Street Railway Journal.

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THE SYSTEM OF THE CONSOLIDATED TRACTION COMPANY, OF NEW JERSEY.

The geographical conditions of the metropolitan district about New York City are such as to present passenger transportation problems entirely different from those affecting any other city. London, Paris and Berlin, while divided by rivers, have had no difficulty in bridging their waterways and expanding homogeneously in all directions. But the location of New York upon a long narrow island, at whose lower end the activity of its vast financial and commercial interests has centered, has compelled its growth toward the north only. In point of accessibility to this business center the neighboring cities of New Jersey and Brooklyn have always compared favorably with the upper part of Manhattan Island, so that at present a very large proportion of the business of New York City is carried on by residents of these cities, who, of course, require regular and frequent communication with the metropolis.

Many of the cities and towns in that portion of New Jersey close to New York City are given up entirely to residences, while others, owing to their proximity to the metropolis, with its large market and shipping facilities, have become extensive manufacturing centers. Among the former are the Oranges, which with Bloomfield and Montclair form probably the largest and most attractive suburban residential district about New York. These towns together cover an area of about thirty square miles, and in this area it is possible to ride for miles through fine streets and broad boulevards lined continuously by rows of beautiful suburban residences. The cities in this district have, also, their own industries and interests and require a considerable amount of short-ride urban transportation. The largest within a radius of fifteen miles of New York are the following, the populations given being those of the census of 1890:

FIG. 1.—INTERIOR OF POWER STATION—JERSEY CITY.

	Population.
Newark	181,830
Jersey City	163,003
Paterson	78,347
Hoboken	43,648
Elizabeth	37,724
Orange and So. Orange	21,950
Passaic	13,028
Hackensack	6,004

Until recent years the interurban transportation service in this district, was performed exclusively by the steam railroads. The business was carried on mainly by the following roads and in extent probably in the order named: the Delaware, Lackawanna & Western Railroad, the Central Railroad of New Jersey, the Erie Railroad and the Pennsylvania Railroad. Each has a separate ferry, landing passengers at different points in New York.

But with the adoption of electric power on street railways a change was made in the transportation status of this region. The first development of it was the connection of the nearest towns with each other by interurban lines. These have been recently extended until it is now possible to travel from any one of the cities of Newark, Jersey City, Hoboken, Elizabeth, Orange, Paterson or Passaic to any other by trolley car. Of course, the greatest tide of interurban travel is to New York through Jersey City. Two lines, both owned by the Consolidated Traction Company of New Jersey, now connect Newark with Jersey City and these will, of course, constitute the great artery through which the greater amount of the electric railway traffic with New York will pass. On these lines through tickets, including ferry passage, are now sold.

Just what effect this competition will have on the steam railroads it is yet too early to determine. That it will draw away a considerable amount of their traffic is certain. While the actual running time is not so high, the ability to take a car at any point is an undeniable advantage, while the lower fares charged will influence many in favor of the electric road, even in cases where the time required is longer. For the transportation of those living more than twelve miles from New York the electric cars can hardly expect to compete to any considerable extent under present conditions as their slower running time would preclude their use by most business men.

On the other hand the railways are undeniably creating a large traffic, not only by building up and developing new territory, but by giving avenues of communication between the different cities, many of which have heretofore been unconnected by rail except by way of Jersey City.

Of this territory in New Jersey under consideration by far the most important parts, considered from a transportation standpoint, are now covered by the tracks of the Consolidated Traction Company of New Jersey. As will be seen from the map facing page 460, the lines of this company furnish the entire transportation system of Jersey City and Newark as well as the interurban service between and around these cities. The company, which was chartered in 1893, is the consolidation of a number of smaller and older companies and is the outcome of the belief of a number of prominent street railway capitalists that the purchase and development under one head of the various properties now forming the company would prove a profitable undertaking. The sub-companies are the Jersey City & Bergen Railway Company, the Newark Passenger Railway Company, the Newark Plank Road Company, the Jersey City, Harrison & Kearney Railway Company and the Rapid Transit Street Railway Company of Newark. Three of these roads were operating by electricity when the work of consolidating and unifying the properties was taken up by Mr. Young, second vice-president of the company. This work which included the change in gauge of every mile of the track, the erection of a new station, the alteration of a large part of the former installations to conform to modern methods, and the prosecution of new work, has now been practically completed. Under the excellent management of Mr. Young, earnings have shown a gratifying increase as may be seen from the accompanying table:

Year ending Dec. 31, 1892.		1893.	1894.	1895.
Rec'ts from pass. . .	$1,213,067	$1,288,141	$2,086,891	$2,487,104
" other sources. .	60,999	16,351	13,854	20,453
" total	$1,274,066	$1,304,942	$2,100,745	$2,507,557

THE company has two power stations, one in Newark, the second in Jersey City. The former is the larger and more modern, and was completed during the past year. It is on the Passaic River between Stiles Street and Coal Street, and is of brick with stone trimmings. The ground dimensions are 150 ft. × 190 ft.

Coal is delivered to the station by the cars of the Pennsylvania Railroad which run on a siding directly in the rear of the boiler room. When the dock in front of the station is completed, fuel can be received by boat. The cars at present discharge into two large storage bins, from which fuel will be taken to the boilers by conveyors, when completed. It is weighed before being admitted to the boiler in which it is to be used.

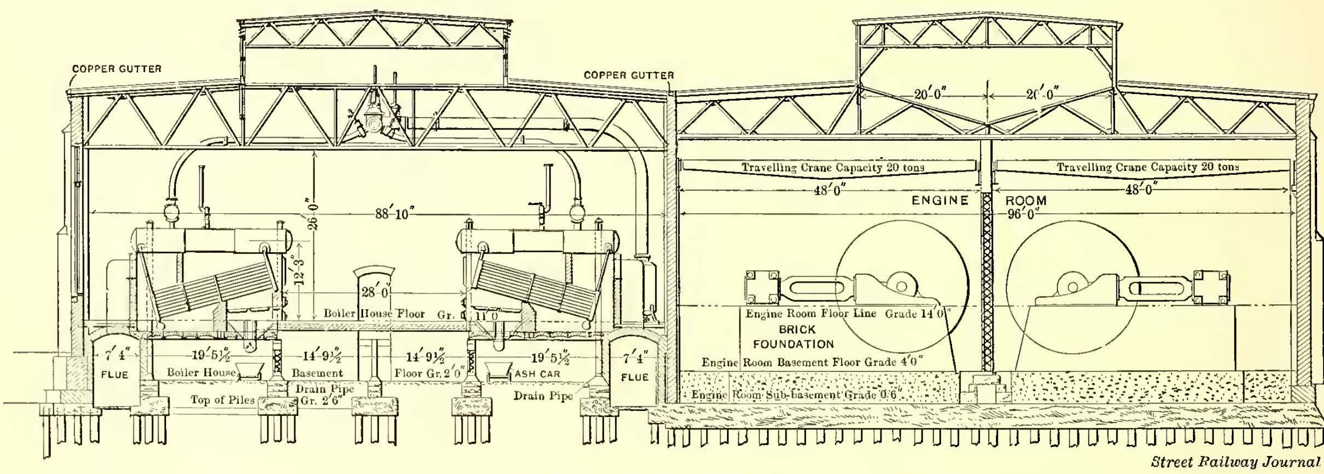


FIG. 2.—SECTION OF POWER STATION—NEWARK.

BOILER ROOM.

The boiler room is 89 ft. × 113½ ft. and contains at present seven batteries of two Babcock & Wilcox boilers each. Each battery has a capacity of 500 h. p. on thirty pounds of water rating. The boilers are arranged on each side of the center line of the boiler room and are faced with enameled brick. The ash pit is cone shaped, with a cast iron valve at the bottom, operated by a lever, the gate closing automatically after being opened. The ashes are discharged from this hopper, into hand cars in the basement, by which they are removed. At the further end of the boiler room is the pump room containing the following apparatus: two Worthington feedwater pumps, Metropolitan injectors, oil injectors, necessary piping, etc. The method of piping is clearly shown in the diagram (Fig. 3).

The flues leading from the boilers are 7 ft. 4 ins. × 10 ft. 10 ins. There is one on each side of the building, and each is led through a Green economizer so arranged with by-pass that it can be cut out of service if desired. This is accomplished by means of a switching damper mounted on ball bearings and operated by a hand wheel in the oil room above the economizers. The dampers in the stack flue are similarly arranged, as shown in Figs. 11 and 12.

From the economizers the boiler gases enter the stack through flues at both sides. The stack is of steel, and 225 ft. in height above the foundation. It is twelve feet in external diameter at the top, eleven feet internal diameter and is surmounted by a crown made up of sheet and angle iron in the form of a ring. This ring is eighteen feet in external diameter and 7 ft. 6 ins. high. The brick lining is carried up at a thickness of 13½ ins. to a height of 15 ft. above the masonry base. Above this the lining is nine inches thick for a distance of eighty-five feet, then six inches thick for a distance of fifty feet, then 4½ ins. thick for the remaining distance of fifty feet.

valves leading to the economizers. The discharge from the economizers is arranged in the same way. This makes it possible for an attendant to manipulate the valves and make the changes quickly in case of accident, or should the temperature of the feedwater in the economizers change, a common occurence. The system is also all shunted, allowing the pumps to be cut in direct with the boilers should occasion require. Provision is made for the use of injectors to be operated instead of the pumps for boiler supply, thus lessening the possibility of not being able to supply the boilers at all times and under all circumstances.

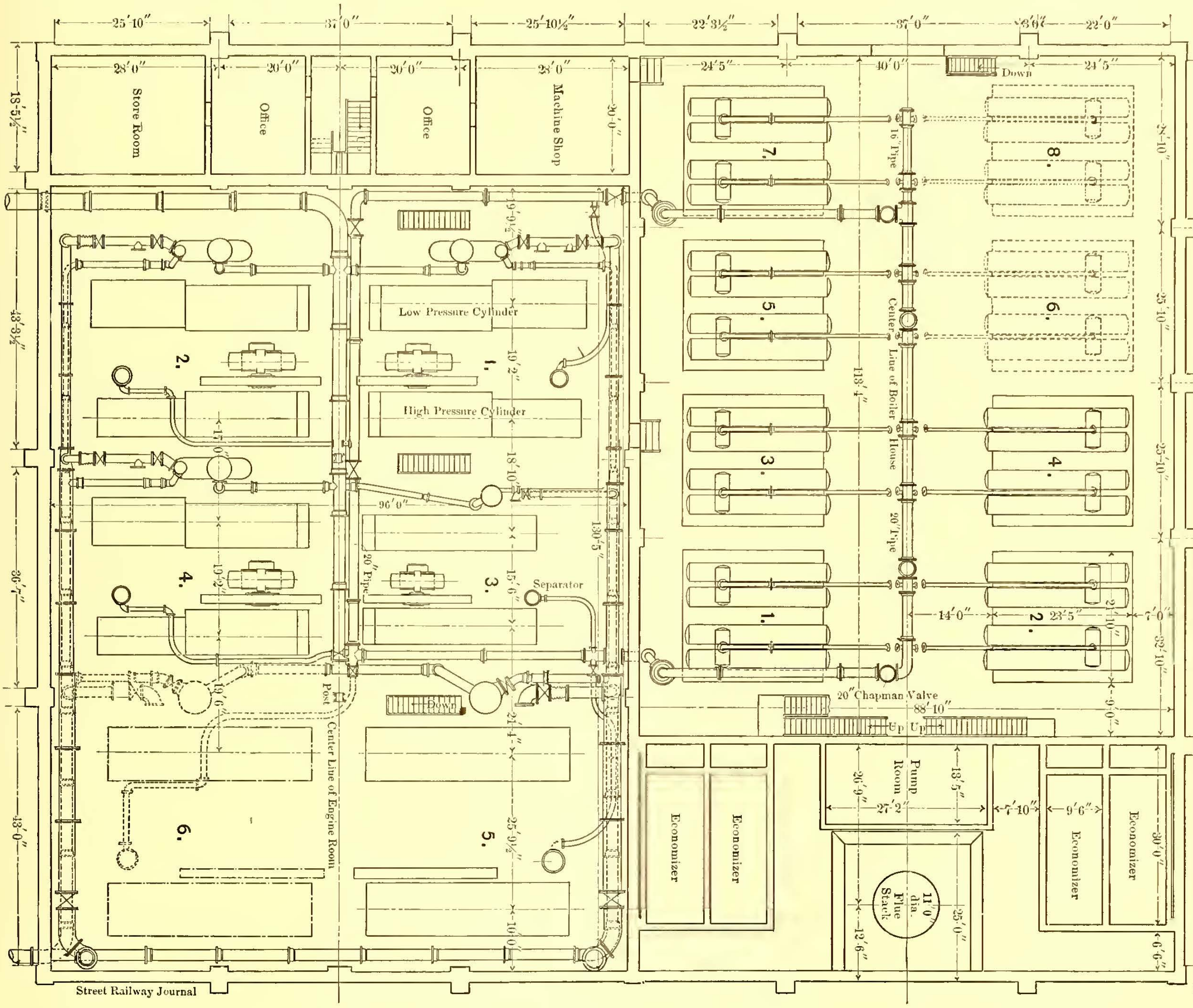


FIG. 3.—PLAN OF POWER STATION, SHOWING PIPING—NEWARK.

PIPING.

At present most of the feedwater used in the boilers is taken from the city supply and is metered to the station. During low tide or for a period of twelve hours out of the twenty-four the water of the Passaic River is fresh and it is the intention of the company to use it as boiler feed. The water will be pumped at low tide into a large tank, holding a twelve hour supply, under the boiler room. As the water to be used is dirty and filled with foreign substances, a set of filters intercepts the source of supply, and all foreign matter is precipitated before the supply reaches the suction tank of the boiler feed pumps. The suction tank is open, allowing a frequent test and examination of the water during the change of tide, as the water will be pumped direct to this tank during the time the supply or reserve is being filled.

The water from the boiler feed pumps is discharged into a manifold and is governed there at will by independent

As mentioned, the water supply can be taken from either the city mains or the river. Still another precaution was taken to secure certainty of operation. A shunt to the city supply is made through the powerful pumps, already mentioned, that supply the reserve. Should the river supply fail and the pressure drop in the city main, these pumps can be cut in and as long as there is any water in the city supply mains they will get it, so that the station is well equipped with the means of obtaining and supplying water to the boilers under the most trying circumstances.

The live steam piping system while not in duplicate is so arranged that the results sought for in duplicate piping are practically secured, that is, each battery has two independent means of communication to each engine.

Flanged steel headers eight inches in diameter connect each battery with a twenty inch main carried on a gallery extending the entire length of the section of the boiler room. As the boilers are set in two rows, this makes the distribution central, and as the headers are in the form of long compound curves, the enormous expansion and contraction which is going on constantly is easily taken up. Directly above the drum of each boiler is a large combination automatic steel stop and check valve with composition seats.

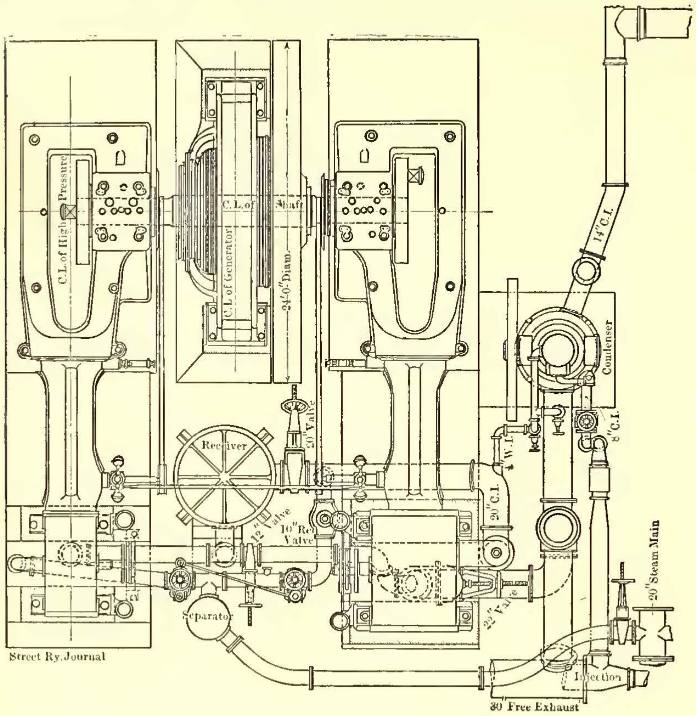


FIG. 4.—PLAN SHOWING PIPING AROUND 2,000 H. P. ALLIS ENGINE.

This is always ready for instant use should the occasion require, such as a rupture serious enough to drive all the attendants from the boiler room. In case of accident this stop will be automatically closed by the steam pressure on the uninjured side.

From the central main in the boiler room two twenty inch pipes are carried into the engine room, entering the latter below the level of the floor. Just before they pass through the dividing wall, each main is carried through a large separator seven feet high by four feet in diameter. The two twenty inch pipes are joined in the engine room by a main twenty inches in diameter extending the entire length of the room between the two lines of engines. From this main branch pipes are led to the engine, eight inches in diameter for the three Watts-Campbell engines, five inches in diameter to the smaller Allis engine, and twelve inches in diameter to the 2000 h. p. Allis engine.

The live steam to each engine is first led to a second separator directly under the engine and used mainly as a reservoir and pressure equalizer for the latter. The separator for the 1000 h. p. engines is six feet high by three feet diameter, and for the 2000 h. p. engine seven feet high by three and one-half feet diameter. This separator is connected with both the high pressure cylinder and with a reducing valve leading to the low pressure cylinder, so that should it be desirable to cut out of circuit the high pressure cylinder the low pressure cylinder can be operated directly without change of boiler pressure. The exhaust from the high pressure cylinder leads into the receiver and also into the main exhaust pipe which is connected with valves so that it will discharge either as free exhaust or into the condenser, so that the engine can be run with the high pressure cylinder only, either condensing or non-condensing. The receiver, which is kept heated by steam from the boilers, discharges directly into the low pressure cylinder whose exhaust is also connected to both condenser and free exhaust.

As in traction work the variations in load are often very great and sudden the reducing valve between the steam line and the low pressure cylinder is arranged to work automatically. In case the receiving pressure drops to a point below that which is intended to be carried, this automatic valve instantly opens, admitting a sufficient quantity of live steam to bring up the required pressure; it then instantly and automatically closes again. This enables the engines to care for great changes in load and maintain a uniformity of speed that is so essential for successful operation.

The individual exhausts are all connected to one main which is equipped with automatic valves, so that in case one of the condensers is cut out from any cause the main will act as a receiver. The other condensers will then take care of the exhaust steam from the condenser shut down, preventing the automatic valve from throwing the exhaust direct to the atmosphere, an important point in the line of economy.

Intersecting the condenser and the atmospheric pipe is another automatic valve that opens instantly should the condensers fail to take care of the discharge from the cylinder of the engine. This makes it impossible for an accumulation of exhaust steam to cause a slackening of the engine speed, and protects against the possibility of a water and steam hammer effect with possible bursting of the pipes. Another precaution taken is that of placing a relief valve not only on either end of the cylinder, but wherever throughout the entire system the pressure can be maintained and there is possibility of trouble arising.

The main exhaust is of ample area to allow all the engines to be run high pressure at the same time. From this it will be seen that there is an enormous margin for safety in case of trouble in this direction.

On each of the two atmospheric pipes are large hoods to protect the buildings and surrounding grounds from condensation should it become necessary at any time to exhaust into the atmosphere, and provision is made to entrain all such condensation and carry it down and away.

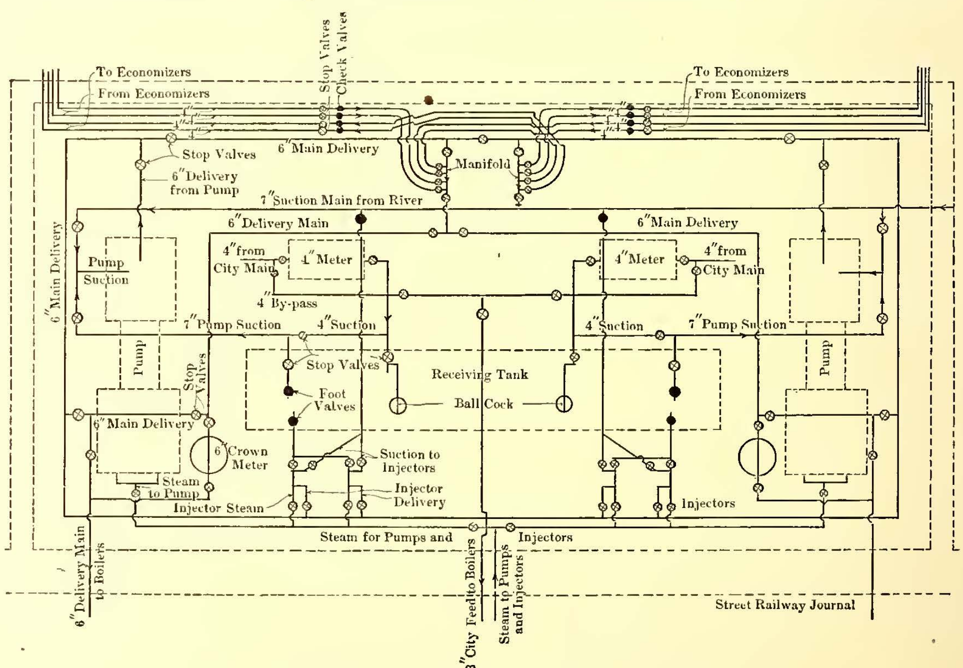


FIG. 5.—DIAGRAM OF CONNECTIONS IN PUMP ROOM.

The condensing water from the Passaic River, in being taken into the station, is first passed through screens of a sufficiently fine mesh to prevent floatings from entering the suction pipe. These screens are removable so that they may be cleaned from time to time. The water then enters a large tank, on the river side of the station, into which the suction pipes are introduced. Provision has been made for the removal of any floating debris such as wood, fish, chips, etc., that reach the main line, by the introduction of a trap consisting of a cast iron receptacle with a perforated brass diaphragm. The condensing water is discharged from the condensers into branches that lead to a common main, and by gravity descends into the river again.

In addition to the piping mentioned the cylinders of the engines as well as of the pumps are being steam jacketed, so that taken in connection with all the other piping there is a large amount of waste condensation. All drips from the mains, which are tapped frequently at each division and subdivision, as well as separator, engine, pump, jacket and cylinder drips, are piped to a general reservoir each independently so that repairs can be easily made without interference to the system. From this reservoir the water is elevated with an appliance similar to an ordinary injector, getting its force from the accumulated condensation and vapor to a second reservoir. From this it descends by gravity in a pipe that extends the entire length of the boiler room. There are leads to each boiler so that a uniform distribution of this condensation is insured. Stops are placed in each branch so that they can be cut out for cleaning and repairs should occasion require.

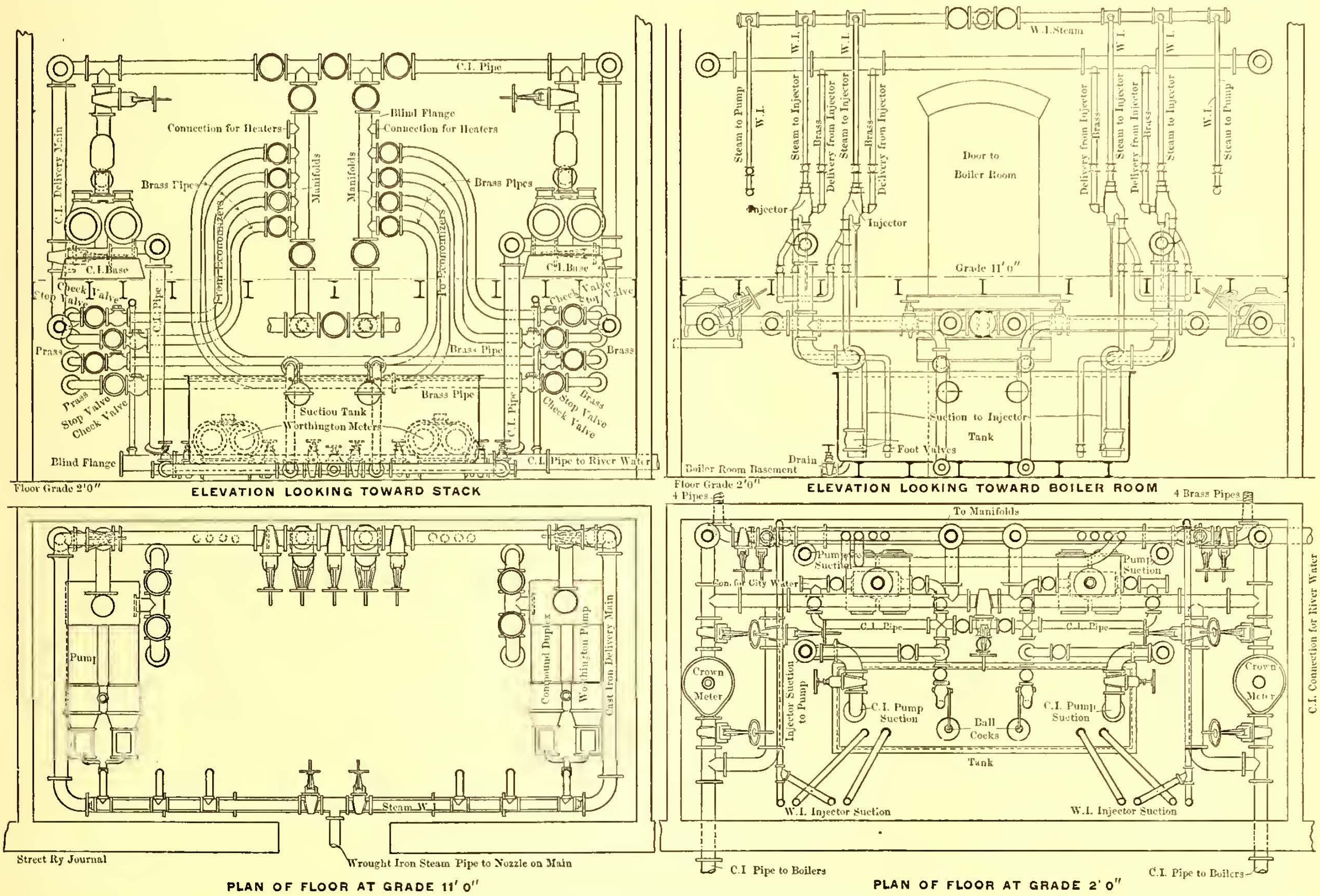


FIG. 6.—ELEVATIONS AND PLANS OF PUMP ROOM.

ENGINE ROOM.

The engine room is lighted by large windows on the north and west sides and by a monitor roof. The latter is supported by trusses resting upon central girders and a row of lattice posts extending through the center of the room.

There are two traveling cranes of twenty tons capacity each. Each runs on the central girder and on one of the girders running along the side wall. There is also a smaller traveling crane at the main entrance running on two girders extending beyond the front of the building and adapted to convey heavy machinery into the building.

The present steam equipment of the plan includes five units. Three of these are Watts-Campbell cross compound engines with cylinder dimensions 26 ins. and 48 ins. $\times$ 48 ins. stroke. These engines will develop at most economical point of cut-off from 900 h. p. to 1000 h. p., and can operate safely for any length of time up to 1600 h. p. They operate at a speed of 80 r. p. m.

The flywheel is 20 ft. in diameter with 17 in. face and weighs 100,000 lbs ; the crank pins are each 8 ins. diameter and 8⅜ ins. long; the crosshead pins are 7 ins. diameter and 7¾ ins. long; the swell on the crank shaft is 22 ins. diameter and the crank shaft journals are 18 ins. diameter and 32 ins. long; the piston rods are each 5½ ins. diameter and the surface area of each crosshead shoe is 270 sq. ins. The cylinder and cylinder heads are steam jacketed.

The valve gear is of the Corliss type with several modifications introduced by the builders and the admission and cut-offs are worked by separate eccentrics. The releasing gear of these engines differs somewhat from that of other builders, the leverage of the detaching gear being uniform under all conditions. The dash pot is also somewhat different. The vacuum which serves to close the valve is maintained in the chamber above the central post of the dash pot. Should any small quantity of air find its way into this chamber it passes out through an automatic valve when the piston descends. The cushioning effect of the dash pot is accomplished by the movement of the piston in a tapering annular cylinder around the central post. As the piston descends its fall is gradually resisted up to nearly the end of the stroke when the piston entirely fills the annular cylinder. The escape of the air then is provided for by a valve with adjustable screw by which the size of the opening can be regulated to any degree desired.

The connecting rod is six cranks in length, a practice followed by the manufacturers in all of their engines.

The 2000 h. p. engine is of the E. P. Allis make and has cylinder dimensions 36 ins. and 62 ins $\times$ 60 ins. stroke and is of the standard type manufactured by this company. The smaller engine is of the Allis make with cylinder dimensions 16 ins. and 32 ins. $\times$ 42 ins.

The engines are all supplied with metallic packing on the piston rods, soft packing being used on the valve stems only.

The largest engine is directly connected to a G. E. 1500 k. w. generator, the three of the next size to three Westinghouse 800 k. w. and the smallest engine to a Westinghouse 500 k. w.

The engine room is also piped with air blast for cleaning off commutators, drip pipe, etc., by the use of a Westinghouse air compressor.

SWITCHBOARD.

The switchboard is at the eastern end of the engine room and is in a gallery about twelve feet above the engine floor. The generator panels are of slate and mounted in the usual way on an iron frame, a short distance from the wall. The feeder panels, of which there are eighteen or twenty, each serving for two feeders, are arranged in the form of a long inclined table extending the entire length of the switchboard gallery. The table is about the height of a man's hand and the purpose of this arrangement is to enable the switchboard tender to more easily manipulate the switches while watching the engines than would otherwise be possible. The circuit breakers are in a row in front of the feeder panels and are fitted with levers so that they can be reset by the switch tender who does this by his foot without releasing his hold of the feeder switches.

Each of the circuit breakers is connected to an electric bell which rings until the breaker has been reset.

The ground is made by connecting the negative bus bar to the track by 10,000,000 c. m. of copper. Two feeders are also connected to the water mains. No return feeders are used except to Elizabeth and Elizabethport,

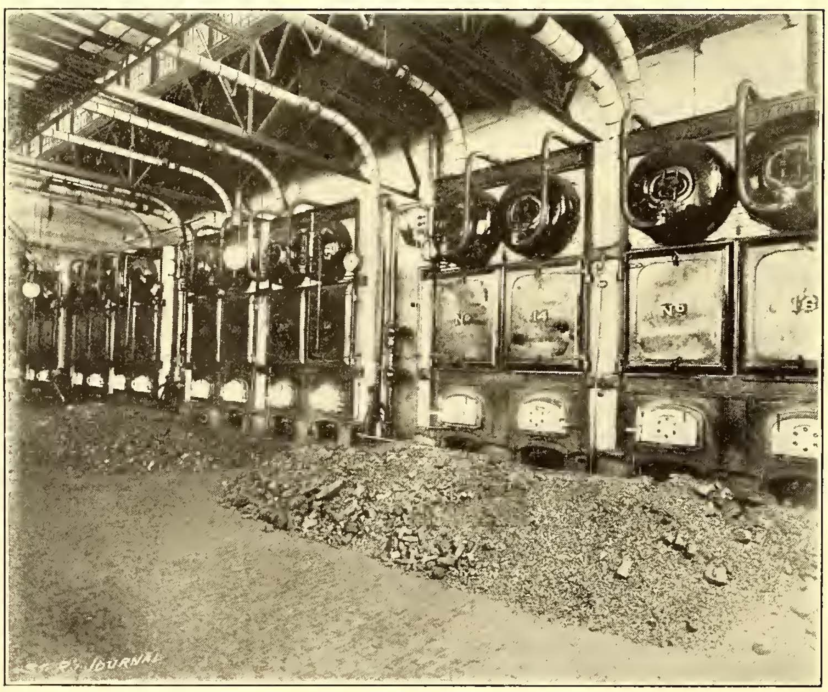


FIG. 7.—BOILER ROOM—NEWARK.

to which respectively two and one feeders of 500,000 c. m. capacity are run. A total number of thirty-one feeders is run from this station, the longest being three miles in length.

The switchboard is also equipped with Thomson recording wattmeter, and readings as well as coal and water records which are taken regularly.

The average maximum load for the station, before the introduction of the 1500 k. w. which was started about July 4, was between 5000 and 5200 amperes, but upon occasions the generators have delivered as high as 6900.

LUBRICATING SYSTEM.

A gravity oil system is in use with power furnished by a small feedwater pump located in the pump room. The oil reservoir tank is in one of the rooms above the engines and at one end of the boiler room. Above this tank is an iron frame made to hold a number of pans of such a size that an attendant can handle them with ease. These pans are fitted with tubes in which are canvas strainers. Oil is delivered to the station in barrels and is pumped to these pans, strained through the cloth and caught in the reservoir tank immediately underneath. From here a supply is taken to every bearing requiring lubrication.

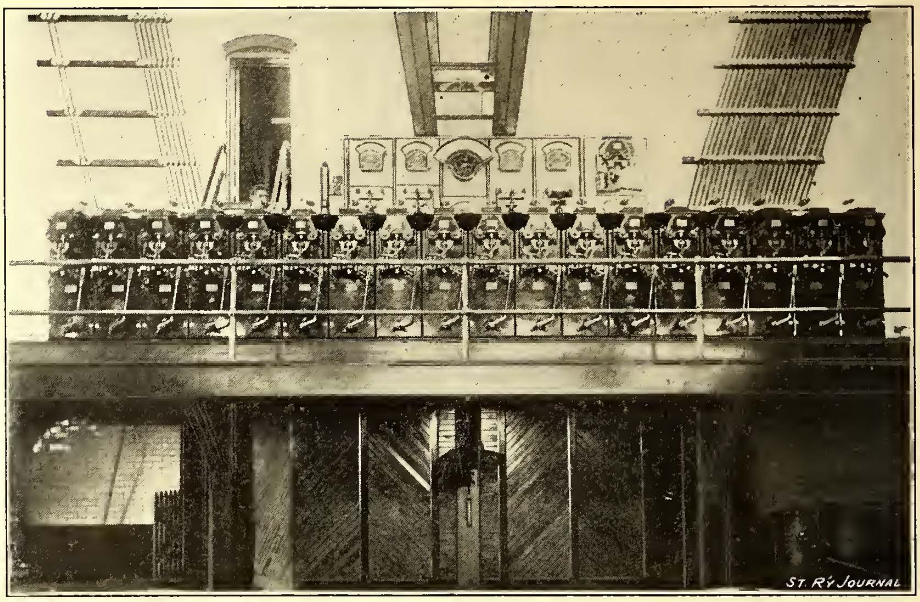


FIG. 8.—SWITCHBOARD ON RAISED GALLERY—NEWARK.

The oil leaders terminate in ordinary glass oilers with sight feed and adjustment. Each cup is set to suit the required amount of oil for the bearing beneath it, and the proper supply is kept in the cup by a stop that regulates the flow from the tank. This relieves the attendants from a great deal of trouble and permits them to care, with perfect safety, for a much greater number of cups than if each cup had to be filled by hand.

After the oil has passed from the bearings, casings and shields are provided for catching and accumulating all the drips which are then piped by gravitation to a tank. When a sufficient quantity has collected it is drawn into a filter and from this filter it is again pumped into the supply tank, and used again and again.

The cylinders are supplied with improved sight feed lubricators, having a lead not only to the steam pipe before entering the cylinder as usual, but in addition to the center of each valve. This allows a chance for direct lubrication should the valve require it. Each valve is also supplied with a cylinder oil pump that can be used, should an accident befall the sight feed lubricator.

OPERATION.

The following report taken from the log book at this station for ten days may be of interest. It should be borne in mind however, that the plant is yet in an unfinished condition, so that later a greater degree of economy will probably be shown.

Wattmeter	302,288,000 k. w. h.
Coal	1,089,900 lbs.

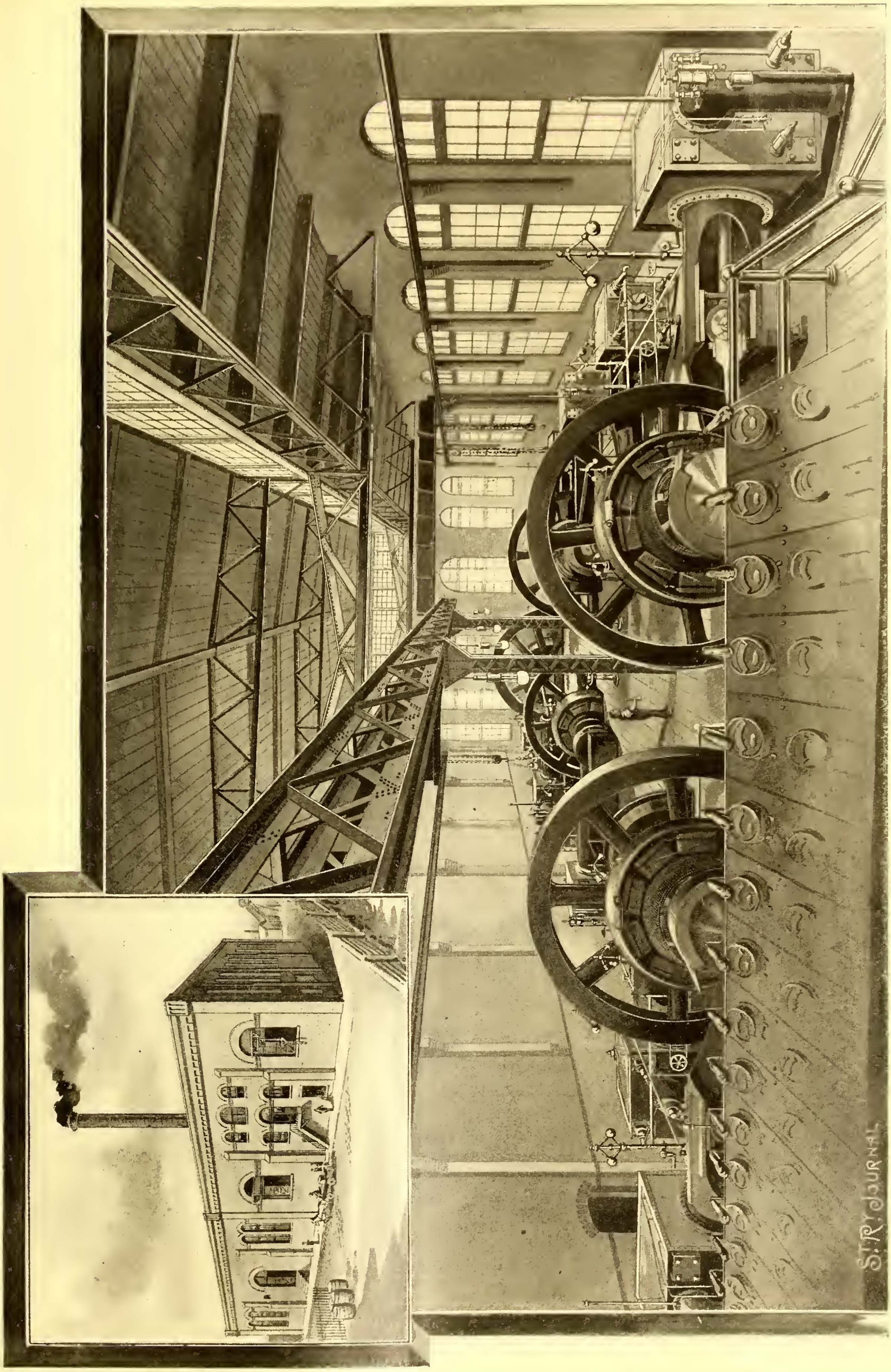


FIG. 9.—ENGINE ROOM AND EXTERIOR VIEW OF THE NEWARK POWER STATION.

Water	1,273,825 gals.
Engine oil	109 "
Cylinder oil	97 "
Waste, colored	37 lbs.
Waste, white	29 "

The station was built from plans and specifications prepared by F. S. Pearson.

JERSEY CITY POWER STATION.

The second power station of the company is in Jersey City near the foot of Montgomery Street hill. It is a long brick building with gable roof, and has been extended a number of times since it was put in operation in 1892. Water for condensing purposes is secured at high tide from the meadows at the foot of the hill, and retained until the next high tide in a reservoir excavated for the purpose.

The engine equipment consists of three Allis cross-compound engines, one of 750 h. p. and two of 500 h. p. each, directly connected to a Westinghouse generator, and six Ball & Wood cross compound engines of 300 h. p. each belted to a Westinghouse generator. The latter formed the plant as originally installed. The boiler room contains five Heine and six Babcock & Wilcox boilers each of 250 h. p. There are six steel stacks each serving two boilers. The station is light and well ventilated, and while not as modern in its appointments as that in Newark, is doing excellent service.

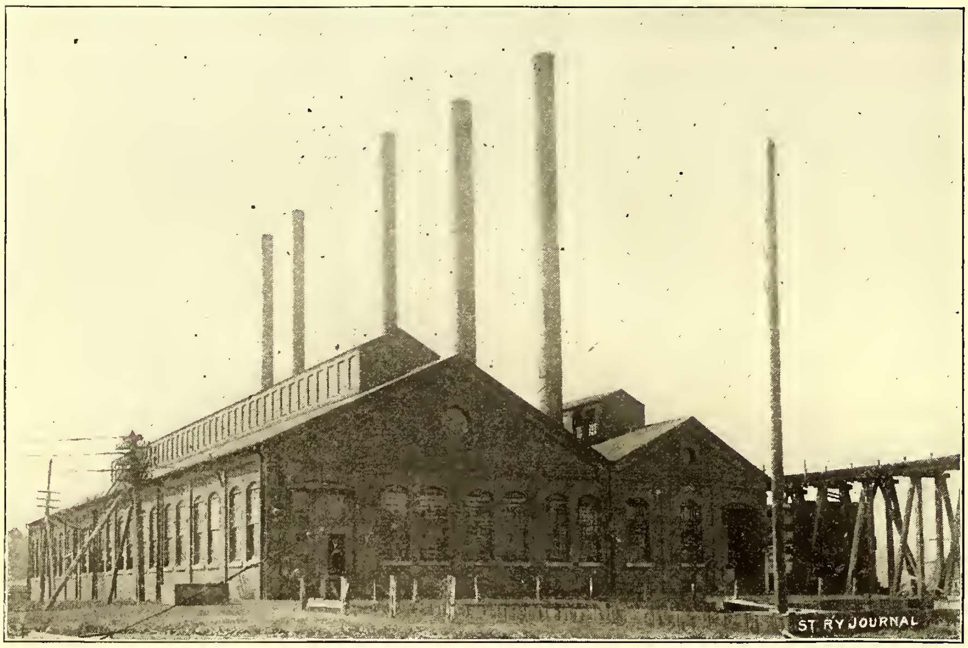


FIG. 10.—EXTERIOR OF JERSEY CITY POWER STATION.

Coal is received directly in the rear of the station from a siding of the Lehigh Valley Railroad. The coal cars run on a trestle some twenty feet in height and dump the fuel directly in the rear of the boiler room. A new switchboard of the General Electric panel type will be installed in this station.

OWING to the fact that the company's older rolling stock was in large part inherited from the former companies now forming the Consolidated Traction Company, and that these companies were operating under different conditions and different managements, the rolling stock is of various types. All recent cars, however, have been of one or two styles which have now been adopted as standard; the twenty foot single truck car for city service and the twenty five-foot double truck car for the interurban lines.

The total car mileage per month for the ten months ending last May is as follows:

Aug.	1,055,349.	Jan.	967,490.
Sept.	1,067,660.	Feb.	927,775.
Oct.	981,610.	Mar.	994,954.
Nov.	980,000.	Apr.	1,006,225.
Dec.	972,000.	May.	1,071,034.

The total number of car bodies owned is 700, of which 105 are double truck cars, employed exclusively on the interurban line. Trailers are not used. The company is also well fitted for caring for heavy snow falls and has in its car houses ready for service, thirty White snow plows and thirty McGuire sweepers.

Many of the leading car manufacturers, including Stephenson, Laclede, Brill, Pullman and Trimble, are represented in the equipment of the company. The last twenty-five foot open cars were supplied by the Laclede Company and the last twenty foot box cars by Brill.

Two body colors are used; red for the double truck interurban cars and lemon chrome yellow for all others. The latter color has been found the cheapest, most durable and in every way the most satisfactory, except that in repainting cars in the repair shop more difficulty has been experienced in matching the shade than with other colors.

The standard specifications for the twenty foot box cars of the company are given on another page.

The cars are fitted with spring seats, those in the center aisle cars being covered with rattan. Numeral registers of the Vernon or Sterling pattern, and Nuttall trolleys are also used. The experience of the company with fenders was a long and exhaustive one, and a large variety was tried on the different lines, as the city authorities in both Jersey City and Newark were extremely anxious to have some reliable fender adopted. As a result of these trials the Consolidated fender was selected as standard, and has given very good results.

TRUCKS.

The company has in use Peckham, Brill, McGuire and Bemis trucks. The 6 A of the first mentioned has been adopted as the future standard for the twenty foot single truck box cars, and the 6 D X for the twenty foot open cars. For double truck cars, the Brill No. 23 truck is used, although fifty-four of the company's double truck cars are mounted on maximum traction trucks. The company has not yet put into operation any Robinson radial trucks, but regards the principle with favor.

MOTORS.

There are 529 double motor equipments made up of 119 G. E. 800, 30 G. E. 1200 and 380 Westinghouse No. 3. Of these the General Electric are the latest added.

Every motor is inspected once a week with a voltmeter and is thoroughly overhauled once every forty days over the pit. At this time the motor is tested for armature clearance, is thoroughly cleaned, the worn parts of the truck and brakes are renewed and the bolts are all tightened up.

The bearings in the axle boxes are cast of standard babbitt, no lead being used. Their life is from 20,000 to 30,000 miles, depending upon the size of the car. The armature bearings are made of the same composition and a life of from 10,000 to 20,000 miles is obtained from them, depending upon the size of the car.


CONSOLIDATED TRACTION CO.,
SHOWING LOCATION OF LINES IN
JERSEY CITY, BAYONNE, NEWARK,
ELIZABETH, BLOOMFIELD
AND
THE ORANGES.
1895
Scale, 1 inch–3632 feet.
UNION COUNTY
SOUTH ORANGE
ORANGE
EAST ORANGE
MONTCLAIR
BLOOMFIELD
BELLEVILLE
FRANKLIN
NEWARK
KEARNEY
HARRISON
ELIZABETH
CLINTON
Village of Irvington
Eagle Rock
To Paterson
To Paterson
To Paterson
Morris Canal
NEWARK BAY
HACKENSACK RIVER
NORTH BERGEN
BAYONNE
JERSEY CITY
HOBOKEN
KILL VON KULL
STATEN ISLAND
NEW YORK BAY
HUDSON RIVER
NEW YORK
Frank Creek
Bound Creek
Street Railway Journal.

The average life of motor parts, gears and lubricants, as determined from the experience of the company, is as follows:

Brushes	2860 miles.
Steel gears	.001 in. per 100 car miles.

The gears are allowed to wear .25 in., so that their life is a little under one year.

Cast iron gears	about half as long as steel gears.
Cut pinions	4, 6 and 8 months.
Gear grease	250 lbs. per 100,000 car miles.
Motor grease	450 " " " " "
Lubricating oil	18 gals. " " " "

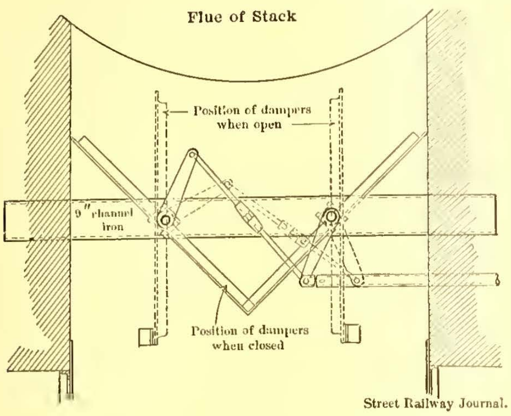


FIG. 11.—PLAN OF STACK DAMPERS IN NEWARK STATION.

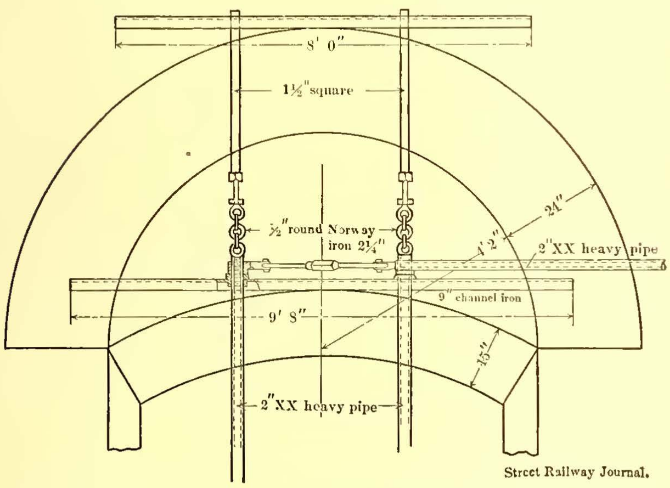


FIG. 12.—ELEVATION, SHOWING METHOD OF SUSPENDING STACK DAMPERS—NEWARK

REPAIRS.

The total cost of repairs for rolling stock per car mile averages about $.017 divided as follows:

Trucks	$.002
Motors	.005
Bodies	.010

In these figures both labor and material are included. The material costs about ten per cent more than the labor. Of the total cost of car body repairs, about twenty per cent is for repainting. The average cost of motor and truck maintenance per car mile is divided as follows:

Material	$.00446
Labor	.00261
Total	$.00707

The figures given above, while those of a single month or average of two or three months, represent very closely the average for the past year. Owing to recent economies made in the repair shop such as the carrying on of all work on the piece system, as will be described later, the figures for the coming year, it is thought, will be materially lower. The results so far secured indicate a reduction of about twenty per cent.

RELATIVE MERITS OF DOUBLE AND SINGLE TRUCK EQUIPMENT.

Some interesting tests have recently been made to determine the power required for operating cars of different lengths under the same conditions. A stretch of track 2½ miles in length on which the grades varied from two to five per cent, was selected, and round trips were made so that the cars returned to the starting point. The live

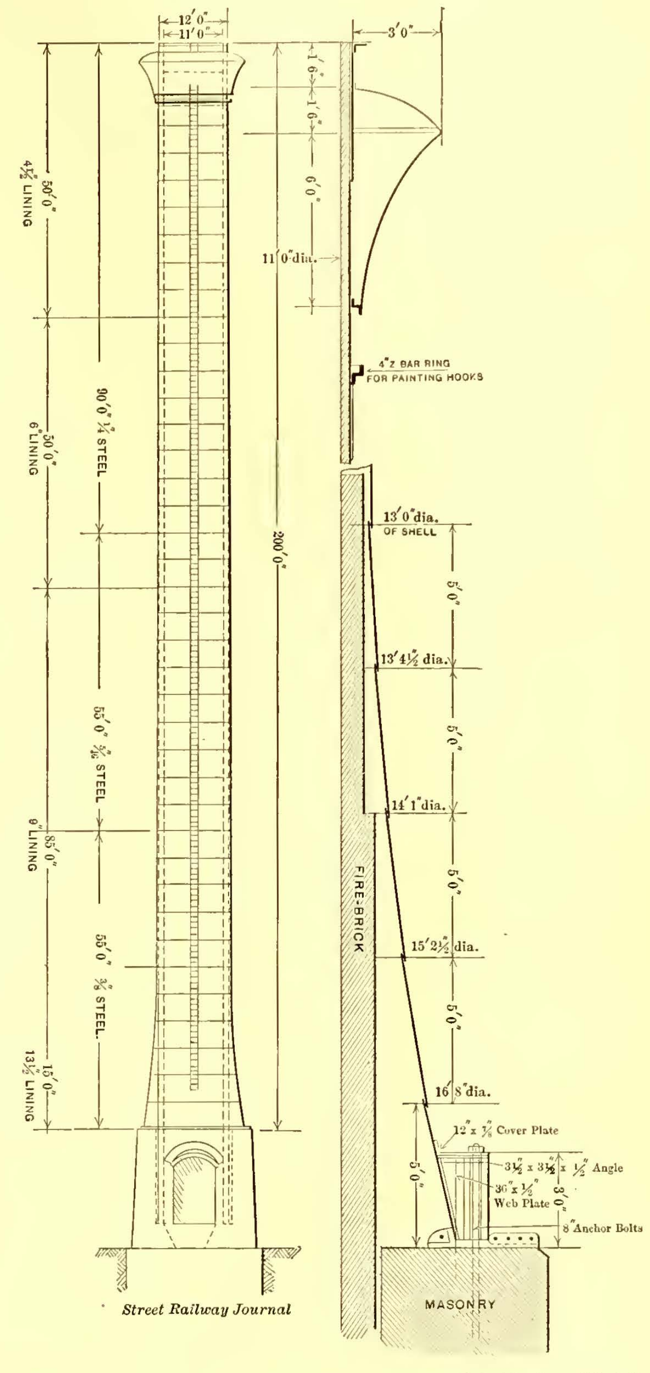


FIG. 13.—ELEVATION AND VERTICAL SECTIONS OF STACK.

load carried on the cars in each case was 600 lbs. A certain number of starts and stops were made, but not as many as in case of actual operation. The averages of a number of tests showed the following results:

	Dead load lbs.	Total load lbs.	Electric Horse Power Consumed.
22 ft. car on (2) swivel trucks	21,000	21,600	22
18 " " " single truck	18,000	18,600	16
16 " " " " "	16,000	16,600	14

These figures indicate a superiority of the single truck car over the double truck car in power consumption as compared with carrying capacity. This superiority extends even to the question of repairs as shown in the accompanying table made up from a representative month.

Repairs per car equipment per car mile.

	Bodies.	Trucks.
Double truck cars	$.02	$.00357
Single truck cars	.00833	.0015

HEATERS.

The company is using a few electric heaters, but is heating most of its cars by stoves. The electric heaters have given very satisfactory service and are looked upon with favor by the management, in spite of the fact that the experience of the company shows that it costs to heat the cars with them about three times as much as by stoves.

The company has in use a variety of stoves, including the McGuire, Standard, Michigan, Lewis & Fowler and Spier. The first two have been found to take less coal than the latter three, but also to give out appreciably less heat. The cost of operating the stoves last winter, including fuel, maintenance and repairs was about as follows:

Each of first two makes	$.07 per car per day.
" " last three makes	$.10 " " " "
General average	$.0014 per car mile.

In addition to the above the cost at the beginning of the season of putting the stoves in shape for the season's use should be added. This averages about $1.50 per stove.

WHEELS.

The service to which the wheels are subjected is in some respects especially severe. With a high car mileage the grades are many and the traffic is often extremely heavy. For a long time the company had considerable trouble with the number of flat wheels which developed in service. When a wheel became flat the entire axle would be removed and sent to fitting shops in New York belonging to the wheel makers, where the wheels were either ground down or replaced and then returned. The number of axles thus removed at times has averaged over eleven a day.

Instructions to motormen to reduce this evil did not seem to have any practical result. Sand boxes had to be used on account of the heavy grades, as sand cars were not looked upon with favor by the management. In addition to trouble from flatting, the wheels showed a tendency to wear with a sharp flange on one side and a double flange on the other. Strange to state, the wheel on the opposite side from the gear was always the one which wore sharp when any difference could be detected. This characteristic held true, independent of the truck. It was first thought that the wheels did not track—in other words, that while the axles were parallel the flanges were not in line with each other. To determine whether this was true, the electrical engineer of the company, C. F. Uebelacker, constructed the wheel gauge described in the STREET RAILWAY JOURNAL for July, 1895. Tests with this gauge have shown that much of the trouble due to sharp flanges arose from the wheels being out of line with each other, and the trouble, being thus located, was reduced, although not entirely eliminated.

The most serious evil however was that of flatting, and to avoid this, trials were made with manganese steel wheels. While these could not be flattened in service, they wore rapidly, losing from one inch to two inches in diameter in covering 20,000 miles. A peculiar feature of the wear was that the worn wheel, besides becoming smaller, developed a fin on the outside of the tread, as shown in the accompanying engravings, which give sections the actual size of two manganese wheels on the same axle which ran 12,942 miles. The striking difference in width of flange already referred to is illustrated clearly in the section reproduced.

The chilled iron wheels used by the company weigh 360 lbs. each, and average 3000 miles in service per month. There was a marked reduction in the number of flatted wheels removed from cars between February and January, and this was, to a very great extent, due to the fact of the company's issuing more rigid instructions to the motormen in reference to the indiscriminate use of sand, and to their sanding a considerable portion of the track, especially on grades, with individual sand cars.

After giving considerable thought to the subject, the second vice-president, Mr. Young, determined to adopt the policy of paying the manufacturer more, and endeavoring to secure a better wheel. Several standard grades of chilled iron wheels have been used heretofore. Under its new contract made with the New York Car Wheel Works, the latter will furnish all the wheels required on the line, for the coming year. The wheels are from assorted mixtures composed of the best grades of charcoal iron and several special brands, notably a Canadian iron made from bog ore. For these new wheels the price agreed upon is about $2.75 per wheel in excess of the price paid for the former wheels, but the service given so far has indicated that these wheels, purchased under special guarantee, will not flatten as easily as the standard wheels, and that they will last so much longer than ordinary wheels that the difference in cost is far more than made up by the longer life and general superior quality. As the cost to the company for changing axles in the repair shop,

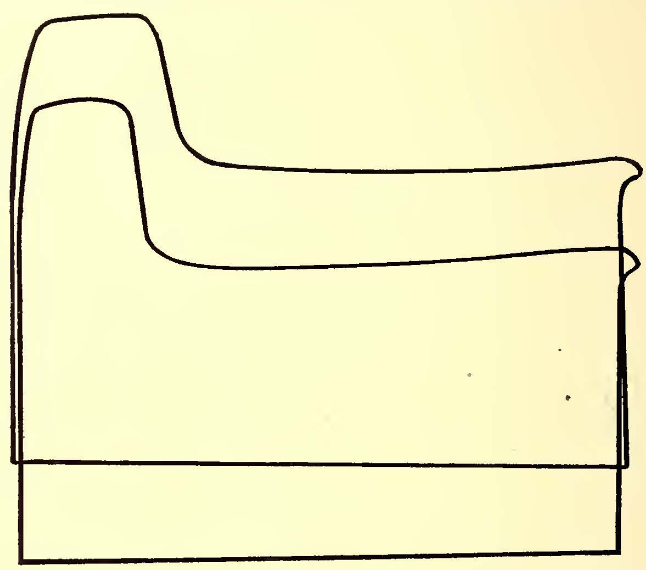
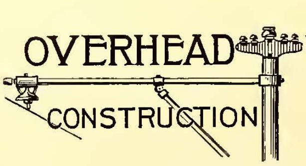


FIG. 14.—SECTIONS FULL SIZE OF MANGANESE STEEL WHEELS FROM SAME AXLE, SHOWING DIFFERENCE IN WEAR AFTER RUNNING 12,942 MILES.

is $1.02 each, an additional economy is readily shown, as special wheels do not require changing for repairs as often as the ordinary chilled wheels.

The first of these special wheels was put in operation Apr. 4, and so far they have given very good results, though they have not been in operation long enough yet to determine just what the results will be. An interesting test was made however which would seem to show excellent wearing qualities. Two pairs of these wheels under an eighteen foot car were chained fast, and the car was then dragged over one hundred feet of sanded track. The flat developed was two inches long, while with ordinary chilled wheels the flat would have been from three-fourths of an inch to one inch longer.

The management feels very confident that the new wheel will solve the problem as presented to them, that the troubles heretofore experienced with flat wheels will be to a large extent eliminated, and that the purchase of a higher priced wheel will be a good investment.



SPAN wire is used exclusively on the lines of the company. The General Electric overhead parts are employed throughout. Most of the iron poles are of the Morris-Tasker make. The standard side pole is 800 lbs. in weight and five, six and seven inch sections. The standard trolley wire is No. 0 hard drawn copper.

The maximum drop in voltage figured for the out-going circuit for ordinary loads is eight per cent, and for the return circuit two per cent. This rule is necessarily subject to certain deviations according to the conditions of different divisions.

The line is carefully divided into sections, to secure greater certainty of operation. Each section is fed by a separate feeder. The arrangement of sections in the Hudson County division of the company's lines is shown in Fig. 15. As will be seen, twenty-six feeders are run from the power station, one for each section.

ROADBED CONSTRUCTION

THE lines of the company, measuring one mile of double track as equal to two of single, are about 175 miles in length. All new construction is with eighty-five pound, nine inch girder rail of either the Johnson No. 281, or the Pennsylvania Steel Company's No. 201 section. This rail is mounted on 5 in. × 7 in. × 7 ft. oak or chestnut ties, spaced 2 ft. 6 ins. between centers. The following are the specifications used for ties:

SPECIFICATIONS FOR TIES.

1. All ties must be made of green or living timber, of good quality, and free from decayed knots or other unsound parts; to be hewn on two sides with straight faces, of an even thickness, sawed off square at each end, and stripped of the bark. White oak and chestnut will be the only kinds of timber admitted.

2. First class ties must be seven feet long, five inches thick, and not less than seven inches face. No variations will be allowed in length and thickness given above.

3. Cullings: All ties less than seven inches face, or five inches thickness, and more than six inches face, or four inches thickness, will be classed as "culls," of which not more than ten per cent will be accepted.

4. All ties in above classes that are more than seven feet long will be taken at a reduction of three cents each to pay for cutting them to specified length.

5. No ties hewn from one-half or one-quarter logs, or sawed from larger timber, will be received.

6. Ties must be delivered by consignee on wharf or railroad siding designated by Consolidated Traction Company, in Jersey City, Newark or Elizabeth.

JOINTS.

Broken and suspended joints are used. The rail is mounted on a tie plate and at present tie rods are being employed to keep the track in gauge, but in future work the company will employ combination tie plate and rail braces. The ordinary eight bolt joints with two No. 00 copper bonds are used in most joints, but the company has also about three miles of old four inch rail connected with cast welded joints. The latter has not yet been in position long enough to demonstrate its value. The general manager believes that the cast joint will prove satisfactory with this section, though unwilling to use it with a deeper rail.

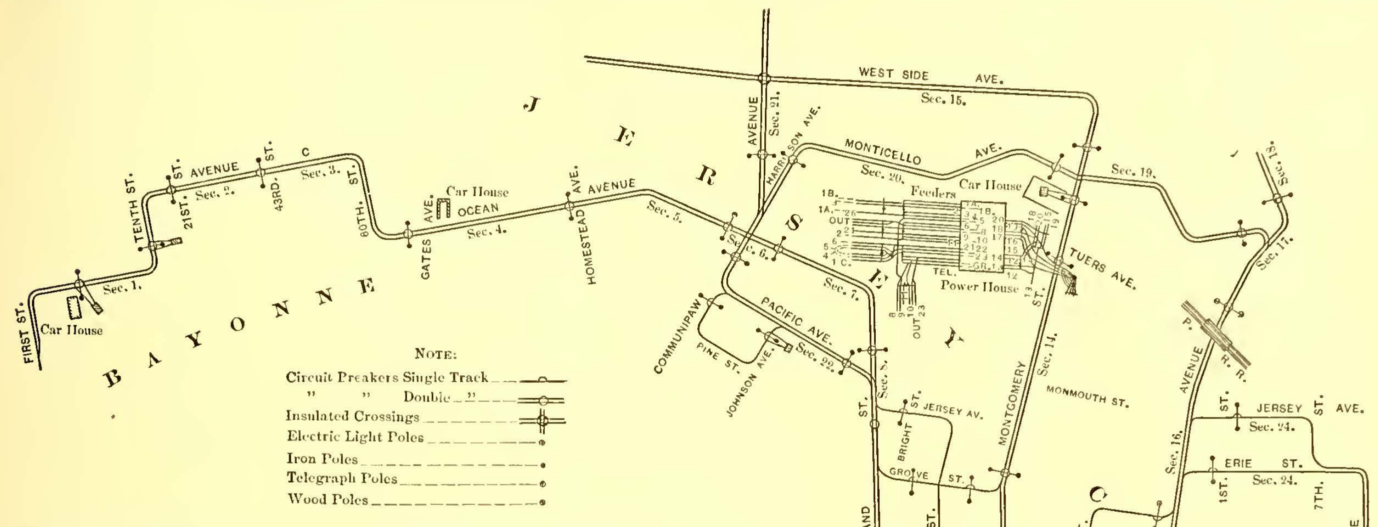
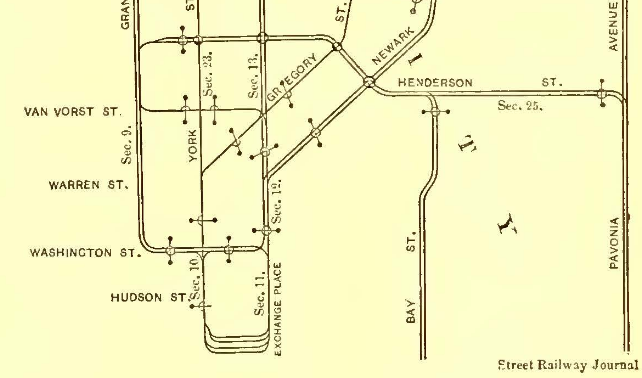



FIG. 15.—JERSEY CITY LINES, SHOWING FEEDER SYSTEM AND LOCATION OF CIRCUIT BREAKERS AND SECTION SWITCHES.

SPECIAL WORK.

Special work has been made quite a study by the company's officers and the line has all of the improved forms of special work. So far, the best results, in the opinion of the management, have been secured with the manganese steel special work of the Wharton Company. One piece of this work was laid about a year and a half ago directly in front of the Jersey City terminus on a curve of 72 ft. 7½ in. radius. About 1000 cars pass over it daily although at a low rate of speed. In spite of this severe service no wear is yet appreciable upon the points.

BONDS AND THE RETURN CIRCUIT.

Nearly every type of bond is used, including channel pins with single, double and triple lacings, Chicago bonds, plastic bonds, riveted bonds, Atkinson bonds, etc. Tests have been made upon the conductive properties and durability of these different types, but as yet the company's engineer is not prepared to give an opinion upon the relative merits of the different kinds used, except in the case of bond wires using soldered rivets which have been condemned. A few return feeders, aggregating in length less than five miles, are used, but the rails themselves are depended upon for the return in most cases. Underground supplementary wires are not employed. Earth returns are used to a limited extent and only where the points to be connected with the power station run near salt water. Here the earth plate is made by employing old dash iron, from which the paint has been cleaned, and which is buried below low tide mark. The connection to the rail is made by riveting and soldering a conductor connected to the rail. Sometimes old cast frogs and mates are employed instead of dash iron. The station earth plate, which however is used only at the Newark station, is made in the same way.

The method of testing the bonds heretofore employed has been with a low reading voltmeter, the connections being made by filing the rails on each side of the joint until a bright surface is obtained. As the current flowing through the joint is usually unknown, however, this method of testing has been far from satisfactory. The company is now having manufactured for this purpose a direct current converter by which from 800 to 1000 amperes can be sent through the bond when its resistance can be learned by the employment of a low reading voltmeter. This method, it is thought, will obviate the trouble heretofore experienced.

TRESTLES.

The most notable trestle construction on the line is that on the turnpike division where the tracks cross those of the Delaware, Lackawanna & Western Railroad on the Hackensack Meadows. The cars mount this trestle at a grade of eight per cent. The trestle was built by the New Jersey Steel & Iron Company, and a view is given in the accompanying engraving.

CAR HOUSES AND REPAIR SHOPS

THE chief repair shops of the company are on the Plank Road interurban line between Newark and Jersey City, about a mile and a half from the Market Street station of the Pennsylvania Railroad in the latter city. Here all the repair work on car bodies, motors and trucks is performed under the direct supervision of the company's electrical engineer, whose office is in the repair shops. The shops adjoin the principal car house of the company. The policy of carrying on all the repairs at one place instead of in a number of different car houses is amply justified in, the opinion of the company, by the results secured.

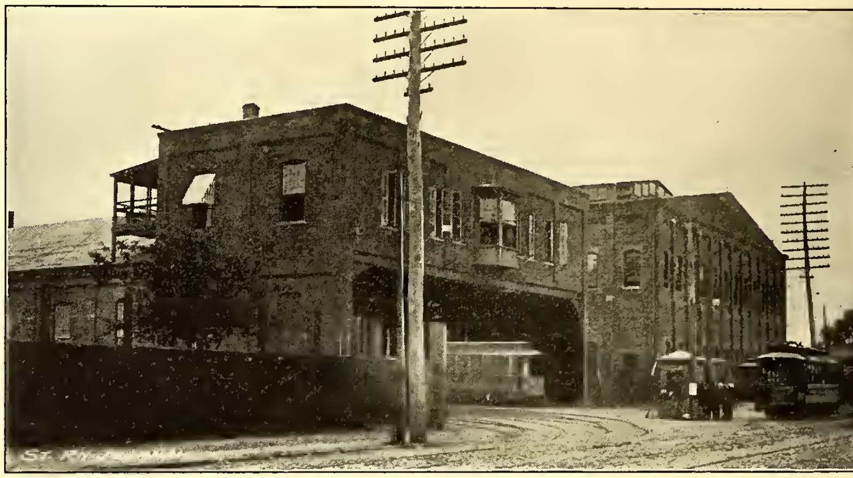


FIG. 17.—EXTERIOR OF PLANK ROAD CAR HOUSE AND REPAIR SHOP.

The repair shop is of brick, two stories in height and measures 120 ft. × 150 ft. The ground floor is devoted to the paint shop, 36 ft. × 120 ft., blacksmith shop and pit room, 75 ft. × 114 ft., and the carpenter shop, 45 ft. × 114 ft. On the second floor are the machine shop, offices and storerooms of the company.

The paint shop has three tracks extending its entire length and is separated from the rest of the building by a brick wall. In the pit room are ten tracks, eight of which are equipped with pits. The tracks from this and the paint shop are served by an electric transfer table, shown in Fig. 22, forty feet away from the building. This distance gives room for the cars to stand outside of the doors.

The paint shop has capacity for ten cars, sufficient to take care of the equipment, on the basis of revarnishing every twelve months and with allowance for additional cars requiring repainting on account of accidents. The carpenter's shop has the usual equipment of borers, shapers, planers, band-saws, etc. The paint shop with the pit room is piped with compressed air furnished under twenty pounds pressure by a rotary blower. This air is used for cleaning out corners, motors, sweeping cars, etc.

As a full description of these shops with plans and engravings was published in the January issue of the STREET RAILWAY JOURNAL, a detailed account of them will not be given here, but occasion will be taken to illustrate some of the special appliances which have been found particularly useful in facilitating the labor of repairs. One of these is the pit hoist shown in Fig. 21, for removing armatures. The head of the hoist is fitted with two rollers which carry the weight of the armature. As the hoist receives the armature these rollers will revolve slightly while the teeth of the pinions are disengaging. The jack is of the ordinary "Barret 3" type with hoist of twenty-six inches. The jack is mounted on a swivel and supported on a small truck which runs on the rails at the bottom of the pit.

Another type of hoist employed by the company is illustrated in Fig. 20. It consists essentially of a traveling jib crane, the hoist of which is operated by an old style railway motor. The hoist is mounted on a truck propelled by a different motor. The cost of the crane was about $125 and it was made in the shops of the company.

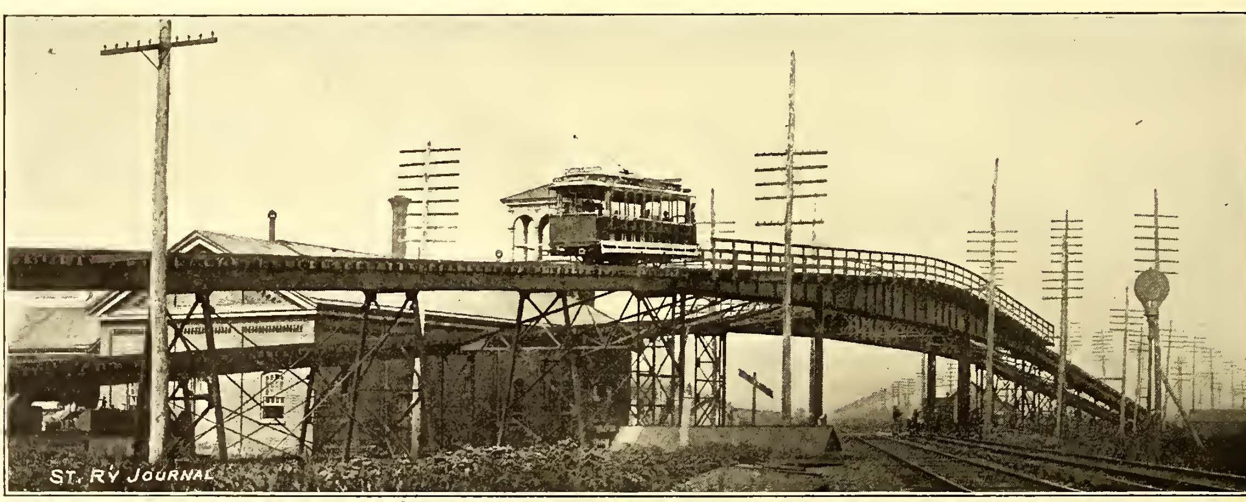


FIG. 16.—VIADUCT ACROSS TRACKS OF THE D., L. & W. R. R. CO.

The method of lifting car bodies is shown in Fig. 19. 6 in. × 12 in. timbers are slipped under the body. These are connected by iron straps and chains with longitudinal stringers which are raised by wire ropes wound around a drum operated by a railway motor on the second floor of the repair shop. The motor is controlled by a switch and rheostat on the ground floor. This device, which was also made in the works of the company, cost about $350 and is in almost continuous use.

With the General Electric motors another kind of tackle is used to remove the armatures from the motors. This is a jib crane attached to vertical posts in the building, but so arranged that when not in use the horizontal arm can be unshipped, when it remains close to the post and occupies no room. The car is run alongside one of these cranes when the arm can be swung into the window and the armature lowered to the pit jack. (See Fig. 18.)

The monthly pay roll of the men engaged in the repair of car equipments and trucks is from $1600 to $2100.

The practice was instituted some time ago of putting as many men on a piece of work as possible. This has been found to be very satisfactory and the working force was in consequence cut down about fifty men. The force is extremely efficient, as is shown by the fact that recently

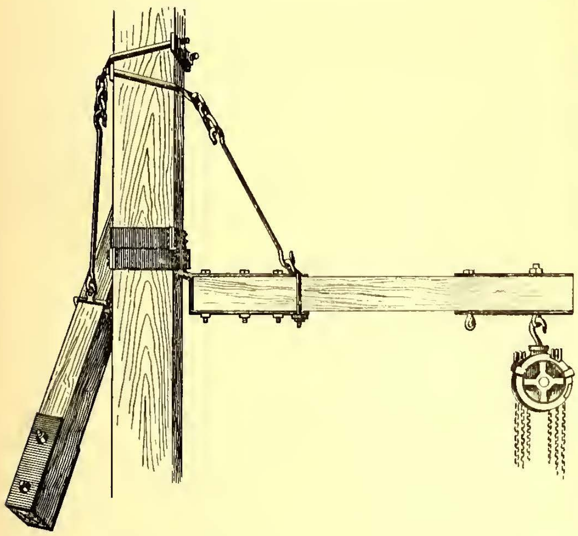


FIG. 18.—TACKLE FOR RAISING ARMATURES INTO CAR.

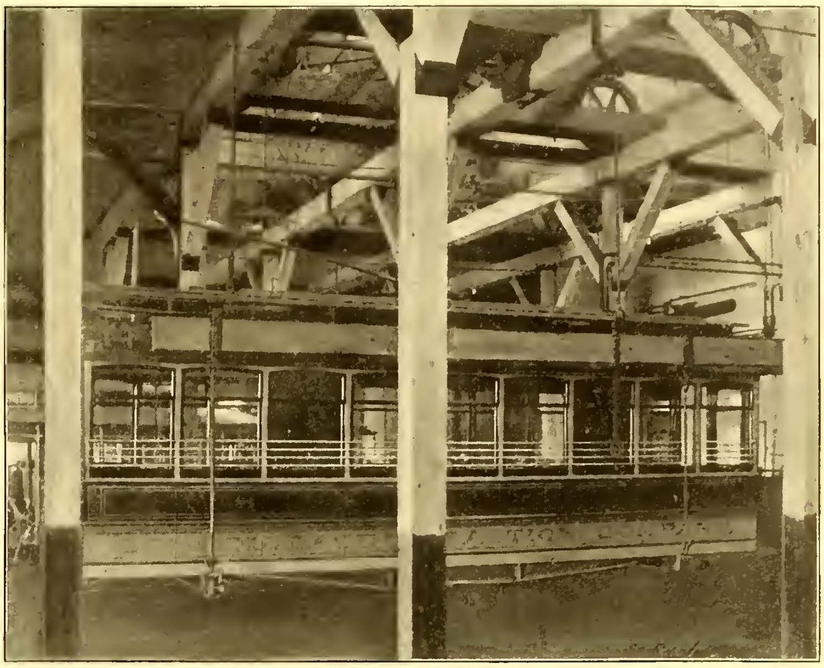


FIG. 19.—CAR BODY HOIST.

FIG. 20.—JIB CRANE.

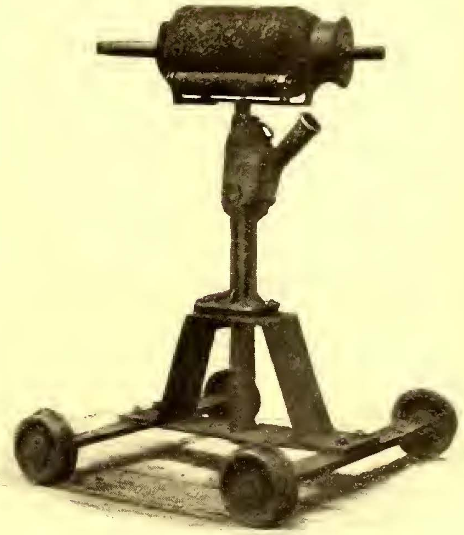


FIG. 21.—PIT ARMATURE TRUCK.

The company has now about 117 men employed in the repair shops for the inspection and repair of trucks, motors and electrical equipment. These are divided as follows:

49	in the pit room.
5	winders.
8	controller repairers.
3	helpers.
2	blacksmiths.
6	machinists.
22	night inspectors and repairers.
22	day inspectors and repairers.
117	

upon the arrival of twenty new cars by railroad, the bodies were taken from the flats, equipped and put on the line within forty-eight hours.

The company has thirteen car houses divided as follows: four in Jersey City, eight in Newark, one in Elizabeth.

ORGANIZATION

FOR convenience in operation the line is divided into three sections entitled respectively, the Hudson County, Essex County and Union County divisions. Each of these is in charge of a superintendent with headquarters respectively in Jersey City, Elizabeth and Newark. The headquarters of the general superintendent are in Newark, while the second vice-president of the company, who has general charge of all departments, divides his time between Newark and Jersey City.

Under the division superintendents are assistant superintendents, each of which has his headquarters at a car house of his division and has charge of all cars running therein.

All car houses, power stations and other offices of the company are connected by an independent telephone system with central stations in both the Jersey City and Newark power houses, so that a general oversight of the operation of the line is had by the general superintendent and second vice-president. Each division superintendent has power to change the headway of his cars within certain limits and to otherwise assume considerable responsibility in the proper operation of the road. Each makes daily reports and otherwise keeps the general superintendent carefully informed upon matters pertaining to his division.

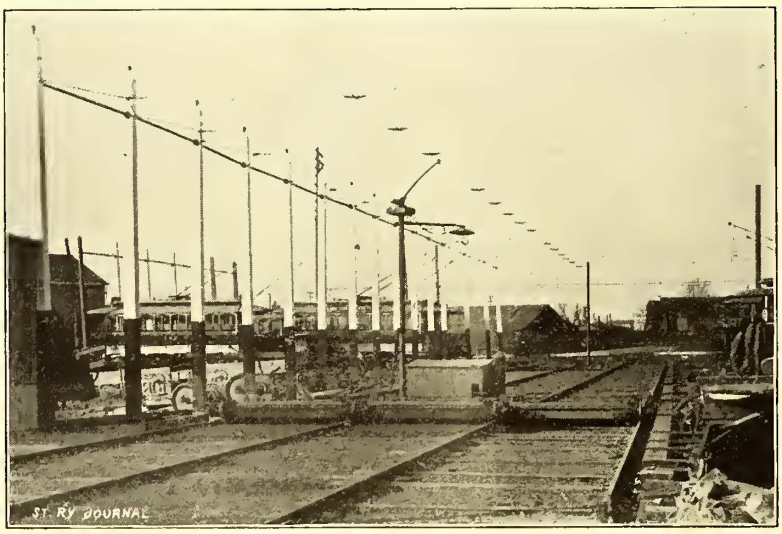


FIG. 22.—ELECTRIC TRANSFER TABLE AT REPAIR SHOPS.

There are three regular emergency stations equipped in the usual way, but upon days of very heavy traffic emergency teams and gangs are placed at different points along the line where they can easily be summoned by telephone in case of need. Thus, on July 4, the company had as many as eight such stations up to 10 P. M. The emergency force upon these extra occasions is largely recruited from the repair shop employes and expert motormen whose places for the time are taken by extras.

Another important feature in the successful maintenance of the service is the employment of a considerable number of traffic inspectors. These are expert motormen who have served in the repair shop, and besides looking out for the spacing of cars, etc., are fully competent to assist in making temporary repairs or helping the man-

FIG. 23.—YARD OF REPAIR SHOPS.

agement in case of any accident, such as the breaking of the overhead line, etc. As the inspectors rank above the motormen and conductors, they immediately assume control upon any occasion where they may be called and if the assistance of a tower wagon is required, one is summoned by the nearest telephone. Each inspector in his daily duties is assigned a certain territory, which, however, is not always the same, as on days of heavy traffic the territory of each will be made smaller and a greater number of men will be put in service.

The accounts of the company are kept upon the system recommended by the American Street Railway Association at its Atlanta meeting.

The table below gives the general system of organization of the company.

THE Baltimore City Passenger Railway Company, is making some changes in its grip, and hereafter the Broadway type of movable upper jaw will be used. Heretofore the method of running trains on the cable lines of this company has been the use of an open grip car and closed trailer. A closed car with center aisle and with grip on the front platform will be substituted for the open grip car, and this will draw in winter closed trailers. The new grip cars are being equipped with Peckham trucks. By this method the company will gain four extra seats and be able to run entirely closed cars in winter if desired. The company is well satisfied with the operation of its cable lines and will not change them to electric power, in the early future certainly.

TABLE SHOWING ORGANIZATION OF THE CONSOLIDATED TRACTION COMPANY, OF NEW JERSEY.

- Board of Directors.
  - President . . .
    - 2d Vice-President . .
      - Auditor.
      - General Supt . . . . . .
        - 3 Division Supts——9 Asst. Supts. . .
          - Inspectors, Conductors, Motormen, Car and Motor Cleaners, etc.
        - 2 Road Masters.
        - Line Superintendent.
        - 2 Station Engineers . . . . .
          - Engineers, Firemen, Dynamo Tenders, etc.
        - Electrical Engineer . . . . .
          - Repair Shop and all Electrical Details.
      - General Counsel.
      - Purchasing Agent.
    - Sec'y-Treasurer.

The Electric Railway System of Rouen.

Electric railways are growing in popularity in France. To the magnificent systems of Havre, Lyons and Bordeaux installed in rapid succession during the past few months and recently described in the pages of the Street Railway Journal, has been added that of Rouen, the prosperous Anglo-Norman city, famous for its battles and sieges.

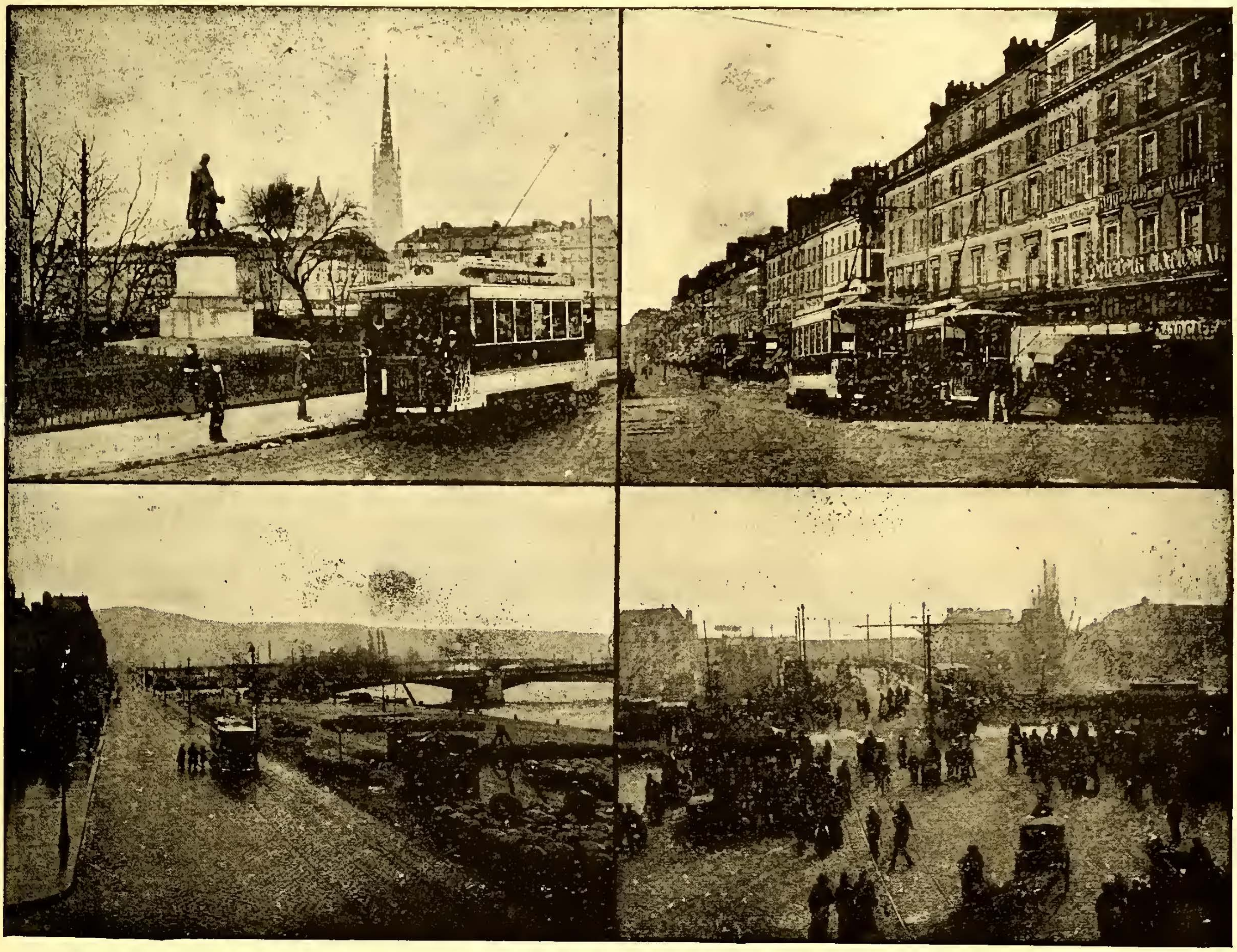
The power house occupies an admirable central position, so far as the distribution of lines and traffic is concerned. It is, however, some distance away from the river, near to which a location was not available, and as the engines are condensing, water has to be pumped to the station.

The steam generating plant consists of four Babcock & Wilcox boilers, supplemented by a Green economizer. The power units are three in number and consist of three Corliss-Farcot horizontal, single cylinder engines, with flywheels moving at seventy revolutions per minute. The engines are belt connected, each to a 200 k. w. G. E. multipolar railway generator, overcompounded for 550 volts at full load. These will shortly be changed for 300 k. w. machines.

The switchboard is of the panel type having three generators and three feeder panels, each of the latter controlling two feeders. Each generator panel carries a K automatic circuit breaker, an amperemeter, two quick-break main switches, one field switch and a field rheostat operated by a wheel on the front of the panel. A luminous dial voltmeter is swung at the side of the board on a bracket. Each feeder panel carries an automatic circuit breaker for both feeders, and an amperemeter and quick-break switch for each feeder.

Each pole is twenty-three feet long above ground, and is divided into four sections. The lower part is set in an ornamental cast iron base, while the top carries a finial of ball and point. On the quays the poles are of the double bracket type and every other one—twenty-seven in all—carries an arc lamp. A number of the span poles are furnished with incandescent lamps, current for which is supplied by the local lighting company, and within a short time, it is said, each pole will be equipped with its own light. Special attention has been given to the overhead construction to render it as sightly as possible, and the local paper has even described it as "a special decoration of the streets of our city."

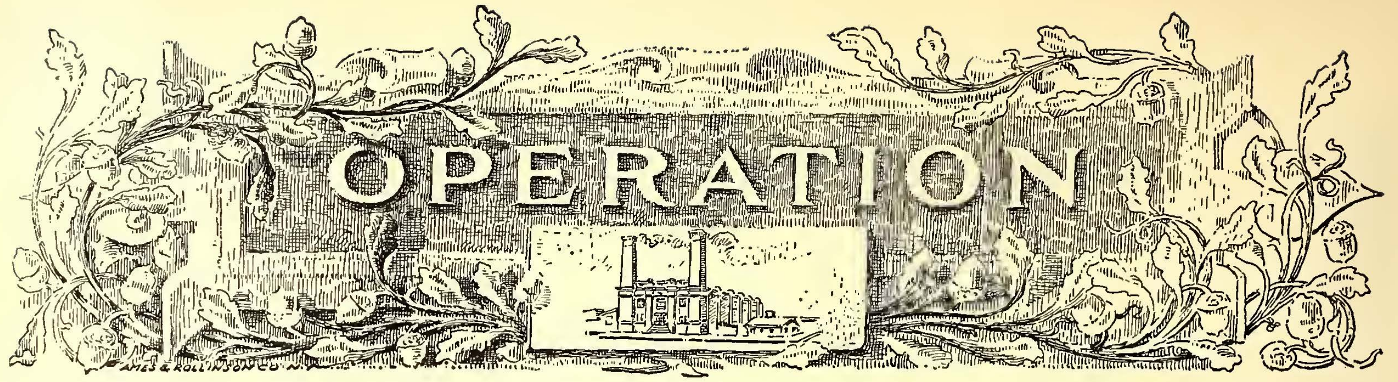
The track is laid with ninety pound grooved girder rails seven inches high. No. 00 Chicago bonds and channel pins are used, two bonds to each rail joint, with careful cross bonding between rails, tracks and to supplementary return. The question of interference with telephone operation is one with which French street railway companies have to reckon. In France the government changes over the telephone service to the metallic return, but charges about half the expense of so doing to the railway company. Preliminary payment is exacted, and no work on the road is done until the matter is thus settled.



VIEWS ON THE ROUEN ELECTRIC RAILWAY.

The rolling stock of the Rouen company consists of sixty cars. Each is divided by a sliding door into two classes. The total number of places is forty to each car, twenty-four inside and sixteen on the platforms. It may be noted here that although the double deck prevails in the horse car and omnibus almost universally in France, the *impériale* is conspicuous by its absence. The weight of each car loaded is seven tons, and each is twenty-six feet long. The trucks were turned out by the Thomson-Houston Company in the works of the Société Postel-Vinay. The platforms are enclosed by handsome wrought iron gates.

Each car is equipped with two G. E. 800 motors and 2 K controllers, magnetic blowouts and the usual accessories.



Studies in Economic Practice.

By C. B. Fairchild.

Shop Methods, Tools and Labor Saving Devices of the Chicago City Railway Company. Part II.

Among the interesting features or labor saving devices in the electrical department is a rope model for making the cables for car wiring. This model is constructed of twelve quarter inch ropes which are separated from each other by being run through holes in blocks of wood. The ends are connected to a board 6 ins. × 12 ins., as shown in Figs. 20 and 21. Each rope is properly lettered and numbered, so the model indicates how each wire is to be attached to the controller, and it also shows to which wire the leads are to be attached. By the use of this method inexperienced men or cheap labor can be employed for making cables. The model is hung at the side of the room, and there are seven horses or jacks in line on the floor. The first of these, the one next the coil of wire, has cleats across the top or spaces one-half inch apart for twenty-four wires, two cables being laid off and put up together. The last horse on the opposite end has holes bored through the top through which the individual wires are drawn. The wires being all cut and laid in at proper lengths, a wedge is inserted beside the wire at the initial end which holds it in place. As soon as the twelve wires are laid out the ends of each are labeled or marked by a tin ferrule having stamped letters to indicate the number and name of the wire. Then the leads are all soldered on at their proper place as indicated by the model. The soldering is done by pouring, after which the joint is washed in ammonia water to destroy the acid. When the leads are attached and taped, six of the ropes are laid on top of the others and the whole is bound into a round cable by means of tapes. It is then drawn into the hose by a reel. The hose is of ordinary two and one-half inch linen and is similar to that employed for fire purposes. The hose is then split opposite the leads, these are taken out and the aperture closed up. The whole is then treated with P. & B. paint. By this arrangement two men can make eight cables a day all finished up ready for placing in the car. The ground wire is tapped in outside the hose.

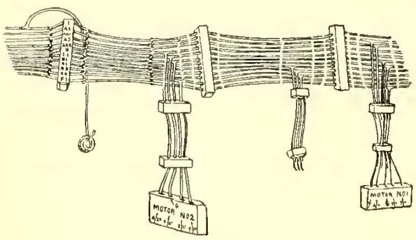


FIG. 20.—ROPE MODEL OF CAR WIRING.

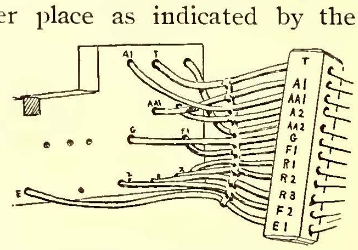
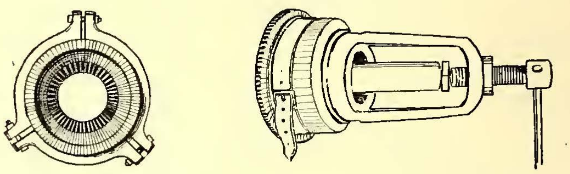


FIG. 21 —ROPE MODEL OF MOTOR CONNECTIONS.

When the commutator bars are being set up they are held in place by a three-section ring shown in Fig. 22. The three sections are of wrought iron with lugs at each end. Each section has holes for two three-quarter inch bolts. When the bars and mica sections are in place the commutator is tightened by means of the bolts. The ends are also fitted with a three-eighths inch dowel so that the sections come in proper relation. This accomplishes quite a saving in time over the ordinary commutator rings where set screws are used for each bar. The ends are then turned up in a lathe, the jam nut is put on, the rings are removed and the commutator is ready for turning up. By the use of liners the same rings can be made to answer for different sizes of commutator.



FIGS. 22 & 23.—RING AND SCREW JACK FOR COMMUTATORS.

A screw jack (Fig. 23) is employed for taking the commutators off the armature shaft. This jack is a base ring six inches in diameter with interior threads to fit in place of the jam nut. There are two arms about fourteen inches long which support a nut through which the screw operates. For using this device the jam nut is removed and the jack is screwed in its place. Then by means of a long lever, pressure is brought to bear against the end of the shaft, readily forcing the commutator from its position. Before the jam nut is removed the commutator bars are supported by a leather strap which is buckled around the commutator as shown in the illustration.

In turning down a commutator the tool employed is not ground to a sharp angle at the point, but has a flat end about one-thirty-second inch in width. In placing the tool in the lathe it is set about the width of one bar above the center of the commutator. This prevents the copper from drawing and being ground into the mica. Two cuts are made on the commutator, the last one being very thin indeed. For finishing up, a file, which is first thoroughly chalked over, is used. The chalk produces a very smooth surface and prevents the copper being mixed in the mica insulation, and after the turning is complete it is not possible to detect by touch any ridge between the mica and copper. The cost for time in turning a commutator is charged up at twenty-five cents only.

The wooden forms for winding the field coils are of the form shown in Figs. 24 and 25. They are made of a two inch plank, about 16 ins. × 12 ins., held together by two bolts and having in each plank two slots, on each side three inches deep and 1½ ins. wide. These slots or grooves provide for holding the ribbons by which the layers of wire are separated. As the form turns round the attendant has but to throw the ribbons from one side to the other without stopping the speed. The core of the form consists of two blocks with concave sides, so that after the winding is done, the two blocks being slightly beveled on their inner surface are readily removed, as the coils do not bind on the side of the plug. The two parts of the winding form are separated by a board so that one-half the coil is first wound, then the form is turned, and the other half wound in the opposite direction. Some of these forms have a shaft by which they are fastened into the turning machine, but where the winding is done on a lathe the forms are clamped by plates on the side.

In the electrical department girls are employed for winding field coils, taping armature coils, and for placing the coils in the armature. These are the only shops with which the writer is acquainted where female labor is employed for this work. It is found by comparison that the work done by the girls is better and neater in every way, and they turn out a greater amount of work in a day than did the men formerly employed. For instance, a man would tape fourteen coils in a day. The girls easily tape one hundred coils and can wind one hundred in a day. Girls are also employed for setting up the commutator bars and for sorting mica. An expert hand will set up the bars of a commutator and tighten up the rings in two hours, whereas it usually took a man more than a day. They are also more efficient than men in making the mica troughs employed on the No. 12-A motors. In the winding department coils for five different types of motors are prepared. Of the Westinghouse motors the company uses the No. 3, No. 12-A, No. 12-B. The No. 5 of the Walker motor and the G. E. 800 of the General Electric Company are also employed.

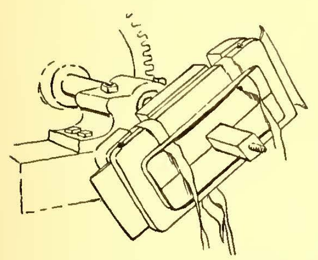


FIG. 24.—FORM FOR WINDING COILS.

The company manufactures its own chipped glass for deck lights and other purposes. This is a very simple process and can be readily done by any company. The concave side of a pane of glass is usually preferred. This is first ground by means of an old file, emery powder and water to make it rough. Good hide glue is then spread over the ground side by a paint brush and left to dry. The glass is then placed in the sun if it is a bright day, or if not it is taken to the armature baking oven which is kept at a temperature of 190 degs. and left there from thirty to thirty-six hours. This causes the glue to curl up taking with it chips of different thickness out of the face of the glass, the figures being usually like frost work. When thoroughly dry the dry glue and pieces of glass are easily brushed off and the glass is ready for service without any additional work.

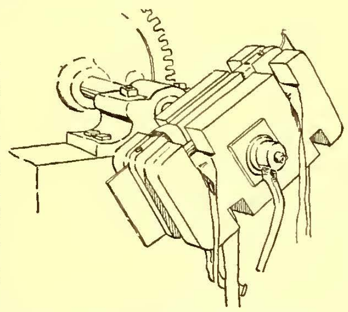


FIG. 25.—FORM FOR WINDING COILS.

Fig. 26 illustrates a device designed by M. K. Bowen, superintendent of the system, and designed to furnish a ready reference record of the character and extent of the repairs made on different classes of cars. It is an oak case, the upper part of which is fitted with folding doors, inside of which are eight hinged frames which carry heavy cardboards, 34 ins. X 24 ins. The frames or sashes are about two inches wide, and are constructed so that the cardboards may be slid down through the top panel. The cards, as shown, are designed for a record of two years and are divided up into one inch squares. These are again subdivided into sixteen small squares. Beginning on the top to the left, opposite the first row of squares, are the figures 1895. Beneath this for the second row, 1896. Above each large square is a space for the number of the car. This runs from left to right over the first row and continues in the same order over the second and third rows. The small squares are numbered on the left 1, 2, 3, 4, to indicate the first, second, third and fourth quarters of the year. A key or explanation of the board is fastened on the inside of one of the doors, and the explanation or use of the board is as follows: one panel is provided for grip cars, the second for the open trailers, the third for the closed trailers, the fourth for the closed motors, the fifth for the open motors. Five colors are employed—black for a car constructed in the shop; blue, one reconstructed from horse car to motor car; green, one repaired; red, one painted, and yellow, one touched up or varnished. The board is corrected each day by an attendant who lays in the colors in the small squares from the daily car reports. A box of paints and material are kept in a drawer connected with the case. By this means the superintendent can tell at a glance what and how much has been done to any one of the cars at any quarter of the two years, so that it is readily compared with the quarter of the preceding year. For instance, the first row of small squares at the beginning of 1896 may contain three colors, green, red and yellow, showing that the car was repaired, painted and varnished during the first quarter of 1896, and so on for any quarter. As the panels fold in the doors, which are locked, no one but the superintendent and the boy who has charge of the daily reports, has access to the case.

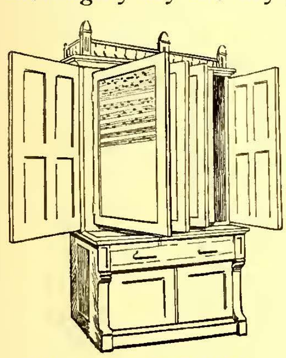


FIG. 26.—CAR RECORD CASE.

Large Electric Locomotive.

The first electric locomotive of any considerable size built in this country, exhibited by the General Electric Company at the Chicago Exposition, 1893, and having a rated drawbar pull of 7000 lbs., has been purchased by the Manufacturers' Street Railway Company, of New Haven, Conn. It is equipped with air brake and is being prepared for shipment from the Schenectady works within a very few weeks. Its total weight is thirty tons and it will be utilized to haul freight cars from the junction of the New York & New Haven Railway at Cedar Hill, which is about one mile from the New Haven passenger depot, to the works of the Bigelow Company, the National Pipe Bending Company, and other manufacturing establishments located along the water front at some distance from the freight yards of the Consolidated road.

The freight cars will be hauled directly into the yards of the manufacturers, and the loads will be collected by the electric locomotive and hauled to the main line of the New York, New Haven & Hartford Railroad where they will be taken up by the steam locomotive for transportation to their destination. The length of the line along which this locomotive will run is nearly two miles, the maximum grade against the load being about 2½ per cent. The guaranteed speed of this locomotive on this grade will be seven miles an hour with a heavy load behind it, but judging by its performance at the Lynn works of the General Electric Company it will probably be able to largely exceed the guarantee.

All the locomotives which the General Electric Company have built will be, when this one is delivered at New Haven, in service. The forty ton locomotive is used as a switch engine at the Taftville Cotton Mills at Taftville, while the three ninety-six ton locomotives are engaged in hauling the freight trains through the belt line tunnel of the Baltimore & Ohio Railroad.

The new highway bridge across the Connecticut River, connecting Middletown with Portland, Conn., is now swung by electricity. The electrical equipment consists of four General Electric 800 motors. Two of these are connected with the swinging mechanism, one working and the other being held in reserve. Of the other two, one is located under each end of the turning span, to raise it from the fixed piers before the third motor begins to swing it. The bridge span is 450 ft. long—said to be the longest single span highway bridge in the world.

Power Distribution for Electric Railroads.

By LOUIS BELL, Ph. D.

VI.—Direct Feeding Systems.—Continued.

A convenient way of entering upon the calculation of a conducting system is to take up the data involved in the following consecutive steps.

1. Extent of lines.
2. Average load on each line.
3. Center of distribution.
4. Maximum loads.
5. Trolley wire and track return
6. General feeding system.
7. Reinforcement at special points.

The first two steps are necessary preliminaries to the third. The fourth determines the permissible drop, the fifth gives the division of the overhead copper between trolley and feeders, and the allowance that must be made for the resistance of the return circuit. The sixth stage is the preliminary calculation of the conductors and the seventh the modification of this to take full account of local conditions. The application of the whole process is best shown by working out an hypothetical system in detail, step by step. Two cases may properly be taken up; first a regular street railway system, and second, an interurban line of moderate length.

Suppose a new system is to be installed or an old one reorganized of which the track is shown in the simple chart (Fig. 42). Here the main line, A B C D, is double track throughout. A B is 10,000 ft., B C 2000 and C D 4000, making a total length of 16,000 ft. At B C the main line is joined by the single track branch, C E, 10,000 ft. long, on which at F G is a five per cent grade 2000 ft. long.

Step 1. Lay out the track to scale, noting the different distances carefully and the extent and position of grades. The scale need not be large, say an inch to the thousand feet, and a couple of tracings of the chart will prove convenient. If any extensions are contemplated, as at E H, dot them in as they will enter into subsequent calculations. As shown, E H is supposed to be 5000 ft. Now divide the road into sections so that in each one of them the service shall be under ordinary conditions fairly constant. For example, the main double track would present tolerably uniform conditions throughout and could be considered as a single section. Owing to the change in direction at B, however, which might conceivably affect the location of the power station, it is better to take A B as

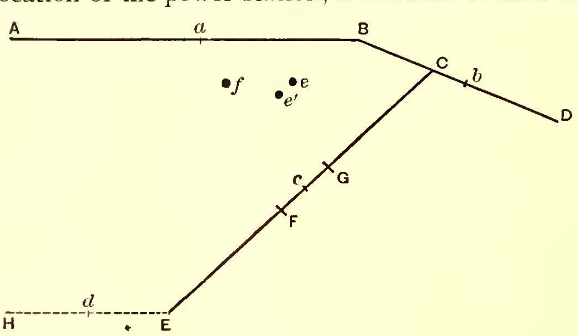


FIG. 42.

one section and B D as a separate one. C E, the long single track branch, will naturally form a third section; while H E may be taken tentatively as a fourth.

Step 2. Now as to the loads upon each section. The number of cars on a road, of course, depends entirely on the traffic. With the advantage of a good population to draw upon, such a line as we are considering might operate as many as twenty motor cars. These would naturally be sixteen or eighteen foot, single truck cars, probably the latter. We may then assume, say, ten such cars on section A B, six on B D and four on C E. Those on C E in the natural course of events would run quite independently, simply serving their own line. We can then assume as the total load twenty eighteen foot cars, each equipped with a pair of standard motors, such as are usually rated at twenty-five horse power each. The power required to operate these cars is, of course, exceedingly dependent on the density of the traffic. So long, however, as the cars are equally loaded the center of gravity of the system is quite independent of the absolute amount of horse power required for each car. Recurring now to the theorems regarding center of gravity in Part I, we are in a position to determine the best position for the power station. The only question to be first decided is what is to be done with respect to the proposed extension. If it is installed as an extension of C E, probably two additional cars would be needed.

Step 3. As the service on each section is uniform the load can be considered as concentrated at the middle point of each section. Determining the center of gravity of the three existing sections by Fig. 43, constructed like Fig. 10, we find this center at *e*. Combining with this the effect of the proposed extension, it appears that the addition of this extra load would shift the center of gravity to e^1, a distance of somewhat less than 500 ft. Transferring these points to Fig. 42 we have the theoretical location for the power station.

Its practical location is, however, a very different matter. Very many things besides cost of copper for distribution enter into the problem. In the first place *e* may fall in a locality in which real estate is very valuable, so that it will pay to shift the center of distribution a considerable distance rather than endure the cost of a site for the power station at *e*. Again *e* may be inconvenient with respect to coal and water supply. The cost of carting coal or pumping the water for condensation purposes may very easily outweigh the saving in copper due to distributing from the theoretical point. It will perhaps be found that there is a considerable region within which the station can profitably be shifted to obtain cheap land, coal and water. It is not difficult to form an idea of the extent of this region. To do so, however, we need an approximate idea of the cost of copper for distributing the necessary power from the point *e*. This is very quickly obtained. We can consider a load of sixteen cars as concentrated at *a* (Fig. 43). This is approximately 3500 ft. from *e*. Similarly six cars are at *b*, 5000 ft., and four cars at *c*, 3000 ft. We have seen in studying Fig. 10 that the total weight of copper required for such a system is

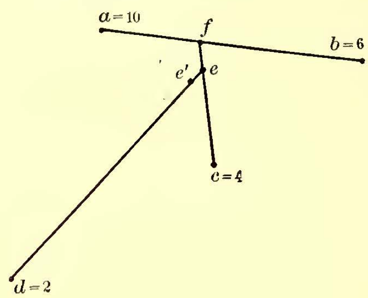


FIG. 43.

$$\Sigma W = K \Sigma c l^2.$$

Remembering that we are considering feed wire alone, since the trolley wire is fixed in location, we may assume a reasonable drop in voltage of, say, thirty volts. K above then becomes $\frac{33}{30}$

Forming the above summation we have at twenty amperes per car,

$$\Sigma W = (10 \times 20 \times 12.25 + 6 \times 20 \times 25 + 4 \times 20 \times 9)\tfrac{33}{30} = 6787 \text{ lbs.}$$

Now at fifteen cents per pound this feeder copper would cost just about $1000. For any other point than *e* the cost will be greater by varying amounts and the increase is about the same for all points equidistant from *e*. As the weight of copper varies with the squares of the distances, the mean distance of the load with respect to weight of copper is determined by

$$L^2 C = \Sigma l^2 c = 6170 \quad \text{where } C = \Sigma c = 400$$

Hence L = 3950 ft. nearly. This distance is the radius of the circle about which the station can be shifted without more than doubling the cost of copper noted above. That is, the station can be located anywhere within about three-quarters of a mile of the center of gravity of the system without increasing the cost of copper more than $1000. Such figures are necessarily approximate only, since in practice wires cannot be run in straight lines, but have to follow the streets, nevertheless they give valuable information.

A brief examination of proposed sites for the power house will generally disclose that which is most advantageous with respect to coal and water, and a quick summation as above will tell quite nearly whether the extra copper will cost too much or not. In the case before us we will assume the point *f* (Fig. 42) as best meeting all the requirements. As the distance $e\,e^1$ is small compared with the displacement of *f*, we can let the extension question take care of itself and are ready to proceed to

Step 4. The predetermination of the maximum or average load is no easy matter, yet upon it depends the proper design of the conducting system. It is not difficult to estimate with a fair degree of accuracy the actual power which must be supplied to drive a car of assumed weight over a certain line at a given speed. But what the real weight of the loaded car will be, and what the condition of the line will be is a case at best for educated guessing. Roughly speaking the power required at the car wheel for a speed of eight miles per hour is .4 h. p. per ton, plus .4 h. p. per ton for each per cent of grade. More exactly

$$P = W\,(.43 + .43\,G)$$

Wherein G is the per cent grade, W the weight of car and contents in tons and P the total horse power. This assumes a straight track and a tractive effort of twenty pounds per ton on the level. But there are always some curves, the speed is often above eight miles per hour and at low speeds the motors are somewhat less efficient than at high speeds. Allowing a complete efficiency of two-thirds from trolley to car wheel and assuming a pressure at the car of about 500 volts we shall not go far wrong in reckoning 1¼ amperes per ton of car *plus* 1¼ amperes per ton for each per cent of grade. This average indicates an average of about fifteen amperes per car. The average current taken while the car is under full headway will frequently exceed this amount, but an allowance of fifteen amperes average throughout the hours of running will generally be nearly right for a road such as that under consideration. With long double truck cars the average current will rise to about twenty-five amperes.

Now the maximum current must be considered. On large systems it may be no more than twice the average. Very often it will be three times the average on such roads as we are discussing. As the number of cars becomes smaller this ratio increases. With one or two cars it is no uncommon thing to find maximum currents of four or five times the average. Still larger ratios would be common if the same speed were maintained on grades as on the level portion of the track. We can now go back to Fig. 42 and form a tolerably clear idea of the current to be furnished. On section 1, A B, we may fairly count on a normal load of 150 amperes, rising to occasional maxima of, say, 450 amperes. On section 2, preserving about the same ratio since it is really a continuation of section 1, we may expect about 90 amperes average and 270 maximum. On section 3 with four cars the average would be about 60 amperes and the maximum about 150 amperes. These figures however do not tell the whole story, for they give no clue to the points at which the maximum currents must be furnished. This matter depends, of course, on local conditions. On sections 1 and 2 it is quite within the range of possibility to have all the cars on either track piled up at either end of the line under unfavorable conditions. We should then be prepared for handling a load of not less than half the maximum at the ends of the sections, and preferably more than this. On a very large system it is quite out of the question for all the maximum load to be concentrated at one end of the line, but on a small road there is a much greater chance of such a contingency. It certainly would not be safe to allow for less than 300 amperes at the ends of section 1, and about 250 on section 2.

With section 3 the case may be still different. Suppose we have a base ball park at E (Fig. 42). To handle the crowds comfortably or at all would probably require massing about E fully double the normal number of cars on the branch and having them all heavily loaded at once, and what is worse starting them all about the same time. 300 amperes is little enough to allow even with careful handling of the cars with respect to starting.

We may now tabulate our currents about as follows:

	Sect. 1	Sect. 2	Sect. 3.
Average	150	90	60
Normal maximum	450	270	150
Extraordinary maximum at end of section	300	250	300

The maximum for the whole road would probably seldom or never exceed 750 amperes, since the conditions which produce maximum loads seldom operate all over the system at once.

With these data we can attack the feeder problem after deciding on the amount of copper to be put into the trolley wire and the value to be assigned to the track return.

Step 5. How large ought the trolley wire to be? The answer to this question must be somewhat empirical, but we can get a line on it by considering the currents it has to carry. Adopting the ladder system of Fig. 35 a very small trolley wire would answer. But we have seen that this arrangement is of little service in equalizing the voltage along the line, and hence it is better on the whole to use the system of Fig. 38 or some modification of it. To avoid running an inconvenient number of feeders it is then desirable to install a trolley wire big enough to carry current for the service of a considerable distance. Referring now to Plate 1, Part I, we see that allowing a drop of five per cent, i. e., twenty-five volts, in the trolley wire, all that should generally be tolerated at normal load, we can get reasonably long distances between feeding points, say 3000 ft. or more, by using No. 0 or larger. No. 00 is a standard size and gives rather better service than No. 0 in case of considerable load being bunched at one spot. Assuming this as the trolley wire, we may pass to the track return. The general principles of this have been very fully discussed in Part II. The only thing needful here is to judge from the general conditions the value to be assigned to the conductivity of the track as compared with that of the overhead system. In the present case we are probably dealing with sixty to seventy pound rails and the main line is double tracked. The bonding is, or should be made good, and since the total service is not heavy the track conductivity is of the better class. It is probable therefore that raising the constant of equation 3, Part I, to 13 will fully take account of the return. Were the service even lighter or the rails continuous we might be justified in assuming 12, while with poor bonding and heavy traffic it might be necessary to assume 14.

Step 6. Approximate data are now at hand for laying out the feeding system proper. We may start with a duplicate of Fig. 42, as Fig. 41, showing now only the actual lines and H, the location of the station. From A to D there are two No. 00 trolley wires, one for each track. From C to E there is one such trolley wire. We may now find more exactly the proper distance between feeders. Beginning with section 1, we find that in regular traffic each trolley wire will supply five cars at various points. Now going back to equation 2, substituting our new constant and transposing we have

$$L = \frac{c.\,m.\;E}{13\,C}.$$

Here $c.\,m. = 133{,}000$, $E = 25$, and $13\,C = 195$. L therefore equals for a single car very nearly 17,000 ft., for two cars 8500 ft., for three cars 5666, for four cars 4250, and for five cars 3400 ft. Hence a single feeder at the middle point of A B would be sufficient to handle the average load uniformly distributed, very nicely. The same is obviously true of sections B D and C E. Just here appears the peculiar characteristic of railway systems—the unpleasantly large maximum loads. If the load at the end of A B should be 300 amperes as we have supposed, i. e., 150 amperes to be supplied by each trolley wire, the corresponding drop in volts would be by equation 3

$$E = \frac{13\,C\,L}{c.\,m.} = 73 + .$$

Which in addition to the loss in the feeder would produce a total drop which would be decidedly troublesome, although hardly enough to cause serious difficulty. The cars would run, but the motors would heat badly and it would be difficult to make time. On B D the conditions would be better, but with the maximum load at E the drop would be enough to stall the cars completely and they would have to be slowly worked away one at a time.

As to the effect of drop, with the usual 500 volt motors, a drop of 75 to 100 volts is decidedly annoying compelling the motors to slow down and work inefficiently, while if the drop reaches 125 volts or more the motors are nearly inoperative under heavy loads, although they will still work if too great demands are not put upon them. It is highly undesirable to deal with more than 100 volts loss under maximum load in a 500 volt system. By overcompounding the generators these conditions can be much relieved. With the maximum drop limited to twenty per cent, it is clear that the average drop, with the ordinary ratios between average and maximum load would have to be limited to five or at the utmost ten per cent.

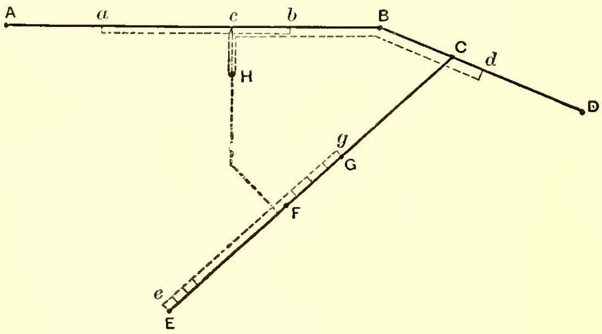


FIG. 44.

If the dynamo be overcompounded, as it should be for at least the average drop, then the maximum drop will generally fall within safe limits. It is a common practice to overcompound ten per cent, i. e., fifty volts, so that even a total drop of twenty-five per cent will still leave the system in fair operative condition.

Coming back now to Fig. 44, we have found that the system is operative at average load by means of the trolley wire alone, but should be well re-enforced by feeders to meet the conditions of heavy load. Since we have found that feeding at the middle point of A B would give too much drop even if the loss in the feeder were as small as five per cent at average load, the next step is to feed at two points. These should be so chosen, if the load is uniform along the section, as to be one-half the length of the section apart. *a* and *b* (Fig. 44) have this position. No load can therefore be more than 2500 ft. from a feeder. Now consider the maximum load of 300 amperes at A. Suppose first that the feeder H *a* is to give five per cent drop, twenty-five volts at average load. This average (half to total average load) is seventy-five amperes. The distance A H is 4500 ft., the wire therefore must be of area,

$$c.\,m. = \frac{13 \times 75 \times 4500}{25} = 175{,}500.$$

This is best met by a No. 000 wire, which is the nearest size (167,000 c. m.) and will give less than one per cent more drop.

With 300 amperes at A the drop in the trolley wires for 2500 ft. would be thirty-six volts. The drop in the feeder would obviously be a little over a hundred volts, making a total quite too great, since the overcompounding, unless a special generator be devoted to the feeder in question responds to the total load on the system and not fully to the load at A. Even the gain from the current path along H B *a* will not relieve matters quite enough. Now we might use a much larger feeder and thus reduce the drop, but a simpler and cheaper way is to cross tie both feeders into the trolley lines at *c*. This, assuming both feeders to be of the same size, puts at our disposal from *a* to *c* no less than 433,000 c. m., with 334,000 c. m. for the 1000 ft. between H and C. The total drop will then be 36 + 31 + 12 = 79 less whatever has been gained from the overcompounding. This last depends on the total load on the system and is consequently indeterminate. It could hardly however be less than half the full overcompounding, say twenty-five volts, thus giving a net drop of fifty-four volts at A.

This cross connecting process is a very useful safeguard against extreme terminal loads, though if the whole line is likely to have a heavy distributed load at the same time, it is better to take a different step as will presently be shown.

Obviously a maximum load at B will produce no trouble, so that we may pass to the section B D. If this be fed in the middle at *d* the loss in the trolley wire at average load is very trifling, not more than that due to the current for two cars over each trolley wire at a distance of 3000 ft.—about nine volts. So far then as average loss is concerned we could properly allot to the feeder carrying ninety amperes a loss of forty-one volts. If B D and A B are connected at B we can get considerable relief in ordinary states of load. The worst possible load would be 300 amperes at B and 250 at D. The drop in B D would then be thirty-six volts. Since with such a compound load the overcompounding would be up to its full amount, we can allow eighty to ninety volts loss between *d* and the station. If this were all in the feeder H *d*, it would have to be of about 288,000 c. m. But on account of the overcompounding we can get material aid from the main line up to B, and so will try to make a No. 0000 (211,000 c. m.) answer the purpose. If the line via B can be counted on for, say, seventy amperes, the No. 0000 will take the rest. With 370 amperes the drop from H to B is about 40 + 45 volts in H *c b* and B *b* respectively, less the overcompounding, while the loss in B *d* would be nominal. In fact a glance at these figures shows that a No. 000 will do admirably, for our line via B can evidently furnish considerably more than seventy amperes without too much loss.

This settles the first two sections. As to the third, it is evident at a glance that it cannot be fed in the middle point since A B with two trolley wires could not be so fed, while C E has only one. Therefore a feeder should be run by the shortest route from the station to C E and then along the line to E, for 300 amperes is too much to carry over a No. 00 trolley wire, and that load must be dealt with at E. Let H *e* be this feeder, 8000 ft. long, 4000 ft. being along the line. Now if we could depend on stiff overcompounding to help us out at E, these feeders could be quite moderate in size. As it is however the chances are that the load on other parts of the system would be rather small when the maximum load is to be met at E. Therefore it is not safe to count on more than twenty or twenty-five volts help from this source. Bearing this in mind the first thought would be to try the No. 000 that served for a similar load at A. From F to E we have a No. 000 plus the trolley wire, i.e., 300,000 c. m. The drop over this line would then be fifty-two volts. It is clear from this that to come within decent limits there must be extra feeder capacity from H to F. A second No. 000 here would give a drop of forty-six volts in all from H to F or a total of ninety-eight to E. This is rather large, but considering the fact that this extreme load at E is only occasional and at known times it is not worth while installing still more copper. Instead, it is a very simple matter to raise the voltage at the station twenty-five volts or so in preparation for the extra load. The feeder should be tied into the trolley at frequent intervals near E and once at F.

Step 7. Now as regards the line from F to C, we reach the final step of reinforcing for the grade F G. The simplest way of doing it is to extend the fender to *g*, connecting it to the trolley wire at several points. For a load of even 300 amperes at G the drop would be only 46+26=72 volts, less the overcompounding. On the stretch from G to C help is received from C so that there is little to be feared.

We have now completed the feeding system and may now pause to take account of stock. It aggregates 25,000 ft. of No. 000 wire weighing, in "weatherproof" grade about 15,000 lbs. and costing about $2-50. It meets the condition of an average total loss of less than ten per cent in the system at average load and gives not less than 425 volts at the motors under the worst conditions of load.

It should be noted that the feeders are practically determined by the requirements of maximum load. As a general rule, if one takes care of the maximum loads the average loads will take care of themselves.

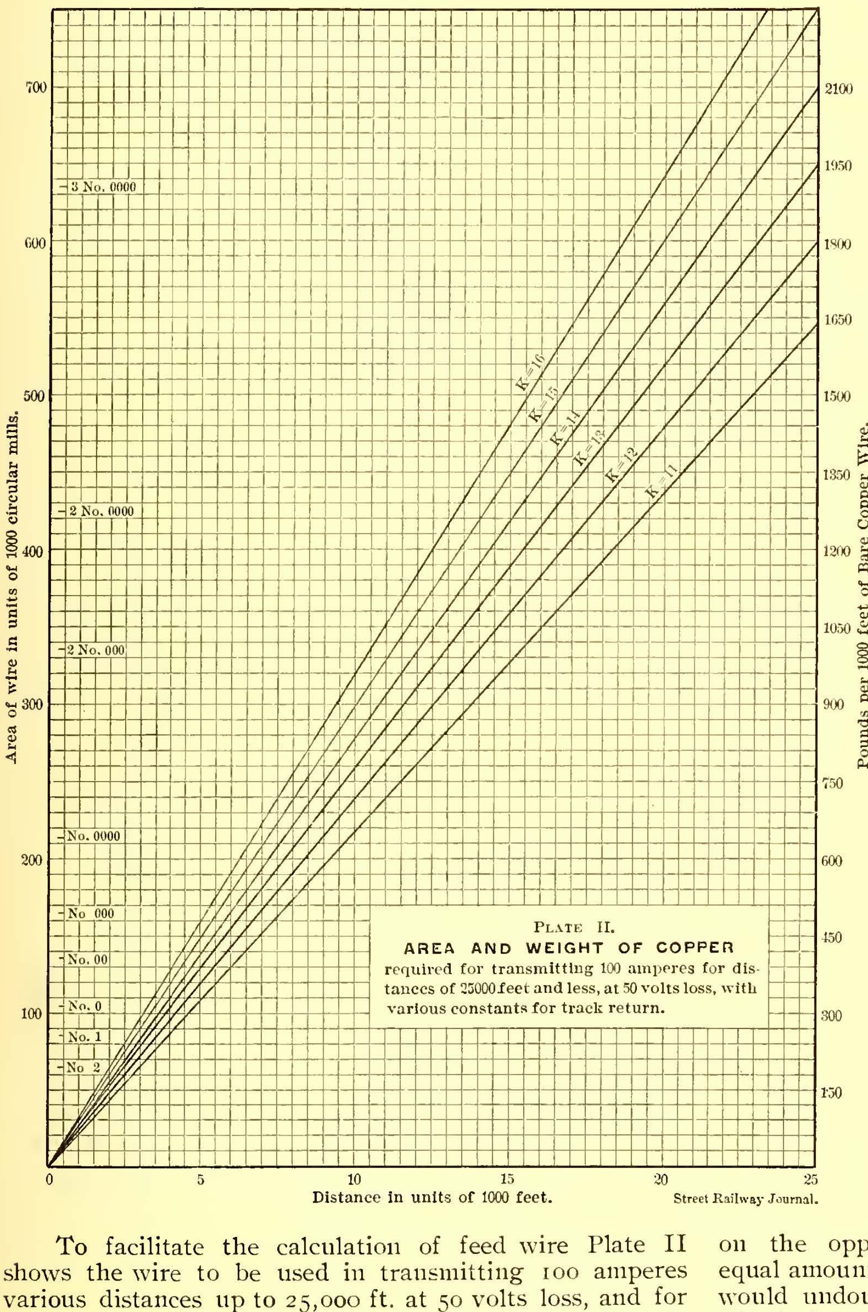


Plate II.
AREA AND WEIGHT OF COPPER
required for transmitting 100 amperes for distances of 25000 feet and less, at 50 volts loss, with various constants for track return.

To facilitate the calculation of feed wire Plate II shows the wire to be used in transmitting 100 amperes various distances up to 25,000 ft. at 50 volts loss, and for various values of the constant K which allows for the conductivity of the track. The distances herein are lengths of feeder. K=12 is to be used for continuous rails or the most perfect bonding, coupled with moderate service. K=13 applies to roads with very fine track and heavy service or to roads with good track and moderate service, while K=14 should be used for roads having only ordinary track and heavy service or poor track and ordinary traffic. K=14 or 15 may be needed when the track return is unusually poor, while K=11 is introduced for comparison.

It should be noted that the amount of feed wire needed for the case in hand is very different from that indicated in the preliminary discussion. This is evidently due to the face that the actual wire is adjusted with reference to maximum rather than average drop. It is safe in looking into the question of distribution, therefore, to figure the approximate feeder copper for an assumed maximum load varying from twice the assumed average in large and level roads to three or even four times the average in small roads with heavy grades.

As to the actual amount of drop to allow circumstances vary widely. In most cases the conditions of economy are theoretically met by losing five to ten per cent of the total energy in the distribution. This means that the average drop over the whole system, figured on the average current during the hours of operation, should be from five to ten per cent. As a matter of fact the average loss is very often determined, just as in the case before us, by the condition that the maximum net drop shall not exceed a certain fixed amount. This condition must always be satisfied and it seldom leads to an excessive average drop. In the case before us the average loss on section 1 is about four per cent, on section 2 about six per cent, on section 3 about three per cent. The average energy loss, therefore, is a trifle over 4½ per cent.

Including 42,000 ft. of trolley wire, weighing about 17,000 lbs, and costing about $2380, the total cost of the copper to give the above loss would be, approximately, $4630. This cost would have to be doubled to save 2¼ per cent of the total energy. The annual charge for this, counting interest and depreciation at ten per cent, would be $463, nearly $206 for each per cent saved. Now the amount of power, based on the average amperes, is about 2700 k.w. hours per day of eighteen hours; the cost of this per year at two cents per kilowatt hour would be $19,710, of which one per cent is $197.10, showing that it will not pay to increase the investment in copper.

The art of feeder design is one that calls for great *finesse* and skilled judgment in assigning the proper values to the somewhat uncertain maximum loads. It cannot be reduced to formulæ that will be of use in anything save special and unusual circumstances. The author has in this issue, therefore, merely attempted to give the general principles to be followed and some idea of the mental processes by which the final approximation is reached. In another issue the special case of long interurban lines will be considered.

A gentleman long connected with the wheel business in the United States makes the suggestion that there should be a frequent and rigid inspection of wheels on street railways, and as soon as one flange begins to show signs of wear the pair of wheels should be reversed until the wheel on the opposite end of the axle has developed an equal amount of wear. On certain roads such a system would undoubtedly produce a great saving because the wheels invariably wear sharp flanges on one side of the car, and reversing the axle does not alter the position of the wear relative to the car body. In grinding wheels that are slightly out of shape there should be an effort made to do this work as soon as flange wear begins to show itself, because if it is allowed to go too long, 1000 or 1500 miles may be easily taken off from the tread in making the wheel true.

The Calumet Electric Street Railway Company has leased the right to operate over a portion of the tracks of the Englewood & Chicago Street Railway Company, and will now run its cars to Manhattan Beach, South Chicago, Pullman, Washington Heights and Grand Crossing. The Washington Heights extension on 103d Street, of the Calumet line, was opened last month.

Street Railway Rolling Stock.

BY W. E. PARTRIDGE.

VIII.—Panels and Roofs.

The panels and roof constitute the covering of the car frame or its enclosures. The panels are supposed to add very materially to the stiffness and strength of the car. The roof, or, more correctly the roof boards, are a great addition to the strength and stiffness of the upper part of the frame. It is difficult to understand just what relations in actual practice the panels have to the strength of the car. Sometimes in taking old cars apart the panels are found in such a condition as to preclude the possibility of their having been of any service other than keeping out the weather. Again we find old cars in which the panels are practically a part of the car side. In such cases they must have been a great addition to the strength as well as the stiffness of the framework.

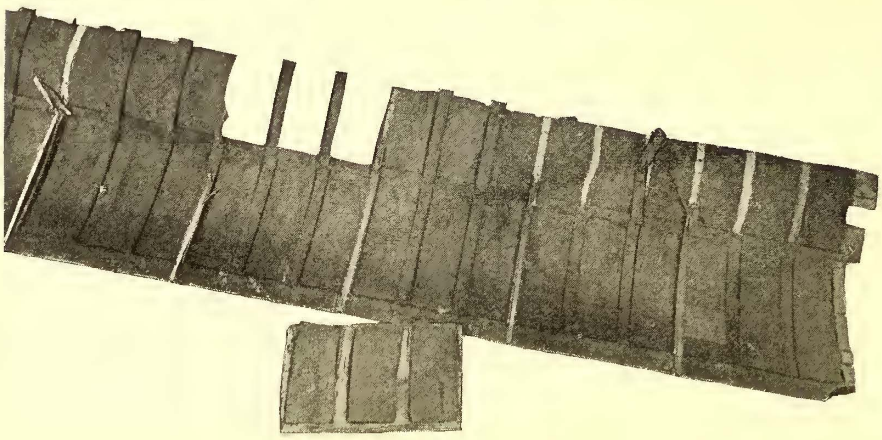


FIG. 1.

The panels have to endure not only the wear and tear of the car frame induced by strains and shocks, but are subjected to violence so frequently that repairs and replacements are the rule. It is generally admitted that a spliced panel has small value in stiffening a car. All builders agree that if it were possible to put on all panels in continuous pieces, great advantages in the way of durability of the car would follow. As the panel is almost always of white wood, its size is limited by the merchantable widths of wide stuff. In different parts of the country this ranges from sixteen to twenty feet. Some builders make splices in the shortest panels on the score of economy.

In tearing down old cars a variety of interesting facts may be learned in regard to paneling and its use. The accompaning engravings show panels just as they were taken off from several cars which had been in use for a great number of years. They were, as will be at once recognized, old horse cars. They had seen service of the most severe character and were in far better condition than the average. Fig. 1 shows an old horse car side just as it was broken out of the car. The posts had been broken off with an axe at the window rail and the panel cleared from the corner posts by cutting them down. The whole side was then rolled out, as it were, in the position shown. In doing so the short length of curved panel shown at the bottom of the engraving dropped out of place. It had neither adhesion to the posts, the belt, nor the sill, and it is difficult to imagine how it remained in place in the car. This piece was covered with scrim which was turned up to a small extent on the post and the sill. With the best of intention the workmen had coated the edges of this repair piece with thick white lead where it was supposed to bear against the strainers. Evidently the strainers had never come in contact with the panel except at one small spot.

To test the general adhesion of the strainers to the panels they were struck light blows with the hammer. Several of them, as shown, gave way at once. An examination of the paint developed the fact that the strainers had never touched the panels except at the ends. The application of paint was a farce and the only strength obtained was that which came from turning the scrims up on to the posts, ribs and rails. This was somewhat surprising, for it has been argued that white lead acted as a cement in such cases, and while excluding water formed a very fair kind of cement. It was evident that however good a cement the lead might be, if the two surfaces to which it was applied never came in contact its adhesive powers would be of no value.

In Fig. 2 another view is given of a panel from the same car. Here the center of adhesion between ribs and panels is equally clear. The panel where it was attached to the post seems to have had somewhat better contact, but the whole strength of this car covering was to be found in the adhesion of the scrims and the nails or screws with which it was fastened.

In Fig. 3 is shown another car side. The construction here was much better than in the previous case. The mortises and tenons seem to fit and the adhesion of the ribs to the panels was greater. While in one instance a blow of a carpenter's hammer was sufficient to take off every rib, in this case a heavy hatchet was used and it required several smart blows to break them away. In both cases the posts were well secured and even with an axe were not broken away from the panel. This is shown in Fig. 3 by the fact that every post has been split and splintered to within an inch or so of the panel without parting at the junction. It should be added that the workmanship in the framing of these cars was above suspicion, they having been built in a shop which has a national reputation. That the car can be independent of the panels can be proved by the sixteen or twenty years of service which these cars had seen in a city where the service is remarkably heavy and where the tracks were among the poorest.

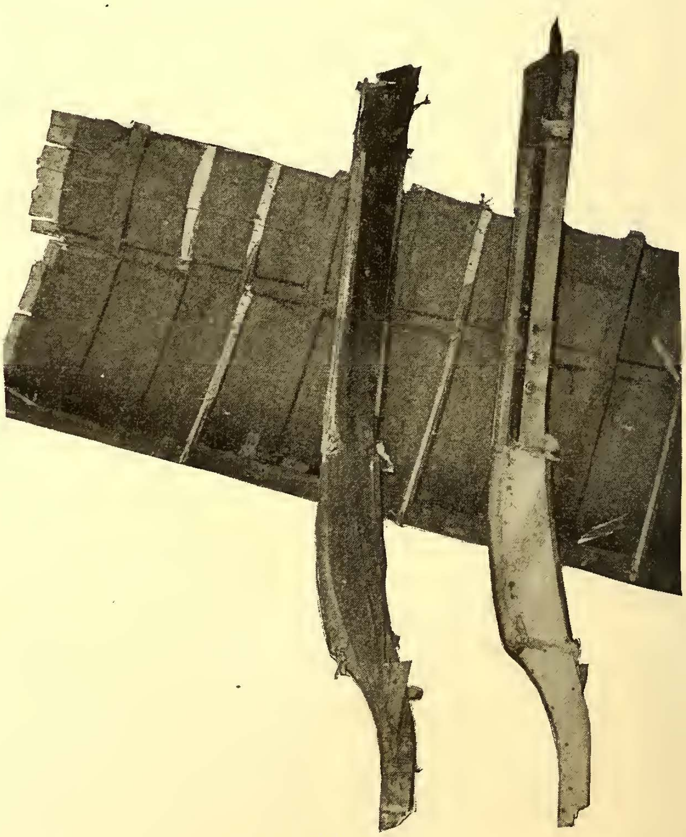


FIG. 2.

To make more clear the exact condition of things, in Fig. 4 an enlarged view is given of the inside of one of these ribs or strainers. It will be seen that it has been well covered with thick paint. It will also be noticed that except along one edge and near the center, the paint never came in contact with the panel, the brush marks being still clear and distinct. This strainer was secured to the panel by scrims. The tenon set in white lead was compressed throughout its length in the mortise. This lesson of sixteen years ago is being used profitably by the builders of the day. In previous articles the practices of many shops in regard to the applying of panels have been illustrated. The universal rule at the present time among shops having any reputation is to use glue upon both the ribs and then by some form of clamping apparatus force the two into absolute contact and hold them firmly until such time as the glue has thoroughly set. This is one of the most delicate, anxious and annoying pieces of work in car building. Car buyers are as finical in regard to the surfaces of finished panels as ladies are in regard to the fit of a dress, and the durability of a car has about as much relation to the surface of the panel as the fitting of a dress has to its wearing qualities.

FIG. 3.

Dimples along the ribs will attract attention and cause remarks of an unfavorable character even though the panel be adhering to those ribs so as to be practically part and parcel of them. With a highly varnished surface it is possible by reflected light to see a depression of perhaps the thousandth part of an inch, yet this will cause unfavorable criticism and remarks.

Fig. 5 is an illustration of how good work is done at the present day. The writer has similar samples from several of the best builders in the country, but this one, taken from a couple of ribs made by the Jackson & Sharp Company, has happened to photograph a little better than any of the others. From one of those causes with which the car builder is altogether too familiar for his own comfort, a finished panel had to be removed and in places it adhered so firmly to two of the ribs that they were removed also. The engraving shows that for nearly the whole surface of both of these ribs, the glue formed so firm a joint that the break took place in the solid wood. With the modern system of construction it may safely be assumed that the panel is an important and valuable strength-giving member of the car side.

FIG. 4.

In this connection, it may be well to note the fact that scrims when properly put on may be fastened to the wood so that when the two are parted the break will take place in the wood itself. This is illustrated by Fig. 6, which shows two pieces of scrims which were removed when a panel was taken off. In many places the wood gave way instead of the glue, and it is noticeable that at the upper end of the sample a portion of the wood of the rail or strainer broke away instead of parting in the glue. The glue used in this case was undoubtedly of unusual strength, but even with that commonly used one would expect to find the joint at least as strong as the white wood of the panel.

The roof of the car has been from time immemorial covered with narrow boards of very slight thickness. These are painted and again covered with very heavy canvas which forms the external surface of the roof. Occasionally the boards are tongued and grooved. In more recent times they are put together without matching. The material used has been various in different parts of the country. In the West whitewood and a kind of cotton wood have been adopted; in the East, whitewood and pine are both used. The thinness of the wood and its natural weakness has prevented it from giving to the roof as much support as is desirable. The canvas can scarcely be depended upon for additional strength and stiffness although in itself it is very strong. Its tendency is constantly to to stretch under the action of the white lead paint with which it is coated.

The whole roof is subjected to very serious longitudinal strains. In electric cars it also has to support no inconsiderable weight in the trolley. It is also subjected to strains from the weight of men who attend to repairs of the trolley stand. It is desirable therefore to obtain a greater degree of strength than has hitherto been available. In the West, they are solving this problem in a very neat and satisfactory manner. At the Brownell Works, in St. Louis, the last cars for the Cincinnati, Newport & Covington Railway are fitted up with veneer roofs in single pieces, that is to say, the upper deck is of one piece of veneer, and the two lower decks of single pieces each. This reduces the thickness to a minimum, gives enormous strength, does away with the numerous joints, and has nearly every advantage.

FIG. 5.

Careful inquiries made of builders and car users who are employing the system failed to discover any objections. If the canvas covering be properly attended to, the only danger which has been suggested, that of water, will be avoided. The single-piece roof is used with a maple underside, and in finishing open cars no lining is necessary. There seems to be no reason as yet discoverable why this is not the most satisfactory, scientific and durable roof that has yet been produced. It would seem to be peculiarly applicable to the covering of hoods of fine cars and apparently not only should a great increase of strength and durability be obtained, but a material reduction in labor be effected.

FIG. 6.

LETTERS AND HINTS FROM PRACTICAL MEN.

Card From the Chicago City Railway Company.

Chicago City Railway Company.
Chicago, July 22, 1896.

Editors Street Railway Journal:

We take this means of thanking our many friends for their proffers of assistance after the loss of our car barn and a great many cars on July 18, 1896.

Chicago City Railway Company,
M. K. Bowen, Superintendent.

Resistance of Cast Welded Rail Joints.

Milwaukee Electric Railway & Light Company.
Milwaukee, Wis., July 18, 1896.

Editors Street Railway Journal:

The reading of the letters published in your July number, touching the resistance of cast welded rail joints, caused me a little uneasiness, lest, as a somewhat recent convert to the welded joint, I had made a mistake in my new faith and had made a poor investment for my company by ordering and having placed a large number of joints, the conductivity of which might be so imperfect as to require, besides the casting, the usual bonding, since the avoidance of the uncertainty, repair and cost of the bond had been a principal excellence ascribed to the new joint. I was particularly frightened by the letter of Mr. Tidman, manager of the Lake Ontario & Riverside Railway Company, in which he so positively controverted the theory that the joint required no bond.

Our company has been especially conservative in the matter of new devices, and if Mr. Tidman were correct, I felt I had contravened our habit to an alarming extent, both as a matter of principle and expense. Although before we made use of any of the Falk cast joints, I had caused to be made, as I presumed, fairly good tests of the joint, and had studied it in its practical use in different cities to such an extent as to lead me to believe that its experimental stage was to a great extent past, yet the statement that the joint, while a mechanical success so far as the passage of cars was concerned, was likely, unless a bond was used with it, to offer so great a resistance to the current as to increase the amount of force necessary to be used in the propulsion of cars, and thus increase the cost at the coal pile, was alarming.

To be sure of the right before going ahead with any more of our joint work, we at once instituted a series of more complete and rigid tests from actual joints in use upon our lines than we had heretofore made, and Electrical Engineer O. M. Rau and his assistants were requested to spare no pains to give us such a solution of the problem as would put the matter beyond question so far as the use of the joint upon our lines in this city was concerned. This we now think has been done, and while I do not desire to use your columns to detail at length the results of the many joints tested under varying conditions, one or two may perhaps be interesting to other railroad men in their study of the cast welded joint.

The first noted below was made upon a section of our Oakland Avenue track, by submitting a total of 130 joints placed by the Falk Manufacturing Company to the test. The joints on this line have been in place and the line has been used by cars constantly, for about two months:

Weight of joints	130 lbs.
Length of joints	16 ins.
Rail	Cambria T.
Weight	60 lbs. per yard.
Length	60 ft.
Size	7 ins. high, 5 ins. flange.
Sectional area	6 sq. ins.
Instruments	Weston Ammeter, 150 ampere scale.
"	Voltmeter, 3 volt scale.

Double track road.

Length of track	1914 ft.
Temperature of track	74 degs. F.
Current flowing	113.4 amps.
Drop, e. m. f.	.823 volts.
Resistance of 1914 ft. of track (two rails and joints)	.0072964 ohm.
Resistance of one joint and sixteen inches of rail	.000008087 ohm.
Resistance of sixteen inches of rail	.00001021 ohm.
Decrease in resistance with joint	.000002123 "
Increase in conductivity over rail	21 per cent.

This test shows rather phenomenal results. It certainly would seem to indicate that bonding is not only absolutely unnecessary, but the joint actually proves a better conductor than the rail itself, as the resistance of the joint is less than the same length of rail.

The second test herewith below noted is that of an individual joint tested under heavy current. This joint was cast some three years ago, and has been lying exposed to the weather during the intervening time. It was cast for us as a sample, and while not actually placed in the ground has at various times, nevertheless, been subjected to breaking strains and other tests. The results obtained were as follows:

Ninety pound Falk joint, twelve inches long, cast welded on a fifty-six pound, five inch girder rail; in comparison with
1 piece rail, 13 ins. long,
1 piece 1,000,000 c. m. copper cable.

Rail:	Current flowing in 13 ins. of rail	711.1 amps.
	Drop of potential	.0117 volt.
	Resistance	.0000162 ohm.
Joint:	Current flowing in 13 ins. of rail with joint.	760.5 amps.
	Drop of potential	.0107 volt.
	Resistance	.0000162 ohm.
Cable:	Current flowing in 13 ins. of cable	736 amps.
	Drop of potential	.00752 volt.
	Resistance	.0000102 ohm.

By the results of the above tests, I feel sufficiently assured of its utility to continue the use of the cast welded joint, without bonding, upon our system, believing that ample margin is shown for any prospective deterioration likely to occur in the life of the joint underground.

C. D. Wyman,
General Manager.

Some Observations on the Return Circuit.

Consolidated Street Railway Company,
Grand Rapids, Mich., July 18, 1896.

Editors Street Railway Journal:

To electric street railway companies who have been paying careful attention to the condition of their return circuit the following remarks will be, in all probability, but a corroboration of their own experiences and efforts, but, to those who still pay an indifferent attention to the return, it will be a matter of interest concerning which they can readily satisfy themselves by a little personal investigation.

The ideal condition of the return conductor would be such that there would be practically no difference in potential between the car wheels and the negative bus bar in the power house. This cannot be reached in actual practice, but can be approached as nearly as possible by careful and systematic bonding. Any road possessing an ordinary direct reading, 600 volt Weston portable voltmeter supplied with calibrating coil and contact post has at hand a practical means of knowing the condition of its bonds. It has been my custom for some time past whenever opportunity offered to go out over the different lines of the system here, testing rail joints for conductivity. I made a suitable contact fork out of two short pieces of trolley wire for the purpose of making contact with the ends of the rails over the joint. A No. 16 flexible drop cord was used, leading from the fingers of the fork to the respective binding posts on the voltmeter. So as not to interfere with the regular traffic or call for special car, I would wait my opportunity and place the instrument behind or in front of a regular car as close as possible to the point of consumption, placing the fork across the joint to be tested and in the direction of the flow of current, then noting the reading on the dial of the voltmeter. I hope to be able before long to take current for rail joint testing direct from the trolley wire through a suitable portable resistance and by so doing not depend on the current of the cars for tests, and at the same time obtain more exact comparative results.

In order to know the conditions of conductivity at a rail joint it is not essential to know the actual resistance of the joint, although that can be readily determined by dividing the actual voltage by the current used in the test. The actual voltage, however, is, of course, the deflection of voltmeter noted multiplied by the constant of the instrument used, but these details are not at all essential for comparative information regarding good or bad conductivity in rail joints. I have found that when the needle deflects only the fraction of one space of the dial with the current of one car it is safe to assume that the bond at that point is in good condition. To be sure, when any deflection is noted, even the slightest, the resistance at that point is greater than for the same distance of rail.

I have gone over some of the recently carefully bonded track of the Consolidated Street Railway Company, of Grand Rapids, which has, and with good reason I believe, been partial to a flexible bond of its own design rather than to the rigid style, and in the majority of cases found no deflection whatever and never over one space deflection. One day I was testing a section of track bonded with rigid bonds, some of which were in plain sight and all of which looked rigid and firm. After testing a number of joints, finding little or no deflection, I found one where the deflection on the deal was quite high, varying, of course, according to the current. I at once began investigating for the cause of the trouble and found that the end of the bond was broken off close to the web of the rail, but was still touching it. So far as appearance went, the bond seemed perfectly sound. Again, when testing the conductivity of the joints of a movable track switch which was bonded over all with a long rigid bond I found a full scale deflection. Investigation showed that although the bond looked in A-1 condition at the rail, it was almost completely destroyed by electrolytic action, and with the familiar sharp points in several places. I have also purposely broken a bond on a high and dry section of track where the rail was supported from the earth on the ties and with the current from one car near at hand tested the broken joint, with the result that the needle would be severely deflected across the complete dial, and again after making the bond complete the deflection rated would be very slight. By this method, both practical and simple, it is easy to keep fully acquainted with the condition of the individual bonds of the various lines of the road and find out the weak spots. To know whether the bond is in good or bad condition without the labor expense of digging up about a joint is of consequence.

Testing for leakages with the regular coil of the voltmeter in circuit from rail to water pipe or gas pipe is also a source of much assistance in locating poorly bonded track as in any case of very poorly bonded track, with the gas and water systems near by, there will be indications of large leakages to those systems. I have observed cases of this kind where the difference of potential was comparatively large between rail and water pipe and where the trouble was almost entirely remedied by simply well bonding the rails end to end. The system of installing pressure wires to distant points on the various lines and a liberal use of a direct reading, low scale voltmeter in connection therewith, is desirable in enabling the railway management to know the total drop of the return.

The present deterioration of bonds through electrolytic action and from crystallization and breakage owing to the constant pounding of joints is food for serious reflection. Bond renewals are certain to be a constant and costly item of maintenance. May I ask here would not possibly an overhead return system throughout with many taps to the track, and these so protected as to reduce electrolytic action as much as possible, be cheaper of maintenance in the long run and insure safer return than the present almost universal system? Electrolytic action exists under the present system of street railway operation and cannot be eliminated entirely either in the bonding of the road itself or in reference to the pipe or telephone systems in the streets. Yet under the present system of construction the electric railway can do no more than bond thoroughly and endeavor to so maintain its bonding that the resistance of the whole system of track return, reduced to a practical minimum, will be as inviting to the return of current as possible.

F. L. Stevenson,
Electrical Engineer.

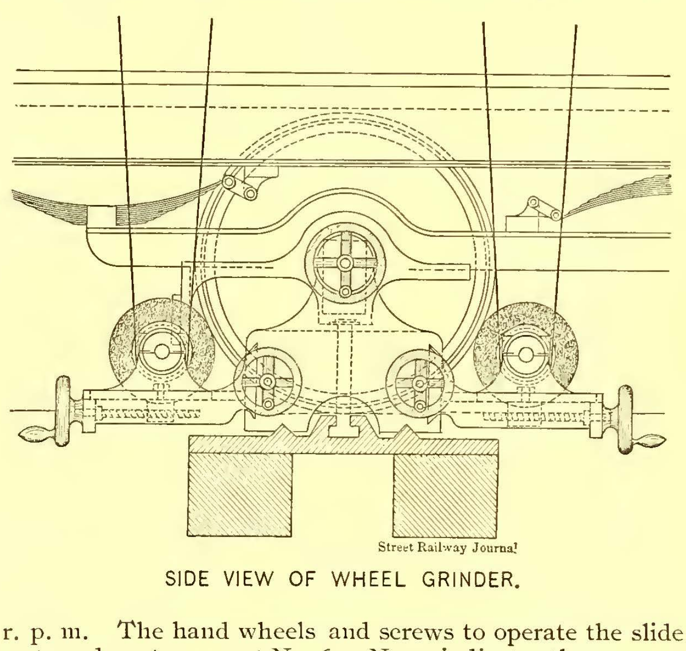
Car Wheel Grinding Machine.

The Second Avenue Traction Company.
Pittsburgh, Pa., July 1, 1896.

Editors Street Railway Journal:

The accompanying drawings show a car wheel grinding machine designed and patented by me, and in daily operation in our car barn. It will grind the wheels without removing them from the car, thus saving considerable time and labor and prolonging the life of the wheels.

No. 1 is a base plate fitted with ways to receive No. 2 which is a tail stock also planed and made to slide upon the ways of the base plate. No. 3 is a slide rest made to work in the slides which form part of the tail stock. No. 4 is a shaft running in self-oiling bearings, having a pulley by which it can be driven, and a pair of flanges on the end to which an emery wheel can be clamped. No. 5 is the emery wheel which should be run about 1400 or 1500



SIDE VIEW OF WHEEL GRINDER.

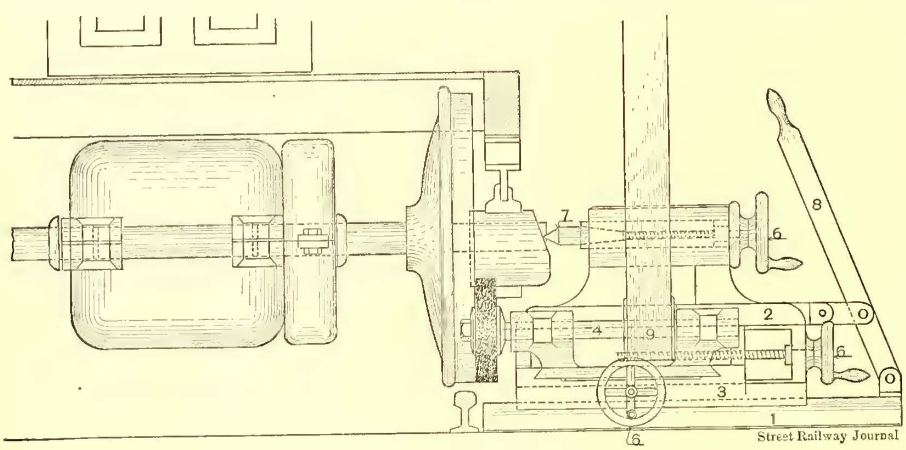
r. p. m. The hand wheels and screws to operate the slide rests and centers are at No. 6. No. 7 indicates the centers, similar to those in an ordinary machine lathe, which automatically push themselves out when run back upon the screw. The levers for moving the whole machine to or from tracks are shown at No. 8. The pulleys for driving the emery wheel shaft at No. 9. The timbers to which the base plate (No. 1) of the grinding machine is fastened down are set below the rails and run directly across the track as shown on this page.

The shaft No. 4 is driven from a countershaft on which are pulleys twice the width of the pulleys on the grinding machine, so as to enable the operator to move the emery wheels in and out without having trouble with the belts. The belts from the countershaft to the emery wheel shaft should be at least five inches wide, and those from the power to countershaft should be seven inches wide. For power the writer is using an old No. 14 Edison motor to drive the countershaft and finds that it works very well, not needing any particular attention.

There are four slide rests and four emery wheels on each machine. Two, only, are used at the same time, one on each end. The purpose of the other two is to save taking down brake rigging, life guards, etc., and also the turning of the car end for end, which would be necessary with only one slide rest and emery wheel on each side. The operator works between the car wheels where there is the least obstruction from truck parts, and simply moves one slide rest away from, or the other towards, the truck. Every part of the machine is as nearly dustproof as is possible to make it. All the latest improvements for taking up the wearing parts, etc., have been added and each part is made in jigs so that if it should be necessary to replace any it can be done at a nominal cost.

To set up the machine it is necessary to have a pit fifteen feet square by three feet six inches deep with track running across the center. There should also be two timbers twelve inches apart extending across the pit in the opposite direction and under the rails. Base plates should be bolted down to these timbers, one on each side of the track, care being taken to get them on the same level and square with the track, putting the tail stocks on the ways. The T-headed bolts should work free in the slot in the base plate. The bolts should be vertical from the countershaft to the shaft on the slide rest.

Having the machine set up the operation becomes very simple. By taking off the journal box lids the ends of the axles are exposed. After getting the center of the axle



END VIEW OF WHEEL GRINDER.

opposite the center of the machine the latter is pushed up as close to the side of the car as the truck will admit. The end of the car on which are the wheels which need grinding is then jacked up, the wheels being raised about one inch above the track. The centers of the machine can then be run into the centers of the axles by means of the hand wheel and screws No. 6, and the emery wheels set running. The time required to remove all flat spots from the wheel should not be more than from twenty to thirty minutes. As the motor on the car axle is used to rotate the car wheels care should be taken to cut out that on the other end of the car. The car wheels should run at about one hundred revolutions per minute. To do this it will be necessary to use some external resistance which can be cut in between the trolley and controller as that is the place most easily reached. An old dynamo resistance box makes a very good rheostat for this purpose.

The machine described is no experiment, but is the outcome of several years' experience by the inventor who is a practical railway man and has gone through all the trials and tribulations of operating an extensive street railway system.

JOHN MURPHY,
Superintendent.

THE Staten Island (N. Y.) Midland Railway Company's lines between Stapleton and Richmond and between Port Richmond and Concord were opened to public traffic on July 26.

Regrinding Wheels.

In conversation with a wheel maker recently the question of wheel grinding as a matter of dollars and cents was brought up, and a letter from a street railway company was quoted as showing where the regrinding became economical. The letter, which was from a superintendent of long and large experience, said that if a wheel came off after having run 35,000 miles or over, he did not consider it advisable to have it reground. But when they were wheels that had made not more than 25,000 or 30,000 miles he had them reground, as he found that under such conditions wheels did not usually make less than 15,000 miles after regrinding. The practical lesson is that there is still sufficient depth of chill after a wheel has run from 25,000 to 30,000 miles to make truing up possible and still have a remaining life of 15,000 miles. There is another element that should come into the account in estimating the value of regrinding, and that is the actual cost of taking the wheels out and replacing them. On some roads where the cost of replacing wheels runs from $5 to $6, it would be manifestly a lack of economy to pay $5 for the sake of from 12,000 to 15,000 miles of service.

Freight, Mail, Express, and Baggage Service.

In an investigation recently made by the STREET RAILWAY JOURNAL of the extent into which the cable and electric street railway companies of the United States were engaged in the transportation of freight, mail and express matter, a series of questions was recently sent to the different companies. A number of replies were published in the May issue. Since the publication of that issue a number of additional replies have been received. Up to the present time from 199 replies 135 companies give no such service whatever. Twenty of them, however, consider that some such service would be profitable, and eleven believe that it would be unprofitable; the remainder express no opinion. The franchises of thirty-six of the companies permit such a service either in whole or in part, while those of twenty-eight do not; by the remainder no information is given on this point. Sixty-three roads out of the 199 carry on a service of this character. A brief extract follows of those whose replies were not given in the May issue.

The Skowhegan (Me.) & Norridgewock Street Railway & Power Company has a contract for carrying the mails and does quite a business in the transportation of mail and baggage by the use of combination baggage and passenger cars. It is found that the business pays about seventy-five per cent on the investment, and the company is so well satisfied that it is ready to largely increase this department of its business.

The Portland (Me.) & Cape Elizabeth Railway Company carries the mails on its regular cars, and as this service did not require any additional investment, this part of the business of the company is clear profit. The mails will be carried more frequently next year.

The Consolidated Traction Company, of Pittsburgh, Pa., also carries the mails on its ordinary cars.

The Wilkesbarre (Pa.) & Wyoming Valley Traction Company also does a mail business, but only to the extent of carrying the mails on its regular cars to one small town. The statement is made that if the payment made for this service were larger, the company would consider an extension of this business.

The Brightwood Railway Company, of Washington, D.C., carries the mails on its passenger cars, and considers this character of work profitable. Packages are also carried occasionally on passenger cars and for this a charge is made.

The Westport (Conn.) & Saugatuck Horse Railroad Company carries fourteen mails per day for six days of the week on its regular cars and as the company is so situated that its employes can handle this without interfering with their regular work, the payment for this service is clear profit. The cars connect with the New York, New Haven & Hartford Railroad, and trunks are also carried on the cars to a considerable extent. When extended the line will be in an excellent position for handling packages, and the superintendendent writes us that even coal, lumber and supplies will be carried if it should prove desirable.

The Mousam River Railroad Company of Sanford, Me., does a freight, mail, express and baggage service as described in the STREET RAILWAY JOURNAL for February, 1894. The express and baggage combination car is used as a trailer, but the company has also a motor car for freight service which can trail any cars that the freight comes on. Mail is also carried. The company is increasing its freight business every year and considers it an important feature of its traffic.

The Omaha (Neb.) Street Railway Company is at present carrying on a mail service, but does not find there is any profit in doing so.

The Salt Lake Rapid Transit Company, of Salt Lake City, Utah, carries mail on one of its suburban lines, but does not operate any special mail cars. Parcels are also carried on one suburban line and for these a charge is made. The company does not find any material profit in its mail service.

The Consumers' Electric Light & Street Railway Company, of Tampa, Fla., carries the mails and also operates two small flat cars to transport tobacco for the factories in Tampa. These are attached to the regular cars and run as trailers.

The East Side Railway Company, of Portland, Ore., operates one motor car between Portland and Oregon City, a distance of fourteen miles. The car, which has a capacity of twelve tons, makes two trips each day, carrying mostly freight and a little light express matter. The rates on freight are very low on account of river competition and this business is not very profitable. The company has also a freight car without motors which is used as a trailer when business demands it. It has a contract with the Government for carrying the mails between Portland and Oregon City and way points. The pouches are delivered and called for by the Government officials. For this service the compensation is $500 per annum.

The Spokane (Wash.) Street Railway Company does a limited amount of freight business in carrying wheat for one of the flour mills in Spokane. Two motor cars and two trail cars are used for this service.

The Seattle (Wash.) & Rainier Beach Railway Company at present does a certain amount of general merchandise transportation business by trail cars, and from five to ten trips are made daily. On account of the severe grades on the line the work is not considered very profitable.

The West Street & North End Electric Railway Company, of Seattle, Wash., operates one motor freight car, and also carries the mails. The company considers that the profit on the necessary investment amounts to as high as twenty-five per cent.

The Sandusky (O.), Milan & Norwalk Company carries on a freight, mail and express business described in the STREET RAILWAY JOURNAL for December, 1895. As the regular agent attends to this traffic no extra expense is attached to it and the company has increased its freight traffic every year.

The Newburgh (N. Y.) Street Railway Company has also a profitable freight business, the details and methods of handling which were described in a recent issue.

One prominent railway company in the West operates eleven motor freight cars and is doing about $500 worth of business a year. While the percentage of profit is difficult to determine, the company considers that it approximates fifty per cent of the gross receipts, and the service will be extended at an early date.

The Cincinnati (O.) Street Railway Company operates one independent mail car and a substitute. It does not consider the service profitable as at present carried on, and does not intend to increase or to undertake freight and express service.

The Lowell (Mass.) & Suburban Street Railway Company carries the mails on one route on its regular cars, does not consider it profitable and does not intend to increase the business or to take up a freight and express service.

The Park City Railway Company, of Bowling Green, Ky., operates one 100 h. p. electric freight car and four trailers. These have not been in service long, but the company thinks that the freight will pay fifty per cent of operating expenses and the cost of maintaining track, or at least twenty-five per cent on the necessary investment.

The Houston (Tex.) City Street Railway Company carries mail on regular cars and does not consider the work profitable as at present carried on.

The Denver (Col.) Consolidated Tramway Company carries mail on regular cars and thinks this service "not very" profitable.

The Fox River Electric Railway Company, of Green Bay, Wis., intends to extend its line south for five miles, and will then operate two cars for light freight and packages.

The Everett (Wash.) Railway & Electric Company, carries small freight and packages on regular cars. No statement of profits is made.

A Pennsylvania company states that it is carrying mail and packages on regular cars and considers the service profitable, although the mail service is not as profitable as it should be as the government rates are low.

A long interurban road in New York State writes that it operates three combination baggage and passenger cars, carries mail and baggage and considers both classes of service unprofitable.

A large Eastern road operates eleven special electric mail cars and considers that the work is "not at present" profitable.

A company in New Jersey writes that it is operating one special express car as a trailer, which makes two round trips daily except Sunday. The gross earnings are about $150 per month, which is nearly all profit as the company does not load or unload cars. This company carries mails on regular cars and considers the work profitable.

A company in Michigan operates a combination car as a trailer under contract with the United States Express Company, and considers the work largely profitable. It carries no mail and does not consider a mail service profitable for its particular field, although it is an interurban road.

A Western company operates twelve twenty foot flat cars for carrying coal and brick, all being used as trailers. The work is considered profitable "if there is enough business," but the company has not had long enough experience to warrant a more exact reply. Mails are carried on the regular cars and the receipts from this source are considered so much clear gain.

A road in the Northwest operates two flat trail cars for freight and considers the work "not particularly" profitable. Mails are carried on regular cars, but at no profit.

The Norfolk & Ocean View Railroad Company, of Ocean View, Va., does an extensive freight business. The line was in operation for sixteen years as a narrow gauge steam road, and for one year has been a standard gauge electric road. It is nine miles long with single track, and during the summer season does an extensive excursion passenger business. The road runs through one of the finest trucking sections in the United States, and this spring it occurred to the management that they could displace the "nigger and mule," and handle this business over their own road. Arrangements were made with the refrigerator car companies, additional switches put in on the line, connections made with the Norfolk & Western Railroad and the New York, Philadelphia & Norfolk Railroad and other truck lines into Norfolk to handle the business, and the Norfolk & Ocean View Railroad Company undertook a class of business which the road in its eighteen years' existence had never before thought of. The result has been an amount of business far beyond the expectations of the management.

So far this season the company has handled 295,000 qts. of berries, 10,000 bbls. of cabbage, 12,000 packages of beans and peas, 30,000 bbls. of potatoes, 150 cars of lumber, brick and fertilizer, and 300 car loads of sand. It addition to this it will handle during the season 90,000 packages of tomatoes and citrons, 150,000 packages of kale, 80,000 bbls. and crates for truckers, and a large quantity of miscellaneous freight. The business increased to such an extent that the road was compelled to buy additional rolling stock to handle it. The freight, of course, is all carried in and out by foreign cars, that is, the cars of the standard steam roads. To accommodate this business the management has purchased two heavy motor cars and a steam locomotive. One car is 100 h. p., and a combination baggage, passenger and mail coach. The other is 200 h. p., and handles light freight trains and passengers cars. The latter car can easily handle six standard steam coaches loaded to their utmost capacity. For heavy trains of truck and lumber it has been found impractical to use electricity as a motive power, for the reason that the present trolley line was not constructed with this idea in view, and would not carry the amount of current necessary to satisfactorily operate an electric locomotive. The management has now under advisement however the purchase of an electric locomotive, to be put in service next spring. At the present time this road has in operation seven electric motor cars, with a capacity of 50 h. p., 100 h. p. and 200 h. p., seventeen standard railway coaches and thirty-five freight cars. When this business has been handled a while longer the company will be in a better position to give some figures as to the profits. In addition to the freight and passenger business, the company handles the United States mail and all the baggage of the guests of the Ocean View Hotel and the cottages and clubs at Ocean View and the numerous stations on the line.

A Large Circuit Breaker.

The largest automatic circuit breaker ever constructed has recently been completed by the General Electric Company. It is designed to break a circuit of 8000 amperes and is to be used on a 160 volt circuit, although made to handle the same current at 600 or 700 volts. The studs which carry the current are 3¼ ins. in diameter; the base is 28 ins. square. It is constructed to open the circuit automatically at any point between 3000 and 20,000 amperes, the opening point being arranged by the adjustment of a tension spring on the armature.

LEGAL NOTES AND COMMENTS.*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer,
of the New York Bar.

An Abutting Owner Versus a Trolley Road.

An opinion has just been handed down by the highest court in New Jersey in the action of Roebling against the Trenton Passenger Railroad Company and the Board of Public Works, which, while it does not state any new doctrine and does not come as a surprise to the profession, yet is of interest and contains much that is suggestive to street railway companies.

A short review of the case and of what points it involves may be of interest to many of our readers.

An ordinance was passed by the Board of Public Works of Trenton under the provisions of an act passed in 1893. The act authorized the use of electric motors instead of horses, provided the consent of the municipal authorities was obtained. The plaintiff in the action was the owner of a lot abutting upon the street in front of which the defendant railway company had erected poles, had strung wires and was running its cars. The action was brought to set aside the ordinance, on the ground that the erection of poles and the stringing of wires, without the consent of the owner of the abutting property, was in violation of the constitution in that it was taking private property for public use without compensation; secondly, because the operation of an electric railway was not a proper street use and for the same reason, therefore, was unconstitutional; and, lastly, that the ordinance was unreasonable in that it authorized a double track road in a narrow street.

The evidence showed that the cars weigh nearly eight tons, while ordinary horse cars weigh but one and a half, and that the cars are more than twice as long as the ordinary horse car, while their speed is from seven to seventeen miles per hour with a mean average of twelve miles per hour. The evidence also showed that express trains of two or more cars were run during the State Fair without a stop between the Fair grounds and the center of the city past the plaintiff's property.

The court holds, after reviewing a number of cases in the New Jersey courts, that the use of the street for a trolley road was a legitimate street use, and, since the ordinance merely allowed the company to use electricity with the necessary poles, wires, cars and motors, it could not be said to be unconstitutional or unreasonable even if the company, by the mode or manner in which it used the privileges conferred by the ordinance, transgressed reasonable bounds. The court, after declaring that the "substitution of electric motors with the trolley "system for horses on street railroads does not *per se* "create an additional easement," says, "but such injuries "as are caused by a manner or mode of user which is not "justifiable on the ground that the *locus in quo* is a public "street, will lay the foundation for, and are redressible by, "action." (Citing: *Beseman* v. *P. R. R.*, *21 Vroom.*, *235 s. c. 23 Id. 221.*)

The Act of 1893 and the ordinance, says the court, granted privileges "capable of being enjoyed without an "excessive or unusual injury to the lands abutting upon "the streets. If the privileges granted by this statute "are made the occasion for unlawfully injuring the owners "of abutting property, such acts are *ultra vires* and "redressible by the suit of the injured party," and in such action "neither the ordinance nor the suit would be justi-"fication." (*Costigan* v. *P. R. R.*, *25 Vroom.*, *234,239.*)

The remarks of the court in reference to the right the company claimed to run trains made up of a motor car and one or more connected passenger cars called trailers during the State Fair as express or through trains, with instructions to the company's employes not to carry local passengers, will be read with interest by the perplexed managers of roads, who on one side, are being beset by the general public to give them additional facilities of the most rapid transit, and by another portion of the public who, like the plaintiff in this case, objects to streets being used for such purposes.

The court says, "It may be difficult to justify such a "use of the streets upon the theory upon which the use of "streets for street railways has been justified as a legitimate "use." The court adds that that question does not have to be decided in the case at bar, for the reasons already set forth.

Neither upon the briefs of counsel nor in the decision of the court are the cases cited which have held that injunctions will lie against the erection of telegraph poles, and the legal status of a trolley pole in the street opposite a complaining abutting property owner is dismissed by the court with small notice.

Some interesting questions are suggested by the *dicta* we have quoted.

Can a trolley line use the street for express trains or express cars? This question may be sub-divided into two:

First; Can a trolley line use its track for express trains and cars exclusively?

Second; Can a trolley line, which furnishes all reasonable accommodation for local traffic, use its lines for express trains?

Perhaps the question is not a very important one except where the road is able to have a four or three track road, as might be possible in such avenues as the Bowery and Fourth Avenue in New York.

Some of the Rights of Street Railways in the Highway.

The purposes of the legal department of the Journal include correspondence with the officers and counsel of street railways throughout the country in respect to the novel questions of street railway law which are constantly arising. One question which is receiving the consideration of some of the courts has been the right, or the alleged right, of the street railways companies to prevent, by injunction or otherwise, the laying of sewers or other mains beneath their tracks when the surrounding conditions are such that they could be as easily laid alongside of them.

The importance of this question is increasing as the roads are laying more expensive tracks to meet the requirements of heavy cars; while the disturbance of the roadbed becomes a greater inconvenience as the traffic increases. If the right exists in the city authorities to lay the mains beneath the tracks and is not reviewable by the courts, it gives to them an additional weapon which they can use to oppress the road, where there is a contention between it and the city rulers.

It is contended, on the one hand, that the right of the city authorities to lay their sewer where they choose is not reviewable by the courts. (*Lynch* v. *Mayor*, *76 N. Y. 760.*)

But that there is a limit to unreasonableness beyond which the courts will not allow the city authorities to go would seem to be clear. (*Kirby* v. *Citizens' Street Ry. Co.*, *48 Md. 168.*

The contention on the part of the street railway com-

*Communications relating to this department may be addressed to the editors, No. 45 Wall Street, New York.

pany is that, where it is shown by proper evidence, conclusive to the mind of the court or the jury that the main can be as easily laid without disturbing the tracks, then the court will interfere and will prevent the city from disturbing unnecessarily the property of the railway company, and that the reasonableness of the plan proposed by the city is reviewable by the courts.

Two cases have arisen directly on this point, and in both cases the railroad companies were successful. (*Des. Moines City Ry. Co.* v. *City of Des Moines, 58 N. W. 906. Clapp* v. *City of Spokane, 53 Fed. 515.*

We would be very much pleased to hear from any of our correspondents of any unreported cases which have been decided in the lower courts. We are aware of one such case, of which we may have more to say later and in which after a trial before a jury a decree issued compelling the city to lay the sewer in some other place than directly beneath the tracks.

FRANCHISES, ORDINANCES, ETC.

A perpetual franchise to exist and operate does not give a street railway company a perpetual right to use city streets, if the consent of the municipal authorities is given only for a limited time.

A statute which permits a street railway company to acquire connecting lines, and to operate them, on the same terms and conditions as its own, but does not in terms give the right to operate such connecting lines in perpetuity, cannot be held to give the right to operate such connecting lines without regard to the conditions on which their own rights to use the streets were granted to them by the municipal authorities, or to the duration of such rights.—(Louisville Trust Co. v. City of Cincinnati, 73 Fed. Rep. 716.)

NEBRASKA.—A railroad company which has, by ordinance, acquired a permanent easement in the streets of a city, is not entitled to compensation from a street railway company as a condition to the crossing of its tracks by the latter, under a grant of power from the city.—(Chicago, B. & Q. R. Co. v. Beatrice Rapid Transit & Power Co., 66 N. W. Rep. 830.)

NORTH CAROLINA.—The mere construction of a street railway does not impose on the street an additional servitude, so as to require therefor the condemnation of the rights of the abutting property owners in the street.—(Merrick v. Intramontaine R. Co., 24 S. E. Rep. 667.)

LOUISIANA.—In order to authorize one street railway company to occupy the tracks of another, there must be legislative permission for the same, or it must result from necessary implication from the grant that an abandonment of the grant would necessarily result from the non-occupancy of the roadbed of the street railway first occupying the street. Miller and Breaux, JJ., dissenting.—(Crescent City R. Co. v. N. O. & C. R. Co., 19 South Rep. 868.)

NEW YORK.—Laws 1892, c. 676, § 59, requires every railroad company, before exercising the powers conferred by law, to obtain from the Board of Railroad Commissioners a certificate that the articles of incorporation have been duly published, and that public convenience requires the construction of the road. Section 93 provides that in cities of over 1,250,000 inhabitants the consent of the local authorities shall contain the condition that the right, franchise and privilege shall be sold at public auction to the highest bidder. *Held*, that the railroad commissioners are not required to issue such cerficate to a corporation organized for the purpose of constructing a street railroad in New York City before it may become a bidder at such a sale.—(In re Empire City Traction Co., 38 N. Y. Supp. 983.)

MINNESOTA.—Sp. Laws 1881 (Ex. Sess.), c. 200, § 15, conferring a charter on the Duluth Street Railway Company, in providing that no car shall remain standing on any of the stations more than ten minutes, except at "each end of the lines," means stations at each end of the track, and not at the end of the run of particular cars.—(Wilson v. Duluth St. Ry. Co., 67 N. W. Rep. 82.)

INJUNCTION.

PENNSYLVANIA.—Defendant built its street railway without any authority so far as it passed through the township in which plaintiff's land was situate. Pending its construction, plaintiff filed his bill, which looked practically for compensation for interference with access to his buildings and fields. Two years after its completion, he amended his bill to make prominent his prayer for injunction. In the meantime the township had approved and ratified the occupation of its highways. *Held*, that the decree denying injunction, and leaving plaintiff to his remedy for damages, would not be disturbed.—(Heilman v. Lebanon & A. St. Ry. Co., 34 At. Rep. 647.)

NEW JERSEY.—In proceedings by the Attorney Gennralto restrain the construction of an electric street railway, on the basis that the consent of the municipal authorities, which has been in fact or form given, is illegal, in that the ordinance does not comply with the traction laws of 1893 and 1894, and the Act of Mar. 11, 1893, governing the use and location of poles in public streets, a preliminary injunction will not be allowed where the questions raised are purely legal, and are pending before a court of law for decision in a proceeding upon which the ordinance, if invalid, may be set aside altogether.

Where the validity of the objections to an ordinance is not clear, and involves a disputed question of fact, the validity of the ordinance will not be considered on ex parte affidavits for a preliminary injunction.—(Stockton v. North Jersey St. Ry. Co., 34 At. Rep. 688.)

LIABILITY FOR NEGLIGENCE.

PENNSYLVANIA.—A passenger on a street car, who, when there is plenty of room inside, without any invitation, goes on the platform, and there occupies the driver's stool, which is high, and without arms or other protection, is negligent; so that recovery cannot be had for his death, occasioned by his being thrown off the car when it was driven rapidly onto a switch.—(Mann v. Philadelphia Traction Co. 34 At. Rep. 572.)

ALABAMA.—In an action for damages resulting from contact with a telephone wire which had fallen across the trolley wire of an electric street railroad company, plaintiff's allegations that defendant railroad company was negligent in failing to protect the trolley wire, and in suffering the telephone wire to remain where it had fallen, are not denied by pleas of authority to construct and operate its road, that defendant had no connection with the telephone company, and that the wire fell without any fault of defendant.—(McKay v. Southern Bell Telephone & Telegraph Co. 19 South Rep. 695.)

UNITED STATES COURT.—Plaintiff attempted to board a car on defendant's cable railway while it was standing near a street corner, waiting to take on passengers. The car was crowded, and persons were standing on the platform, and one on the step of the car. Just as plaintiff took hold of the railing of the platform and placed his foot on the step, the conductor (who was inside the car, and did not see the plaintiff) gave the signal to go ahead. The car started, and, as it went round a curve at high speed, plaintiff's hold on the railing was broken before he had been able to secure a firm footing on the car, and he was thrown off and injured. *Held*, that the conductor was negligent in failing to ascertain that all passengers were on board before starting the car, and that defendant was liable.—(Dudley v. Front Street Cable Ry. Co., 73 Fed. Rep. 128.)

PENNSYLVANIA.—In an action against a traction company to recover for an injury caused by a defect in the street alongside of said company's tracks, it was not error to charge that, if it was the traction company's duty to know that the defect was there, and that it was dangerous, then it was negligence in said company to allow the hole to remain there, and it would be liable for all the consequences resulting therefrom.—(McLaughlin v. Phil. Tr. Co., 34 At. Rep. 863.)

NEW YORK.—It is not negligence per se to ride on the side step of a street car, where the car is so crowded that the passenger cannot obtain a place inside.

In an action for injuries received by plaintiff while riding on the side step of defendant's street car, it appeared that as the car passed a truck, the horses attached to which were drinking at a water trough, plaintiff was struck by the tailboard of the truck. There was evidence that as the car approached there was sufficient space for it to pass the truck without striking, but that the horses moved backward while the car was passing. *Held*, that the question of the negligence of defendant's motorman was for the jury, as he should have considered the possibility of a movement by the horses.—Wood v. B'klyn City R. Co., 38 N. Y. Supp. 1077.)

LOUISIANA.—Ordinarily, passengers on street cars are expected to alight with some haste.

When, however, a person is infirm, or clumsy, or incumbered with packages or other hindrances, more prudence is required than ordinarily.—(Boikens v. N. O. & C. R. Co., 19 South Rep. 737.)

NEW YORK.—A motorman who was injured in consequence of a defective brake, whereby he was prevented from stopping the car on an incline, assumed the risks by continuing to work on the car with knowledge of the defect.

Knowledge of the motorman that a man was not employed by the company to place sand upon the track to prevent the car from slipping on the incline, does not necessarily show an assumption of the risk resulting from the neglect to employ such an employe, as the motorman may not have had knowledge of the need of such an employe.—(Windover v. Troy City Ry. Co., 38 N. Y. Supp. 59.)

UTAH.—A street railway company has no superior right on a public street to that of the public at large, except the right to lay its track and operate its cars; and if it adopts a dangerous propelling power it must be held to a degree of care proportionate to the increase of danger to the public.

The ordinance showing the rate of speed a car was allowed to run was competent evidence and should have been admitted, unless it was invalid and did not apply to the case.

While some courts hold that, where the speed is greater than that permitted by the ordinance, it is negligence per se, yet the better rule appears to be that that is a circumstance from which negligence may be inferred, and is always proper to be considered by the jury.

Persons traveling on a public street, along or across a street, are not held to the exercise of the same degree of care as when traveling along, or upon, or across an ordinary steam railroad.—(Hall v. Ogden City St. Ry. Co., 44 Pac. Rep. 1046.)

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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, 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 Directory, our Financial Supplement, or our news columns.

All matters intended for publication in the current issues must be received at our office not later than the twenty-second of each month.

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THE summer season having at least half passed, the present time is a good one for considering the necessary steps for preparing for the coming winter. Snow plows cannot be built at a moment's notice, nor can the best arrangements be made for a long season's business if all preliminary work is postponed until the near approach of cold weather. The most serious problem, perhaps, of winter operation is that of the best method of heating cars. Whether to heat them at all or not and the expense of maintenance and operating expense of the different heaters on the market are questions which are demanding answer. To select between the various makes of stoves and electric heaters on the market is by no means an easy task. Many heaters have been condemned unjustly because while in operation the car windows were not tight, the doors were left open and the heat generated was dissipated before it reached the passengers. Care should be taken, especially with electric heaters whose temperature is most easily regulated, to, first, prevent the needless loss of heat, and, second, to distribute it to best advantage in the car. To accomplish these results with an electric heater the latter should be located preferably on the riser, not underneath the seats, so that all heat generated may be utilized to best advantage. The circulation of air through the heater should be unimpeded as much as possible, and the heaters should be well distributed throughout the car to secure uniformity of temperature. For the economical operation of electrical heaters some degree of judgment must be exercised by the conductor, who, by a little forethought in cutting down the current consumed when the car is crowded with passengers, can effect a material economy in the long run. The question of a decision between electric heaters and stoves is one which can only be made by the manager of each particular road. Few manufacturers of electric heaters, we believe, now claim that the electric heater, if used to produce as much heat as the stove, is as economical. Whether their advantages in other ways more than counterbalance the greater coal consumption is a question which must be left to the local conditions of each individual case.

THE system of the Consolidated Traction Company of New Jersey, described in the leading article in this issue, is unique in that, while one of the largest in the country, it does not have the urban traffic of a city of the first magnitude. It is particularly interesting for this reason, because short interurban traffic has been necessarily a large part of its business and consequently this feature of electric railway operation has been carefully studied and developed. While the company originally, like many other large street railway corporations, was the result of the unifying of a number of smaller companies, the consolidation took place at a comparatively early period in the process of the equipment of the lines with electric power, so that the expansion of the system in general has been homogeneous and upon concordant lines. The advantages of consolidation, as shown in the line of better service with consequently larger receipts, have been most clearly marked in this case. The task presented to the owners at the commencement of their work was enormous, the lines being disunited, of different gauges and with dissimilar equipment. But with the work of reconstruction the economies practicable upon a large system were introduced, so that the company is now in a position to enjoy the benefits of the expenses incurred. In this connection it is interesting to consider the practical value which any large consolidation, such as this, has to street railway interests in general. The extended scale upon which the affairs of a large system must be conducted demands at the head of each department an expert in each particular line. Such a man must necessarily have more time and opportunity to devote to the problems arising with the apparatus under his care than can the superintendent of a small company where the details of many departments are placed under the charge of one individual. This gives as a result a large corps of independent workers on the difficult problems connected with street railway operation whose practice must necessarily be of great value to the industry in general.

WE rarely find it necessary to discuss in these columns questions upon which the great political parties of the day are divided. The municipal transportation industry is not ordinarily affected, directly at least, by the successes and defeats of parties or by changes in national policy. But among the party issues of this presidential year, upon which will be fought a political battle more severe and, in its final results, more momentous, perhaps, than any through which we have passed since 1860, is one which affects street railway prosperity in so immediate and serious a manner that we should be clearly evading our responsibilities were we to be silent upon the burning question of the moment: Shall the United States establish the free coinage of silver in advance of an international bimetallic agreement? Whatever the effect on other industries, no one, it seems to us, can fail to see the serious menace to street railways which lies in a "silver" policy. It is claimed by the free silver party and admitted by their opponents that free silver means a rise in the price of all commodities, measured in dollars. It is admitted, too, that the ultimate, though not immediate effect, would be some rise in the wages of labor, since the present wages, measured in dollars, will not permit the laborer to purchase higher priced commodities or to live as well as now. Street railway companies are, therefore, in the position of seeing their operating expenses, both for supplies and for labor, enormously increased, while their franchises, in most cases, do not permit them to raise the price of transportation beyond the present five cent limit. Moreover, the interest on their mortgage indebtedness is in most cases payable by contract in gold, so that if gold should go to a premium they will be forced to make another large increase in annual disbursements in paying this premium. Of course, general insolvency would be the inevitable result where street railway corporations are heavily capitalized, while with others dividends will be reduced or will disappear. We strongly urge street railway managers to stand as a unit in opposing the spread of the free silver policy in every section of the country and we advise an educational campaign among their employes—an exceptionally intelligent class of voters—which will make it impossible for them to join in this movement.

IT is useless to deny the fact that America has much to learn from Europe in the matter of the business management of municipalities. Through centuries of experiment and by means of mistakes as glaring as those now committed in American cities there has been evolved in Great Britain and most of the continental countries a system of municipal administration which is certainly economical and efficient in most cases, and is certainly far more scientific in principle than that found in general in this country. The especial feature of the European system is the selection of trained engineers of the highest character for the principal departments where engineering ability is required and for the higher positions, even up to the mayoralty, of men who have not only proven themselves good men of business, but who are fitted by special experience for the positions which they occupy. An administrative corps of this character is far superior to one selected for political reasons or whose members are mere accidents of the hour. Another point of advantage in the European system is the close interdependence of the various departments of a city, district and national government. Mr. Magee showed clearly in our last issue how thoroughly the various interests of German cities are protected by the engineers who have special charge of each department of the work. With such a system it is possible to push through great municipal improvements at an expense much less than that which is found necessary in this country having similar work, in spite of the formalities and "red tape" which are necessarily involved. New York, for example, should have, and must eventually have, a complete system of underground tunnels similar to that of Paris, into which should go gas, water and steam pipes, and wires of all kinds for the transmission of electric power. Nothing can be more unsatisfactory and obviously temporary in character than the present system so common in American cities of burying pipes and wires in any place where room can be found. The constant work upon our American streets by a great number of quasi-public corporations is a menace to health, to say nothing of the inconvenience to the public and the enormous cost to the corporations themselves. Work of this kind will never be done however until it is more clearly seen that the administration of a city's affairs is a work for engineers and business men, not politicians and ward heelers.

A NUMBER of letters from different street railway companies engaged in the transportation of freight, express, and mail matter, are published elsewhere in this issue and confirm the opinion expressed in the May issue of the STREET RAILWAY JOURNAL that, taken as a whole, this business offers little inducement to street railway companies. Within the limits of a city a freight service pure and simple is practically out of the question, while with an express service the difficulties of collecting and delivering packages complicate the problem of operation. Again, in urban roads there is often a decided objection on the part of the general public, to the use, by the railway company, of its tracks for any other purpose than that of the transportation of passengers, so that, in a consideration of the subject, this sentiment should be considered, even in cases where the franchises do not prohibit the prosecution of such a service. On interurban roads there is more opportunity for a freight or express business, but even here, except under special conditions it is doubtful whether in most cases the return will be sufficient to repay the company for the trouble of its maintenance or for any considerable investment in cars. Probably more companies have engaged in the carrying of mail in connection with their passenger traffic than in any other outside line, one inducement being that the operation of mail cars will be protected by the Federal authorities in case of riot. Looking at the matter from the purely business standpoint of direct returns, however, the inducement to engage in this business are certainly not very great. The prices paid for this service are absurdly low when the cost of accomplishing the same results by other means is considered. Another element affecting the profit and desirability of engaging in this business is the possibility of being compelled to wait a long time for payments. We know of one instance in which a large company has already paid out in labor and and other operating expenses, excluding entirely the cost of motive power and the depreciation on its cars, nearly three times as much as it is getting for its postal service, yet it has been obliged to wait eighteen months for its pay, the Government not having made any appropriation to cover this service. It is not necessary to say that the managers of this road are not very enthusiastic upon the subject of maintaining or extending their mail service.

THE suggestion has been made by one of our electrical contemporaries, as if it were a new idea, that discarded light weight rails could be utilized to advantage for return circuit feeders. The plan, as outlined, is to carefully bond these rails, bury them in the ground, and connect them at the proper point with the rails, the argument in favor of this course being that as the conductivity of the rail is large compared with copper cable of the same value, there are advantages in the line of economy in utilizing the old scrap. While, undoubtedly, economy is one of the cardinal virtues and cannot be too strongly preached, especially during the present times, it seems to us that economy of this kind is certainly a step in the wrong direction. Old rails, while of not very much value, are far from worthless, and the amount received for them at $10 per ton would go a considerable way towards purchasing a durable and reliable copper return feeder. The chief objection to the proposed scheme, however, is in the extremely weak character, electrically and mechanically considered, of the bonded rails. Railway managers who have control of many miles of track understand the difficulties of keeping their track bonds in good condition. This feature of the track construction is always a subject of care and worry lest any defective bond cause a lowering of conductivity in the return circuit, with corresponding increase in the power consumed. A feeling of confidence that this portion of the circuit is in good condition is only secured when careful and continuous tests are made to determine any possible trouble. But with the rails entirely buried, as would be the case in a return circuit such as is proposed, the present difficulties of individual bond testing would be greatly multiplied. To protect the rail from deterioration from the soil, the rails would probably have to be imbedded in pitch or some kind of composition surrounded by wooden conduits, and this, we understand, was the method which was followed in at least one case where this plan was tried. In addition to the electrical difficulties of this proposed method, the difficulties presented by the inflexible character of the old rails would detract very much from the convenience of its employment in following the curves of the line and in making other bends as occasion might require. In the installation already referred to the rails are bonded with plastic bonds which would seem, perhaps, the most easy method of connecting them electrically; at the same time, the manager of the road states that while the operation of the system has been satisfactory so far, the probabilities are that old rails could have been sold and copper purchased and placed in the ground and the same results secured at a less expense than by employing the old rails for the return circuit.

THERE is one element in the operating expenses of every road which is always a most uncertain factor and often, in spite of the most careful provisions taken, may change a comfortable surplus from a year's operation to a most inconvenient deficit. We refer, of course, to the accident account, which is now one of the most serious problems confronting street railway managers. The importance of this subject is growing with the introduction of higher speeds on electric railways, especially as there is an undoubted tendency on the part of courts toward the kindlier treatment of claimants and the granting of larger amounts as damages. Without doubt a consensus of the experience of most roads would show a greater number of accident claims presented since the introduction of electric power than when horses were used, and in greater proportion than is warranted by the higher speed and greater weights of electric cars. The publicity given by the daily press to trolley accidents has undeniably encouraged the bringing against railway companies of an enormous number of claims for injuries, slight or imaginary, many of which would not otherwise have been thought of. In most of the large cities this practice has been fostered by a set of unscrupulous lawyers who make a specialty of such cases and who seize any chance injury of this kind to make a profit to themselves at the expense of the railway company. So eagerly are these cases sought that there have even been instances where the lawyer has brought claim for damages before consulting the injured person, expecting to make terms with him afterwards should his first demand on the company prove successful. In these cases he has sometimes found that the adjuster of the railway company has already settled the claim and secured a release for the company One method of discouraging this practice would be to secure a law similar to that passed recently in New Jersey, but vetoed by the governor, compelling the attorney to file with his brief a statement of the terms upon which he took the case. If such a law were in force it would tend to discourage the practice of the lawyer paying all expenses and accepting in payment from fifty to seventy-five per cent of the damages secured and would thus reduce the number of unnecessary suits brought against railway companies.

But while this evil is sufficiently serious in itself, another, that of the bringing of damage suits by people who have never been injured, is one which is even worse. The report of a bad accident on a trolley line is often the occasion of several illegitimate suits of this kind, the true character of which it is often extremely difficult to prove. Electric railway lines are more subject to these cases than are steam railroads, because the plea can always be made that the person who claims to be injured was removed from the scene of the accident soon after its occurrence, and plenty of witnesses can be secured who will swear to the truth of the story decided upon. About the only practicable way of defeating dishonest claims of this kind, for sickness can be simulated, is by showing up, if possible, the past bad records of the parties concerned, if they have made a practice of this business. This has been done in a number of cases of this kind. One great aid in defeating these claims, however, would be some method by which the claim departments of the railway companies could impart to and obtain from each other information concerning persons engaged in this business. Whether this could best be done by individual correspondence, through the American Street Railway Association, the State Associations, or by a separate organization of the claim and adjusting departments of the railway companies is a question. Undoubtedly in any concerted treatment of this subject many important lines would develop in which unity of action would be found desirable. The whole subject is very broad and one in which it would seem that co-operation might be found very useful. We shall be glad to publish the opinion of any companies or managers upon this subject.

CONSTRUCTION

Recent Electrical Overhead Work in San Francisco.

By S. L. Foster.

In the spring of 1894, the Market Street Railway Company organized a construction department and began an extensive course of construction and reconstruction. Many of the company's franchises were about to expire and many old horse car lines needed reconstruction. The work has been continued steadily for the past two years and to-day there is to the credit of the construction department over eighty-five miles of electric road. The Market Street Company has the reputation of doing everything it undertakes well and in this case no exception was made. As a result of this thoroughness the appearance of the overhead work has been frequently commented upon favorably by Eastern and foreign visiting engineers.

There are two salient features of the construction. The poles are designed, built and set for a given strain and no more than the expected strain is put upon them. The result of this is to give the finished work an appearance of solidity and sufficiency. It also does away with guys which always give to poles an appearance of weakness.

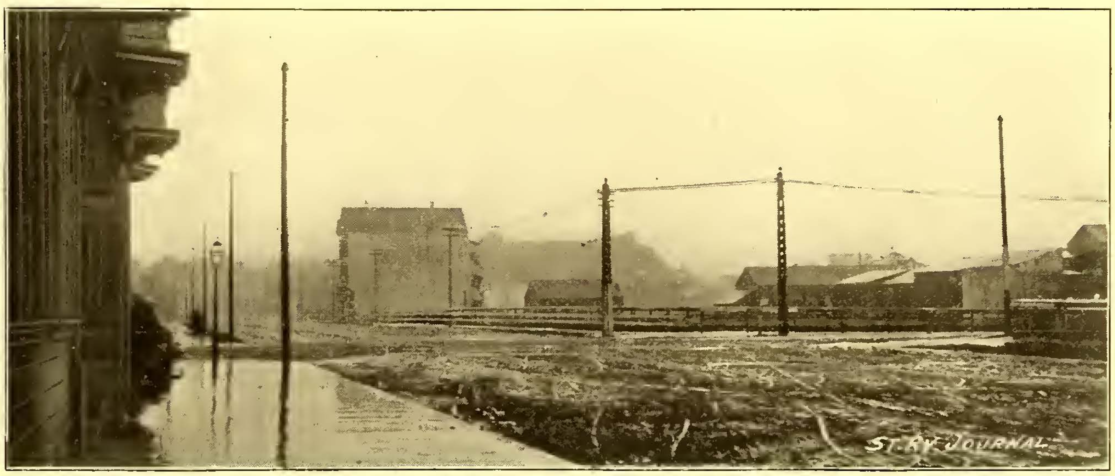


FIG. 1.—CURVE CONSTRUCTION ON CHURCH STREET—SAN FRANCISCO.

The second feature—the height of the trolley wire above the rail, twenty-one feet—improves the appearance of the street and removes to a great extent the bad impression of "dangerous overhead wires."

The poles after being finished are tested to ascertain the safe load that they will support without suffering a permanent "set." The deflections at the different strains are noted and when the poles are set they are raked from the strain such an amount that when the expected pull has been applied the accompanying deflection will still leave the poles raked two inches from the perpendicular. This is to allow for the possible yielding of the foundation.

For single track lines on streets not over forty feet wide, a pole made of wrought iron tubing in three sizes, respectively four inches, five inches and six inches in diameter is used for side pole work. For usual double track work on spans up to sixty feet, side poles of standard wrought iron pipe—five inches, six inches and seven inches diameter—are employed; for heavier straight line work, five inch, six inch and seven inch hydraulic pipe poles; for "pull-offs" ends and 150 ft. and 200 ft. spans, poles made of hydraulic pipe six inches, seven inches and eight inches in diameter, while for turns on trunk lines of feeders latticed iron box poles tested to a safe strain of 8000 lbs. are erected.

The five inch, six inch and seven inch pipe pole is the Market Street Company's standard for city work, and of these some 4000 have been used in the two years' work. These poles are made by the Atlas Iron Works, are 30½ ft. long and the joints are what are known to engineers as "rust" joints. The three different sizes of pipe fit the one into the next like the parts of a telescope, leaving just enough clearance all around to allow a filling of sal ammoniac and iron borings to be rammed in. As soon as this mixture has become solid the poles are stacked up to dry. This drying requires about two weeks and when once dry the pole is as strong at the joint as elsewhere. The "shimmed" joint sometimes works loose, the "swaged" joint is solid, but expensive to make, whereas the "rust" joint has proved to be both solid, permanent and cheap.

The setting depends on the locality, but usually holes are dug 2½ ft. square and 6½ ft. deep. Six inches of concrete is first put in the bottom of the hole as a foundation and as a seat for the bottom of the pole. When this is solid, the pole is set so that when raked, as much concrete will be behind the pole at the bottom of the hole, as in front of it on top. The hole is then filled with concrete made in the proportions of 1 to 9 and firmly tamped.

The old cast iron base or fender has been given up as harboring moisture and tending to the deterioration of the pole at a point where the fibres of the iron are under the greatest tension—that is, at the top of the concrete—the fulcrum of the lever. Light cast iron rings as a finish to the joints and the old wooden plug and cast iron top, familiar in early construction, are still retained, the latter as a second point of insulation for the anchor guys and curve strain wires. After the poles are in place they are allowed to stand at least a week for the concrete to set before any strain is put on them. These poles will stand a strain of 750 lbs. at a point twenty-four feet above the fulcrum without permanent "set".

The setting of the "pull-off" and latticed feeder poles depends on the locality more than the side poles, but is usually about three feet square by seven feet deep for the round "pull-off" poles and five feet square by eight feet deep for the latticed poles.

In setting the round poles a light portable derrick mounted on a dray is used together with a "crab" winch. This winch works in combination with an ordinary "snatch" tackle and "snatch" block and has a total leverage of 30 to 1 exclusive of friction. With one derrick seventy poles are usually set in one day.

When cellars extend under the sidewalks to the curbstone, the poles are strapped inside the cellar to the wall at the lowest point of the pole to prevent the bottom "kicking out." To distribute this inward pressure over a large area the bolts that are used to secure the poles to the wall extend through the wall for two feet and terminate in large plates buried in a mass of concrete. On outside lines wooden side poles are used. These poles are of tapered, square, sawed and planed redwood 8 ins. × 8 ins. at the top, 12 ins. × 12 ins. at the butt, 30 ft. long and set in 2½ in. × 2½ in. × 6 ft. holes. These wooden poles are not set in concrete nor yet in the excavated material, but in clean broken rock. The tarring of the bottoms of the poles for six feet, and the setting of broken rock with the unfilled voids and drainage effect are expected to secure as long a life for the part of the pole below ground as the upper part will have. On the curves and ends of wooden pole lines extra heavy iron pull-off poles are used so that the absence of guy stubs is as noticeable here as elsewhere.

Where works of foreign companies are met with, the two companies share in the expense, and higher poles are used so as to accommodate both sets of wires with a single line of poles. This is shown clearly in Fig. 3.

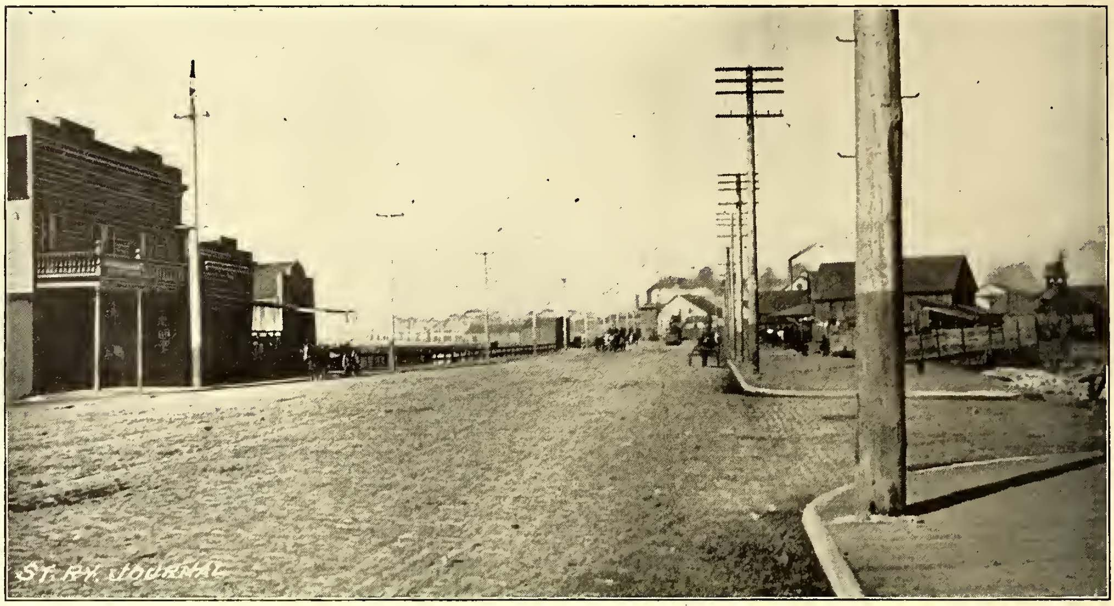


FIG. 3.—VIEW ON RAILROAD AVENUE, SHOWING FIRE ALARM, POLICE, TELEPHONE, ELECTRIC LIGHT AND RAILWAY WIRES.

The height of the trolley is fixed at twenty-one feet, on ordinary work and twenty-two feet over steam railway crossings. The sag that will produce the strain for which the poles are raked is told the wiremen, fixing thus the point for attaching the span wire to the pole, and the final pulling up of each span wire is done with a tape wire held from trolley to rail level. This uniformity in height of the trolley wire reduces to a mimimum the swaying of the wire. For spans up to sixty feet ¼ in. signal strand has been used for span wire and for longer spans $\frac{5}{16}$ in. strand. The span wires are insulated from the poles at either end by spherical strain insulators.

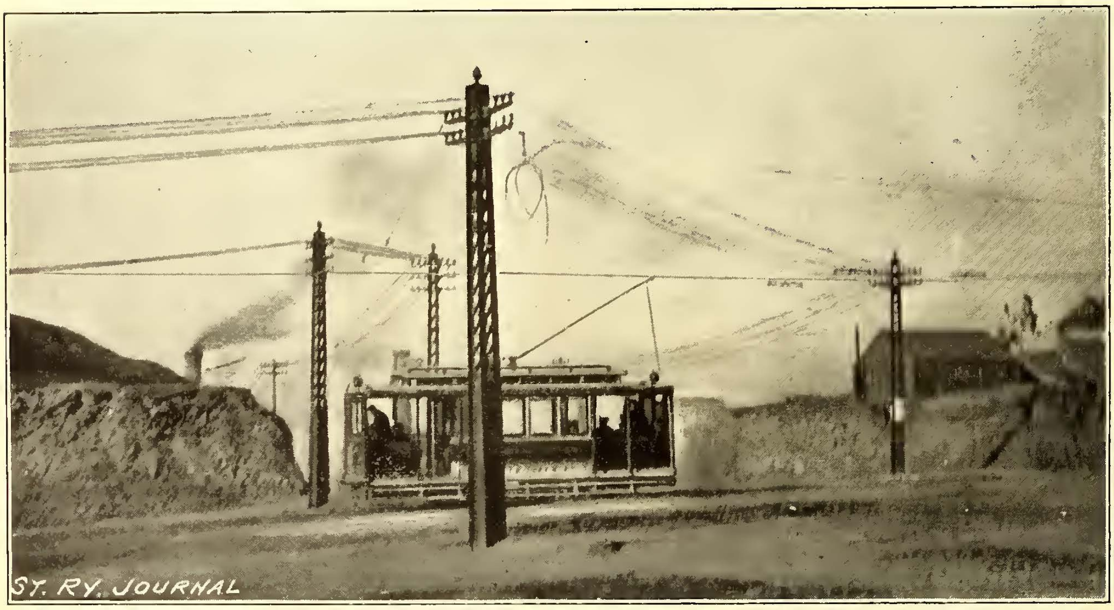


FIG. 2.—HEAVY FEEDER POLES ON TURN.

So far No. 0 B. & S. trolley wire has been used, and on account of the small variation of temperature met with in San Francisco, where the limits are 40 degs. F. and 90 degs. F., it has been found possible to put up a much tighter wire than can be done East where the variation is from — 20 degs. F. to 100 degs. F.

Soldered ears have been used throughout, the wire being carefully tinned before applying the ear, and the clips being filed off smoothly to ensure an even surface for the trolley wheel. Splicing ears for joints have been the rule with as much of the sides filed off as is compatible with safety. Strain ears are located every 1000 ft., on each side of all curves and on each side of all overhead crossings.

Two guard wires have been put up over each trolley, No. 6 B. W. G., extra B. B., bare galvanized iron wire being used for the purpose and having spherical strain insulators cut into each wire every 1000 ft.

These guard wires have saved much trouble to other companies and have caused some to the Market Street Company, but they seem to be a necessary evil in the city proper. No. 4 B. W. G. galvanized steel is used for guard spans. When the company opened the first line it operated two styles of cars—double truck and single truck. The former was of twenty-two feet wheel base and the latter of 6½ ft., so that it was impossible to locate the trolley wire on curves at the point of minimum wear. Since the employment of a standard seven foot wheel base car the exact location of the wire is easily found from the formula given on page 367 of the June issue of the STREET RAILWAY JOURNAL.

General Electric overhead parts have been used almost exclusively, the latest bronze parts being adopted as soon as they were put on the market.

The trolley wire is divided by sectional insulators into sections of lengths depending on the headway and the grades, so that an average of not more than two per cent shall be lost between the ends of the feeders and the ears. Each section has its separate feeder and is connected to the next section through a switch and fuse, thus securing both the advantage of a continuous trolley wire and that of cutting out of separate sections. These section insulators require regular attention, but the advantages have proved to more than offset the additional care.

Intersecting lines are insulated from one another by insulated crossings and where intersecting lines have a curve connecting them the trolley wire over the curve contains a section insulator connected to a switch and fuse. Thus the whole network of lines is completely connected electrically, and yet each section of every line can quickly be isolated.

On all the latest work the two trolley wires on double track lines have been connected electrically at every fourth span so as to get the benefit of all the copper in position. In track work the rails are carefully cross bonded every 150 ft. to make the four rails practically one conductor, and yet on double track lines the two trolley wires have in some places been thoroughly, though unintentionally, insulated from one another for hundreds of feet. A car on a grade using a heavy current has only the conductivity of one No. 0 wire between it and the feeder wire, while the other trolley wire, but eleven feet away actually, is electrically perhaps a thousand feet distant and useless as a conductor of current for this particular car.

FIG. 4.—TWO HUNDRED FOOT SPAN CONSTRUCTION.

No lightning arresters are used outside the power house as none have as yet been needed.

In calculating the feeders an equal conductivity is expected of the rail return and of the overhead wires. Each feeder is connected to its section of trolley at the electrical center of that section; that is, at a point so that as much current will be absorbed on one side of it as on the other—Professor Bell's "center of gravity." This electrical center is the main "feed-in" point for the section, but in case a heavy grade occurs near by a tap is run to the trolley at the center of the grade. The sizes of the feeders are No. 0000 B. & S. 300,000 c m. and 500,000 c. m.—all being run overhead. For supporting these feeders, cast iron cross arms or brackets are used with wrought iron pins. These brackets are in two halves and clamp the pole by means of four ⅝ in. bolts, being held securely on the smooth surface of the pole in addition by a ½ in. cupped set-screw. Four sizes of these cross arms are used, two-pin, four-pin, six-pin and eight-pin.

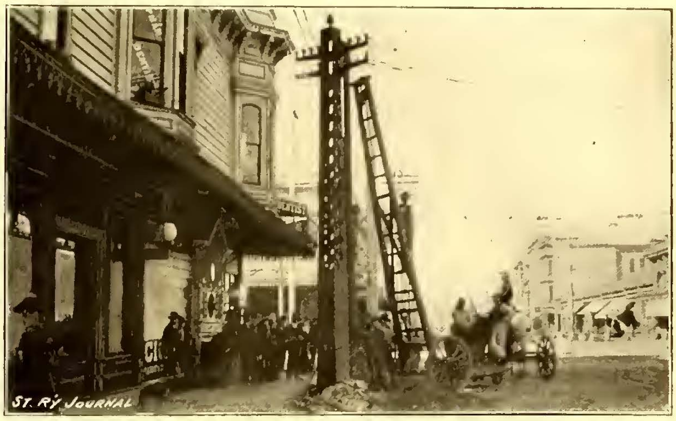


FIG. 5.—CORNER POLE AND DERRICK.

For straight line work one inch pins and for turns one inch widening to 1½ ins. at the base, are used. Wires up to No. 0000 are supported on cable glass insulators screwed on the pins previously wrapped with tape, but 300,000 and 500,000 c. m. cables require fibre insulators. For turns and ends only corner insulators of fibre have been found to stand the strains.

Fig. 1 is a view at Sixteenth and Church of the standard double trolley construction showing tubular five inch, six inch, seven inch iron side poles, one row carrying two six-pin crossarms and supporting six 500,000 c. m. feeder cables for the "Western addition;" it also shows the guard wires and the curve work with its three six inch, seven inch and eight inch hydraulic pipe pull-off poles and its two latticed poles for the feed wires.

Fig. 2 is a view of one turning point for feed wires at Sixteenth and Bryant, showing sixteen No. 0000 wires on one pole and six 500,000 c. m. cables on another.

Fig. 3 gives an idea of how foreign wires are cared for on the outside lines. The location is on Railroad Avenue. On one side of the street is a row of forty foot poles and on the other a row of thirty-five foot poles. To the forty foot ones the railway span wire is attached ten feet from the top. The fire alarm and police patrol wires have the next five feet and the Telephone Company's wires the remaining five feet of the pole. On the thirty-five foot poles the Electric Light Company's territory is from the top down five feet and the railway's the rest. This makes neat construction and obviates a double set of poles.

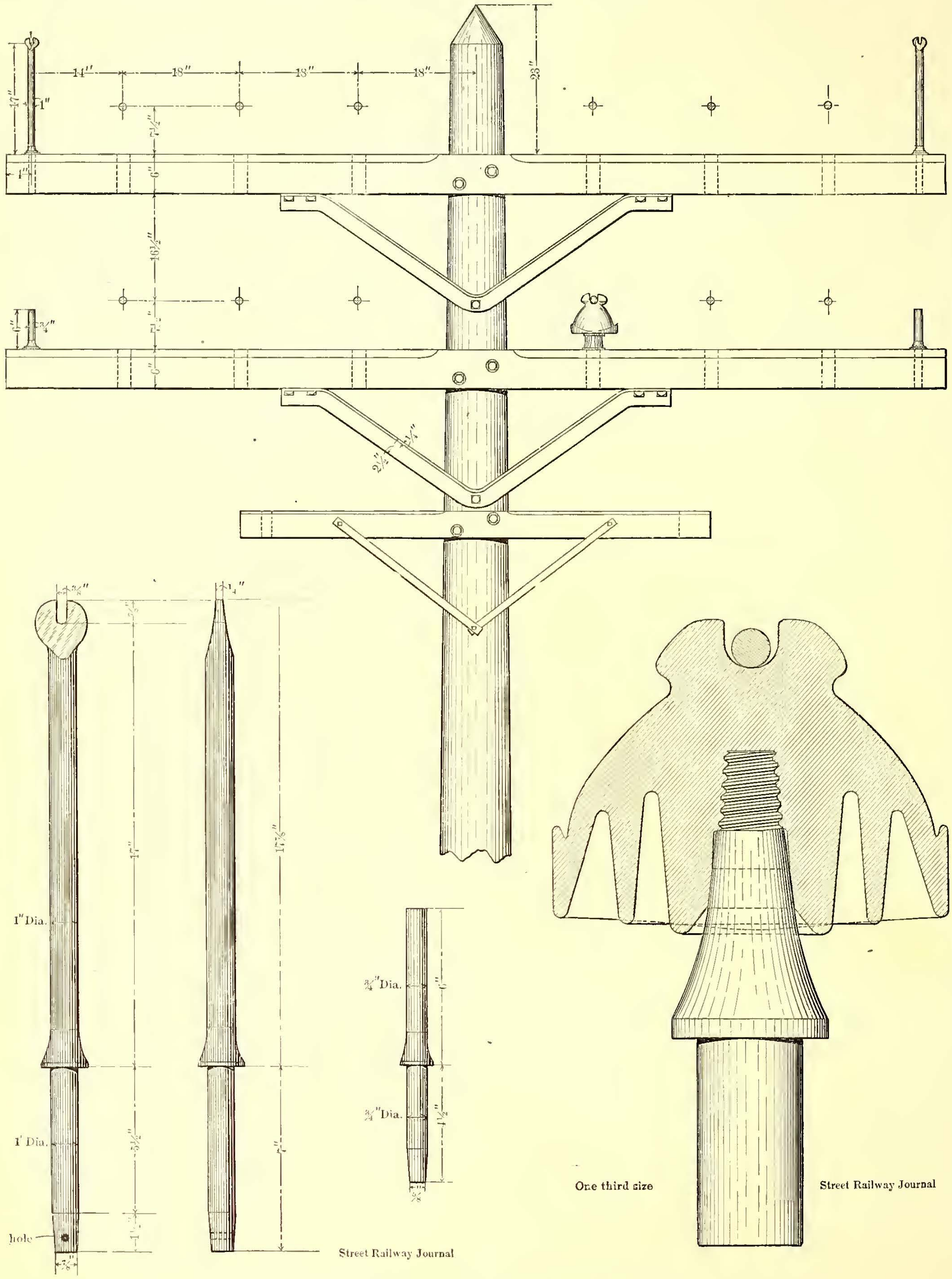
Fig. 4 is a partial view of what is believed to be the longest succession of street railway trolley spans in the world. It is on East Street, fronting the wharves and of fourteen spans. The least is 131 ft. long and the greatest 217 ft. The railway company sought the privilege of erecting center poles here, but the Harbor Commissioners refused.

A good piece of work was made of the construction by using six inch, seven inch and eight inch extra heavy tubular poles for side poles and in the light of the frequent accidents that occur in cities where center poles are used and where accidents would not have occurred with side pole construction, the side pole method will probably be cheaper in the end for the railway company. The span wire strains on this street run from 1050 to 2050 lbs.

Fig. 5 shows the derrick used for setting round poles and also gives a good view of one of the corner feed poles.

High Voltage Transmission Line.

The work on the pole line for the electric power transmission between Niagara Falls and Buffalo is being carried forward rapidly by the contractors, the White-Crosby Company. In the city of Buffalo, among the first users of power will probably be the Buffalo Railway Company. Owing to the high voltage carried and the importance of keeping the line in good condition for use, the greatest care is being exercised in its erection.



DETAILS OF NIAGARA HIGH VOLTAGE TRANSMISSION LINE.

The pole line will extend for the greater part of the distance over the company's own right of way, which will be fenced in. The poles will be of cedar, circular in section, and in height from 35 ft. to 65 ft. above the ground. They will be set in the ground to a depth of from 7 ft. to 8½ ft. In firm earth the poles will be set in the earth, which will be carefully tamped about the butts; in soft earth, the poles will be set in concrete. The distance between the poles on straight line will be 100 ft. The diameter of the poles at the top will be not less than 8 ins., and from this down it will gradually increase in diameter. At the ground line the 35 ft. pole will be 14 ins. in diameter and the 65 ft. pole 28 ins. in diameter. On curves the poles will be considerably heavier than those used on straight line.

Each pole will carry three cross arms, the upper two for the power wires and the lower for telephone wires. The power cross arms will be of heart pine 12 ft. in length, and 4 ins. × 6 ins. in cross section. They will be supported by steel angle braces 2½ ins. × 2 ins. × ¼ in. These braces will be in one piece to better keep their place and at curves braces will be used on both sides of the pole. Each brace is secured to the cross arm by four ½ in. lag bolts 4 ins. long, and to the pole by 1¾ in. lag bolts 5 ins. long.

The pins are of straight grained locust, of special shape so as to secure a good bearing for the insulation. The spindle is 2 ins. in diameter, and the pin at the shoulder, 3 ins. in diameter.

The insulators themselves are of special shape, with double petticoat to secure the best of insulation. The feeders are carried in a slot on the top of the insulator and are held in position by tie wires. There will however probably be little or no strain on these tie wires as the whole strain will come on the insulator itself. The insulator has also a skirt on each side to drain any rain away from the cross arm, so far as may be possible.

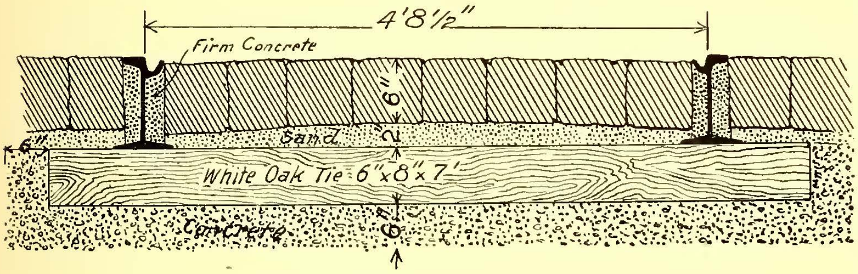
A very novel feature in the pole line will be the provisions for lightning protection. The power wires will be guarded on each side by ordinary galvanized barbed fence wire which will be carried on pins shown on page 488 mounted at the extreme ends of each cross arm. An ingenious method of grounding these pins is provided by drilling in the lower end of each pin where it projects through the cross arms a hole through which a No. 6 copper wire can be strung. Each lower cross arm has also a shorter pin for guard purposes.

The third or lowest cross arm is of the standard six foot, six pin type.

Substantial Track Construction in Richmond.

The accompanying engraving shows a method of track construction adopted by the Richmond Traction Company in its new line opened for operation this season. The company has laid in this way eight miles of track, constituting all of its city line. The method was adopted upon the recommendation of the city engineer and was laid under the supervision and according to plans drawn up by A. Langstaff Johnston.

As will be seen the ties are imbedded in concrete



HEAVY TRACK CONSTRUCTION.

which forms a continuous foundation for the roadbed and is laid six inches below the tie. The concrete is made of the following mixture :

1 part American cement,
2 parts sand,
4 parts broken stone or creek gravel.

The ties are white oak throughout and measure 6 ins. × 8 ins. × 7 ft. They are spaced equal distances and laid fourteen to a thirty foot rail.

The joints are supported and broken. The joints are made of twenty-two inch and eight bolt channel plates with one inch bolts. The Johnston rail bond, ranging in size from No. 0000 to No. 000000, is used. Tie rods are employed every seven feet.

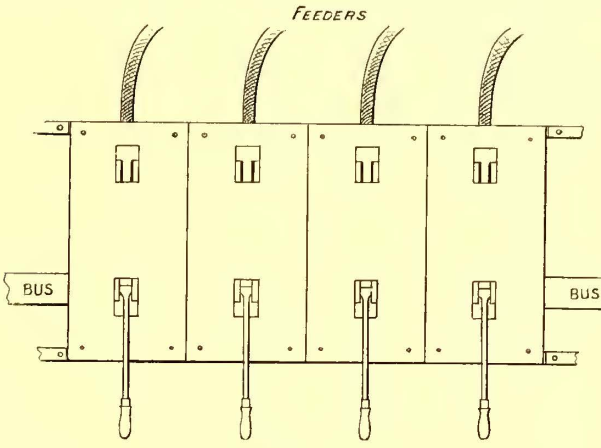
The rails are of the Johnson section No. 216, and weigh ninety-five pounds to the yard. Fine cement is used on each side of the web of the rail to allow the pavement blocks to fit against the lip of the rail. The blocks are six inches in depth and rest on a bed of sand two inches in depth. The cost of laying the track per mile of single track was about as follows :

Rails	$ 6,000
Ties at forty cents each	1,040
Bonds	250
Labor of laying and concrete	10,560
Total	$17,850

The Grand Jury of Brooklyn, N. Y., recently recommended the construction and use of special trolley cars on the lines leading from Coney Island to Brooklyn for the transportation of prisoners between the two places.

A Panel Equalizer.

A novel device has been installed in the power station of the City & Suburban Railway Company, of Baltimore, for relieving the load on the circuit breaker of any feeder which may be temporarily carrying an excess of current. This is often unavoidable, especially in winter, when one



A PANEL EQUALIZER.

or two sweepers may be on a certain section, or in summer when very heavy loads are being cared for. The method adopted prevents a constant opening of the breaker on a feeder operating under such conditions while providing a method by which it would open in case of an actual short circuit.

On the rear of the board is placed what is called a panel equalizer, illustrated in the accompanying engraving. Leads from the feeder terminals are brought to a series of panels which are fitted with ordinary knife switches, one pole of which is connected to a copper bus bar. By throwing the overloaded feeder in with a lightly loaded feeder, by means of this switch the current on the two is divided equally between the two circuit breakers, accomplishing the result sought. If necessary, three can be connected together.

In this station the company is using a booster for its distant lines. This is only required in summer and is an ordinary series wound machine, generating eighty amperes at 125 volts. It is belted to a small engine, which is also used for carrying the light night load by means of another generator.

Electric Railway in Versailles.

Versailles is to have an electric street railway and within two months the old horse cars will give way to the new system. The street railway will be run from the light and power station.

The steam generating plant will consist of four semitubular boilers supplying steam to four horizontal, single cylinder engines aggregating 350 h. p. for the light and power service in the city, and two steam engines aggregating 240 h. p. for the street railway. The electric generating plant will consist of two General Electric monocyclic machines aggregating 250 k. w. and two direct coupled railway generators of the same make aggregating 200 k. w. The rolling stock will be fifteen cars, each equipped with G. E. 800 motors and controllers.

The installation will be carried out for the Société Versailles de Tramways et de Distribution d' Energie Electrique by the Cie. Fcse. Thomson-Houston, of Paris.

The Salt Lake City Street Railway Company recently carried 105,000 passengers during a three days' carnival, and on July 4 it carried 41,628 passengers.

Car Specifications.

The following are the standard specifications employed by the Consolidated Traction Company, of New Jersey, in ordering twenty foot box cars.

Dimensions.

Length of car body over end panels at sill . . . . 20 ft.
Length of car body over platform crown pieces . . . . 28 ft.
Width of car at sill, including panels . . . . 6 ft. 6 ins.
Width of car body at belt rail . . . . 7 ft. 6 ins.
Height inside center . . . .
Height of car from under side of sill to top of trolley board, 8 ft, 4 ins.

Doors.—Double doors 1¼ ins. thick.

Windows.—Seven windows on a side; two in each end. Shape of window heads, arched.

Platforms.—Length of platforms, 4 ft., either with opening and step at both sides or with dasher. Dasher to be of No. 16 sheet steel 2 ft. 6 ins. high.

Bottom Framing.—Side sills of oak, 3¾ ins. × 5⅞ ins. plated on outside with ½ in. steel plates.
End sills of oak, 5⅞ ins. × 3¾ ins.
Center cross joists of oak, 3½ ins. × 3¾ ins.
Intermediate cross joists, 3½ ins. × 3¾ ins.

Framing to be done in the most substantial manner; all mortises and tenons to be thoroughly white leaded and driven together and secured by tie rods of refined iron.

Floor.—Framing to be arranged with trap doors to suit the requirements of the electric motors.

Floor boards to be ⅞ in. × 3¼ in. yellow pine, dressed on both sides, securely fastened to body framing with screws.

Floors to be fitted with ash tapered floor mat strips screwed to floor: dimensions, ⅝ in. at top and ¾ in. at bottom, reaching the entire length of car floor, excepting a space of two inches at each end to allow for sweeping.

Trap Doors.—The trap doors to be made to suit either General Electric or Westinghouse electric motors; to be framed of ash; frame work 1 in. × 3 ins. tenoned, mortised and doweled.

Body Framing.

Corner posts . . . . 4½ ins. thick.
Side posts . . . . 2¼ ins. thick.
Sweep of posts . . . . 6 ins.
Belt rail . . . . 1 9/16 ins. × 4¼ ins.
Top rail . . . . 1¾ ins. × 2¾ ins.
Lower ventilator rail . . . . 1¾ ins. × 3⅛ ins.
Upper ventilator rail. . . . . 1 in. × 2¼ ins.

All body framing to be of straight grained white ash, free from sap and shakes, thoroughly dry and well seasoned. All joints white leaded and all tenons pinned.

Posts to be mortised into sills, and shoulders boxed ¼ in. into sills and fastened with strap bolts.

On concave panels there should be four ash ribs of tough ash between every two posts; dimensions of ribs, ⅝ in. × 1¾ ins. These should be mortised into sills and fastened on concave rails securely with screws. The center panel ribs should be of same dimensions above and mortised into belt and concave rails, draw-bored and pinned. The belt rail should be grooved to receive the panel and not nailed along the upper edge. The side belt rail should be dovetailed into posts, no wedges being used. All panels to be heated before being placed in position and glued to posts, ribs and rails being nailed only at the posts; panels backed with a good quality burlap securely glued in place. After glue is thoroughly hardened the burlap should be painted one heavy coat of mineral paint.

Truss rods to be of ¾ in. double refined iron, placed underneath seats, extending entire length of body.

Roof.—The roof to be monitor deck pattern, full length of car body, with eight ventilator sash on each side and two stationary lights at each end.

Roof to be strengthened with concealed steel rafters, ⅝ in. × 1 in. These rafters are to be placed in the roof so as to relieve to the best advantage the strain of the trolley apparatus, and are forged to the shape of the roof in a solid piece with "T" at each end, by which they are fastened to top rail with wood screws.

Roofing to be at least ½ in. thick and painted with thick white lead, and all nail holes, screw holes and joints puttied, and covered with No. 6 cotton duck well laid in white lead and painted three coats.

Ceiling.—Of curly white maple three ply veneer, neatly and tastefully decorated and varnished. Card rack moulding on each side full length of car.

Trolley Board.—Trolley board fitted on the outside made to suit the requirements of any specified trolley. The board to rest on ribs laid in white lead.

Hoods.—Hoods to be detachable, oak frames and ash carlines, covered with ⅜ in. tongued and grooved poplar boards 2½ ins. wide. The entire hood to be covered with No. 6 cotton duck and treated in same manner as rest of roof.

Dasher Posts.—End dasher posts extending from crown rail to under side of hood. The bottom of dasher posts where they go through washer, crown piece and knees, to be tapered so that when drawn down they wedge and always maintain the same position.

Dasher caps of bronze extending full length of dasher.

Steps.—Malleable iron hangers with oak treads securely rodded on under side. Steps to be provided with a back fender or riser closing step opening, so as to prevent accidents to passengers by foot slipping through.

Brakes.—One brake shaft on each platform to be 1⅛ in. diameter at the top and 1⅜ in. at the bottom, and provided with 12 in. Brill's patented ratchet brake handle of solid bronze metal.

Gates.—Brill's patented gravity gates arranged to be set on the step, hinged to car body, so that when gate is folded up it swings inwardly toward the car body and is latched thereto.

Buffer.—Brill's design of angle iron buffer.

Drawbars.—Drawbars to be of Fitzgerald-Van Dorn pattern.

Sand Boxes.—Car to be fitted with two Brill sand boxes with agitator placed at diagonal corners of car and worked by levers extending to platform.

Gongs and Bells.—One twelve inch pedal alarm gong.

Two signal bells with loose hammer attachment to prevent crystallization of the gong, one bell under each hood. The bell cord to be ⅜ in., round leather belting and of sufficient length to reach to the outer edge of hood.

Outside Trimmings.—All trimmings to be made of the very best quality bronze metal, as per sample, highly polished and secured in place with solid bronze screws.

Lamps.—Two oil lamps in diagonally opposite corners.

Inside Finish.—To be what is known as No. Palace. The wood employed to be cherry, including doors, linings, and mouldings.

Back of veneer ceiling if used to be painted before being put in position.

Hand poles of cherry and with grained leathered hand straps double riveted; with ornamental bronze metal trimmings.

All interior finish to be of most modern design and secured in place with bronze oval headed screws, as per sample to be seen at office of Master Mechanic.

Seats to be of cherry slats covered with Wilton carpet.

Space underneath seats to be closed with panel work, extending from floor to under side of seat rails, with door in center on each side with spring hinge at bottom and provided with bronze catch; said panel work to be easily removable.

All mouldings to be of solid cherry, and the entire inside finish rubbed to a dead finish, or highly polished and first class in all particulars.

Sash.—Sash to be of cherry ¾ in. thick and glazed with double thick French glass set in felt and screwed in position by mouldings; the bottom of the sash, when lowered, to be protected from bruising by gum cushions attached to foot of posts.

Blinds or Window Shades.—Cherry blinds with maple slats.

Mirrors.—Two beveled-edge, chipped plate glass mirrors in each end of the car, placed above the end windows in neat cherry frames.

Hand Rails.—Of cherry, mounted on bronze ornamental brackets and supplied with twenty hand straps of fancy leather—ten on each side.

Painting.—All parts to be thoroughly primed with white lead, filled, puttied and surfaced until a perfectly smooth surface is obtained, and to receive from three to five coats of body color, or until the surface is thoroughly covered. The style of ornamentation, color and lettering to be decided on shortly after the contract is awarded. Varnishing to be done in the best workmanlike manner and the quality of varnish to be equal to the best varnish.

The inside lining at the end of the car to be one inch thick.

A strong corner iron to be put at the top of each post at each side.

Cars to be arranged for trucks.

Cars to be wired for light and trolley,

Three-light clusters inside of the car and one lamp on each platform.

Material and Workmanship.—The material and workmanship entering into the construction, finish and painting of the car body, to be performed in a thoroughly first class and workmanlike manner. All rails and sills to be full length and without splicing. Mortises and tenons must fit each other tightly without false filling, and to be well white leaded before driving together.

THE Helena Water & Electric Power Company is constructing a thirty foot dam across the Missouri River, fifteen miles from the city. The contracts have been let and the work has begun. The dam will produce 8500 h. p. at the wheel shed. Of this, however, only 1500 h. p. will be used at present in Helena by the Electric Light Company, the Street Railway Company and the various motors. 1000 h. p. will also be used by the Peck and the Corbin concentrators at East Helena, twenty-four miles distant.

SCIENCE · ENGINEERING · INVENTION

New Trolley.

The Walker Company has recently placed on the market a new trolley which is said to avoid the claims of infringement against the Van Depoele patent, and at the same time to be of superior merit to the ordinary trolley.

This trolley can be used on lines as now constructed for the old grooved wheel trolley, passing under the switch plates without difficulty. On this page is given a detailed description of this trolley with engravings showing its construction.

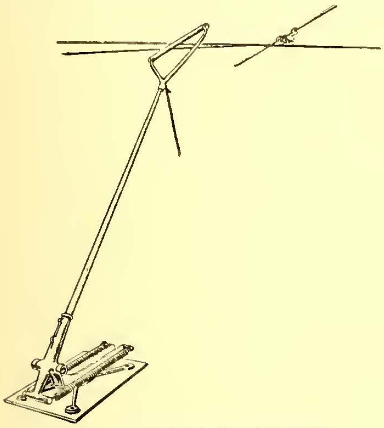


FIG. 1.—TROLLEY COMPLETE.

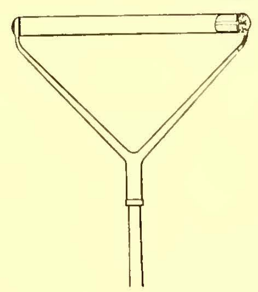


FIG. 2.—TROLLEY HEAD.

Instead of a wheel, this trolley has a roller $35\frac{3}{4}$ ins. long, and $1\frac{3}{4}$ ins. in diameter. This roller is made of seamless drawn steel tubing, case hardened and sheathed with a suitable coating of metal to make the best contact with the trolley wire. In each end of the tube is a case hardened steel cone and at the end of this cone is an adjusting cone also of case hardened steel. The bearings consist of twelve $\frac{1}{4}$ in. diameter steel balls at each end of the roller, bearing between the two cones as shown in Fig. 3. At a speed of 5000 r. p. m. and a pressure of thirty pounds on the trolley wire these bearings require no lubrication whatever, thus entirely avoiding the use of oil in the trolley bearings which is so detrimental to the grooved wheel trolley.

Through the roller passes a cold rolled rod which retains the cones in position and carries the roller in position on the ball bearings. The current is taken from the roller by small copper brushes which are secured to short pieces of brass tubing which revolve on the rod, this device preventing the current from passing through the ball bearings, and thereby avoiding pitting of the latter due to the small contact surface, which would be detrimental.

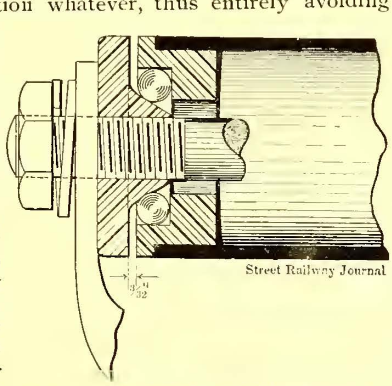


FIG. 3.—SECTION SHOWING BALL BEARINGS.

The fork is of malleable iron and into it are fitted two pieces of seamless steel tubing, one inch in diameter, which form the support for the rod passing through the roller. The ordinary trolley pole is used. The trolley has no lateral motion whatever, therefore is always parallel with the track, making it impossible for the roller to leave the wire.

With this trolley expensive switch plates on the wire are unnecessary. Fig. 4 shows a trolley line clamp which is designed to attach the switch to the main trolley line, thus making a very much more substantial junction of the wires, and at the same time at a greatly reduced expense, compared with the ordinary switch plates.

The clamp is made of one piece of cast brass and has two grooves running its full length to receive the wires as shown by the end elevation (Fig. 4). The wire slot is wide enough to admit the placing of one wire in position, while room enough is left to place the other wire in position without disturbing the wire first placed. Then the clamp is closed up by means of five $\frac{5}{8}$ in. bolts as shown in Fig. 4. This brings the two wires in close contact throughout

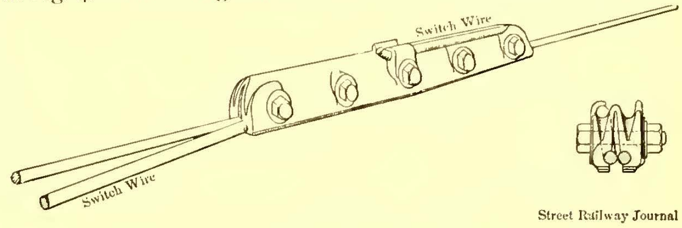


FIG. 4.—OVERHEAD SWITCH.

the entire length. The switch wire is turned up over the end of the casting, lying in either groove as shown by Fig. 4. The wire continues to the center where it passes behind the lug, which is turned down over the wire, thus preventing the possibility of the switch wire pulling out.

The bottom edges of the clamps near the end are rounded off to bring an easy rise from the bottom of the wire to the bottom of the clamp so as to allow the roller to have free passage under the clamp. This casting has two grooves at either end and two lugs in the center. This makes it unnecessary to have "rights" or "lefts" and the switch wire may be turned up from either side on either end and held in position as shown. The total weight of this clamp including bolts is $8\frac{1}{2}$ lbs.

Improved Electric Heater.

Some changes have been made by the Gold Street Car Heating Company in its electric heater, based upon the performance of the heater last winter, and the company is now prepared to supply its new heaters in large quantities for the coming winter trade. The principle followed in the manufacture of these heaters has been to utilize to the best advantage the electric energy absorbed and this is accomplished by the construction of the heater in which the cold air passing into the heater is separated into small portions by the hot resistance wires in the process of heating. The coils, which are an inch and a quarter in diameter and generally three coils high, are placed one above the other in horizontal position. These coils are held securely in position by slight grooves in specially prepared asbestos boards so that in the improbable event of a wire breaking it would be impossible for it to leave its original position. In this way any short circuit or burning of wires or fuses is avoided and as the wires are supported for their entire length there is no strain or tension upon them when in position. As there is no core to obstruct the flow of air the circulation through the heater is excellent.

With the heater three graduations of heat are obtainable. A special switch is used by which any one of the three degrees can be obtained. The heater was in use last winter on a car of the Consolidated Traction Company, of New Jersey, and gave excellent results.

Proposed Changes on the Broadway Line.

To obviate the difficulties experienced from running the Broadway cars at full speed around the Fourteenth Street curve, New York, President Vreeland of the Metropolitan Street Railway Company has suggested to the municipal authorities two remedies. One is a tunnel 150 ft. in length under Union Square to be built by the railway company at an estimated cost of from $150,000 to $200,000. The other proposition is the operation of a slow speed relay cable on the curve, Whether this slow speed cable will be driven directly from the Houston Street power station, from the main cable, or by power transmitted from the main station by other methods, has not been stated. No definite decision between the two plans has yet been reached.

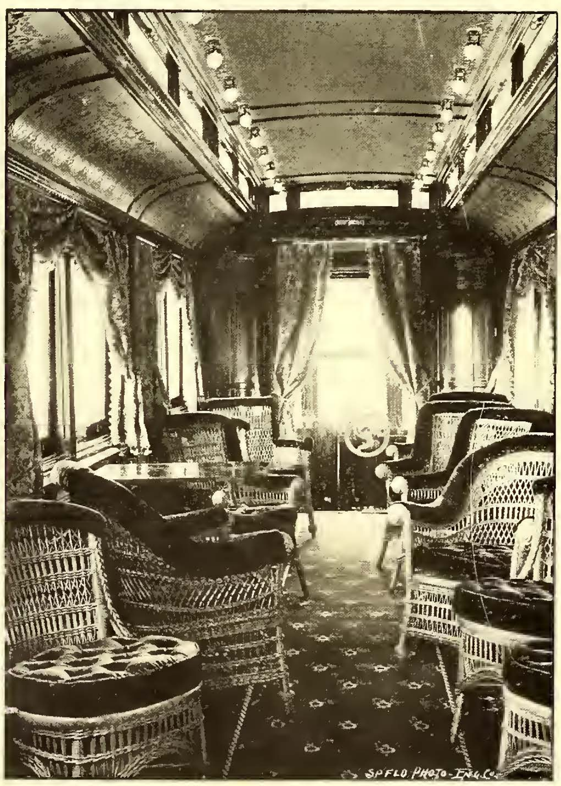
Handsome Parlor Car.

The limited dimensions of a street car make somewhat difficult a combination of the conveniences and comforts attained in modern parlor coaches used on steam railways. The Wason Car Company, has, however, just delivered to the Springfield (Mass.) Street Railway Company a parlor or chair coach that is not only a departure from the usual street railway pattern, but is planned and furnished with the same attention to details that characterizes the work of this well known concern.

Its exterior differs from the ordinary street car, the windows being arranged in pairs, with decorated panel between each pair and at each end. The panels below the windows are sufficiently concave and convex, yet afford practically vertical panel work for the interior. Its body is twenty-five feet long with vestibule of extra length at each end. Entrance to the vestibule is on one side only, while the side and end windows coming nearly to the floor, provide an anteroom that has advantages over the so-called observation end of a railway coach. Its interior finish is in mahogany. At either corner is a curved cupboard extending from floor to ceiling. These cupboards are arranged for china, glassware and provision storage and a fourth encloses a refrigerator, over which is located a portable tankard for ice water and drip, a chafing dish and other accessories for the preparation of quick lunches. The interior effect is exceedingly pleasing, the color scheme being in rich browns and creams leading from the Wilton carpet, the chair upholstery, the drapery of windows and doors and ceilings. Recognizing that the service over dusty streets and country roads necessitated careful attention the builders have arranged the several mouldings, and provided as little drapery for the lodgment of dust as was consistent with a rich and pleasing interior effect.

The deck sashes are glazed with a partially opaque opal glass that gives by day a mellow light to the cream colored ceiling, which effect is also secured at night from opal electric lamps arranged in a closely studded row about the edges of the upper ceiling. The

PARLOR CAR FOR SPRINGFIELD, MASS.



INTERIOR OF CAR.

lamps are spherical in form and are embedded in an artistic brass husk that forms a feature in the ceiling's decoration.

The chairs are of rattan, partially upholstered and include several designs from the ladies' armless, the easy, to the double divan or tête-à-tête. Adjustable tables are ingeniously stored back of stationary upholstered seats in the vestibules; the camp stools are likewise at hand when needed.

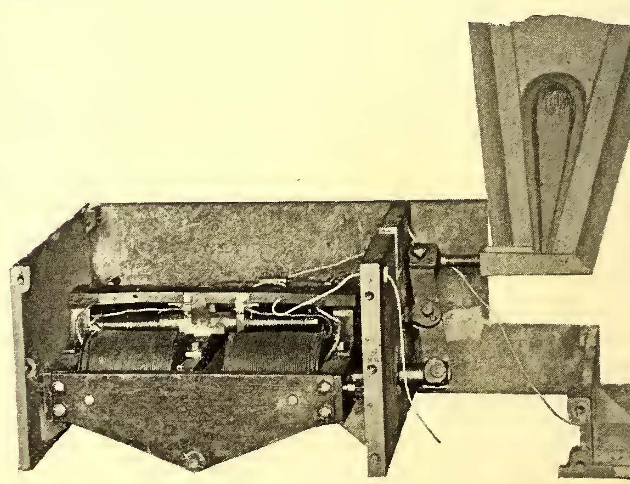
The car is heated with Consolidated heaters and is mounted on the latest Bemis No. 30 traction trucks which are designed to obtain eighty-five per cent of the load upon the driving wheels. At the same time these trucks swivel from their centers, each pair of wheels having equal travel. This and the short wheel base, allow the car body to be set close to the rail as the wheels will not interfere with the sills when curving. It also does away with the necessity of using small wheels on idle axles. They have a very powerful and quick acting inside brake, which is arranged to get the same proportionate amount of braking power on the driving wheels as on the idle wheels. The inside brake also allows of the truck frame being much shorter than an outside brake would.

Electric Track Switch.

The original Wharton track switch, in dispensing with the need of switchmen for turning tongue switches, created a revolution in street railway track construction many years ago. Later, while horses were still used for motive power, the platform track switch came to be regarded as an essential part of the track equipment of roads where many branch lines were in operation. Since the general adoption of electricity on street railways there has been a demand for an efficient and reliable switch which could be operated in some way from the car. The advantages of such a device are apparent when the large number of switchmen required on any one of our large roads is considered, since the annual outlay for their wages is a very considerable item of expense.

The switch shown in the accompanying engraving is one that has been in use on the lines of the North Hudson County Railway Company, of Hoboken, N.J., on Fifteenth and Madison Streets, and has given the best results. The cars pass this corner on an average of two or three a minute, yet the motormen have no trouble in throwing the switch in the direction desired without stopping and by a single movement of the controller handle.

The method of operation is as follows: a section of track about thirty feet in length, and about twenty feet distant from the switch tongue, is insulated from the remainder of the track and is electrically connected with the magnets in the switch box. These magnets are four in number, two on each side of a reciprocating soft iron armature which is connected through a lever with the switch tongue. The negative terminals of the magnets are grounded and electrical connections in the box are so arranged that only one of these two pairs is excited at the same time, the bar being alternately attracted from one side to the other. Each time that it is so thrown the connections are reset so that the next impulse of current will attract it in the other direction. If a car then passes on to the insulated section the current from the wheels, instead of passing directly to the ground, passes through the rails and magnets and turns the



ELECTRIC TRACK SWITCH.

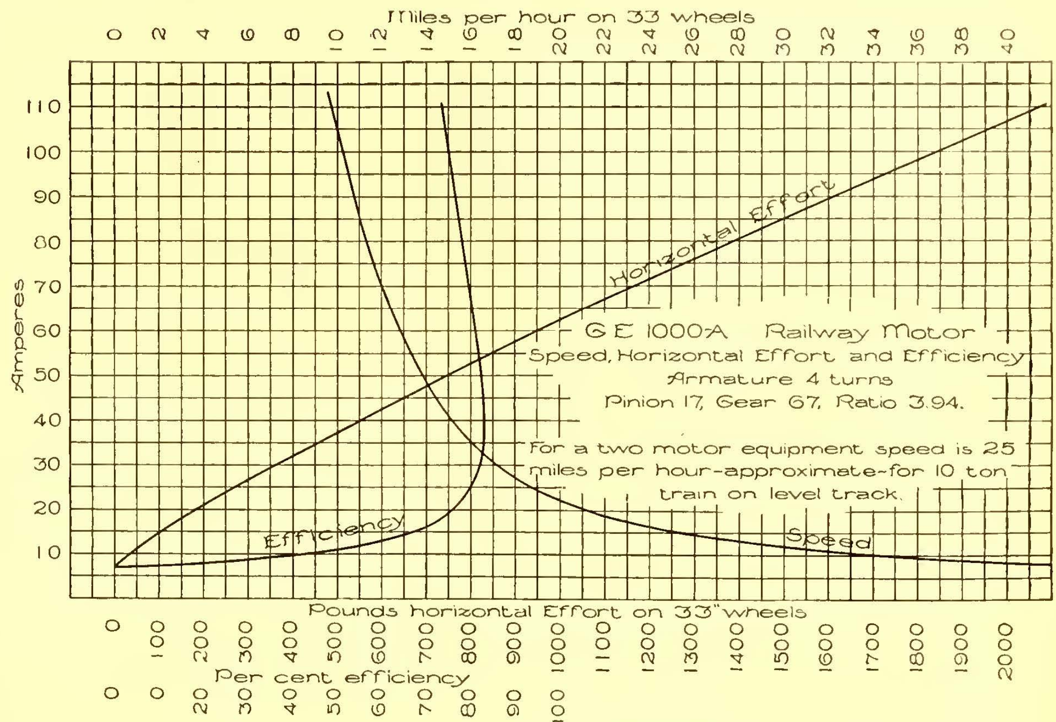
switch. If, on the other hand, the motorman of a car approaching the switch should not wish to move the tongue, he simply shuts off the current by his controller and his car passes over the insulated section by momentum.

As the difference in potential between the ground and the insulated section, when the current is passing through it, is necessarily very small, no great care is required in insulating the rails. The only steps which have been found necessary are to mount the rail on a wooden stringer, employ oak fishplates and place thin shims of hard fibre or other similar material between the ends of the rails where they are butted together.

The box itself is of cast iron and the magnets are completely protected from weather or mechanical injury. The device is owned by the New York Switch & Crossing Company. A number of electric railway managers have examined the device and speak unhesitatingly in its favor.

New Railway Motor, G. E. 1000.

The most prominent feature in the development of electric railway work during the past two seasons has been the remarkable increase in the number of suburban and interurban railways, the majority of them operated in conjunction with the city lines. As the same cars are operated from the heart of the city into the suburban districts, a street railway motor of a capacity between that of the G. E. 800 and G. E. 1200 became necessary to meet the requirements of the virtually dual service. The G. E. 1000 has been produced in answer to the demand.



The armature is of the usual iron clad type with slotted core, consisting of disks of high grade annealed iron, built up on the shaft. The coils are similar in character to those on the G. E. 800 armature with the additional advantage, however, of having the short commutator lead start from the center of the end of the coil, to facilitate the removal of the coil in case of repair. With this change in position of the short lead, only half as many coils need be lifted when the armature is undergoing repairs. There are ninety-three coils in all with four turns per coil. The diameter of the armature is 14½ ins. and its weight only 750 lbs.

Two bowl shaped castings hinged and bolted together form a strong watertight frame of a type which has never been broken. The lower half can be lowered into the pit, being hinged at the front to the upper half suspended from the axle and a suspension yoke. A hand hole in the bottom of the frame, under the commutator allows any foreign matter to be easily removed. This opening has a cover suitably fitted so as in no way to impair the watertightness of the motor. The weight of the top field complete is 884 lbs., of the bottom field 495 lbs.

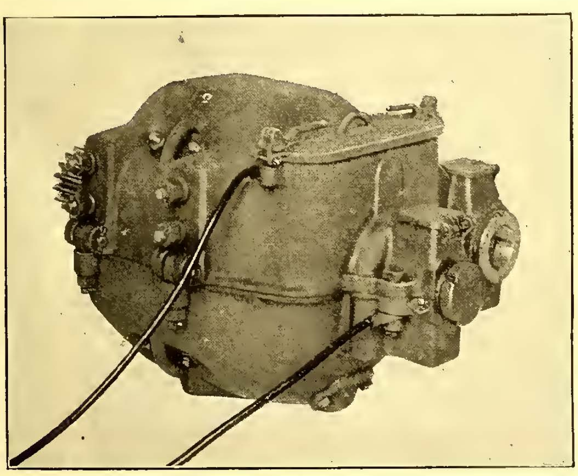
The field coils are interchangeable and four in number, secured in place by an extension of the pole piece which in turn is held in place by two bolts passing through the frame. One particular advantage of having four coils is that any heating is distributed over a greater surface.

The commutator is constructed without bolts, the clamping ring being held in place by a ring nut and no chance given to oil or other substance to work itself underneath the segments. The surface of the commutator is grooved where the commutator leads are connected in such manner as to form an ear. The advantage of this in case of repair to the armature when removing the leads is obvious. Ninety-three bars of hard drawn copper, with one inch allowed for wear, are used. The diameter of the commutator is 8¼ ins.

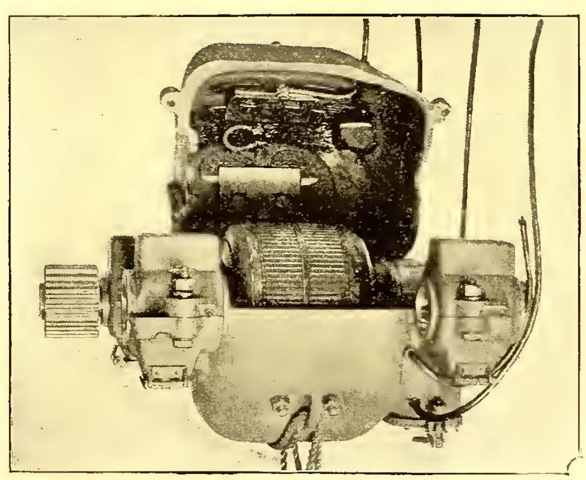
The brush holder is a modified form of that used in the G. E. 800, the brushes being held radially, and the yoke being treated with a special insulating compound with enamel finish to insure cleanliness and freedom from leakage.

The bearings are of babbitt and of ample size to secure long life and cool operation. The form is such that oil or grease can be used with equal advantage, without chance of leakage into the interior of the frame. Wool waste is used in the grease box on top of the bearings in case oil is used and the oil is discharged entirely outside. The gear reduction is 3.94 to 1.

The suspension of the G. E. 1000 is somewhat similar to that used with the W. P. 50, but differs in that the bar is bolted to the nose of the motor and its ends carried backward toward the axle and attached to the truck frame at points in line with the armature shaft. As this axle is virtually the center of weight of the motor, the suspension balances the motor and gives an effect equivalent to the side bar suspension. This method is termed the "yoke" suspension. The yoke supporting an ordinary church bell is a comparison in kind, but not in degree, since the church bell is only partially balanced, while in the "yoke" suspension the same idea is carried out to a perfect balance. For this method of suspension a

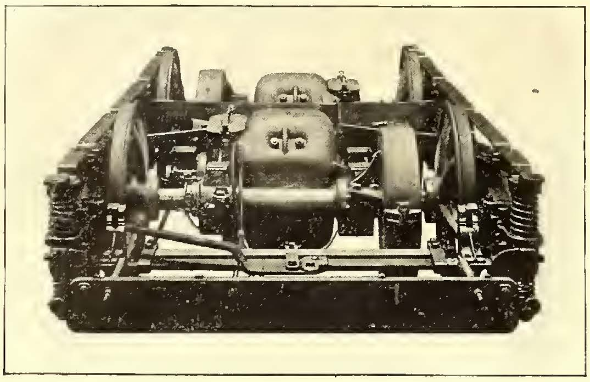


MOTOR WITH CASE CLOSED.



MOTOR WITH CASE OPEN.

superiority over all other methods is claimed. The axle bearings are relieved of the greater part of the weight, and the hammer blow on tracks reduced to a minimum. The motor practically rests upon springs.

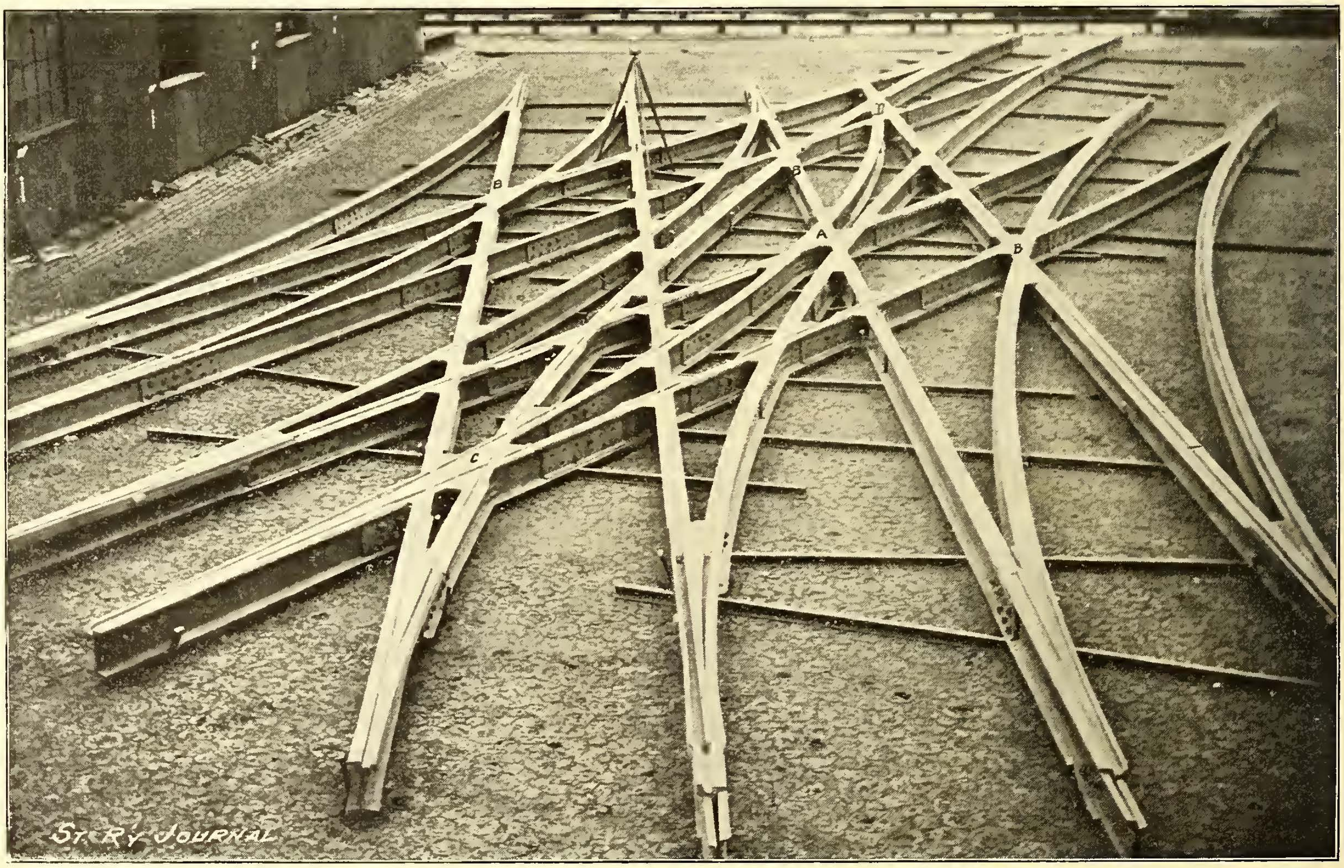


TRUCK WITH G. E. 1,000 MOTORS.

The total weight of the motor is singularly low, being only 1950 lbs.

Solid Cast Steel Special Work.

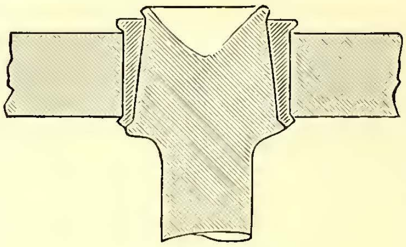
The Steinway Railway Company, of Long Island City, has recently received from the shops of the Pennsylvania Steel Company an interesting piece of special work that contains several peculiar features. All of the frogs as well as the switches and mates are of solid cast steel made by the open hearth process. That this material is well adapted to such complicated construction will be revealed on a close examination of the accompanying engraving, taken from a photograph of the work as assembled on the inspection pavement at the factory. Particular attention is called to the nest of frogs at the point marked A. There are five intersections within a space of three feet square, which with the eight arms radiating therefrom, are comprised in one solid steel casting about eleven feet long and five feet wide. This piece if built up of rails in the ordinary way would contain not less than twenty seperate pieces in addition to the fifty or sixty bolts or the mass of cast iron that would be required to hold them together. At the several points marked B there are three intersections or frogs contained in one solid piece. At C there are four. In other cases there are two frogs so near each other that the joint that would be used in ordinary work would be too short to be of much service—in such cases the joint is entirely eliminated and the two frogs connected in one casting. The few joints required in this class of work is an important feature. Another interesting fact in connection with this work is that but thirty-eight per cent of the track is made up of rail—the remaining sixty-two per cent being steel castings.



COMPLICATED SPECIAL WORK—STEINWAY RAILWAY COMPANY.

The Columbia Rail-Bond.

The Columbia bond, the terminal of which is illustrated herewith, has just been put on the market by the J. A. Roebling's Sons Company. It consists of three parts, two copper thimbles and the connecting copper rod. On each end of the copper rod is a truncated cone head with a fillet at the base. The inside of the thimble is tapered to fit the head on the bond, while the outside is slightly tapered in the opposite way.



SECTION OF BOND.

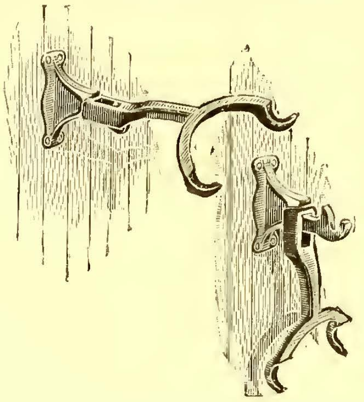
In applying the bond the cone shaped heads are placed in the holes in the rail from one side and the thimbles are slipped over them from the other. A portable hand press is then applied, and the wedge shaped head of the bond is forced into the thimble so that it is not possible to see the line separating the thimble and the head in a cross section of the two. The end of the head of the bond is expanded by a center punch, held in position in the press.

The special features claimed for the bond are that it consists of but few parts, and that when installed, owing to the pressure between the head and the thimble, and also to the fact that they are of the same kind of metal, the two become one, both electrically and mechanically. The bond has, therefore, all the advantages which may be claimed for a one-piece bond. The contact with the rail is seven times the section of the wire, providing ample contact to compensate for the poorer conductivity of the steel in the rail. The contact of rail and bond is made by a wedge expanding the thimble against the hole in the rail.

Again, this wedge is not driven in with a hammer, but is put in with a press. The press can be so set that no matter what may be the intelligence or care of the workman, he cannot put in the bond in any way except the right way. As the bond is wedged both ways, it cannot get loose.

Bicycle Carrying Attachment for Electric Cars.

The use of bicyles has become so general that the transportation of wheels on steam roads has already received a great deal of careful attention and numberless devices have been suggested for this purpose. Electric railways in general have undoubtedly suffered from the present bicycle craze, and it seems that if some profit could be made from wheelmen it would certainly be a just retribution. Many lines leading from the centers of cities into the suburbs could undoubtedly carry many wheels and wheelmen if suitable methods of caring for the wheels could be employed. A device for this purpose has recently been put on the market by George C. Ewing, of Boston, and is illustrated in the accompanying engraving.


BICYCLE ATTACHMENT FOR CARS.

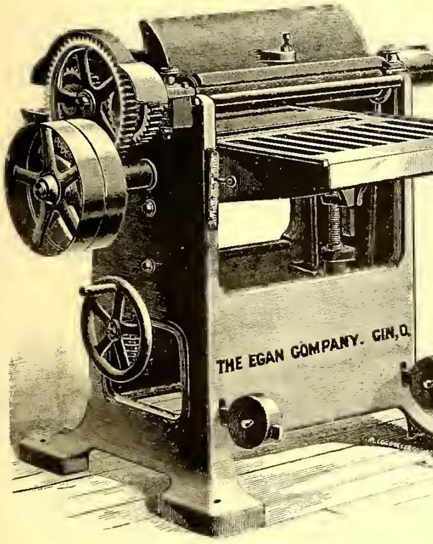
As will be seen, it is a support for the wheel which can be attached to the side of the car, forming a bracket upon which wheels can be hung. The latter are then carried on the outside of the car resting against the guard rail, and consequently occupy no room available for passengers. Of course, on a double track road where the tracks are close together, or where center poles are used, all the wheels must be hung on the outer side of the car to avoid possibility of accident. The bracket shown has been employed by several roads and seems to be giving good results.

Surface Planing Machine.

The surface planing machine shown herewith is 24¼ ins. wide and is manufactured by the Egan Company. The frame is adapted for strength and strain and is cast in one piece. The bed is also cast in one piece, and is dovetailed into the frame, making a stiff machine for all kinds of hard and soft lumber, and a cut entirely free from ridges. The bed is strongly gibbed to the frame, and any wear can be taken up by bolts from the outside of the frame, thus insuring great durability and the very best of work.

The boxes for the cylinder, being cast on the machine, furnish a very solid and rigid bearing, free from all vibration. The cylinder is of the best refined steel, and the bearings are long and lined with genuine babbitt. A pressure bar goes on each side of the cylinder, thus insuring steadiness, even when planing short or thin stuff. The pressure bars are self-adjusting, always regulating themselves to the various thicknesses of lumber being planed.

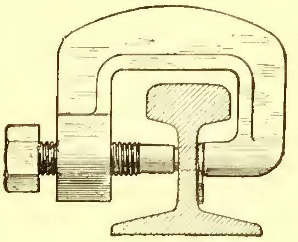
The changing of the machine to cut different thicknesses is quick and simple, the bed being raised and lowered by a single hand wheel. The feed rolls are adjustable, and the cylinder being in stationary boxes, when once set, are always the same, and when the bed is raised or lowered a glance at an index on side shows the thickness to be planed, and requires no further setting. The four feed rolls, which are of steel, are extra large, the front one being fluted, and held down by weights. The friction rolls in table are easily adjustable. The gearing is strong, and every device is introduced to make a strong, reliable feed. It planes from $\frac{1}{16}$ in. to 6 ins. thick and 24 ins. wide, on hard or soft wood.



SURFACE PLANING MACHINE.

The Horse Shoe Rail Bond.

In the last issue of the Street Railway Journal, a description was given of the new rail bond manufactured by J. M. Atkinson and employed on a number of lines. The engravings herewith show the method of attaching the bond through the rail. After the terminals of the bond are driven with a hammer into the holes drilled for their reception, the machine illustrated is put in place and the terminals compressed, causing them to expand in the rail web until every little inequality left by the drill is filled. This gives, it is claimed, a perfect electrical as well as mechanical contact. The whole process of application occupies less than three minutes per bond.


METHOD OF ATTACHING BOND.

The patent covers also the use of a flexible body of loop form with lateral rivet lugs, the bond being made up in a series of flattened wires with their ends cast welded into copper terminals. The latter are drop forged into shape and finished. The loop form, of course, provides for contraction and expansion. The bond is of such a shape as to allow it to be applied under the fishplates, thereby insuring it against the possibility of theft, being cut off by derailment of cars, or deterioration from the action of the earth.

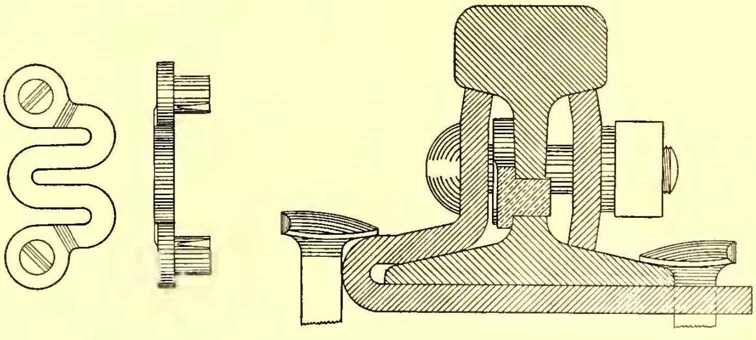
Commutators of G. E. 800 Railway Motors.

The maintenance of the quality of a railway motor depends to a large extent upon the accuracy with which those parts which are subject to wear can be replaced to render the motor as perfect as when new. In refilling the commutator, for instance, considerable difficulty is usually experienced on account of the necessity for great accuracy in turning the segments to fit the cones of the shell, which cannot readily be done unless special tools are employed. To obviate this difficulty the General Electric Company is now furnishing complete sets of segments and segment insulations for all types of railway motors, securely bound together by a band of wire to prevent movement and finished ready for assembly on the old shell. In addition to the preparation of the cone fits, the segments are slotted and tinned for the reception of the armature leads. The only work necessary in the shops of the purchasing company is to screw together the cap and shell clamping rings, solder in the leads and true off the face of the commutator. As the segments are clamped together by hydraulic pressure, they are firmer than those usually manufactured by street railway companies.

Hard rolled copper only is used for these segments and to give a longer life the depth to which the segments can be turned has been increased by forty per cent. The new segments known as form 6 can be used in the repair of form 4 commutators. No change in the brush holder is involved, only a slight readjustment on the yoke.

New Rail Bond.

The present tendency of inventors and manufacturers of rail bonds is towards a short, heavy bond constructed so as to be placed under the angle bar or joint plates. The bond illustrated herewith and known as "Caldwell's self-regulating, self adjusting 'W' electric bond" belongs to this type. Located under the fishplate it is protected from the weather, vehicles and from being tampered with maliciously.


NEW RAIL BOND.

It is made in one piece from Lake Superior copper. The terminals or posts, which are made in various sizes and have a wedge shaped slot in the center, pass through the rail and are then expanded and made solid by driving in a hard copper wedge or key, no other tool than a couple of hammers being required. The manufacturer claims a contact superior to any other method, and that the bond will adjust itself to all conditions. E. P. Caldwell, the manufacturer of this bond, has a very favorable certificate of test made by Professor Stine of Armour Institute.

STREET RAILWAY NEWS

Convention of the Pennsylvania Street Railway Association.

The fifth annual convention of the Pennsylvania Street Railway Association will be held in Altoona, Sept. 2 and 3. The members of the association will convene Wednesday, Sept. 2, at eleven o'clock A. M., at the Casino of Lakemont Park, Altoona, at which meeting the usual annual business of the association will be transacted, including the election of officers of the association for the ensuing year. Scientific papers on different subjects of general interest to the members of the association will be read and discussed and methods for the promotion of the general welfare of street railways considered. The second day will be devoted to a series of entertainments provided for the members and visitors of the association, including an excursion over the lines of the City Passenger and Altoona & Logan Valley Electric Railways, a trip to Wopsononock and closing the day with a banquet at the Mountain House, Cresson. An interesting programme has been arranged and will in due time be published and mailed to members and street railway companies throughout the state.

All street railway companies in the state of Pennsylvania are eligible to active membership and all manufacturers or dealers in street railway supplies, by recent amendment to the by-laws of the association, are eligible to associate membership in the association, the membership fee in each case being $25. Those desiring membership with the association can acquire it by sending membership fee of $25 and one year's annual dues, $10, to the secretary, S. P. Light, Lebanon, Pa.

The president of the association, B. F. Meyers, urges all members of the association to send as many representatives as possible to the convention, and others who have not yet joined the association are not only invited, but earnestly requested to be present and participate in the exercises and entertainments of the convention.

Change of Management on a New York Road.

The Metropolitan Street Railway Company, of New York, which recently acquired control of the New York & Harlem Railroad (City Line) and branches, through lease, commenced the operation of the line July 15, 1896. The system will be known as the "Fourth Avenue Division" of the Metropolitan Street Railway system.

The authority of the officers and heads of departments of the Metropolitan Street Railway Company will be extended over this division as follows:

J. W. Ritchie, assistant general manager, in charge of general operation.

John H. Oakley, assistant superintendent, in charge of transportation.

Henry A. Robinson, attorney, damages and claims.

H. S. Beattie, treasurer, receipts and disbursements.

Chas, E. Warren, secretary, office and organization.

W. C. Kimball, auditor, accounts.

A. C. Tully, purchasing agent and storekeeper, supplies.

Thos. Millen, general master mechanic, rolling stock and building.

W. S. Reed, engineer maintenance of way, track.

Dr. H. Neher, veterinary.

Rewards to Motormen.

The Brooklyn Heights Railroad Company last fall published a notice that during the seven months between Oct. 1 and May 1 all conductors and motormen who would have a clean record would participate in a division of $10,000 as a special reward for their services. At the end of this time the clerks in charge of the record found that the number which participated was 1299 out of a total of 2600, making the amount which each received about $7.70.

During this time the company has found that accidents have visibly decreased and the management announces that it has been satisfied that the amount divided has been well invested. Its future policy in regard to rewards has not been announced, but President Rossiter assured a representative of the STREET RAILWAY JOURNAL that the same liberal policy in general in regard to his employes would be followed and if the money expended for them did not take the form of cash premiums it would be spent in making the quarters of the men at the different depots more comfortable and in other ways the company would contribute to their welfare. The company has established at a number of its depots well furnished reading rooms, baths, etc., and is seriously contemplating the establishment of a gymnasium for the benefit of its employes during off hours.

San Francisco Notes.

The Market Street Railway Company, has just disposed of an annoyance in the transfer business that may be of interest to other railway companies. At several points where transfers were issued in from four to nine different directions, a traffic in transfers sprang up that was a source of considerable loss to the company In the morning many passengers who did not need nor intend to use transfers took them from the conductor at these points. The transfer was then given to one of the many newsboys present, who immediately began crying his paper "and a transfer." Twenty minutes used to be allowed on transfers and the boy usually succeeded in finding some one going in the direction indicated in this interval. Papers sell for five cents in San Francisco, so that the business increased rapidly.

At night when his patron of the morning returned the boy was ready with a transfer that he had procured for the proper destination. The boy made sure of a sale of two papers, the passenger had two rides for ten cents and a newspaper besides, while the railway company had received but one fare for two passengers.

Numerous ways out of the difficulty were suggested, but only two sure solutions seemed to be possible—total abolition of the transfers or a deep cut in the time allowance. The latter was adopted and transfer agents were placed at the transfer points. "Checks" were issued by conductors to passengers. These "checks" were not good for a ride and had to be presented to the transfer agents who exchanged them for transfers in any direction allowed under the rules, but only good on the next car of that line, the trip number of the car being punched out instead of the time limit of the transfers. This worked well as regards those who understood the system, but so many stupid or malicious persons attempted to ride on the "checks" and so many "scenes" were made that the supervisors drafted an ordinance forbidding the company to have transfer agents on the sidewalks. Before the ordinance passed an amendment was added, making it a misdemeanor to engage in the traffic in transfers. When the ordinance was passed the transfer agents disappeared and with them the transfer traffic.

For some time past an elegant switchboard of Inyo marble has been under construction at the Bryant Street station of the Market Street Railway Company. This board consists of fourteen feeder panels, fourteen generator panels and a center station panel. The feeder panels accommodate fourteen feeders each, making fifty-six feeders in all. Each feeder has a 400 ampere Weston round pattern shunt ammeter, a Westinghouse circuit breaker and a heavy single pole knife switch. There is one generator panel for each generator and, when finished, each will have a Weston illuminated dial shunt ammeter and a Westinghouse circuit breaker upon it together with the other usual panel instruments.

The center station panel will be equipped with a 10,000 ampere, illuminated dial Weston shunt ammeter, a 600 volt, illuminated dial Weston voltmeter, hung so as to be swung into view from either direction, a 6000 k. w. Thomson recording wattmeter and a small table for holding record blanks, etc.

The board is to have a handsome hardwood cornice along the upper edge and is to be flanked by offices finished in oak for the chief engineer and electricians. Although lightning is seldom seen in the vicinity of San Francisco and has up the present time never struck any electric railway apparatus, each feeder is to be protected by a Wurts lightning arrester connected just after the wires enter the power house and before reaching the switchboard. The winding of the Westinghouse circuit breakers is expected to serve to some extent as a choke coil, and both devices being helped out by the lightning arresters on the numerous cars, ample protection is considered to be secured without adding the tank arrester now so popular in the East.

S. L. F.

The Glasgow Corporation Tramways.

The street railway system of Glasgow is particularly interesting as in that city the operation of the tramways is being carried on directly by the municipality. The construction of the system was authorized by a Legislative Act in 1870. The lines were built at the expense of the municipality and have always been the property of the city. In 1871, however, they were leased for a period of twenty-three years to a stock company, which operated the lines up to July 1, 1894. At this time, the lease having expired, the operation was resumed by the municipality, and John Young, who for seventeen years had been Superintendent of Cleansing, was appointed general manager of the system.

At this time the merits of the various systems of mechanical traction were carefully considered, but in view of the fact that the operation of the lines could not be interfered with until the expiration of the lease, and for other reasons, it was decided to continue for the time the operation of the cars by horse power. Upon the assumption of control by the city the fares were radically reduced and are now in half-penny stages, varying from a half-penny, or one cent, to six-pence or three cents which maximum is only charged for the longest ride. The system also includes the operation of a certain number of busses.

The following table gives some of the details of operation of the street railway system.

Details of operation of tramways for year ending May 31,

	1895.	1896.
Miles in operation.		
Double track	31 m. 3176 ft.	32 m. 3531 ft.
Single "	3336 ft.	3336 ft.
Cars	305	337
Car mileage	5,169,109	6,831,379
Passengers carried	56,907,519	85,951,230
Receipts	£221,880	£327,751
Average per mile	10.29 *d*	11.51 *d*
Operating expenses	£202,209	£251,110
Average per mile	9.39 *d*	8.69 *d*

Under the direction of the municipality, General Manager Young and one of the committee on mechanical motors recently visited the principal cities of Europe in which mechanical systems are employed.

The following are the conclusions given by the sub-committee in its report:

(1) That the time has arrived when the Glasgow Corporation should make arrangements for beginning, as soon as it conveniently can, to work some of the tramways by mechanical traction.

(2) That the overhead system of electric traction is the best we have seen, and can be made quite applicable to any part of the city.

(3) That the Corporation should begin by testing this system on an important route. The increasing traffic is sure to require further extensions of the tramway service before next summer, and if a trial line, as suggested, could be ready for working next spring, this would save further extension of the present system, and give the Corporation an early test of mechanical traction.

(4) That, in the erection of the overhead lines, the cross-span wires should be fixed to buildings wherever practicable.

(5) That the installation at Hamburg, being the largest installation of electric traction in Europe at present, is one which should be specially included in the list to be inspected.

A Souvenir Number.

The *Scientific American*, has signalized its fiftieth anniversary by the publication of a very handsome seventy-two page special number, which consists of a review of the development of science and the industrial arts in the United States during the past fifty years. The many articles are thoroughly technical, and they are written in a popular style, which makes the whole volume thoroughly readable.

Thayer & Company.

This is the title of a new company recently organized under the laws of the State of Massachusetts by Winthrop Thayer, of Boston, Rodney Thayer and Frank A. Thayer, of New York, and W. C. Turner, of Philadelphia. The headquarters of this company will be at 1015 Tremont Building, Boston, Mass., 145 Taylor Building, New York City, and 415 Drexel Building, Philadelphia, and it will act as general sales agent throughout the Eastern district for the Cahall vertical and Babcock & Wilcox horizontal water tube boilers, as manufactured by the Aultman & Taylor Machinery Company, of Mansfield, O.

Before severing his connection with the Babcock & Wilcox Company, of New York, on July 1, Winthrop Thayer was for fourteen years connected with its sales department and for the last eight years was manager of its New England district. Mr. Turner and Rodney Thayer were also connected with the Babcock & Wilcox Company, of New York, the latter as manager of the Atlantic District. Frank A. Thayer was formerly general manager of the Goubert Manufacturing Company, of New York.

News Items.

Berryville, Ark.—At a recent meeting of the citizens of Berryville a committee consisting of W. P. George, M. O. Hines, J. W. Freeman, J. P. Fancher and C. S. Denton, was appointed to solicit subscriptions, procure rights of way and otherwise promote the interests of an electric railway to be built from Berryville to Eureka Springs.

Catskill, N. Y.—The Catskill, Cairo & Windham Street Railroad Company expects to begin construction work on its lines as soon as the State Railroad Commissioners render a favorable decision to them. Among the directors of the company are Daniel Sharp, of Catskill; S. Mattison, of Newark, N. J., and Louis E. Robert, of Brooklyn.

Chicago, Ill.—The North Chicago Electric Railway Company has been authorized to build and operate electric lines in North Robey Street, Bryn Mawr Avenue, East Ravenswood Park, Balmoral and Lawrence Avenues and Montrose Boulevard.

Dayton, O.—The County Commissioners have granted a franchise to the Dayton, Springfield & Urbana Street Railroad Company to construct and operate its lines. Among those interested are John Harshman, of Enon, O., and John Webb, of Springfield.

Easton, Pa.—The Quakertown & Easton Railroad Company is being organized by John Jameson, of Bloomsburg, Pa.; John Ott, of Pleasant Hill, Pa.; John Ozias and H. H. Souder, of Quakertown, Pa.; Henry Mill and Henry Funk, of Springtown, Pa., and David Fluck and James Shelley, of Richlandtown, Pa., to build an electric railway from Quakertown to Easton. The capital stock will be $150,000.

Great Neck, L. I., N. Y.—Several of the wealthy residents of Great Neck, whose homes are in the vicinity of the steamboat landing, are discussing the question of organizing a company for the purpose of building and operating an electric railway between the railroad station and the landing at the shore. The distance is about two miles, and the estimated outlay is $30,000.

Lyons, N. Y.—The Wayne County Traction Company has been incorporated to build an electric railway from Lyons to Newark. The officers of the company are: president, A. C. Robertson, of Athens, Pa.; vice-president, Orlanda F. Thomas, of Lyons; secretary, D. N. Johnson, of Athens, Pa.; treasurer F. K. Harris, of Athens, Pa.; directors, F. N. Dean, of Ithaca, N. C. Harris, of Athens, Pa.; Burton Hammond, Charles T. Ennis and Clement R. Sherwood, of Lyons. Capital stock, $60,000.

Marysville, Cal.—The Marysville & Nevada Water Power Company has been organized to use water power for generating electricity and to use the water for irrigation. The company proposes to build an electric railway from Santa Rosa to Sonoma in Sonoma County.

Sing Sing, N. Y.—The Ossining Electric Railway Company may extend its lines to Pleasantville.

Worcester, Mass.—On July 27 the State Railroad Commissioners approved the terms of lease of the Worcester & Shrewsbury Street Railway and the West Shrewsbury & Worcester Street Railway to the Worcester Consolidated Street Railway Company.

Personals.

Mr. L. Bentley has been appointed superintendent of the New London Street Railway Company, *vice* E. A. Brown.

Ex-Gov. Frank Brown, of the Baltimore Traction Company, has resigned as president. William A. House, general manager of the company, has been elected his successor.

Hon. W. A. McGuire, of the McGuire Manufacturing Company has gone abroad to organize a new company entitled The W. A. McGuire Manufacturing Company, of London and Chicago, and to extend the sale of McGuire trucks in Europe.

Mr. Charles R. Barnes, of Rochester, has been appointed by the New York State Railroad Commission consulting electrical engineer and expert to the Commission. This position was created by an act of the last Legislature and the salary is fixed at $3,000, with traveling expenses.

Mr. Cyrus Robinson has severed his connection as manager and engineer of the Jeffrey Manufacturing Company and has accepted the position of general manager of the sales department of the J. H. McEwen Manufacturing Company. Mr. Robinson is a well known engineer, and the J. H. McEwen Company will undoubtedly find his services an important acquisition.

Mr. Henry R. Newkirk, formerly superintendent of the Atlantic Avenue Railroad Company, of Brooklyn, N. Y., and recently with Hoefgen, Moxham & Company, has been appointed general manager of the Zanesville Street Railway Company, of Zanesville, O. This company has recently secured new capital and will be improved and extended under Mr. Newkirk's supervision. The title of the company has been changed to the Zanesville Railway & Electric Company.

Obituary.

MR. R. A. CRAWFORD, the inventor and manufacturer of the Crawford fender died in Philadelphia, July 20. He was a native of Allegheny, Pa., and resided in that city until a few years ago when he moved to Philadelphia and engaged exclusively in the manufacture and sale of the fender bearing his name. Mr. Crawford was married a few months ago and was about thirty years of age.

MR. GEORGE LAW, president of the Eighth and Ninth Avenue Railroad Companies of New York died last month. He was the son of George Law, one of the early builders of street railways in New York and was a large owner in and prominently identified with a number of the street railway companies in that city.

AMONG THE MANUFACTURERS.

The Clonbrock Steam Boiler Company, of Brooklyn, N. Y., is enjoying an excellent business. The company's works are said to be rushed to their fullest capacity with orders ahead.

The Berlin Iron Bridge Company, of East Berlin, Conn., has received a contract from the Seymour Manufacturing Company, of Seymour, Conn., for the steel work of the enlargement of the boiler house of the latter company.

The Metropolitan Electric Company is putting on the market a double coil filament incandescent lamp for street car use. This lamp is said to give unusual satisfaction for this class of work as it resists jarring, the filament will not break, and the lamp is long lived, without any appreciable blackening effect.

The Bethlehem Iron Company, of South Bethlehem, Pa., is now ready to roll plates from high grade open hearth steel on its new plate mill, the rolls of which are 126 ins. in length. The company's product in this line will consist of plates for all purposes, which includes ship plate, boiler plate, tank, stacks, etc.

Geo. C. Ewing, of Boston, Mass., reports a very large trade in general railway supplies, having booked several nice orders for full motor car equipments. The Neal headlight has forged ahead, until it now stands at the head as a popular seller. Mr. Ewing also reports a large demand for Western Electric line material and general railway supplies.

Emil Calman & Company, of New York, is probably the oldest varnish house in the United States, having been established in 1850. The firm makes a specialty of railway varnish and has enjoyed a large sale in this line. Emil Calman & Company manufacture all kinds of varnishes and japans and report an excellent business, especially with street railways.

Messrs. Breese & Mansfield, the agents in Philadelphia for the Walker Company, of Cleveland, O., have recently moved their offices from the Betz Building to the Drexel Building. The firm has recently been enlarged by the association with it of William Gibbs Bain, of Boston. Mr. Bain is a prominent business man of the latter city and will add much to the strength of the firm.

The American Car Company, of St. Louis, Mo., has recently published a handsome catalogue illustrating a large number of different cars manufactured by it. Some of these cars are handsomely illustrated in colors giving a very good idea of their appearance. The catalogue is tastefully bound in leather and forms one of the most attractive car catalogues which has ever reached this office.

The J. A. Fay & Egan Company, of Cincinnati, has received an order from Messrs. Weis & Lesh, manufacturers of spokes in Jackson, Tenn., for seven of the Egan Company's new and improved automatic lathes. With these lathes, owing to the many improvements embodied in them, Weis & Lesh are enabled to dispense with the use of their former twelve lathes and yet to nearly double the capacity of their plant.

The Composite Brake Shoe Company, of Boston, Mass., has published a small pamphlet descriptive of the results secured by its brake shoes in the tests recently made of them by the committee of the Master Car Builders' Association at the Westinghouse Works, Wilmerding, Pa. In these tests the Composite brake shoe gave very good results as compared with those of other makes. The pamphlet also gives the new agents of the company, which were mentioned in a recent issue.

The Babcock & Wilcox Company, of New York, has issued a circular it which the managers of the company state that it having come to their notice that various parties are offering to build what purports to be Babcock & Wilcox boilers, they wish to notify all whom it may concern that no outside concern has been authorized to build their boilers. Without infringing a large number of patents owned by the Babcock & Wilcox Company no one can build other than a very antiquated form of Babcock & Wilcox boilers.

The Sterling Varnish Company, of Pittsburgh, Pa., reports that the Siemens & Halske Electric Company has adopted the Sterling varnish for its work, the test to which the varnish was subjected having proved satisfactory. The company is also in receipt of several large orders from Europe, and the fact that during the six months ending July 1, 233 street railway companies have opened accounts with them and are in the majority of cases using Sterling varnish exclusively is excellent evidence of the merits of the varnish.

Meyer & Englund, of Philadelphia, Eastern representatives of the International Register Company, of Chicago, have closed a contract with the Fairmount Park Transportation Company, of Philadelphia, for an equipment of sixty International "iron clad" fare registers to be installed in thirty-six foot open cars now being built. The firm has also secured the contract for furnishing all the overhead line material for the Fairmount Park Transportation Company. All of this material will be of special designs and extra large and heavy, as No. 0000 round trolley wire and ½ in. span wires will be used.

The Brooklyn & New York Railway Supply Company, of Elizabeth, N. J., has recently shipped a number of new electric cars to run between Coney Island and Brooklyn. The works are said to be extremely busy at present and 450 men are employed in the different departments. Since the company moved to its new works at Elizabeth a large number of shipments have been made of cars to different companies. Among these are roads in Norwalk, Conn., and Plainfield, N. J. Arrangements are being made to turn out a considerable number of electric snow plows during the coming season.

Merrill Brothers & Company, of Brooklyn, N. Y., have made a specialty for a long time of drop forged turnbuckles and have achieved an excellent reputation for the high quality of the goods manufactured in this line. The evolution in the manufacture of turnbuckles is an exceedingly interesting one to study and is well illustrated by a card which this firm publishes showing the different crude forms which preceded and led up to the present weldless type. These buckles are made of one piece of iron and smooth finished, and the ends are drilled by special machinery so that they are true in line and are threaded for the U. S. standard thread. The firm also does a large business in the sale of vises of all kinds.

H. E. Collins & Company, of Pittsburgh, Pa., sales agent for the Cahall vertical water tube boilers manufactured by the Aultman & Taylor Machinery Company, of Mansfield, O., has recently published in pamphlet form the reports of several tests made by Thomas Pray, Jr., of Cahall water tube boilers in the Armstrong Cork Company's Works, Pittsburgh, Pa. The boilers are fitted with a Hawley down draft furnace, and excellent results were obtained. These included 13.9 lbs. of water evaporated per pound of combustible at and from 212 degs. F., with efficiency of 85.86 per cent and horse power developed, 257 h. p. on builder's rating at 250 h. p. At the test made the following day 11.7 lbs. of water were evaporated per pound of combustible at and from 212 degs. F. at an excess in horse power developed over manufacturer's rating of 66.4 per cent.

The Fiberite Company, of Mechanicville, N. Y., has published some of its recent testimonials under the heading "Here are a few of the pleasantest words that ever blotted paper." The Fiberite Company has been noted for its advanced ideas in treatment and construction of its specialties. Having practical experience, coupled with an intimate knowledge of the requirements of electric roads, unusual facilities for turning out the best class of work and a determination to furnish nothing but the very highest class of equipment, the Medbery overhead material has achieved an excellent reputation. The new line of Medbery knife switches lately put on the market have also met with a large sale. Under the able management of H. J. Medbery the business of the Fiberite Company has developed to large proportions and its business extends wherever electric roads are in operation.

The National Switch & Signal Company, of Easton, Pa., has been awarded the contract of putting in the large interlocking plant for the new arrangement of tracks of the Philadelphia & Reading, known as the junction of the Norristown and Germantown lines at Seventeenth Street and Indiana Avenue, Philadelphia. The same company has also been awarded the contract for interlocking the crossing of the C. & W. M. R. R. with the M. & G. R. R. R. near Baldwin, Mich.; also the contract for interlocking the crossing of the Wisconsin Central with the Chicago, Milwaukee & St. Paul roads at Hilbert Junction. The company will also install a seventy-two lever machine for the crossing and terminals of the Great Northern with the Northern Pacific at Seattle, Wash.; also a plant in Chicago for the crossing of the Chicago, Milwaukee & St. Paul with the North Chicago Street Railway at Indiana Street.

The Q. & C. Company, of Chicago, is an evident believer in a "campaign of education," for the pamphlets issued by it are certainly most interesting and instructive. The company has reprinted in pamphlet form two very interesting treatises by Benjamin Reece upon the general subject of economies in track construction and the value of tie plates. These are papers originally read by Mr. Reece, one before the New York Railroad Club, in 1892, the other before the Buffalo Association of Railroad Superintendents in 1894. They discuss the question of the protection of ties, proper method of spiking and preserving the gauge, and similar subjects in a masterly way, should certainly have a wide circulation and are worthy of a careful perusal. The Q. & C. Company has offered to send copies of these pamphlets, as well as one entitled "The Use and Economy of Tie Plates," to any reader of this paper, upon request.

Harold P. Brown, of New York, is having excellent success with the Edison-Brown plastic bond and reports that this bond has been used this season by the Fairmount Park Traction Company, of Philadelphia, Pa., the Hamilton Radial Electric Company, between Hamilton and Burlington, Ont.; the twenty mile road built at Hingham, Mass., by Pepper & Register; the extensions of the Louisville

Railway, the Richmond (Va.), Railway; the Staunton (Va.) Railway, the Denver Consolidated Tramway Company, the Staten Island Railway and other roads. The results in Buffalo where the bond has been in use have proved very satisfactory as the following letter, recently received by Mr. Brown from the master mechanic of the road, shows: "I have examined a rail joint bonded with the plastic bond, which examination shows it to be as good as the day it was put in, both rail and angle plate being as bright as a new dollar, after being a year in use. I am satisfied that this is the correct method of bonding when properly done."

The John A. Meade Manufacturing Company, of Rutland, Vt., reports an unusual run of good business on its coal conveying machinery. During the last thirty days the company has closed contracts to equip with coal conveying machinery the following plants: Long Island Railroad; Pawley Brothers, Asbury Park; Dominion Coal Company, Cape Breton, Nova Scotia; Reed & Castello, Lynn, Mass.; Sprague & Breed, Lynn, Mass.; Warren Batchalder, Boston, Mass.; Chicago Street Railway Station, Chicago; Siegel & Cooper Company; Thos. S. Watkyns, Troy, N. Y.; Poughkeepsie Light & Power Company, Poughkeepsie; Central Gas Company, New York; J. F. Swords New England Coal Company. A representative of the STREET RAILWAY JOURNAL recently had the pleasure of visiting the works of the Meade Company at Rutland and found one of the most complete factories in this country, equipped with the very latest labor saving machinery and with its own foundry to supply casting. The company is in a position to manufacture coal conveying machinery at the very lowest possible price.

The McGuire Manufacturing Company, of Chicago, reports an amount of orders on hand never before equalled at this season of the year. The outlook is very promising, particularly so in the sweeper and stove departments. It is quite surprising to note the number of orders already on hand for the company's rotary track cleaners for fall delivery. The company starts the season with an unequaled record for its track cleaners through the past winter, and that they stood the severe tests satisfactorily is proven by the fact thet all but four orders now on hand are from roads that used them last year, and the McGuire Company considers a duplicate order a good letter of recommendation. While it is a trifle early for the stove business, the company is making arrangements to handle double the business of last year, and expects to receive more than this number of orders. The company has also a number of orders on hand for its patented ratchet handles, and they are being adopted as standard by many large companies. The company's new Eastern agent, H. P. Hirsch, has already secured a number of orders and states that the demand for McGuire apparatus is on the constant increase.

The J. H. McEwen Manufacturing Company, of New York, reports the following sales for the month of June: dynamos: 60 k. w. direct connected to 16 in. × 16 in. McEwen engine, to Jeffrey Manufacturing Company, Columbus, O.; 50 k. w. and 100 k. w. direct connected to 12 in. × 12 in. and 15 in. × 16 in. McEwen engines to Bissell, Dodge & Erner Company, Toledo, O.; 100 k. w. and 150 k. w. belted machines, to Link Belt machinery Company, of Chicago. 30 k. w. belted, to Jeffrey Manufacturing Company, Columbus, O.; 25 k. w. belted, to New York Safety Insulated Wire Company, New York; 200 k. w. direct connected to McEwen tandem compound engine and a 400 k. w. direct connected to McEwen tandem compound engine, to Tacony & Frankford Electric Railway Company. This is the second order placed by this company, the first having been for two 200 k. w. generators direct connected to McEwen engines. In sales of engines the company reports the following: 9 in. × 10 in., to W. M. Johnston & Company, Chicago; 8 × 10 ins., to Elk Tanning Company, Philadelphia; 13 in. × 14 in., to Jeffrey Manufacturing Company, Columbus, O; 13 in. × 14 in. to Scranton Electric Construction Company, Scranton, Pa.; 8 in. × 10 in., to Jeffrey Manufacturing Company, Columbus, O.

The Hazelton Boiler Company, of New York City, reports the following recent sales of boilers aggregating 2450 h. p.: the Rochester Gas & Electric Company, Rochester, N. Y. (8th order), 500 h.p.; the Lambertville Rubber Company, Lambertville, N. J. (3d order), 200 h. p.; the Goodyear Rubber Company, Middletown, Conn. (3d order), 150 h. p.; the Bristol Electric Light & Railway Company, Bristol, Conn. (3d order), 200 h. p.; the Equitable Gas Light Company, New York, 500 h. p.; the Pettebone-Cataract Paper Company, Niagara Falls, N. Y., 250 h. p.; the North Adams Gas Light Company, North Adams, Mass. (3d order), 150 h. p.; and the Newton Falls Paper Company, Newton Falls, N. Y., 250 h. p. It has also recently completed contracts with the Capewell Horse Nail Company, Hartford, Conn., and P. & F. Corbin, New Britain, Conn. The Hazelton Company reports that nearly all its orders now being received are for the very earliest possible delivery, and that many of its recent sales have been made to old customers, who are now enlarging their plants. The original boilers sold to these customers have been in constant operation for from eight to ten years, without repairs, still carrying high pressure, and giving the same fine results as when new. This, together with the fact that the Hazelton Company has made various improvements in the construction and setting of its boilers, increasing their efficiency and economy, and improving their appearance, makes it much easier to make sales now than formerly. The facts are not only gratifying to the company, but also seem a pretty sure indication of an improved feeling and condition in manufacturing business generally throughout the country.

The Fiberite Company, of Mechanicville, N. Y., manufacturer of the Medbery insulation, is having a very large demand for its products. The increased demand among conservative railway managers for a high grade of overhead equipment shows itself in the extraordinary sale of this material to roads which require only an equipment that will be durable and permanent. The company has recently had large orders for the Medbery insulation from the Brooklyn Heights Railway Company and Nassau Railway Company, Brooklyn; Steinway Railway Company, Long Island City, N. Y.; Union Traction Company, Philadelphia; Frederick & Middletown Railway Company, Frederick, Md.; Union Railway Company, Providence; Wilkesbarre & Wyoming Valley Traction Company; Buffalo City Railway Company; Akron Street Railway Company; Chicago City Railway Company; Market Street Railway Company, San Francisco; Pasadena & Los Angeles Electric Railway Company; Oshkosh Street Railway Company; Suburban Street Railway Company, Chicago, and many other roads of this class. The Medbery insulation is made of a high grade of aluminum bronze and a composition that is claimed to be absolutely weatherproof, and which shows a very high electrical resistance. It is of the best material that can be procured, and in no case is the work slighted to cheapen the production. The sales of this company are more than triple those of last season, which indicates the high esteem in which the Medbery insulation is held by all thoughtful railway managers. The Medbery switches for station and railway use are fast taking a leading position. They are entirely of polished bronze and copper.

Alfred G. Hathaway, of Cleveland, O., reports a large call for the Murray brake, of which he is the manufacturer. The Murray brake was described and illustrated in the 1895 Souvenir issue of the STREET RAILWAY JOURNAL, and is a mechanism for setting the brakes on a car by simply using the momentum of the car to do so. Friction is employed to accomplish this and is obtained by pressing the winding drum against an iron collar keyed on to the axle, with a fibre or leather washer placed between the two. To the winding drum is attached a chain which connects with the brake gear. The whole brake turns on a brass bronze sleeve perforated with holes filled with paraffine and graphite, which act as a lubricant. Ball bearings take the pressure applied by the motorman, thus enabling him to make a smooth stop and rendering it impossible for the brake to set after once being released. Where trail cars are not used, a single brake on one axle is all that is needed. Should trail cars be used it is better to have a brake on each end of the car and connect the brake rod of the trail car with a chain to the friction drum. This enables the motorman to set the brakes on both cars by means of the same movement. This brake is claimed to be as efficient as any air or electric brake and is guaranteed by the manufacturer to stop a car in as short a distance as any brake in the market. The Third Avenue Railroad Company, of New York, brakes a large number of trailers by means of this device. The brake has also been adopted by the West Chicago Street Railroad Company and the Missouri Street Railroad Company, of St. Louis, and Mr. Hathaway is now equipping with it all the cars of the Chicago & Englewood storage battery lien.

The Brussels Tapestry Company, of Chauncey, N. Y., reports a very large increase of orders for its wool terries, which are used on steam railroads for window shades more extensively, it is claimed, than any other material. As the Brussels Tapestry Company has been manufacturing this line of goods for the past twelve years the company has been able to keep pace with demands and watch what changes were necessary in order to have its goods of the highest quality, both for holding color and wear. The line of patterns and colors of this company are so varied, and its patronage so extensive and broadly scattered over the United States, Canada and Mexico that it is able to duplicate any sample. The highest recommendation claimed for these goods is that they are standard upon the principal sleeping car lines of the United States and Canada, and upon more railroads than all others combined. Now that electric cars are being built and finished as finely as railroad coaches a cheap looking curtain is very much out of place. Another point in favor of wool terries made by the Brussels Tapestry Company is that they can be cleaned the same as any wool cloth, and if given any kind of attention will look good as new for years. It is said that the Brooklyn Elevated Railroad Company has its curtains cleaned three or four times at a very small expense each time, thereby giving the curtain the life and looks of a new one for a great number of years. This cannot be done with inferior materials. As the cost of curtains for a car amounts to considerable it will pay to get the best, particularly when it costs no more than other materials manufactured for car curtain purposes. The "Perfect" self-adjustable curtain fixture manufactured by the Brussels Tapestry Company is being very generally adopted for electric cars on account of its simplicity and durability.

The Edward P. Allis Company, of Milwaukee, Wis., numbers among its recent orders the following: two cross compound engines of 1000 h. p. each, direct coupled to electric generators, for the Syracuse Street Railway Company, Syracuse, N. Y.; one engine of 800 h. p. for the Brockton Street Railway, Brockton, Mass.; large hoist for Butte, Mont.; four large engines for the Otis Falls Pulp Company, Me.; cross compound condensing engine for the McCormick Harvester Machine Company, Chicago, and tandem compound engine for the Sandusky Electric Light Company. The company's engine department has well in hand the order recently received from the Northwestern Elevated Railway Company, of Chicago, for 9000 h. p. of engines. The company has also just shipped a vertical compound condensing engine of 2500 normal h. p. to the Warren Manufacturing Company. An Allis twin tandem compound, condensing engine of 2500 h. p. has just been started in the new Berkshire Cotton Manufacturing Company's mill, Adams, Mass. The company has also just started the first of the six large pumping engines which it is building for the City of Pittsburgh. It is also just shipping the Canal & Claiborne Street Railway Company, New Orleans, two tandem compound, condensing, direct coupled engines of 700 h. p. each. The company's mining department is also busy. It has just received an order for the complete machinery of a large new reduction works to be built in Colorado. This order includes the engine, boilers, crushers, rolls, concentrators, clorination barrels, etc., etc., in fact the entire machinery of the plant. The company's saw mill department has just received an order for the complete machinery of a large mill to go to California. This mill will be one of the largest of its kind in the country. The Allis Company will supply, in addition to the saw mill machinery, the necessary engines and boilers. The company has now in operation six of the twelve vertical compound, condensing, blowing engines building for the Carnegie Steel Company.

The White-Crosby Company, of New York, has enjoyed an excellent business during the present season. The following are some of the principal contracts upon which the company has been engaged since Feb. 1, 1896: about ten miles of track and overhead for the Norwalk Tramway Company, five of which are completed and in operation and the remainder being finished up as rapidly as possible; six miles of complete line for the Rahway (N. J.) & Sewaren Electric Railway, which is about completed, and will soon be in operation; five miles of overhead, including fifteen miles of feeder, for the Bergen County Traction Company, completed and in operation; contract with the Baltimore City Passenger Railway Company for special work and overhead line connecting one of this company's cable tracks with an electric line; five miles of overhead for the Baltimore Traction Company, on its new Westport line; five miles of extra feed wire for the Baltimore Traction Company, to give sufficient power for the company's base ball business; the equipment of the Druid Hill Avenue line of the Baltimore Traction Company, for electric service (about eight miles); two thousand feet of subway for the Baltimore & Ohio Railroad Company for lighting the company's new Mt. Royal station from the present power house, which operates the Belt Line Tunnel electrically, the equipment of the overhead extension of the Gywnn-Oak line of the Baltimore Traction Company; building and equipment of the smallest electric railway in the country, connecting with the Walbrook extension of the Baltimore Traction Company. This road is only about 3000 ft. long, and is complete within itself. The company is also acting as electrical engineers for the Helena & Livingstone Smelting & Reduction Company's new plant. This is a power transmission plant, including two 225 k. w. and five 150 k. w. Crocker-Wheeler 500 volt machines. The distance of transmission is 1½ miles. The company is also acting as electrical engineers for the Helena Water & Electric Power Company, which is installing the Westinghouse alternating apparatus, to transmit power to East Helena and Helena, twelve and seventeen miles, respectively. The station is planned for eight 650 k. w. generators (four of which are now being installed), step-up transformers, step-down transformers, and the necessary station apparatus. The voltage will be about 10,000 on the transmission line, distributing through Helena and East Helena at required voltages. The company has completed about five miles of the Atlantic Highlands, Red Bank & Long Branch Electric Railway, and will furnish the line by fall.

New Publications.

REPORT OF THE FOURTH ANNUAL MEETING OF THE PENNSYLVANIA STREET RAILWAY ASSOCIATION.

The Pennsylvania Street Railway Association has adopted the commendable practice, followed by too few of the state associations, of printing the reports of its annual meetings. The report of the fourth annual meeting, which is at hand, contains as its principal article the interesting paper by Mr. Baylor on "Power Consumption by Electric Railways" printed in the October, 1895, issue of the STREET RAILWAY JOURNAL. The pamphlet also contains the Constitution and By-Laws of the Association and a list of its active and associate members.

REPORT UPON MECHANICAL TRAMWAY MOTORS, made to the Tramways Committee of Glasgow upon mechanical motors by Councillor Crawford and the general manager of the Glasgow Corporation Tramways. Published by the Glasgow Corporation, April, 1896.

This report is the result of a trip on the continent of Europe authorized by the Glasgow Municipality. The principal cities of Germany, France, Italy and Austria, in which motors operated by mechanical power were used, were visited, and interesting particulars and engravings of the principal systems are given in the report. The conclusions reached by Messrs. Crawford and Young are given elsewhere and are, in brief, that the city make arrangements as soon as possible for the equipment of some of its tramways by the overhead electric system.

THE ENGINEERING INDEX. Volume II. 1892-1895. Edited by J. B. Johnson, C. E. Cloth. Octavo, 474 pages. Price, $4. Published by the *Engineering Magazine*, New York.

So many are the technical publications of the present day and covering as they do every branch and sub-division of engineering work, the modern engineer does not have, and cannot be expected to have, time enough to read thoroughly every periodical which treats of the work in which he is interested. For this reason indices to periodical technical literature, when carefully compiled, are most valuable. Of the many which have been published, we have always considered that issued by the *Journal of the Association of Engineering Societies* the most complete. Owing to a recent arrangement made by the publishers of this journal with the *Engineering Magazine*, the work of the Journal will be carried on in the pages of the latter periodical, the editors of which have changed their former method of indexing to conform with the practice of the Journal. The volume referred to above contains the index published by the Journal during the four years mentioned, 1892 to 1895 inclusive, and will be followed annually by similar volumes. The index is most carefully classified, and forms a most valuable publication.

Trade Catalogues.

BRAKE SHOES. THE MASTER CAR BUILDERS' TEST. Published by the Composite Brake Shoe Company, Boston, Mass. Eight pages.

STANDARD PRICE LIST OF ELECTRICAL MICA. Published by Eugene Munsell & Company. New York. Sixteen pages. Illustrated.

REPORT OF TEST OF CAHALL VERTICAL BOILER AT VANDEGRIFT, PA. Published by the Aultman-Taylor Machinery Company, Mansfield, O. Twenty-four pages. Illustrated.

List of Street Railway Patents.

U. S. PATENTS ISSUED JUNE 16, 1896, TO JULY 14, 1896, INCLUSIVE.

JUNE 16.

TROLLEY.—John H. Holland and Peter F. Glazier, Indianapolis, Ind. No. 561,991.

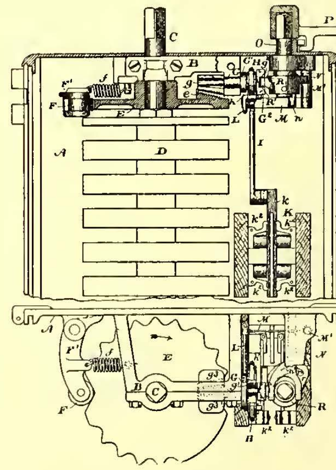
A trolley wheel in two sections divided horizontally and pivoted together so as to form a swivel construction and having ball bearings between the meeting faces of the sections.

RAIL BOND OR CONNECTION.—H. P. Wellman, Catlettsburg, Ky. No. 562,055.

A bond wire having iron or steel terminals and a copper bar or connection electrically welded thereto at its opposite ends.

CONTROLLER FOR ELECTRIC CARS.—E. A. Sperry, Cleveland, O. No. 562,100.

Consists of a controlling cylinder, a reversing switch, operating connections between the cylinder and the movable contacts of said switch, and means for causing said connections to move the switch in either direction at will, irrespective of the direction of movement of the cylinder.



PAT. NO. 562,100.

EMERGENCY ELECTRIC BRAKE.—B. F. Card, Brooklyn, N. Y. No. 562,118.

Has an electro-magnet inverted under a car, and rigidly connected thereto, and having an armature electrically connected to the car, brake shoes provided with horizontal operating arms connected elastically to the armature.

TROLLEY FOR ELECTRIC RAILWAY.—M. T. Graf, Buffalo, N. Y. No. 562,132.

AUTOMATIC CAR FENDER.—Chas. Cogniasse and D. F. Shultz, San Francisco, Cal. No. 562,171.

CAR FENDER AND BRAKE.—E. F. Dieterichs, Cleveland, O. No. 562,288.

TROLLEY WIRE SWITCH.—S. D. Cushman, Akron, O. No. 562,356.

A switch having line and switch wire terminals and a rocking tongue to bring either switch terminal in alignment with the main terminal.

BRAKE SHOE.—Wm. W. Whitcomb, Brookline, Mass. No. 562,346.

A brake shoe consisting of a body portion provided with a longitudinal slot or groove, of a width substantially equal to the width of that portion of the car wheel worn by the rail, and a body of softer material inserted into said slot to form a braking surface for the portion of the wheel worn by the rail.

JUNE 23.

CAR FENDER.—L. L. Mincer, Rochester, N. Y. No. 562,477.
Consists of a frame pivoted to the car, springs for rocking the frame in opposite directions, and means secured to the car for limiting the downward movement of the advance end of the frame.

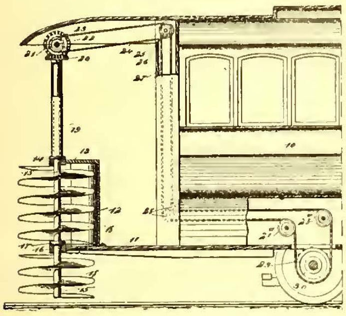
TROLLEY.—H. A. Seymour, Washington, D. C. No. 562,494.
A pivoted trolley pole, a bell crank lever and intermediate connections, whereby the bell crank lever may serve to raise and lower the trolley pole to lock it in its raised position.

CAR TRUCK.—E. Cliff, Newark, N. J. No. 562,579.

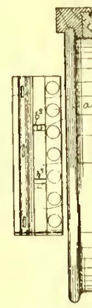
CAR FENDER.—A. Knoblauch, Minneapolis, Minn. No. 562,769.

JUNE 30.

CAR FENDER.—O. A. White, New York. No. 562,870.
A car fender consisting of a shaft having a wide flange proceeding spirally about it and formed of India rubber, the outer edge of the flange being the same distance from the shaft or parallel therewith throughout its length



PAT. NO. 562,870.



PAT. NO. 562,346.

CAR TRUCK.—C. E. Canfield, Philadelphia, Pa. No. 562,884.
A radial car truck, consisting of a pair of load carrying wheels, longitudinal wheel pieces mounted upon the axle of said wheels, a top frame supporting the car body, springs and parallel link connections between said wheel pieces and top frame, and a pair of guiding wheels held in the ends of said wheel pieces.

ELECTRIC RAILWAY.—W. E. Hanshue, Kalamazoo, Mich. No. 562,894.
A double electric conduit, with a portion projecting up between the two, and an insulating material extending around the interior portions of said conduit continuously up over the portion first named.

TROLLEY WHEEL.—I. B. Metzger, Canton, O. No. 562,904.

AUTOMATIC SPEED CONTROLLER FOR ELECTRIC CARS.—H. A. Seymour, Washington, D. C. No. 562,925.
A speed governor arranged to be operated by the armature shaft, an electric brake mechanism, two sets of resistances, one included in the motor circuit and the other in the electric brake circuit, and means connected with the governor for automatically and simultaneously actuating the contact arms of both resistances.

ELECTRIC RAILWAY.—J. Tatham, Philadelphia, Pa, No. 563,094.
A slotted conduit, a conductor therein, an insulating lining within the conduit, and insulating blocks for supporting the conductor therein, said blocks having inclined approaches for lifting the current collector.

CAR TRUCK.—G. W. Lacy, Kingston, N. Y. No. 563,187.
A side frame comprising two similar symmetrical truss portions connected by an intermediate device formed of adjacent bars, one member of each truss and of the intermediate connection being double, with a pedestal secured between the members of each truss portion.

CONTINUOUS TRAMWAY RAIL.—W. H. Wright, Buffalo, N. Y. No. 563,242.

ELECTRIC RAILWAY TROLLEY SYSTEM.—W. C. Keithley, San Francisco, Cal. No. 563,244.

JULY 7.

COMBINED FENDER, BRAKE MECHANISM AND TROLLEY ARM OPERATING DEVICE FOR CARS.—W. Walter, Bridgeport, Pa. No. 563,338.
A rising and falling fender having a rearwardly projecting arm in combination with a swinging frame in front of said fender and adapted to operate the same and a shoe against which said arm is adapted to bear when the fender is lowered.

POWER GEARING FOR ELECTRIC CARS—E. A. Sperry, Cleveland, O. No. 563,425.

CAR FENDER—W. H. Bell, New York, N. Y. No. 563,439.

STREET CAR BRAKE—C. W. Carter, Minneapolis, Minn. No. 563,446.

SPEED INDICATOR—T. O. Bateman, Fort Worth, Tex. No. 563,544.

TROLLEY WIRE FROG—M. F. Bean, Springfield, Mass. No. 563,546.

CAR FENDER—R. C. Hoyer, Memphis, Tenn. No. 563,594.
A lower fender located beneath the car body, a second fender mounted to have a rotary reciprocating movement, and means for operating the upper fender by the movement of the car.

CAR FENDER AND BRAKE—J. Matzinger, Mount Vernon, N. Y. No. 563,606.

AUTOMATIC CAR FENDER—D. Bently, Philadelphia, Pa. No. 563,642.

JULY 14.

BRAKE FOR ELECTRIC CARS—W. V. Ash, Irvington, N. J. No. 563,725.

PNEUMATIC TRACK SANDING DEVICE—F. M. Dean, Huron, S. D. No. 563,751.
A sand box, and its discharge pipe, a blast nozzle, the pressure from which is adapted to eject sand from the box through the discharge pipe and a needle located in the nozzle passage and controlled by the air pressure.

CAR FENDER—O. B. Finn, Philadelphia, Pa. No. 563,951.
A fender having a trigger with a series of independently operating sections, an emergency brake, a wheel guard, a sand box, and a circuit breaker, all simultaneously operated by said trigger.

CAR FENDER—C. K. Colby, Brooklyn, N. Y. No. 564,006.

SAFETY GUARD FOR STREET CARS—C. M. Pratt, Towanda, Pa. No. 564,027.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of twenty-five cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY, HAVEMEYER BUILDING, NEW YORK.

Our Financial Supplement.

The welcome extended by the financial, technical and daily press of the country to our financial supplement for 1896, "American Street Railway Investments," which was published last month, has been so cordial that its editors feel amply repaid for all the labor and care which they have bestowed upon it. The following are a few of the many kind words spoken by contemporaries:

This valuable volume is no stranger to the public. It is in fact, the law and gospel to people interested in street railway properties. —*Brooklyn Eagle.*

A most valuable compilation of statistics in regard to street railways in this country.—*United States Investor.*

A valuable contribution to the statistical literature of the time. * * It is an exceedingly complete book.—*The Economist.*

Full of the most valuable and interesting data and information on the subject treated.—*Financial Record.*

A publication that is standard for those interested in street railway affairs. * * The book is a mine of useful information.—*Mail and Express.*

As regards the new and small corporations the work is of especial value.—*Commercial and Financial Chronicle.*

A compendium of the latest information of every street railway enterprise in the United States.—*Cleveland Daily Plaindealer.*

Full of the most valuable and interesting data and information on the subject treated.—*Cincinnati Inquirer.*

The book is very complete and covers all points upon which an owner of street railway securities could desire information.—*Philadelphia Press.*

"American Street Railway Investments" is full of the most valuable and interesting data and information.—*Daily Financial News.*

The volume has justly become to be regarded as an authority on all matters pertaining to street railways.—*New York Times.*

The supplement for 1896 of the STREET RAILWAY JOURNAL is a work which should be in the hands of all investors as well as bankers.—*Philadelphia Stockholder.*

An authority on street railway properties and investments.—*Chicago Times-Herald.*

The book is very complete and covers all points that an owner of street railway securities could ask.—*New York Journal of Commerce.*

A very reliable and comprehensive publication.—*Electrical Review.*

A most valuable reference book in connection with all departments of the street railway business.—*Boston Transcript.*

It contains within its red covers information of permanent value to investors interested in electric railway properties. It contains by far the most complete record of street railway properties published anywhere. A particularly valuable feature of this work is the fact that a very large majority of the companies whose operations are reported have themselves revised the final proofs and approved the general form of the statement. The figures are presented so as to show at a glance the comparison with previous years, without the necessity for reference to previous volumes.—*Wall Street Journal.*

FINANCE

Statistics of Mileage, Cars and Capitalization of American Street Railway Properties.

In the accompanying table of statistics is presented a close approximation to the number of miles of street railway track in the different states in actual operation by horse, electric, cable and miscellaneous motive powers; the number of cars of all kinds in use; and the gross outstanding capital stock and funded debt. The difficulties in making a compilation of this kind are very great, owing to the absence of a central official board at Washington to prescribe forms and rules for street railway returns and to insist upon such returns. Nevertheless the figures here given for capital stock and funded debt are believed to be correct within seven per cent, and in most of the states within three or four per cent, while the statistics of mileage and cars do not differ more than three or four per cent from the actual figures in any one state. Moreover, possible errors in individual cases will to a large extent counterbalance each other.

The compilation has been made from the information contained in the STREET RAILWAY JOURNAL'S Financial Supplement, "American Street Raliway Investments," most of which was given and afterwards approved by the individual companies themselves.

In tabulating the figures for capital stock and funded debt, the amounts actually issued have in all cases been used, no accounts being taken of the amounts authorized and not yet issued. Bonds held in escrow to retire prior issues have been used and the prior issues themselves omitted, although there is usually no difference in the amounts. In the case of leased companies whose capital stock or funded debt is held in the treasury of the lessor as security, the capital stock or funded debt of the lessee has not been included, and the mileage has been added to that of the lessor company. The table therefore shows the actual charges upon the actual mileage of the street railways of the United States and Canada.

Commenting briefly on the figures as given, it will be seen that the Southern States have the smallest capitalization per mile of track, due, no doubt, to the percentage of horse mileage yet remaining in these states and also to the absence of expensive city construction.

In New York, New Jersey, District of Columbia, Rhode Island, Illinois, Minnesota and Louisiana, the gross average capitalization exceeds $100,000 per mile of track, due, of course, to the influence of the large cities in these states, the majority of the roads in which are equipped with improved motive power, and where the cost of construction is very great. The result of this influence is shown to the greatest extent in New York State in the enormous gross capitalization of $182,800 per mile of track, while South Carolina, Florida, Mississippi and Idaho show the absence of such influence in a gross capitalization of less than $11,000 per mile of track.

Statistics of the Steam Railroads of the United States.

The Eighth Statistical Report of the Interstate Commerce Commission, has just been submitted. Some of the information given is most interesting. On June 30, 1895, 169 roads were reported in the hands of receivers, showing a net decrease of twenty-three during the year. The roads under receivers operated 37,855.80 miles of line, which shows a decrease of 2,963.01 as compared with 1894. The railway capital represented by these roads was nearly $2,500,000,000, or about 22.20 per cent of the total railway capital in the United States.

The total railway mileage in the United States on June 30, 1895, was 180,657.47 miles, an increase of 1.09 per cent. The aggregate length of all tracks in the United States was 236,894.26 miles. The number of railway corporations was 1965. Of these forty-two companies operate 55.67 per cent of the total mileage and 133 or 12.05 per cent of the operating companies operate 80.24 per cent.

The number of men employed by railways shows an increase of 5426, as compared with last year, the number of employes being 785,034.

The amount of railway capital on June 30, 1895, is shown to be $10,985,203,125, or $66,330 per mile of line. This was distributed as follows: $4,201,697,351 was common stock, and $759,561,305 preferred stock; the funded debt was $5,407,114,313, classified as bonds, $4,659,873,548, miscellaneous obligations, $445,221,472, income bonds, $246,103,966, and equipment trust obligations, $55,915,327; the current liabilities amounted to $616,830,156. Stock to the amount of $3,475,640,203, or 70.05 per cent of the total outstanding paid no dividend, and $904,436,200, or 16.90 per cent of funded debt, exclusive of equipment trust obligations, paid no interest during the year covered by the report.

The number of passengers carried by the railways during the year ending June 30, 1895, was 507,421,362, which shows a decrease of 33,266,837. The number of tons of freight carried as reported by railways was 696,761,171. The gross earnings were $1,075,371,462, an increase of $2,009,665 for the year. The expenses of operation for the same period were $725,720,415 which were $5,693,907 less than for 1894. The percentage of operating expenses to operating income, for 1895, was 67.48 per cent.

Michigan Labor Statistics.

The report of the Bureau of Labor and Industrial Statistics, of Michigan, for the year ending Feb. 1, 1896, contains some very interesting information. Among other facts are the following: the average age of street railway employes is thirty-two years, the maximum seventy-five and the minimum sixteen. Nearly sixty per cent of the employes are American born. Sixty-nine per cent are married and thirty per cent are single. The average time on duty is 9.9 hours per day out of 10.3 hours constituting a day's work. About twenty-nine per cent of the employes work overtime, sixty-nine per cent do not and two per cent do not answer. Of those who work overtime seventy-seven per cent receive extra pay and twenty-three per cent do not. Sixty-three per cent receive pay for overtime at the same rate as for regular time, seventeen per cent receive more and twenty per cent do not answer. Forty per cent of the total number of employes have had their pay increased during the year and forty-four per cent report no increase. Two per cent report a decrease while fourteen per cent do not answer. The average amount of the increase is stated to be nine per cent.

Forty-three per cent of the employes save money during the year, about fifty-three per cent report no savings and four per cent do not answer. Less than twenty-five per cent own their own homes. About forty per cent report that they can earn more than enough to support themselves and families, forty per cent say that they cannot earn more than a comfortable support for themselves and families, and fifteen per cent, comprising a large proportion of single men, do not answer. About fifty-seven per cent belong to labor organizations a large proportion of these being in Detroit, about thirty-four per cent do not belong to such organizations and about nine per cent give no answer. Of those who belong to labor organizations over ninety-eight per cent are satisfied that the effect of these organizations is to increase wages. Ninety-eight per cent also report that the labor organizations have neither sick nor death benefits.

"Outside Securities" in Financial Markets.

The increasing interest in what are known on the New York stock market as "outside securities," which include street railway, gas, waterworks and miscellaneous stocks and bonds, has been a noticeable feature in the three or four principal cities of the country, during the last two years. Several of the New York and Philadelphia daily papers have been devoting considerable space in their financial columns to news notes and market points upon these outside securities, the greatest attention being given, of course, to street railway securities. The *Mail and Express*, of New York, has been particularly active and successful in this line and was, in fact, the pioneer in breaking away from the conservatism in such matters, which was a characteristic of the daily press until within the last two years. The financial columns of the *Mail and Express* are particularly well edited and are newsy and attractive in every particular.

Report of the Alton Railway & Illuminating Company.

The Alton Railway & Illuminating Company reports earnings as follows:

Ten months ending July 1,	1896.
Receipts from light and power	$22,858
" " railway	24,257
" total	$47,115
Operating expenses	22,210
Earnings from operation	$24,905

STREET RAILWAY STATISTICS OF THE UNITED STATES.

MILEAGE, CARS, CAPITAL STOCK AND FUNDED DEBT.

STATES.	No. of Roads.	Horse.		Electric.			Cable.			Miscellaneous.			Total.		Capital Stock.		Funded Debt.		Capital Liabilities.	
		Miles.	Cars.	Miles.	Motor Cars.	Trail Cars.	Miles.	Grip Cars.	Trail Cars.	Miles.	Dummy Engines.	Coaches.	Miles.	Cars.	Total.	Per Mile Track.	Total.	Per Mile Track.	Total.	Per Mile Track.
New England.																				
Maine	13	17	34	98	165	64	...	...	...	...	...	...	115	263	1,977,875	17,200	2,253,000	19,600	4,230,875	36,800
New Hampshire	5	14	38	38	80	35	...	...	...	...	...	...	52	153	373,100	7,200	550,000	10,600	923,100	17,800
Vermont	5	...	...	29	37	9	...	...	...	...	...	...	29	46	472,000	16,300	401,000	13,800	873,000	30,100
Massachusetts	59	54	692	1,093	3,445	240	...	...	...	6	9	...	1,153	4,386	37,114,200	32,200	23,200,900	20,100	60,315,100	52,300
Rhode Island	8	3	2	137	379	212	...	...	...	...	...	...	140	593	8,320,200	59,400	8,357,200	59,700	16,677,400	119,100
Connecticut	23	...	21	334	702	200	...	...	...	...	...	...	334	923	9,646,740	28,900	6,676,000	20,000	16,322,740	48,900
Total	113	88	787	1,729	4,808	760	...	...	...	6	9	...	1,823	6,364	57,904,115	31,800	41,438,100	22,700	99,342,215	54,500
Eastern States.																				
New York	109	295	2,058	1,382	4,559	688	55	821	201	172	483	1,571	1,904	10,381	174,374,161	91,600	173,593,596	91,200	347,967,757	182,800
New Jersey	36	40	200	543	1,202	135	2	2	...	...	...	...	585	1,539	35,035,250	59,900	33,627,000	57,700	68,662,250	117,600
Pennsylvania	110	10	174	1,451	3,715	239	27	156	...	3	10	4	1,491	4,298	134,862,445	90,500	73,067,688	49,000	207,930,133	139,500
Delaware	2	...	...	27	63	...	...	...	...	...	...	...	27	63	419,480	15,500	600,000	22,200	1,019,480	37,700
District of Columbia	10	53	289	59	100	171	28	142	175	...	...	...	140	877	14,910,500	106,500	4,360,000	31,100	19,270,500	137,600
Maryland	6	...	100	233	464	95	36	132	60	...	...	...	269	851	12,826,150	47,700	12,985,000	48,300	25,811,150	96,000
Virginia	17	10	27	163	247	39	...	...	...	4	1	4	177	318	5,600,250	31,600	4,800,000	27,100	10,400,250	58,700
West Virginia	4	6	7	26	32	6	...	...	...	9	4	20	41	69	1,240,000	30,200	600,000	14,600	1,840,000	44,800
Total	294	414	2,855	3,884	10,382	1,373	148	1,253	436	188	498	1,599	4,634	18,396	379,268,236	81,800	303,633,284	65,500	682,901,520	147,300
Central States.																				
Michigan	31	3	5	438	1,004	222	...	...	...	9	4	5	450	1,240	9,137,900	20,300	7,244,500	16,100	16,382,400	36,400
Ohio	62	15	28	1,073	2,087	954	44	154	103	3	7	6	1,135	3,339	57,146,800	50,400	26,035,500	22,900	83,182,300	73,300
Indiana	26	25	40	305	479	228	...	...	...	...	...	...	330	747	10,276,550	31,100	8,651,000	26,200	18,927,550	57,300
Kentucky	10	45	139	167	291	220	...	...	...	...	...	...	212	650	7,465,900	35,200	6,585,000	31,100	14,050,900	66,300
Wisconsin	16	4	2	271	330	137	...	...	...	...	...	...	275	469	9,510,000	34,600	8,744,000	31,800	18,254,000	66,400
Illinois	48	74	427	877	1,787	2,662	82	677	329	27	78	305	1,060	6,265	78,450,305	74,000	64,102,650	60,500	142,552,955	134,500
Minnesota	11	7	11	278	667	318	7	40	...	...	...	...	292	1,036	19,714,000	67,500	14,123,000	48,400	33,837,000	115,900
Iowa	24	13	19	212	273	140	7	14	20	5	4	4	237	474	8,786,000	37,100	4,268,000	18,000	13,054,000	55,100
Missouri	31	24	62	484	963	696	101	326	490	...	...	...	609	2,537	29,375,300	48,200	29,161,000	47,900	58,536,300	96,100
Total	259	210	733	4,105	7,881	5,577	241	1,211	942	44	93	320	4,600	16,757	229,862,755	49,900	168,914,650	36,700	398,777,405	86,600
Southern States.																				
North Carolina	8	2	3	39	62	9	...	...	...	2	2	...	43	76	611,000	14,200	710,000	16,500	1,321,000	30,700
South Carolina	6	36	63	10	6	4	...	...	...	...	...	...	46	73	462,000	10,000	193,000	4,200	655,000	14,200
Georgia	13	15	21	225	311	72	...	...	...	9	9	2	249	415	4,436,400	17,800	4,968,500	20,000	9,404,900	37,800
Florida	7	12	23	37	23	6	...	...	...	...	...	...	49	52	336,500	6,900	4.600	100	341,100	7,000
Alabama	15	15	23	76	99	53	...	...	...	103	23	88	194	286	5,617,800	29,000	2,475,000	12,800	8,092,800	41,800
Mississippi	5	12	23	4	4	...	...	...	...	4	4	24	20	55	195,000	9,800	16,500	900	211,500	10,700
Tennessee	19	16	21	208	302	92	1	2	...	9	7	3	234	427	5,773,500	24,700	3,887,600	16,600	9,661,100	41,300
Louisiana	11	22	54	156	427	4	...	...	...	6	7	49	184	541	11,619,700	63,200	9,029,400	49,100	20,649,100	112,300
Arkansas	9	34	78	38	61	35	...	...	...	5	2	2	77	178	1,530,375	19,900	773,700	10,000	2,304,075	29,900
Total	93	164	309	793	1,295	275	1	2	...	138	54	168	1,096	2,103	30,582,275	27,900	22,058,300	20,100	52,640,575	48,000
Western States.																				
South Dakota	4	6	7	11	5	2	...	...	...	...	...	...	17	14	350,000	20,600	75,000	4,400	425,000	25,000
Nebraska	12	26	28	187	207	221	...	...	...	...	...	...	213	456	8,437,500	39,600	4,420,000	20,800	12,857,500	60,400
Kansas	12	22	30	103	118	77	...	...	...	11	5	13	136	243	3,665,000	27,000	2,635,000	19,400	6,300,000	46,400
Texas	32	73	149	254	304	49	4	1	...	11	4	15	342	522	6,335,500	18,500	5,280,600	15,400	11,616,100	33,900
Colorado	10	7	4	208	256	254	30	79	78	22	4	10	267	685	10,355,000	38,800	9,419,000	35,300	19,774,000	74,100
Montana	3	...	2	47	34	16	2	4	1	...	...	...	49	57	1,700,000	34,700	1,250,000	25,500	2,950,000	60,200
Idaho	1	...	...	4	2	...	...	...	...	...	...	...	4	2	54,000	13,500	....	...	54,000	13,500
Utah	4	...	...	92	105	17	...	...	...	8	2	...	100	124	1,456,000	14,600	1,000,000	10,000	2,456,000	24,600
Washington	22	4	6	210	155	27	18	45	15	...	...	...	232	248	9,802,000	42,300	6,074,457	26,200	15,876,457	68,500
Oregon	10	5	4	105	163	14	3	16	...	24	13	29	137	239	2,684,500	19,600	2,310,000	16,900	4,994,500	36,500
California	47	200	469	401	527	67	152	718	70	67	78	43	820	1,972	42,356,900	51,700	22,088,000	26,900	64,444,900	78,600
Total	157	343	699	1,622	1,876	744	209	863	164	143	106	110	2,317	4,562	87,196,400	37,600	54,552,057	23,500	141,748,457	61,100
United States.	916	1,219	5,383	12,133	26,242	8,729	599	3,329	1,542	519	760	2,197	14,470	48,182	784,813,781	54,200	590,596,391	40,800	1,375,410,172	95,000
Canada.	30	13	37	450	714	436	...	...	...	...	...	...	462	1,187	17,517,300	37,900	5,665,000	12,300	23,182,300	50,200

TABLE OF OPERATING STATISTICS.

Notice.—These statistics are carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement, "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years.

Abbreviations.—The following abbreviations are used: * including taxes. d. deficiency. m. months.

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
ALBANY, N. Y.						
The Albany Ry.	3 m. Dec. '94	122,382	85,240	37,142	22,579*	14,564
	3 " " '95	132,407	83,928	48,479	21,457*	27,022
	12 " " '94	461,918	298,972	162,947	92,592*	70,354
	12 " " '95	522,276	314,319	207,957	88,657*	119,300
BALTIMORE, MD.						
Baltimore Traction Co.	12 m. Dec. '94	1,012,319	623,010	389,279	359,243*	30,037
	12 " " '95	1,179,191	639,707	539,485	413,097*	126,387
BATH, ME.						
Bath St. Ry. Co.	12 m. June '94	16,300	12,862	3,438	2,500	938
	12 " " '95	21,703	14,698	7,005	3,400	3,605
BAY CITY, MICH.						
Bay Cities Cons. Ry. Co.	12 m. Dec. '94	83,450	52,011	31,439	30,000	1,439
	12 " " '95	88,658	58,517	30,141	30,000	141
	1 " June '95	9,778	4,930	4,848		
	1 " " '96	8,696	4,298	4,398		
	6 " " '95	40,241	26 883	13,358		
	6 " " '96	41,455	27,325	14,130		
BIDDEFORD, ME.						
Biddeford & Saco R R Co.	12 m. June '94	24,219	14,813	9,406	6,391*	3,016
	12 " " '95	24,287	12,186	12,101	5,915*	6,186
BINGHAMTON, N. Y.						
Binghamton R. R. Co.	12 m. Jan. '95	121,969	69,581	52,388	30,152*	22,237
	12 " " '96	128,972	73,345	55,628	35,459*	20,169
	1 " May '95	10,860	5,981	4,879		
	1 " " '96	12,725	6,619	6,106		
	4 " " '95	35,176	23,962	11,214		
	4 " " '96	42,849	25,487	17,362		
BOSTON, MASS.						
West End St. Ry. Co.	12 m. Sept. '94	6,823,879	4,807,083	2,016,796	725,064*	1,291,732
	12 " " '95	7,746,171	5,633,163	2,113,008	746,963*	1,366,044
North Shore Traction Co.	12 m. Sept. '95	1,381,389	784,392	59,997	391,681*	205,316
	1 " Apr. '95	93,714	66,523	27,191		
	1 " " '96	104,316	65,127	39,189		
	7 " " '95	631,830	440,120	191,710		
	7 " " '96	681,538	466,054	215,484		
Lynn & Boston R. R. Co.	12 " Sept. '94	1,238,410	746,304	492,106	379,029*	113,077
BRIDGEPORT, CONN.						
Bridgeport Traction Co	12 m. Dec. '94	144,447				
	12 " " '95	298,883	151,697*	147,186	75,000	72,186
	1 " May '95	25,523	12,351	13,172		
	1 " " '96	30,012	15,368	14 644		
	5 " " '95	102,770	63,852	38 918		
	5 " " '96	119,839	69,469	50,370		
BROCKTON, MASS.						
Brockton St. Ry. Co.	12 m. Sept. '94	214,370	143,511	70,859	70,974*	d 115
	12 " " '95	266,892	154,950	111,942	84,691*	27,251
	1 " May '95	22,549	11,847	10,701		
	1 " " '96	26 698	15,274	11,424		
	8 " " '95	152 891	88,323	64,568		
	8 " " '96	179,400	113,962	65,438		
BROOKLYN, N. Y.						
Brooklyn Elev. R.R. Co	12 m. Dec. '94	1,730,848	1,041,095		831,093*	d 141339
	12 " " '95	2,082,937	1,158,219		859,447*	65,271
	1 " May '95	186,930	97,396	89,534		
	1 " " '96	152,243	90,439	61,804		
	5 " " '95	954,975	509,540	445,435		
	5 " " '96	775,704	457,917	317,787		
Brooklyn Traction Co.	1 " Jan. '95	44,599	56,3 7	d 11,728		
	1 " " '96	82,796	52,236	30,560		
Atlantic Ave. R. R. Co.	12 m. Dec. '94	1,011,258	615,863	395,395	265,118	130,277
	12 " " '95	891,940	706,900	185,040	302,918	d 117877
Brooklyn, Bath & West End R. R. Co.	12 m. June '94	111,605	86,717	24,888	39,718*	d 14,830
	12 " " '95	130,928	79,394	51,535	61,150*	d 9,616
Brooklyn City & Newtown R. R. Co.	12 m. Dec. '94	595,449	346,285	249,164	120,632*	128,532
	12 " " '95	598,691	372,554	226,137	127,647*	98,489
Brooklyn, Queens Co. & Sub. R. R. Co.	12 m. June '94	543,413	427,101	116,312	169,225*	d 52,913
	12 " " '95	625,537	415,255	210,282	339,068	d 128 786
	9 " Mar. '95	443,790	303,612	140,178	250,594	d 110,416
	9 " " '96	508,819	329,146	179,673	257,293	d 77,620
Brooklyn Heights R.R. Co.	12 m. Dec. '94	3,509,016	2,143,567	1,365,448	1,468,553	d 103,105
	12 " " '95	4,076,117	2,682 614	1,393,504	2,102,061	d 706,758
	3 " Mar. '95	655,600	669,850	d 14,250	512,760	d 527,010
	3 " " '96	1,003,611	635,382	368,229	497,210	d 128,981
Coney Island & Brooklyn R. R. Co.	12 m. Dec. '94	316,183	207,478	108,706	52,157*	56,549
	12 " " '95	383,367	236,547	146,820	52,861*	93,959
	1 " Feb. '95	24,418				
	1 " " '96	19,313				
	2 " " '95	51,242				
	2 " " '96	40,801				
Nassau Elec. R. R. Co.	3 m. Dec. '95	82,140	59,904	22,236	20,286*	1,950
	6 " " '95	173,757	106,127	67,630	33,627*	34,003
BUFFALO, N. Y.						
Buffalo Ry. Co.	12 m. Dec. '94	1,536,284	856,631	679,653	468,917*	210,736
	12 " " '95	1,351,919	649,097	702,822	417,038*	285,783
CHICAGO, ILL.						
Chicago City Ry. Co.	12 m. Dec. '94	4,264,618	2,838,684*	1,425,934	207,878	1,218,057
	12 " " '95	4,476,824	2,807,726	1,669,098	300,389	1,368,709
Chicago General Ry. Co	12 m. Dec. '95	82,082	64,334	17,748		
Lake St. Elev. Ry. Co.	12 m. Dec. '94	428,095	290,090	138,005		
	12 " " '95	517,301	319,606	197,695		
	1 " Jan. '95	44,670	28,180	16,490		
	1 " " '96	52,855	30,713	22,142		
No. Chicago R. R. Co.	12 m., Dec. '94	2,565,618	1,347,326	1,218,292	465,648	752,644
	12 " " '95	2 780,487	1,311,607	1,468,880	471,251	997,629
West Chicago R. R. Co	12 m. Dec '94	4,181,237	2,518,627	1,662 610	859,471	803,139
	12 " " '95	4,201,477	2,267,195	1,934,282	902,016	1,032,266
Chicago & So. Side R. T. Co.	12 m., Dec. '94	711,685	551,811	159 874	541,750	d381,876
	12 " " '95	744,167	513,704	230,463	571,680	d341,217
	1 " June '95	54 908	42,867	11,041		
	1 " " '96	59 941	37,864	22,077		
	6 " " '95	377,790	280,402	97,388		
	6 " " '96	370,158	238,429	131,729		
CINCINNATI, O.						
Cinn. Newport & Cov. Ry. Co.	12 m., Dec. '94	497,950	370,606	127,344		
	12 " " '95	624,034	418 710	205,324		
	1 " Apr. '95	45,959	33,701	12,258		
	1 " " '96	50 950	35,733	15 217		
	4 " " '95	165 994	132,249	33,745		
	4 " " '96	185,825	142,750	43,075		
CLEVELAND, O.						
Cleveland Elec. Ry. Co.	12 m. Dec. '94	1,306,522	783 366	523,156		
	12 " " '95	1,503,620	912,538	591,082		
	3 " Mar. '95	311,051	221,311	89,740		
	3 " " '96	372,666	252,524	120,142		
COLUMBUS, O.						
Columbus St. Ry. Co.	12 m., Dec. '94	566,811	269 362	297,449	176,648	120,801
	12 " " '95	629 995	311,594	318,401	183,506	134,895
	1 " Apr. '95	55,077	26,979	28 098		
	1 " " '96	58 169	26,038	32,131		
	4 " " '95	188,803	96,550	92,253		
	4 " " '96	206,676	104,587	102,089		
DENVER, COL.						
Denver Cons. Tramway Co.	12 m., Dec. '94	753,483	445,684	307,798	244,172*	63,625
	12 " " '95	723,480	441,283	282,198		
	1 " May '95	59 302	36,133	23,169		
	1 " " '96	62,713	37,502	25,211		
	5 " " '95	273,908	171 936	101,972		
	5 " " '96	284,831	174,871	109,960		
DULUTH, MINN.						
Duluth St. Ry. Co.	12 m., Dec. '94	208 105	111,105	97,000		
	12 " " '95	213,229	95,329	117,900		
	1 " Apr. '95	17,765	8 347	9,418		
	1 " " '96	17,564	8,863	8,701		
	4 " " '95	65,291	36,481	28,810		
	4 " " '96	65,706	34,879	30,827		
FITCHBURG, MASS.						
Fitchburg & Leominster St. Ry. Co.	12 m., Sept. '94	89,260	61,416	27,845	7,209	20,636
	12 " " '95	110,275	74,103	36,172	7,017	29,155
GALVESTON, TEX.						
Galveston City R. R. Co.	12 m., Dec. '94	199,133	131,407*	67,726	50,000	17,726
	12 " " '95	216,271	141,080	75,191	50,000	25,191
	1 " Feb. '95	12,449	8,741	3,708		
	1 " " '96	13,058	9,303	3,755		
	2 " " '95	27,010	18,602	8,408		
	2 " " '96	26,317	19,610	6,707		
GIRARDVILLE, PA.						
Schuylkill Traction Co.	12 m. Sept. '94	88,288	56 564	31,724	25,000	6,724
	12 " " '95	90,981	52,851	38,130	29,770*	8,360
	1 " June '95	8 224	4,822*	3,402	2,083	1,319
	1 " " '96	7,080	4,161*	2,919	2,083	836
	9 " " '95	63 198	43,090*	20,108		
	9 " " '96	69,597	40,158*	29,439		
GREAT FALLS, MONT.						
Great Falls St. Ry. Co.	12 m., Dec. '94	26,431	24,905*	1,526		
	12 " " '95	26,650	28,126	d 1,476		
HAZLETON, PA.						
Lehigh Traction Co.	12 m., Dec. '94	97,202	50,605	46,597		
	12 " " '95	119,588	67,979	51,609	39,297	12,312
	1 " June '96	9,453	4,805	4,648		
	6 " " '96	57,433	33,142	24,291		
HOBOKEN, N. J.						
No. Hudson Co. Ry. Co.	12 m., Dec. '94	818,280	611,482*	206,798		
	12 " " '95	871,273	619,830	251,443	246,649*	4,794
HOLYOKE, MASS.						
Holyoke St. Ry. Co.	12 m., Sept. '94	75,427	48,546	26,881	3,524*	23,356
	12 " " '95	112,547	69,627	42,920	20,058*	22,862
KANSAS CITY, MO.						
Metropolitan St. Ry. Co	12 m, May, '95	1,701,155	1,058,136	643,019	871,720	271,299
	12 " " '96	1,780,940	1,033,042	747,898	484,227	263,671
LAWRENCE, MASS.						
Lowell, Lawrence & Haverhill St. Ry. Co	12 m., Sept. '95	269,740	205,816	63,924	73,423*	d 8,498
	12 " " '96	403,530	262 935	140,595	84,081*	56,514
	1 " May, '95	36,554	20,945	15,609		
	1 " " '96	36,652	19,598	17,054		
	8 " " '95	205,520	150,883	54 637		
	8 " " '96	236,018	157,495	78 523		

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
LORAIN, O.						
Lorain St. Ry.	12 m., Dec. '95	80,176	46,092	34,084		
	1 " May, '95	7,164	3,132	4,032		
	1 " " '96	6,147	4,370	1,777	1,000	777
	5 " " '95	29,632	17,328	12,304		
	5 " " '96	26,532	20,581	5,951	5,000	951
LOUISVILLE, Ky.						
Louisville Ry. Co.	12 m., Dec. '94	1,176,790	633,206	543,584	355,799*	187,784
	12 " " '95	1,288,172	672,080	616,092	359,366*	256,726
LOWELL, MASS.						
Lowell & Suburban St. Ry. Co.	12 m. Sept. '94	277,029	179,409	97,620	66,624*	30,995
	12 " " '95	329,817	199,346	130,471	66,575*	63,896
MACON, GA.						
Macon Cons. St. Ry. Co.	12 m., Dec, '95	69,190	44,529	24,661	16,711*	7,951
MARSHALLTOWN, IA.						
Marshalltown Light, Power & Ry. Co.	12 m., Dec. '94	38,758	24,190*	14,568	7,650	6,918
	12 " " '95	40,757	24,307*	16,450	7,500	8,950
MINNEAPOLIS, MINN.						
Twin City R. T. Co.	12 m., Dec. '94	2,003,679	1,044,548	959,131	738,961*	220,170
	12 " " '95	1,988,803	979,485	1,009,319	750,839*	258,479
	1 " May, '95	164,006	70,539	93,467		
	1 " " '96	170,10[illegible]	74,015	96,093		
	5 " " '95	754,080	354,433	299,647		
	5 " " '96	789,695	363,461	426,234		
MONTGOMERY, ALA.						
Montgomery St. Ry. Co	12 m., Dec. '94	35,216	21,724	13,492		
	12 " " '95	50,645	27,915	22,720		
	1 " June '95	4,910	2,085	2,825		
	1 " " '96	5,215	2,192	3,023		
	6 " " '95	23 082	13,971	9,111		
	6 " " '96	26,510	13,329	13,181		
MONTREAL, CAN.						
Montreal St. Ry. Co.	12 m., Sept. '94	897,838	628,454	269,384	55,363*	214,021
	12 " " '95	1,102,778	652,812	449,966	98,617	351,349
	1 " Mar. '95	78,638				
	1 " " '96	92,146				
	6 " " '95	462,431				
	6 " " '96	664,997				
NEWBURGH, N. Y.						
Newburgh Elec. Ry. Co.	12 m., Feb. '96	91,156	55,190*	35,966	26,458	9,507
NEWBURYPORT, MASS						
Haverhill & Amesbury St. Ry. Co.	12 m., Sept. '94	98,346	58,061	40,284	27,664*	12,691
	12 " " '95	104,853	65,936	38,917	28,223*	10,694
NEW HAVEN, CONN.						
New Haven St. Ry. Co	12 m., Dec. '94	126,183	69,517	56,666		
	12 " " '95	198,719	124,454	74,265		
	1 " Mar. '95	11,742				
	1 " " '96	12,679				
	3 " " '95	34,712				
	3 " " '96	39,988				
NEW LONDON, CONN.						
New London St. Ry. Co.	12 m., Sept. '94	49,899	29,150	20,749	6,423*	14,326
	12 " " '95	51,759	30,230	21,528	7,650*	13,878
NEW ORLEANS, LA.						
New Orleans Traction Co.	12 m., Nov. '94	951,528	620,508	331,020		
	12 " " '95	1,327,756	752,158	575,598		
	1 " May '95	123,436	65,298	58,138		
	1 " " '96	125,698	70,440	55,258		
	6 " " '95	619,489	344,164	275,325		
	6 " " '96	689,536	375,994	313,542		
NEWTON, MASS.						
Newton & Boston St. Ry. Co.	12 m., Sept. '94	33,478	25,262	8,216	7,677*	539
	12 " " '95	32,297	24,685	7,613	7,108*	504
Newtonville & Watertown St. Ry. Co.	12 m., Sept. '95	7,580	6,599	981	809*	172
NEW YORK, N. Y.						
Third Ave. R. R. Co.	12 m., Dec. '94	2,178,336	1,177,344	1,000,991	341,083*	659,909
	12 " " '95	2,355,154	1,456 782	1,198,372	328,917*	869,454
Metropolitan St. Ry. Co.	12 m., June '94	5,398,466	3,223,956	2 174,510	1,859,971*	314,539
	12 " " '95	5,772,260	3,183,210	2,589,050	2,016,889*	572,161
	9 " Mar. '95	4,201,147	2 384,571	1,816,576	1,466,449	350,127
	9 " " '96	5,553,530	2,933,224	2,620,306	1,813,483	806,823
Manhattan Ry. Co.	12 m., Dec. '94	9,953,840	5,446,029	4,507,811	2,674,049*	1,833,762
	12 " " '95	9,731,213	5,533,959	4,197,254	2,988,167*	1,209,087
	3 " Mar. '95	2 525,955	1,407,082	1,118 873	661,323	457,550
	3 " " '96	2,412,891	1,417,712	995,179	610,418	384,761
Central Crosstown R. R. Co.	12 m., Dec. '94	546,026	385,309	160,717	90,427*	70,291
	12 " " '95	547,491	379,523	167,968	101,526*	66,442
D. D., E. B. & Bat'y R. R. Co.	12 m., Dec. '94	691,861	465,236	226,626	171,423*	55,202
	12 " " '95	748,443	557,074	191,369	138,112*	53,256
Eighth Ave. R. R. Co.	12 m., Dec. '94	768,064	565,927	202,138	95,545*	106,592
	12 " " '95	530,009	424,706	105,303	68,978*	36,324
42d St., Man. & St. N. Ave. R. R. Co.	12 m., Dec. '94	645,130	517,445	127,685	122,804*	4,881
	12 " " '95	626,337	527,155	99,182	122,800*	d23,618
New York & Harlem R. R. Co.	12 m., Dec '94	1,106,017	670,970	435,047	37,524*	397,523
	12 " " '95	1,015,076	693,487	321,589	40,150*	281,439
Second Avenue R.R. Co	12 m., Dec. '94	987,923	755,395	232,529	140,078*	92,450
	12 " " '95	941,290	724,417	216,873	124,566*	92,308
Union Ry. Co.	12 m., Dec. '94	470,446	254,973	215,473	141,934*	73,539
	12 " " '95	457,457	280,435	177,022	127,287*	49,735
NORRISTOWN, PA.						
Schuylkill Val. Trac. Co	12 m., Dec. '95	50,752	36,580	14,172		
NO. ABINGTON, MASS.						
Rockland & Abington St. Ry. Co.	12 m., Sept. '94	52,762	38,836	13,926	5,282*	8,644
	12 " " '95	67,815	49,759	18,056	6,008*	12,048
NORTHAMPT'N, MASS.						
Northampton St. Ry. Co	12 m., Sept. '94	50,090	28,904	21,186	2,375*	18,811
	12 " " '95	83,504	46,240	37,264	3,131*	34,133
NORWALK, CONN.						
Norwalk Tramway Co.	12 m. Sept. '95	43,315	29,858	13,457		
NORWICH, CONN.						
Norwich St. Ry. Co.	12 m. Sept. '94	80,069	50,693	29,376	16,035*	13,341
	12 " " '95	85,210	53,454	31,756	17,400*	14,356

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income
OAKLAND, CAL.						
Central Av. Ry. Co.	12 m. Oct. '94	32,668	26,781	5,887	1,852	4,035
	12 " " '95	30,808	26,148	4,660	3,785	875
Oakland Consol. St. Ry. Co.	12 m. Dec. '94	129,351	95 821	33,530	31,139*	2,390
	12 " " '95	125,485	94,115	31,370	25,140	6,230
ORANGE, N. J.						
Suburban Traction Co.	12 m. Dec. '94	42 502	42,938*	d 431		
	12 " " '95	52,000	56,000	d 4,000		
PATERSON, N. J.						
Paterson Ry. Co.	12 m. Dec. '94	243,921	157,520	86,401	88,597	2,196*
	12 " " '95	298,689	174,619	124,070	97,264	26,806
	1 " June '95	31,065	17,619	13,446		
	1 " " '96	27,951	15,856	12,095		
	6 " June '95	133,592	82,429	51,163		
	6 " " '96	155,739	90,419	65,320		
PHILADELPHIA, PA.						
People's Traction Co.	12 m. June '94	1,044,159	673,479	380,680		
	12 " " '95	1,660,676	829,815	830,861		
Hestonville M. & F. P. Ry. Co.	12 m. Dec. '94	286,021	315,762	207,450	97,966	109,485
	12 " " '95	523,212				
Electric Traction Co.	12 m. June '94	1,900 606	1,120,026	780,580		
	12 " " '95	2,151,853	1,241,584	910,269		
PORT HURON, MICH.						
City Elec. Ry. Co.	12 m. Dec. '94	46,702	32,585	14,117		
	12 " " '95	52,848	34,771	18,076		
POUGHKEEPSIE, N. Y.						
Poughkeepsie City & Wappinger's Falls E. R. Co.	12 m. Dec. '95	93,557	60,257	33,300		
	1 " May '96	8,453	3,472	4,981		
	5 " " '96	31,040	19,979	11,061		
ROCHESTER, N. Y.						
Rochester Ry. Co.	12 m. Dec. '94	782,520	448,304	334,216	269,045*	65,171
	12 " " '95	873,445	517,519	355,926	307,118*	48,808
ST. LOUIS, MO.						
National Ry. Co.	12 m. Dec. '94	1,353,136	776,582	576,554	337,684	238,870
	12 " " '95	1,403,957	821,315	582,642	366,587	216,055
SCRANTON, PA.						
Scranton Trac. Co.	1 m. June '95	26,867	12,344	14,523		
	1 " " '96	29,275	14,162	15,113		
	12 " " '95	270,628	157,183	113,445		
	12 " " '96	330,308	164,029	166,279	124,426	41,853
SEATTLE, WASH.						
West St. & No. End Elec. Ry. Co.	12 m. Dec. '95	29,737	15,031	14,706		
SPRINGFIELD, MASS.						
Springfield St. Ry. Co.	12 m. Sept. '94	373,903	252,269	121,634	18,210*	103,424
	12 " " '95	442,006	277,156	164,850	30,637*	134,213
SYRACUSE, N. Y.						
Syracuse Cons. St. Ry. Co.	12 m. Dec. '94	194,547	181,105	13,442	197*	13,244
	12 " " '95	164,626	178,072	d 13,446	304*	d 13,750
TERRE HAUTE, IND.						
Terre Haute Elec. Ry. Co.	1 m. Dec. '94	5,354				
	1 " " '95	11,602	7,939	3,663		
	6 " " '94	60,336				
	6 " " '95	83,507	48,855	34,652		
TRENTON, N. J.						
Trenton Pass. Ry. Co.	21 m. Dec. '94	198,681				1,129
	12 " " '95	222,761				1,771
TORONTO, ONT.						
Toronto St. Ry. Co.	12 m. Dec. '94	958,371	517,708	440,663		
	12 " " '95	992,801	489,915	502,886		
	1 " Apr. '95	75,199	39,205	35,994		
	1 " " '96	76,241	41 217	35,024		
	4 " " '95	278,404	161 048	117,356		
	4 " " '96	298,536	171,533	127,003		
TROY, N. Y.						
Troy City Ry. Co.	12 m. Dec. '94	432,596	212,407	220,189	130,474	89,705
	12 " " '95	490,489	242,775	247,714	126,116*	121,598
UTICA, N. Y.						
Utica Belt Line St. R.R.	12 m. Dec. '94	149,105	90,754	58,351	29,844*	28,508
	12 " " '95	160,284	105,297	54,988	44,791*	10,197
	3 " Mar. '95	33 613	21,455	12,158		
	3 " " '96	38,650	24,866	13,784		
WASHINGTON, D. C.						
Capital Traction Co.	12 m. Dec. '95	1,063,776	634,013	429,754		
WATERBURY, CONN.						
Waterbury Trac. Co.	12 m. Dec. '95	247,730	142,073	105,657		
	1 " May '95	20,386				
	1 " " '96	20,254	9,798	10,456	3,648	6,808
	5 " " '95	89,153				
	5 " " '96	97,343	54,212	43,131	16,280	26,851
WHEELING, W. VA.						
Wheeling Ry. Co.	12 m. Dec. '94	133,517	119,378	14,139		
	12 " " '95	150,094	88,552	61,542	32,248*	29,294
WILKESBARRE, PA.						
Wilkes Barre & Wyoming Val. Trac. Co.	12 m. Dec. '94	400,143	196,824	203,319	122,607*	80,711
	12 " " '95	451,941	209,600	242,341	134,215*	108,127
	1 " June '95	38,372	17,319	21,053		
	1 " " '96	43,101	20,626	22,475		
	6 " " '95	189,798	97,513	92,285		
	6 " " '96	236,505	113,908	122,597		
WILLIAMSPORT, PA.						
Williamsport Pass. Ry. Co.	12 m. June '94	64,863	49,646	15,217	10,255	4,962
	12 " " '95	66,845	52,459	14,386	9,691	4,695
WORCESTER, MASS.						
Worcester Cons. St. Ry. Co.	12 m. Sept. '94	355,000	284,215	70,785	45,479	25,306
	12 " " '95	420,498	309,787	110,711	51,778	58,933
	1 " May '95	37,549	25,231	12 318		
	1 " " '96	45,728	32,424	13 304		
	8 " " '95	157,286	121,326	35,960		
	8 " " '96	191,528	144,116	47,412		