all-round single track work. The changes made this year, as stated, are not in design, but are mainly in the substitution of timber and

wrought iron in place of cast iron. For ordinary work the excessive weight is not often necessary. For the heaviest kind of drift work, such as is met in Maine and Canada, however, the company makes the Taunton heavy-nose plow, which weighs twice as much as the plow described above.

A New Steel Trolley Pole

A trolley pole which differs in many important respects from the ordinary ones now on the market has recently been brought

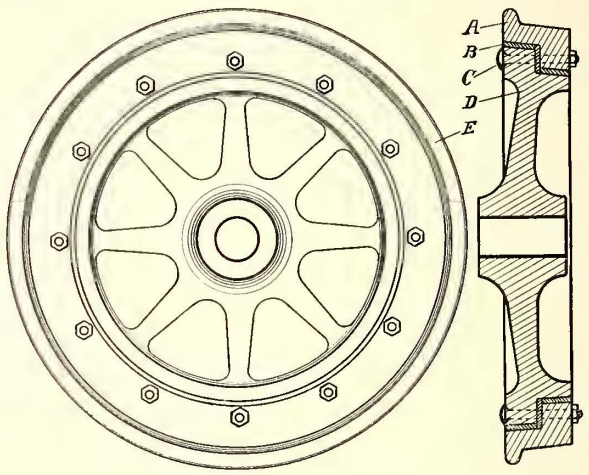


SECTIONAL TROLLEY POLE

out by the Pressed Steel Car Company, of Pittsburgh, Pa. The accompanying engraving presents a good idea of the general appearance of the pressed steel poles, sectional views being given to aid the reader's understanding of its construction. The new style is made in two semicircular sections, so firmly riveted together that they become practically one piece. Thus a maximum standard of strength is established throughout its entire length, and the occasional uncertainty which accompanies the use of poles having two or more longitudinal sections is eliminated. Brackets of a form shown in the illustration are placed on the flanges of the pole at the ground line and at the base, which give additional rigidity. The manufacturers claim that a pole of this kind can be made more cheaply than a tubular pole, and have prepared dies which enable them to turn out any size from 24 ft. to 40 ft. A malleable or cast-iron cap covers the top of the pole, which gives an artistic finish to its handsome appearance.

A Noiseless Car Wheel

The introduction of 2 or 3 lbs. of paper beneath the tire of a car has been tried with marked success in Chicago. Four wheels made in the manner shown in the accompanying sketch have been in operation for some time on a street car, and a similar equipment is being tried by one of the steam roads. This new style of



NOISELESS CAR WHEEL

wheel is the invention of I. Hogeland, of Chicago, who claims that by its use a sufficient recoil or cushion is obtained to render steel tires unnecessary, even for heavy steam railroad practice. The wheels were made by the Wells & French Car & Wheel Company. The tests are being made under the severest conditions, the street car on which the wheels have been placed running over some of the worst track in Chicago, so that the satisfactory operation of the invention under less trying circumstances is assured.

New Method of Hardening Steel

The Bethlehem Steel Company has recently perfected a new method of hardening steel, which is particularly adapted to tool steel. This process, which is called the Taylor-White process, has been employed in the Bethlehem works with remarkable results, and has enabled the company to speed up its main lines of shaft from 90 to 250 r. p. m. and greatly to increase the output of its machine shops.

One virtue of the Taylor-White process is that it gives to the steel the very valuable and exceptional property of retaining a high degree of hardness when heated to a visible red heat. It is possible with one of these tools to cut steel at a speed so great as to heat up the point of the tool to redness and have it continue to cut for several minutes at this speed, leaving an unusually smooth finish on the work, as well as cutting accurately to size. The advantage in leaving a smooth roughing cut and of having the work accurately to size will be readily appreciated, as it materially lessens the work of finishing. The practical speeds at which these tools will run has been found to be from two to four times that of any steel with which the company has experimented, and it has endeavored to obtain the best in the market. The effect of the Taylor-White process, which is applied after the tool has been dressed or machined to shape, penetrates to the center of the steel, even in the largest tools ever treated, i. e., 4 ins. square.

All of the standard brands of self-hardening steel which have been experimented with are improved to a more or less extent by the treatment; it is preferred, however, to use a steel of special composition in order to get the greatest uniformity and maximum results. This special steel forges so much more readily than the general run of self-hardening steels that tools of difficult shapes may easily be made up.

The company has also discovered a simple and comparatively rapid method of annealing this special steel by which tools may

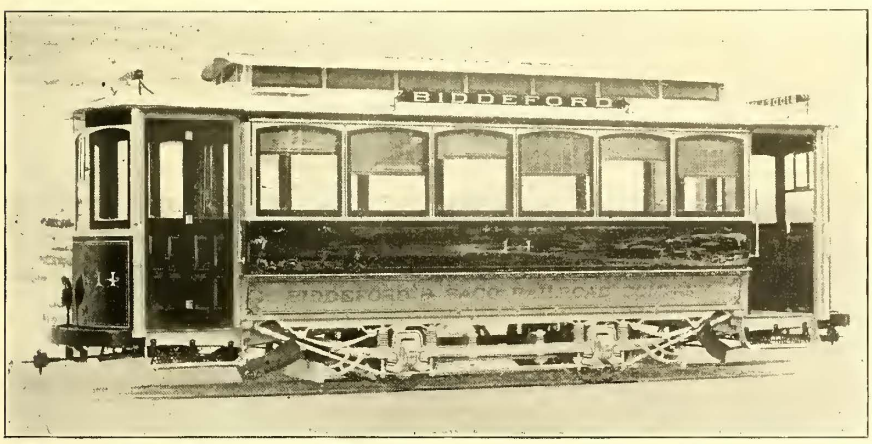
be easily machined to shape, making it applicable to twist drills, chasers, inserted cutters, etc., which have heretofore not been made from self-hardening steel.

A very important feature resulting from the use of this process is that the tools are extremely uniform in quality, so that work on which they are used can be regularly performed at the maximum rate of speed. The variation in the quality of these tools does not run over 5 per cent, which insures a much greater degree of uniformity than is attained in any other tools that we know of, whether made either of tempered or any air-hardening steel. With uniform tools the piece-work system can be most efficiently used, as the piece rate must always be based not on the average cutting speed of the tools, but on the speed of the worst tool in use.

The company proposes to sell shop rights to use this process, the price to be based upon the number of tools in use, as well as their size and character.

Car for Cold Climate

The type of car shown in the accompanying engraving is one which has been found useful and satisfactory for suburban lines



CLOSED CAR FOR BIDDEFORD

in very cold and trying climates. The car in question was built by the J. G. Brill Company for the Portland Railroad Company to be operated on the Biddeford & Saco line. The body is 18 ft. long and is mounted on No. 21-E trucks, furnished with two motors. The platforms are 4 ft. 6 ins. long with so-called circular ends. They are completely enclosed, having folding doors which turn back against the body of the car. This gives complete protection to both motorman and conductor, a feature highly necessary in a climate where the thermometer often drops below zero and where high, piercing winds are the rule during the winter. The cars measure 27 ft. over all and are 6 ft. 2 ins. at the sills and 7 ft. 6 ins. over all. Looking at the engraving it will be noticed that scrapers are fitted at each end of the car. These attachments are almost equivalent to a snow plow, and enable the car to run through light snow and even move the small but annoying drifts which are common on some parts of the line. Scrapers could be more frequently used to advantage, as they prevent many delays in winter operation, which are both annoying and costly. The ends of the car are fitted with Brill angle-iron bumpers, sand-boxes, Dedenda gongs and electric headlights. The track is standard gage, 4 ft. 8½ ins. The wheel base is 7 ft., thus securing great steadiness of motion and enabling a high speed to be maintained with comfort. The car measures 12 ft. from the head of the rail over the trolley board.

The finish over the windows inside is of mahogany, the sashes are of mahogany with arched tops, and the head lining is of three-ply quartered oak. Four-sided reversible signs are placed on the sides and ends of the car. The trim throughout is solid bronze. The total weight of the car without motors is 11,800 lbs. The seats are longitudinal, with spring seats and backs covered with crimson plush. Cars of this general type are easily heated and the practice is fairly divided between electric heaters and stoves.

Nelson C. Draper has been appointed superintendent of the Peoria & Pekin Terminal Railway Company, of Peoria, Ill., to succeed Mark H. Hubbell, resigned. Mr. Draper has been connected with this road for some time as electrical engineer, and was formerly connected with the Central Railway Company, of Peoria.

A New Incorporation

Messrs. Fowler and Robert, comprising the firm of Fowler & Robert, the organization of which was announced in the Street Railway Journal a few months ago, have found their business as manufacturers and dealers in general railway supplies has increased so rapidly as to call for a large extension of their facilities. For this reason, they have organized a company, which will be known as the Fowler & Robert Manufacturing Company, have secured good-sized works at 1263 Atlantic Avenue, Brooklyn, and have enlarged their field and personnel. The latter is now extremely strong, and includes not only Messrs. Fowler and Robert, who are well known in the street railway field, but also George W. Linch, for a long time superintendent of the Dry Dock, East Broadway & Battery Railway Company, in New York City, and Fred Vieweg, as well as others. The company is prepared to supply all the specialties formerly made by the Lewis & Fowler Manufacturing Company and the Brooklyn Railway Supply Company, and will make a specialty of the L. & F. improved fare register. This register, which is the former Lewis & Fowler, but in which have been embodied a number of important improvements, has stood the test of service for twenty years, and is one of the earliest and best known in the field. The new company believes that now that these registers will be manufactured and supplied by the same persons who were instrumental in its original design and manufacture, and now that repair parts for it can easily be secured, the machine will be received with all its former popularity. In addition, the company will manufacture repair parts for L. & F. electric snow sweepers and car heaters, and will manufacture, or has secured the agencies for, all kinds of car trimmings, bells, gongs, brake-shoes, bearings, special track work, trolley wheels and harps, commutators, canopy switches, etc., as well as the Thistle brand of metallic paints. The New York office remains at 149 Broadway.

New Publications

Horseless Vehicles, Automobiles and Motor Cycles. By Gardner D. Hiscox. Published by Norman W. Henley & Company, New York City. 459 pages. Illustrated. Price, $3.

In this book the author again exhibits his faculty of practical discrimination. From the immense field offered by the present state of automobile manufacture he has made most happy selections, and compiled a series of illustrated descriptions of steam, internal combustion, compressed air and electrical vehicles, which cannot fail to prove of service to those interested either in their production or operation. As is natural in books of this kind, unlimited use has been made of patent drawings, illustrations from trade catalogues, etc., but as they admirably serve their intended purpose no fault can be found with their introduction. The first two chapters contain many interesting facts concerning the utility and history, and considerable space is given to the running, care and repair of automobiles, but the greater part of the volume is devoted to the various styles which the author has chosen to describe.

Gas-Engine Construction. By Henry V. A. Parsell, Jr., and Arthur J. Weed. Published by Norman W. Henley & Company, New York City. 296 pages. Illustrated. Price, $2.50.

The amateur mechanic who is interested in gas engines will find much information in this volume. After thirty-eight pages of rather meager description of the various types and some commercial forms, the author devotes nearly the entire remainder of the book to the manufacture of a ½-hp engine. Starting at the patterns, instructions are given in great detail for every operation until the work is completed. The book is uniquely illustrated by reproductions of photographs taken during the actual construction of such an engine by the author, as well as the ordinary working drawings. A feature which will, perhaps, make the book of interest to engineers is an annotated list of gas-engine books and periodicals published in the English language, with which it closes.

Corporations and Public Welfare. Published by McClure, Phillips & Company, New York. 208 pages. Price, $1.50.

This book contains a collection of addresses delivered at the annual meeting of the American Academy of Political and Social Science in Philadelphia in April. The volume contains many papers of interest to students of sociology, and the subject of municipal control receives quite a little attention.

CURRENT NEWS

Third Rail Attacked in Brooklyn

The Department of Public Buildings, Lighting and Supplies has begun an attack on the Brooklyn Rapid Transit Company, and has officially notified the company that it must either make the system absolutely safe or do away with it altogether on the elevated lines. This action is said to have been prompted, as officially put, "Because of the numerous serious accidents on the system since its installation," but is believed to be a similar political demonstration to that made against the Manhattan Company by Tammany Hall late last year.

Proposition for a Sub-Sidewalk Railway in Chicago

J. H. Farrar, of Chicago, has submitted plans and detailed explanations of a sub-sidewalk railway to the Street Railway Commission. The chief merits of the system are in the cost of construction and the high speed which may be attained. The scheme provides for the construction of the road directly under the sidewalk.

For use on the sub-sidewalk railway the inventor proposes an open car, resembling a carette with the top cut away. The sidewalk above furnishes the top for the car and prismatic walks above give light, aided by electric lights within. Heat is to be furnished from gas radiators along the curb.

Wire-Tapper Caught in Milwaukee

On Aug. 25 the engineer of two large Milwaukee buildings was arrested on the charge of stealing electricity from the Milwaukee Electric Railway & Light Company. Secret connections were made with the lighting lines of the company, and power was stolen for lighting both buildings. Superintendent Rau, of the Milwaukee Company, had his suspicions aroused, it is said, by the unusual hours at which lights were lighted in the building, and at once began an investigation, feeling certain that the plants in the building were not being operated at the unusual hours at which the lights were used. It is said that the case will be prosecuted to the bitter end and that an example will be made of the thief.

Reorganization in Elmira

A meeting was held last week of the Elmira Water, Light & Railroad Company, the new company in Elmira, at which officers were elected, and the company took over the property of the old Elmira Municipal Improvement Company. The latter has, for some time past, been in the hands of a reorganization committee, consisting of George W. Young, chairman; Walter G. Oakman, James C. Simpson and E. C. Jones. The new company owns and operates the water, gas and electric light properties in Elmira, as well as the former street railway property of the Municipal Improvement Company. The board of directors of the new company consists of Frank R. Ford, of New York, president; Charles F. Uebelacker, vice-president and general manager; John Alvin Young, H. M. Francis and Frank H. Davis. J. M. Diven is secretary and treasurer, and H. D. Benner is assistant secretary.

From Schenectady to Albany

The United Traction Company, of Albany, N. Y., and the Schnectady Railway Company have come to an understanding regarding the construction of an electric railway from Schenectady to Albany, and a company has just been incorporated to carry out the project. The company is known as the Albany & Schenectady Traction Company, and is capitalized at $100,000. The road will be built over the Schenectady turnpike. The company has been granted the right to operate over the lines of the United Traction Company to the heart of Albany. Following are the officers and directors of the company: Jesse H. Leonard, president; J. S. Klingelsmith, vice-president and general manager; C. D. Miller, secretary; Edward P. Williams, treasurer. Directors: Jesse H. Leonard, Edward P. Williams, C. D. Miller, T. Kerwin and J. S. Klingelsmith, of Albany; Charles Pfisger, of New York; B. B. Griffen and William Hay Bacus, of Saratoga Springs; G. G. Evertonson, Bath-on-the-Hudson.

Operating Changes in St. Louis

The St. Louis Transit Company is planning to make a number of important changes in the operating routes of its lines, and is now constructing a number of switches at different points in the city to permit making the changes. In the downtown district a number of switches are being constructed with a view to arranging loops at the eastern terminals of all the roads, and those in the west end are being constructed with a view of arranging new lines. The three most important changes will be made in the Olive Street, Channing Avenue and Southern Electric lines. The Olive Street line will be continued to Forsythe Junction, where connections will be made with the present road to Clayton; the Channing Avenue line will be a new division, and will run east from the city limits on Easton Avenue to Grand, south on Grand to Cook, east on Cook to Channing, south on Channing to Laclede and then east over the Laclede Avenue tracks on Market to Broadway; the northern terminus of the Southern electric line will be changed so as it will make a loop around Seventh, Morgan and Sixth Streets instead of going north as far as Howard Street, as at present.

Reorganization of the Chicago General Railway Company

The stockholders of the Chicago General Railway Company are in receipt of a letter outlining a plan for the reorganization of the company, which gives them permission to file, within a specified time, their holding of stock with the Real Estate Trust Company, of New York, in order to take advantage of a pending settlement and a sale of the property. Joseph P. Mahoney, William A. Goodman and Charles L. Bonney are named as a stockholders' committee, with full power to transfer and vote the stock at their discretion, and to represent all the stockholders, signing the agreement in the prospective sale of the company's property. It is said that more than $300,000 out of a total $500,000 stock issue have already been deposited with the New York Trust Company. The majority control is, therefore, already assured. This is one of the final steps taken by the Chicago General's reorganization committee to prevent a foreclosure sale under the present receivership proceedings and to protect the company's stockholders. The plan was drafted by the New York creditors of the company, who are opposed to allowing a foreclosure sale.

The fact that the Chicago General Company has valuable franchises from the city and that negotiations have several times been in progress for a transfer of these rights to the Chicago City Railway, is the basis for the new stockholders' agreement. It is reliably stated that a standing cash offer for a controlling majority of the stock is already in the new stockholders' committee's possession. Another committee representing the bondholders is also working on the same lines. This is composed of James P. Black and Lyman M. Paine, of Chicago, and Newbury D. Lawton, of New York. Practically all the outstanding bonds, except those deposited with the Merchants' Loan & Trust Company, of Chicago, and those in the possession of ex-President James H. Witbeck, have been deposited under a similar agreement with the Real Estate Trust Company in New York. The bondholders' interests are thus divided between the Merchants' Loan & Trust Company, which also represents the company's floating debt creditors; the Witbeck and King holdings, which are the subject of litigation in the courts, and the New York creditors. It is understood that an amicable settlement may soon be arranged, under which the three coteries of bondholders will pool their interests.

A Striking Advertisement

The Chicago Union Traction Company is now carrying a large advertising card in the press of that city, especially appealing to the G. A. R. guests, who are now in that city, and setting forth how Chicago may be seen for a dime. The advertisement is in large type, and is headed: "See Chicago for a Dime on the Trolley Car." In the left-hand upper corner of the card is a cut of a car well filled with G. A. R. delegates, showing in the background the outline of the great Ferris wheel, and dated Chicago, 1900, while in the left-hand lower corner is an outline picture showing

the troops on their triumphant return to Washington in 1865. The advertisement is divided into five paragraphs, each ending with the words, "ON THE TROLLEY CAR," in large type. The last paragraph ends with these words in especially large type stretching across the entire bottom of the card. The introductory words of each paragraph are in large type and are quite prominent. We reprint three of the paragraphs as they appear in the advertisement, to show how well written and forcible they are:

SPECIAL INVITATIONS are extended to the visitor this week to inspect Chicago and its suburbs and see the great changes that have taken place since the days of '61. This western town has fought its battles and won its victories until it stands to-day in the front rank of the great cities of the world. The things which make it great may be seen easily by all who are clever enough to look for them ON THE TROLLEY CAR.

ONE OF THE FORCES which has aided materially in the success of the city has been the trolley car—the great modern population distributer. The evolution from the old one-horse car of the sixties to the modern, double-truck, air-brake, electric-lighted creation of to-day, might call forth a repetition of Milton's sentiment: "Peace hath her victories no less renowned than war." The victories in the street-car field have resulted in placing the trolley car on the health-restoring, pleasure-giving list of modern inventions, so that now it is quite the proper thing to see the sights of the city, its suburbs, parks, groves, boulevards and outing resorts by going to them ON THE TROLLEY CAR.

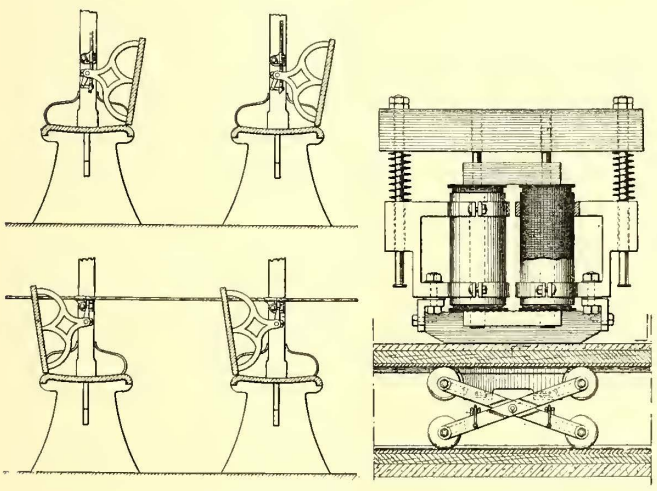
FOR SOCIAL PARTIES special trolley cars are in service going to any part of the city. There are many pleasant trips of this character around suburban Chicago, and this would be a delightful way to entertain one's friends. There are over 500 miles of tracks covered by the trolley cars in operation by the Union Traction Company on the north and west sides of town, and one may readily select a route covering a score of interesting points. If in doubt, address the general offices of the company, at 444 North Clark Street, Telephone North 736, and find out about where to go and how to get there ON THE TROLLEY CAR.

Street Railway Patents

[This department is conducted by W. A. Rosenbaum, patent attorney, 177 Times Building, New York.]

UNITED STATES PATENTS ISSUED AUG. 21, 1900

656,183. Gate for Open Cars; C. M. Fairbanks, Central Falls, R. I. App. filed April 18, 1900. Each seat is provided with two gates, one at each end, both of which are operated at the same time by the turning of the seat, the one opening and the other closing.



PATENTS NOS. 656,183 AND 656,511

656,188. Car Seat; H. S. Hale, Philadelphia, Pa. App. filed March 20, 1900. A construction providing for the lower edge of the back clearing the surface of the seat cushion when the back is shifted.

656,207. Trolley Wheel; H. A. Osborne, Plainville, Conn. App. filed Dec. 6, 1899. The flanges of the wheel are provided with cutting ribs to remove the ice from the wire.

656,219. Seat Structure; W. L. Schellenbach, Philadelphia, Pa. App. filed July 22, 1899. Gearing is arranged between the seat and the levers, which move the seat back, so that the back will be given a certain inclination when it is swung from one side to the other.

656,226. Rail-Joint; B. Sturenberg, Alfhausen, Germany. App. filed Feb. 6, 1900. The distinguishing feature is a double wedge-shaped fish-plate lying against the suitably tapered heads and webs of the rail.

656,276. Electric Railway System; L. E. Walkins, Springfield, Mass. App. filed Dec. 15, 1898. The pressure of the car wheel first throws the switch to close the circuit to the sectional conductor, the circuit being thereafter held closed by an electro-magnet, until the vehicle has passed.

656,372. Guard for Controller Brushes; A. L. Riker, New York, N. Y. App. filed Jan. 8, 1900. The guard prevents the controller brushes from catching upon the controller segments.

656,379. Brake; G. E. Seymour and F. Kahler, New Albany, Ind. App. filed June 7, 1900. The releasing device is a button on the end of the brake staff by pushing which an instantaneous release is affected without movement of the handle.

656,381. Anti-Vibrating Car Truck; L. C. Thompson and F. Kirk, Cuyahoga Falls and Akron, Ohio. App. filed Oct. 19, 1899. The invention relates to a pair of four-wheeled electric car trucks supporting the car upon the motor drive-wheels and bracing the guide wheel in a manner to receive the vibratory shock generated at the electric motors in connection with the motor armature, including the vibration generated by the rapid revolving motion of the car wheels.

656,445. Cooling Brakes; A. Ekstrom, Schenectady, N. Y. App. filed April 27, 1898. A piping system is arranged to deliver a cooling liquid against the brake shoes to reduce the temperature due to frequent use.

656,477. Auxiliary Car Mover; P. Ryan, New York, N. Y. App. filed Dec. 29, 1899. An eccentric on the axle vibrates a pusher-bar, which acts against the roadbed.

656,511. Electric Railway System; G. L. Campbell, New York, N. Y. App. filed Dec. 15, 1899. A trolley carrying an armature is dragged through a conduit by a magnet on the car. In moving along the trolley closes the circuit between the main and sectional conductor.

656,571. Controller for Electric Motor; T. S. Perkins, Idlewood, Pa. App. filed Jan. 13, 1900. In connection with the contact fingers one or more electro-magnets and arc shields are provided, with magnetic flux conductors, which project between adjacent fingers and into proximity to the pole pieces of the magnets for the purpose of preventing arcing.

656,608. Brake Mechanism; C. E. Moore, Chicago, Ill. App. filed Dec. 23, 1899. The combination with a brake-shoe head, of a hanger for suspending or supporting the same, provided with a ball-and-socket connection between said hanger and brake shoe and a ball-and-socket connection at the upper end of said hanger between the same and the truck frame, each of said ball-and-socket connections comprising a ball and a two-part socket surrounding the ball.

PERSONAL MENTION

MR. H. J. McGOWAN, president of the Indianapolis Street Railway Company, of Indianapolis, Ind., has been elected president of the Kansas City Gas Company, of Kansas City.

MR. A. J. PURINTON, of Waterbury, Conn., has been elected general manager of the Palmer & Munson Street Railway Company, of Palmer, Mass., to succeed Mr. D. F. Burritt. Mr. Purinton will also have charge of the plant of the Central Massachusetts Electric Company.

MR. HERBERT W. SMITH has accepted a position with the Stuart-Howland Company, of 283 Devonshire Street, Boston, as assistant manager of its railway department. Mr. Smith's extensive experience in the street railway supply business well fits him for his new duties.

MR. F. I. BROWN has been elected president of the Jacksonville Street Railway Company, of Jacksonville, Fla., to succeed Mr. D. F. Jack. Mr. Jack resigned because of the pressure of his duties as general traffic manager of the Plant system. Mr. Brown is also president of the Main Street Railroad Company, of Jacksonville, and the supervision of both systems will thus be brought under one head.

MR. HENRY S. NEWTON has resigned as manager and purchasing agent of the Syracuse, Lakeside & Baldwinsville Railway, of Syracuse, N. Y., to accept the position of general superintendent of the Beaver Valley Traction Company, of Beaver Falls, Pa. Mr. Newton has previously been connected with the Consolidated Street Railway Company, of Wheeling, W. Va.; the Syracuse Street Railroad Company, and the Syracuse Rapid Transit Company.

MR. T. B. GOODYER, general traffic superintendent; Mr. H. M. Sayers, power engineer, and Mr. J. A. Lycett, district superintendent of the British Electric Traction Company, of London, England, who are now studying American electric railway practice, were in Buffalo Aug. 20. Messrs. Goodyer, Sayers and Lycett inspected the lines of the International Traction Company and expressed themselves as well pleased with the system. It is their purpose to visit Toronto, and then go to New York. They will sail for London about Sept. 1.

NEWS NOTES

WASHINGTON, D. C.—The assistant attorney for the district has forwarded to the Commissioners an opinion holding that passengers of the Brightwood Railway Company are not entitled to free transfers to the Metropolitan Railroad Company, and that the act of Feb. 26, 1895, authorizing and requiring the Brightwood Company to sell four coupon tickets for 25 cents, good for one continuous ride in the District of Columbia over the lines of the said company and the lines of the Metropolitan Railroad Company, is still in force. For the past five or six months passengers on the Brightwood road have been given free transfers at the terminus of that road for a continuous ride over the line of the Metropolitan Railroad Company. Under an arrangement announced by the Washington Traction & Electric Company these free transfers will be discontinued on Sept. 1, and passengers desiring to transfer to the Metropolitan line will be required to use a four-for-a-quarter ticket good for one continuous ride in the District of Columbia over the line of the Brightwood and Metropolitan roads, or pay cash fares.

CHICAGO, ILL.—Coal is to be substituted for oil as fuel in the Western Avenue, Hobbie Street and Rockwell Street power houses of the Union Traction Company. The plants are being fitted with automatic stokers in preparation for the change. Economy is given as the reason for the change.

PALMER, MASS.—The Palmer & Monson Street Railway Company has accepted the franchise recently granted it by the Council of Wilbraham.

NEW BRUNSWICK, N. J.—A car of the Middlesex & Somerset Traction Company ran into a freight train on the Raritan River Railroad, Aug. 20. Seven passengers, who were on the car, escaped injury by jumping from the car. The motorman and conductor remained at their posts, and both were shaken up badly.

ROCHESTER, N. Y.—Twelve persons were injured, one mortally, and forty others were in danger through an accident on the Manitou Beach Railroad at Greenway's Bluff, near Charlotte, on Aug. 24. A crowded car was derailed by the breaking of a flange, and it plunged into a gully 15 ft. below.

CLEVELAND, OHIO.—A car on the Cleveland & Chagrin Falls Electric Railway jumped the track on a curve near Chagrin Falls Aug. 22, while running at high speed. The car was wrecked and the crew and twelve passengers cut and bruised. Five persons were seriously injured.

CLEVELAND, OHIO.—The Cleveland Electric Railway Company is receiving the first of a lot of fifty double-truck cars ordered some time ago from the J. G. Brill Company, of Philadelphia. In the near future all lines operated by the company will have been equipped with these cars.

COLUMBUS, OHIO.—The employees of the Columbus Railway Company were given their fourth annual outing at Olentangy Park a few days ago. Twenty-three hundred metal badges were issued to the families of employees, furnishing free transportation and admission to the park and all entertainments to the holders. The car crews were arranged in shifts so that every employee was given a chance to participate in the festivities.

COLUMBUS, OHIO.—The Urbana, Mechanicsburg & Columbus Electric Railway Company has presented a proposition to the city for a franchise on certain city streets. The company agrees to carry passengers at the rate of 5 cents for single fare, seven tickets for 25 cents and twenty-eight tickets for $1, the fare to Urbana not to exceed 2 cents per mile. A bond for $1,000, with approved security, accompanied the proposition.

BEAVER FALLS, PA.—On Aug. 24 a closed car of the Beaver Valley Traction Company jumped the track on a steep grade, overturned and plunged into two trees, where it hung suspended 150 ft. above the Fort Wayne Railroad tracks. There were about fifty passengers on the car, many of whom were injured.

RICHMOND, VA.—The Richmond Passenger & Power Company and the Richmond Traction Company have practically agreed upon a system of general transfers, covering all the lines in Richmond and Manchester.

SEATTLE, WASH.—The Supreme Court has just handed down a decision ordering that the temporary injunction restraining the Seattle Electric Company from proceeding with certain improvements in its system, as authorized in the franchise grant to J. D. Lowman and Jacob Furth, dated March 8, be dissolved. The effect of the decision is that the ordinance granting the franchise does not violate any of the provisions of the charter of the city of Seattle, and the procedure adopted by the City Council in passing the ordinance is in substantial compliance with the procedure marked out in the charter. As an immediate result of the decision, it is said the plans of the Seattle Electric Company, for which the franchise was secured, will be put into operation, involving substantial and costly repairs to existing lines of street railway controlled by the company, the reduction of fares, the inauguration of a complete transfer system and the early commencement of work on many miles of extensions.

CONSTRUCTION NOTES

SAN BERNARDINO, CAL.—The Board of City Trustees have granted Judge J. L. Campbell a franchise for constructing and operating an electric railway over a specified route here. James H. Boyd is associate with Judge Campbell in the promotion of the enterprise.

NEW BRITAIN, CONN.—The Connecticut Lighting & Power Company only awaits the action of the Legislature before beginning work on its new line from Lazy Lane to Waterbury. With a line to Waterbury the Connecticut Lighting & Power Company will have a direct route from Hartford to Waterbury.

MERIDEN, CONN.—The directors of the Meriden, Southington & Compounce Tramway Company have voted to extend the company's lines through Cheshire to Waterbury, a distance of 15 miles. The Legislature will be petitioned at its coming session to allow the extension. When the line is built four leading cities of Southern Connecticut—New Haven, Waterbury, Meriden and Bridgeport—will be connected by trolley. The connection between New Haven with Waterbury and Meriden will be made at Cheshire, as the Fair Haven & Westville line has voted to extend its line from Mount Carmel to Cheshire, to connect there with the Meriden and Waterbury line which is planned. When the proposed extensions are built complete trolley line will be established between Hartford and Bridgeport, a distance of 53 miles.

JUNCTION CITY, KAN.—The City Council has granted Frank V. Crouch, of Carrollton, Mo., a franchise for the construction of an electric railway here. Mr. Crouch has announced that he has financial backing to the amount of $500,000, and that it is the purpose of the promoters to also erect a power plant with a capacity for furnishing light and power for industrial purposes in both Junction City and Fort Riley.

LEXINGTON, MASS.—The Lexington & Boston Street Railway Company has completed and placed in operation its extension from Bedford to Concord.

WASHINGTON, D. C.—The Council of Rockville, Md., has at last ratified the ordinance granting the Washington & Rockville Electric Railway Company a franchise in Rockville. The work of surveying for the new line has begun, and it is announced cars will be in operation in a very short time.

BOSTON, MASS.—The Boston Elevated Railway Company has just been granted a permit for the erection of a large car house on the south side of the Charles River. The new house is to be of brick and wood, and will be 506 ft. long, 34 ft. wide at one end and 71 ft. at the other. The storage capacity of the house will be 250 cars. There will be rooms for the motormen and conductors, offices, waiting room, lunch room and all conveniences. The cost of the building will be about $65,000.

LYNN, MASS.—The Lynn & Boston Railroad Company will shortly apply to the Council for franchises for the extension of its lines in two parts of Lynn. One of the locations desired is on Western Avenue at the intersection of that thoroughfare with Eastern Avenue, and provides for the continuation of the belt line over the Salem and Boston Turnpike, with a double track to the dividing line between Lynn and Salem. Another extension for which permission will be asked is from the intersection of Eastern and Western Avenues and the Salem and Boston Turnpike to Washington Street, parallel to the track now laid. The Council of Salem will also be petitioned by the company for permission to extend its lines from the dividing line between the two cities to the business section of Salem. The laying of these tracks, it is thought, would prove of great convenience to the traveling public between the two cities.

ST. LOUIS, MO.—The St. Louis County Court has granted the St. Louis & Suburban Railway Company, of St. Louis, Mo., permission to construct a track across Carson road near the city limits of Ferguson, and to cross and run over the Florissant Rock road for a short distance, forming part of a new line to Ramona Park, where connection will be made with the Florissant division to Ferguson. Practically the entire route, over 2 miles, will be over a private right of way.

LARCHMONT, N. Y.—The Larchmont Horse Railway Company has completed and placed in operation its extension from Larchmont Manor to Port Chester. On the west the line connects with the Union Railway for New York, making it possible to ride by trolley from extreme southerly end of New York City to the Connecticut State line, a distance of 32 miles.

MOUNT VERNON, N. Y.—The New York, Westchester & Connecticut Traction Company has commenced the construction of its line over the White Plains road in Bronxville, as provided for by a franchise recently granted by the village trustees. This line is a continuation of the North Mount Vernon line, of Mt. Vernon, and ultimately, it is expected, will be extended to White Plains, a distance of 8 miles.

JERSEY CITY, N. J.—The North Jersey Street Railway Company is now securing the consents of property owners for the extension of its lines in the Orange Valley. The new line will probably be a continuation of the present Central Avenue Road, which ends at Fourteenth Street. The new line will run from Fourteenth Street west on Central Avenue, through East Orange, Orange, Centre Street, Orange, to Tremont Avenue, and westerly through the Orange Valley, a thickly populated section needing trolley accommodation.

CINCINNATI, OHIO.—The Millcreek Valley Electric Railway Company has purchased a tract of land at Hartwell on which to erect a new car house and power house. It is estimated that this improvement will cost $125,000. The company will rush work on its Glendale extension, and expects to have the line completed by Oct. 1. Next spring the road will be extended to Hamilton. This branch will run over the Carthage pike to the intersection of Spring Grove Avenue, at St. Bernard; thence along Spring Grove Avenue to Chester Park, where it will connect with the Consolidated line, thus giving a direct line from Hamilton to Fountain Square, passing through the villages of Glendale, Wyoming, Lockland, Reading, Hartwell, Carthage, Elmwood Place and St. Bernard.