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THE SYSTEM OF THE ORLEANS RAILROAD COMPANY,

NEW ORLEANS, LA.

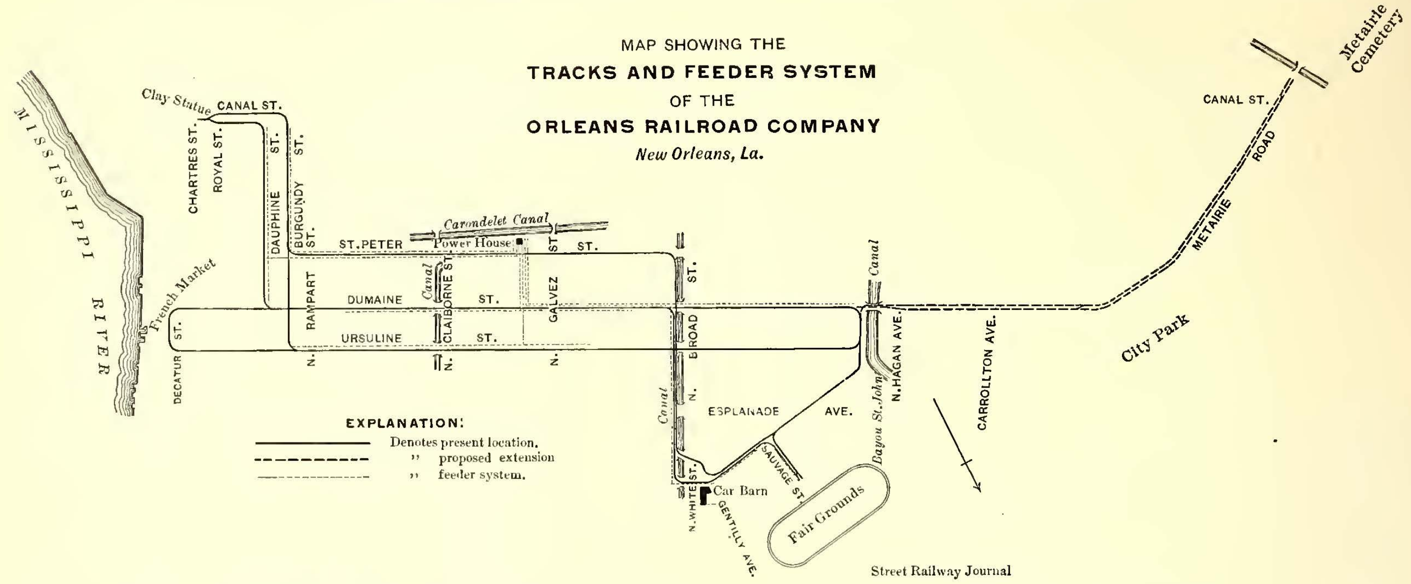
A few years after the war the Orleans Railroad was built by a company of French-American gentlemen and operated as a horse line. Ample returns were made to its owners until with the equipment by electricity of other lines in New Orleans its traffic was diverted and profits reduced. In February, 1895, its stockholders finally decided to authorize the issue of bonds for its reconstruction and electrical equipment, and some months later actual work was begun. Despite the delays caused by an unusually rainy summer season the construction was completed by November and the road has operated without serious delay or stoppage since.

The surroundings and methods of management are perhaps somewhat different from those of any other road in this country, and are hence of interest. The stockholders, officers and even the car operatives are mostly French-Americans or Creoles, and the road traverses the old French quarter bounded by Canal, Rampart and Esplanade Streets. It connects the modern business center, the Clay Statue on Canal Street, with the French residence section of Dauphine, Burgundy, Dumaine, St. Peter and Ursulines Streets and with the picturesque French Market on the Mississippi. The suburban termini are the well known race track of the Crescent City Jockey Club at the Fair Grounds, and the beautiful Bayou St. John with its old Creole country seats. Both of these localities, stimulated by the benefits of rapid transit, are being built up with the residences of the working classes. The City Park and Metairie Cemetery are points to which the company is now seeking access, and due to their natural and artificial attractions will be sources of profitable revenue.

A visitor to New Orleans is impressed with the dirtiness of the streets and the rough paving.

FIG. 1.—CANAL STREET DURING PROCESSION OF REX, MARDI GRAS DAY.

Although the general contour of the city is flat, the intersections of the cross streets were until recently higher than the centers of the blocks, and on narrow streets the crown of the streets was so decided that, in connection with the poor paving, wagon traffic was largely confined to the railway tracks. As a horse line, the Orleans Railroad was universally nicknamed the "Cream Cheese Line." Tradition has it that the French habitants upon bringing their cans of milk from the Bayou to the Market in the Orleans cars would find the contents turned to cream cheese upon its arrival. The natural sentiment of the people is displayed in perpetuating this little romance by the coloring of the new cars, which is (Broadway) orange and cream, or "cream cheese" colors. Another touch of romance is in the gray uniforms of the car operatives signifying a remembrance of the Lost Cause.



MAP SHOWING THE TRACKS AND FEEDER SYSTEM OF THE ORLEANS RAILROAD COMPANY *New Orleans, La.*

ROADBED CONSTRUCTION

THE streets of New Orleans, especially those of the old town, are peculiar in that they are either very narrow, averaging from twenty-two to twenty-four feet between curbs, or very wide, in some cases 180 ft. between curbs, with a small park in in the center of the driveway called the neutral ground which is sodded over and has two or four rows of trees. Here the street railway tracks are placed—an ideal location for an electric railway both for economy of construction and for speed. Canal Street, the Broadway of New Orleans, is 135 ft. wide between curbs and upon its neutral ground for a distance of about a mile are built five continuous tracks into which turns every street railway line of the city. The three inner tracks are owned and operated by the New Orleans Traction Company, while the two outer ones are trunk tracks owned by the Canal & Claiborne Railroad Company, and used by the New Orleans & Carrollton Railroad Company, the Orleans Railroad Company and the St. Charles Street Railroad Company under a system of trackage rentals. The difficulties of the construction can be seen from the illustrations, Figs. 3 and 4. Two of the four trunk lines have a 4 ft. 8 ½ in. gauge, and two 5 ft. 2 ½ in. gauge, so that three rails are used. Each company has its individual trolley wire so that at a section taken at Clay Statue, there are four wires above one trunk track and three above the other, with one each over the three center tracks. A combined bracket and span construction was devised to ensure strength and reliability, for if all ten wires were supported from a span, the breakage of one or two spans might disable the entire railway traffic of the city.

At every cross street, a street railway line either crosses Canal Street, or swings into a trunk track, or crosses it to branch into one of the three Traction Company's inner tracks. Many complicated pieces of special track and overhead work result from these conditions, and this is perhaps the most difficult mile of work of this kind in the country. More than fifty special insulated overhead crossings are used within the mile of street over the the two trunk tracks. All line material is of special design, and is now in process of erection. Trolley wires above the same track are eight inches apart. Poles are of extra heavy piping, thirty-two feet long, weigh 1200 lbs., are spaced ninety feet apart and are set in Dyckerhoff cement concrete.

The paving at Clay Statue consists of imported Belgian blocks laid on a two inch sand cushion, on six inches of stone concrete, the interstices between blocks being filled with Assyrian asphalt. This track and overhead construction was designed and built under the personal direction of Ford & Bacon, who are engineers not only for the Orleans Railroad Company, but also for the Canal & Claiborne Railroad Company and the New Orleans & Carrollton Railroad Company.

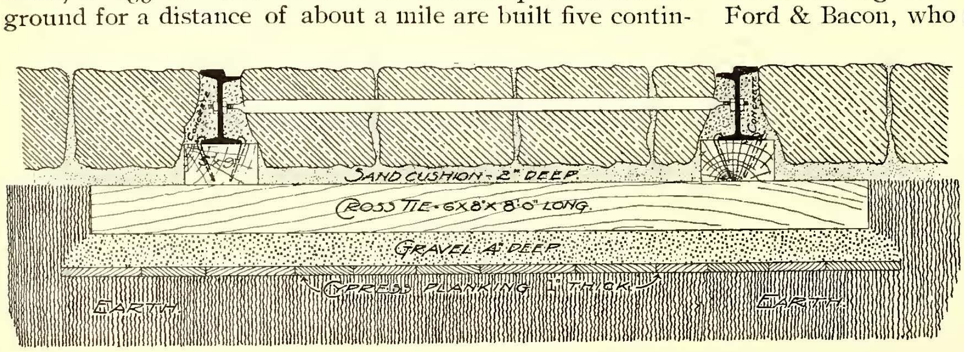
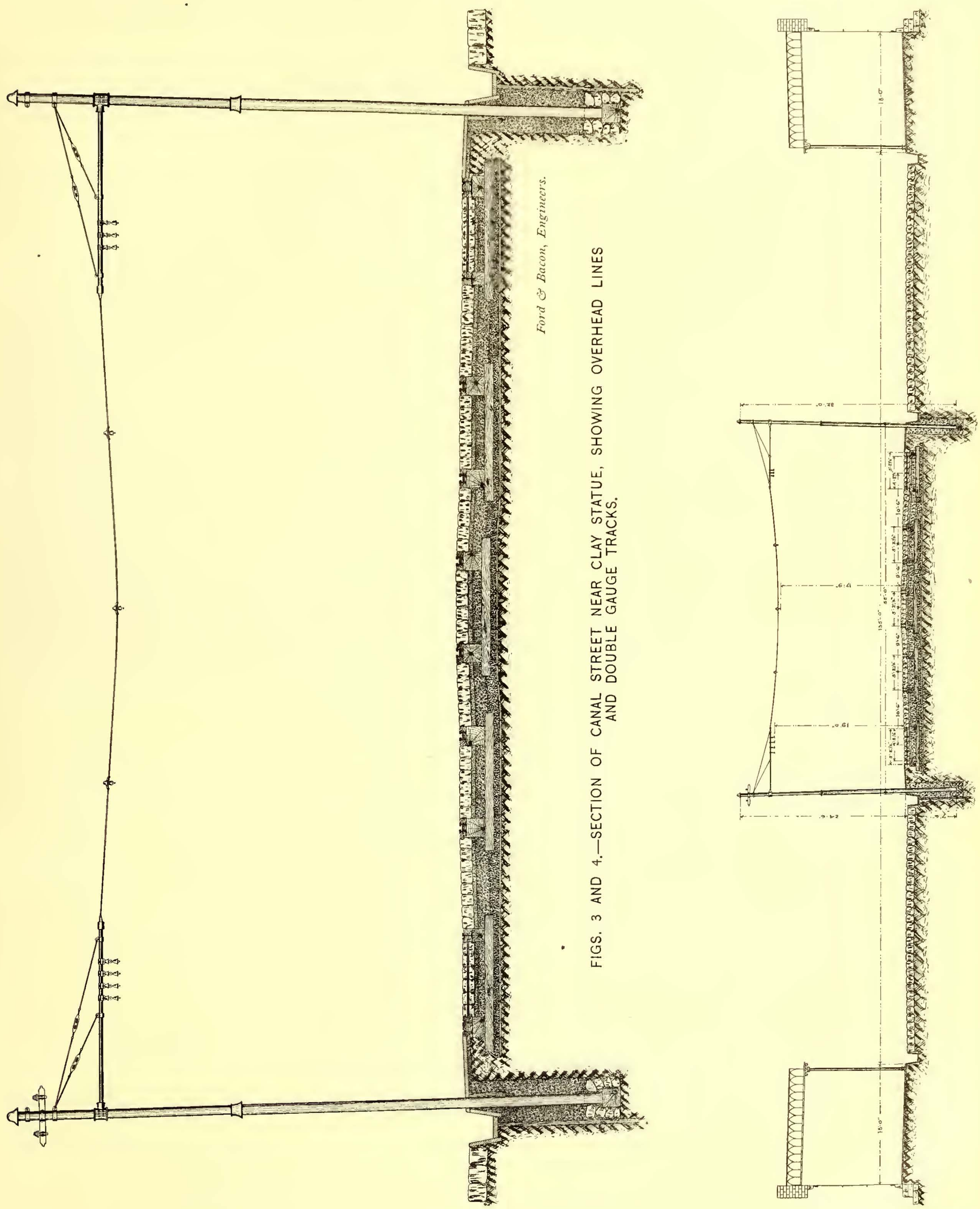


FIG. 2.—SECTION OF TRACK WITH NINE INCH RAIL AND DEEP BLOCK PAVING.

On the narrow streets, special construction was necessitated in other directions. In the old town, Dauphine and Burgundy Streets are each about twenty-three feet between curb lines and are paved with rectangular granite blocks. These were brought down to New Orleans as ballast and average about 12 ins. × 18 ins. face × 11 ins. depth, and are so heavy as to require two men for lifting each stone. Their depth necessitates the use of longitudinal 5 in. × 9 in. cypress stringers with a nine inch girder rail. As shown in Fig. 2 in this construction, the trench is made twenty-five inches deep. Water is reached in many places at a depth of a foot below the surface, and the trench has usually to be kept pumped out. Upon the subsoil, which is a black alluvium, is placed a flooring of one inch cypress boards eight feet eight inches wide and extending the whole length of the track. Upon this planking is placed four inches of Rosetta or Bartlett gravel which concretes under pressure. The flooring and concreted gravel form a sufficient bearing for the ties which, in turn, support the stringers and the rail. Ties are 6 ins. × 8 ins. × 8 ft. spaced twenty inches at centers on joints, and thirty inches elsewhere. Cypress lumber is used throughout for sub-surface work, and owing to the moisture in the ground it



Ford & Bacon, Engineers.

FIGS. 3 AND 4.—SECTION OF CANAL STREET NEAR CLAY STATUE, SHOWING OVERHEAD LINES AND DOUBLE GAUGE TRACKS.

is practically indestructible. On other streets, where cobble, Belgian block and plank paving are encountered, the longitudinal stringer is omitted, and the trench made twenty inches deep. As practically all of the road is built upon paved streets, nine inch girder rail is used throughout, weighing ninety pounds per yard for straight rail, and 117 lbs. for guard rail. Twelve bolt "suspended" joints, thirty-two inches long are used and all bonding is triple-lacing secured with channel pins. Abutting ends of rails are placed in contact, and joints are placed opposite. Tie rods are spaced every six feet. Culverts or gutters for surface drainage are encountered at many cross streets, and in order not to interfere with the flow, the nine inch girder rail is cut away so as to leave only five inches vertical depth, which is reinforced with angle iron riveted to the rails.

All track construction is to the new grades as established by the city engineer, L. W. Brown, for the drainage system about to be adopted by the city, and consequently the paving, curbs and culverts on the streets along the route had to be relaid by the company, entailing a considerable expense, but insuring permanent construction.

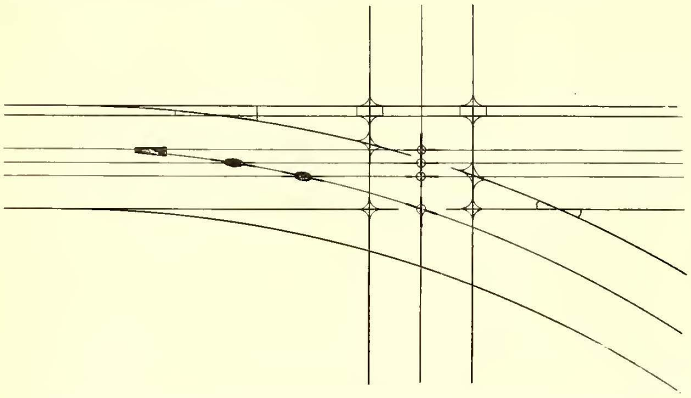


FIG. 5.—SPECIAL OVERHEAD FROGS AND CROSSINGS.

All rail material for the Orleans Railroad Company was furnished by the Johnson Company. The Canal Street rail material, owned by the Canal & Claiborne Railroad Company, was furnished by Wm. Wharton, Jr., & Company. The contract for track laying and paving was executed by C. E. Loss & Company and C. B. Fisher.

The overhead construction is shown on page 216, the map indicating the layout of the feeder system. The greatest variation of pressure at any point on the line is about fifty volts. The overhead line is divided into six sections, each fed and controlled separately from the power station switchboard. The arrangement of section insulators, pole cut-outs and track switches is such that the line can never be shut down by a fire or break in any one section. This precaution is necessary on account of the narrow streets which become impassable in the event of a fire.

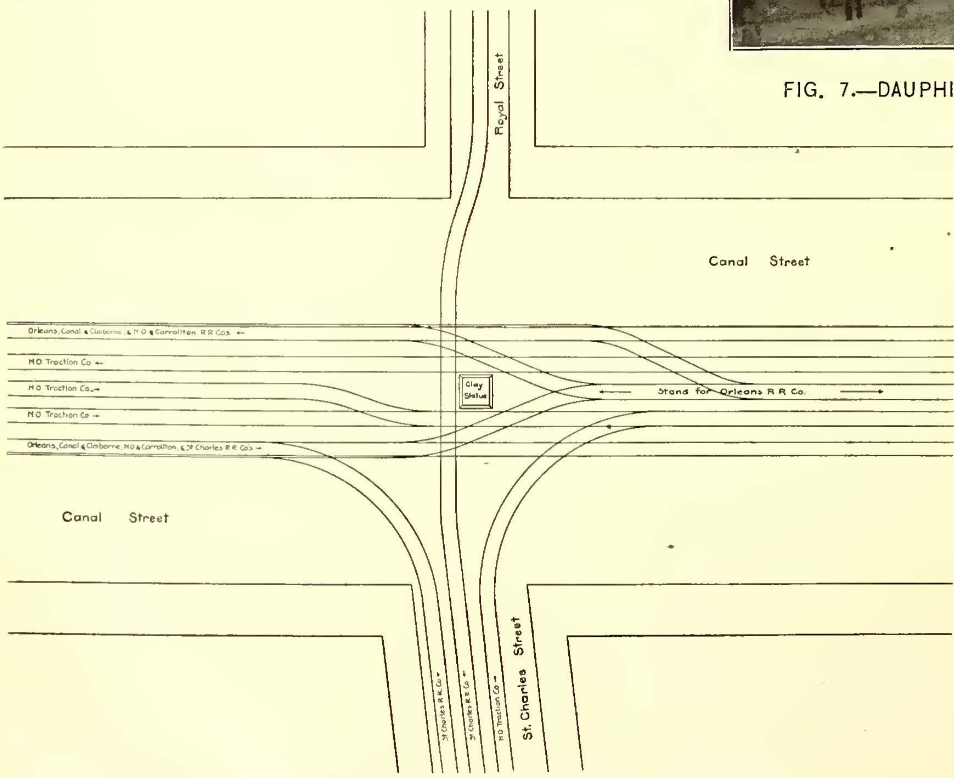
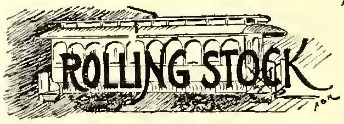


FIG. 6.—TRACK LAYOUT ON CANAL STREET AT CLAY STATUE.

Except in the outlying sections, heavy steel poles are used. On account of the nature of the soil, special care must be exerted in pole setting. Wooden plugs or base blocks are inserted in the bottom of the pole to give a bearing, and the pole set in hydraulic cement concrete seven feet deep for straight line work and eight feet at curves. On the narrow streets, side bracket construction is employed, the bracket arms being about fourteen feet long and suspended by a double truss rod. Double insulation is used for all steel pole construction, the bracket hanger consisting of two insulated bells joined by a double eye bolt, which affords the necessary flexibility. On account of the high balconies overhanging the sidewalk, a special insulator for feed wire is clamped to the bracket arm as shown. Overhead material was furnished by the Creaghead Engineering Company which was also contractor for its erection. Schminke & Newman furnished the line material for the Canal Street work, and the special insulated crossings were manufactured by the H. W. Johns Manufacturing Company.



THE design of cars for this road was determined by the conditions encountered. The narrow streets with short radius track curves prescribed narrow cars with short wheel base trucks. The traffic is not heavy, and the speed is necessarily moderate, so that short, light cars enabled the use of single motor equipments, and hence of single trucks.

FIG. 7.—DAUPHINE STREET WITH SIDE BRACKETS.

The important desideratum for passenger traffic is comfortable riding, which is secured by the long spring base truck and the spring cushion seat. The interior finish of the cars, on account of the warm climate is as cool and light as possible. This effect is secured by the use of swamp white ash and holly with natural finish, birch veneer with plain mouldings, and rattan seats and backs. Open cars are not successfully used in New Orleans on account of the frequency of heavy showers which arise with but a few minutes' notice. Closed cars are made with drop sash in doors and ends, thus securing for summer use a current of air through the whole breadth of the car. To protect the body framing and corners from the rather frequent collisions in the narrow streets, special guard rails and heavy malleable castings are used. The bumpers are of white oak, full length of nose piece and faced with heavy angle iron. The width of car bodies is seven feet three inches at corner posts, and the length eighteen feet over corner posts, with four foot platforms.

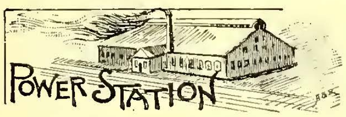
The arrangement of lights in the car has probably been more commented upon by the general public than any other feature. It was devised by Superintendent Malochée and consists of three single sixteen candle power lamps in the monitor ceiling, and three on each side on the window posts, just below the moulding of the advertising panel, as shown in Fig. 8. The lamps are spaced evenly with rela-

FIG. 8.—INTERIOR OF CAR, SHOWING LIGHTING.

tion to the length of the car and the sockets are decorated china receptacles. An excellent diffusion of light is obtained and passengers seated have the light suitably disposed for reading. The tenth lamp of the double series is always lit on the rear platform.

Car bodies and fenders were furnished by the Brill Company, car seats by the Hale & Kilburn Manufacturing Company, registers by the New Haven Car Register Company, single G. E. 800 motor equipments by the General Electric Company, and trucks by the Baltimore Car Wheel Company.

The carrying capacity of this line was largely overtaxed during the recent Mardi Gras season. Fig. 1 shows the Orleans cars on Canal Street during the procession of Rex, King of the Carnival.



THE location of the power plant is on the Carondelet Canal, a central point with reference to the requirements of the feeder system and convenient to the canal, for coal supply and condensing water. There is a fourteen foot driveway on each side of the building with room in the rear of the lot for the extension of the building to a capacity fifty per cent greater than at present.

The design of a power station should embody ample provision for light and ventilation. This is especially necessary in a Southern climate. Architecturally the building should preserve a simple powerful style obtained by the combination of large flat surfaces, heavy arches and massive pilasters. Straight lines should be adhered to and detailed decoration avoided. The general design of the Orleans plant lends itself readily to this construction, as shown in the accompanying illustrations. A flat roof was used obtaining the square strong lines, with minimum of waste wall and at a less outlay than for a ridge roof. Heavy pilasters support the trusses and crane track, with curtain walls merely sustaining their own weight. Groups of small windows in the parapet walls extend around the building near the roof line, affording more efficient ventilation and light at less cost than a monitor roof construction, without the objectionable feature of leakage during the heavy driving rains. All sides of the building have large door and window openings 8 ft. and 10 ft. wide with casement sashes which swing in, and make the building practically an open structure. The boiler room is especially light and roomy, having seven door openings 8 ft. × 16 ft. and 10 ft. × 16 ft. besides the windows.

The building is divided by a fire wall into a boiler room and engine room, each 48 ft. × 82 ft. interior dimensions. A floor eight feet above the ground level forms a basement for the engine room. The basement contains the foundations of the engines and generators, the piping, separators and condensers, while the engine room proper contains the engines, generators, switchboard, gauge boards, air pump cylinders and valve stands for the manipulation of engine and condenser valves.

The building is faced on the three exposed sides and interior of engine room with pressed brick. The rear wall is of common brick and can be removed to the rear property line when extension is required. The wall coping, water table, sills, etc., are of Memphis limestone, and the door sills are of New England granite. The boiler room floor is of Schillinger pavement placed on eight inches of Dyckerhoff cement concrete, in proportions of one, two and three. The engine room floor is of heavy mill construction. Steel trusses and framing support a Fletcher roof on North Carolina pine sheathing.

All foundations for building and machinery are floated. The necessary batter is given to ensure a substantial bearing, estimated at one square foot to 700 lbs. weight of machinery or 900 lbs. dead weight of building. In the trench is laid a flooring of two transverse layers of three inch cypress plank spiked together, upon which is erected the brick

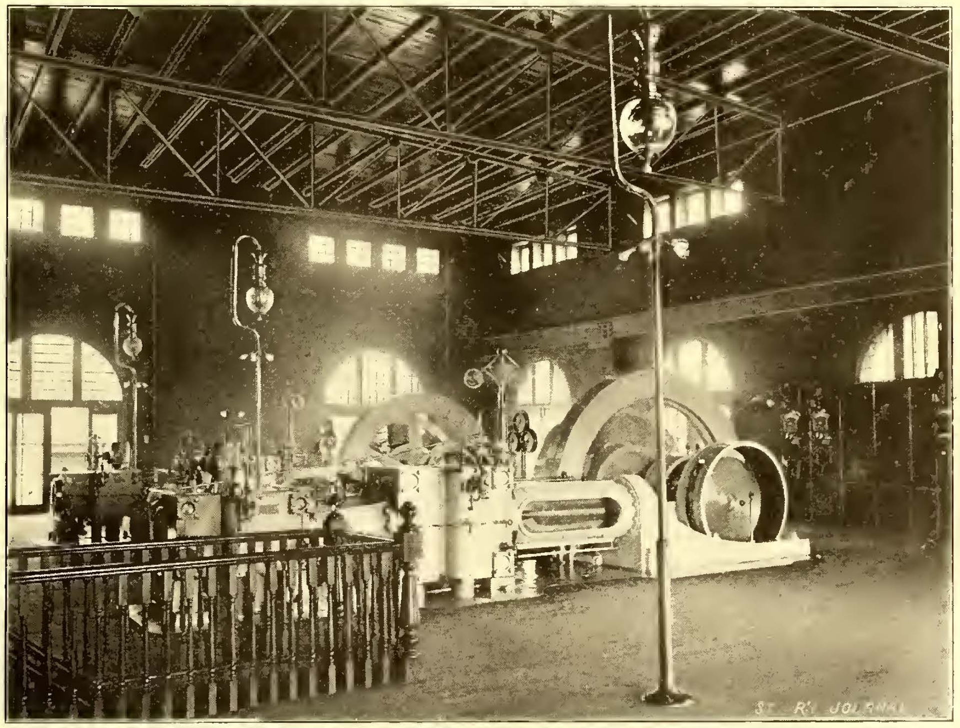


FIG. 9.—INTERIOR OF ENGINE ROOM.

work laid in Dyckerhoff cement mortar in proportions of one to one and one to two. The subsoil consists of black alluvial muck, containing a number of cypress stumps. The Gillette-Herzog Company furnished and erected the roof trusses, and Charles Garvey was the contractor for the complete building and foundations for machinery.

A six inch artesian well, driven 750 ft. through deposits of river sand secures a flow of 150,000 gals. in twenty-four hours and pumps 345,000 in twenty-four hours. The temperature is constant throughout the year at about 70 degs. F. It is of interest to note that cypress stumps were encountered at a depth greater than 400 ft.

The boiler plant is laid out for 1000 h. p. of Heine boilers in two batteries, half of which are at present installed. The setting is in St. Louis pressed brick with all external exposed steam surfaces thoroughly protected by asbestos, an air space and brick jacketing. These boilers were installed under the highest guarantees and have so far met the requirements of practical service in an admirable manner.

The stack, flue and breechings are of steel and are designed for the capacity of the present boiler room. The stack is self supporting, 125 ft. × 5 ft. 6 ins., and is anchored to a concrete foundation 22 ft. × 22 ft. × 8ft. An extension in height will accommodate an additional battery of boilers when the building is enlarged. The stack is lined with fire brick to a height of forty feet. The breechings and flue are placed directly over the discharge openings from furnaces, thus avoiding one turn in the travel of the gases.

The engine plant is designed for 1200 h. p. Allis tandem compound condensing engines in three units, two of 300 h. p. and one of 600 h. p. The two 300 h. p. units now installed have cylinders 14 ins. and 26 ins. × 36 ins., and run at 120 r. p. m. To obtain satisfactory action of dash-pots and valve gear at this speed, the valves are double ported and all of the valve rods and gear lightened as shown in the illustration (Fig. 15). The exhaust valves on the low pressure cylinder are operated by a separate eccentric in order to permit a wide range of cut-off in the admission, increasing the capacity of the engine for overload. The cylinders are lagged with sheet steel enclosing a two inch layer of mineral wool. The flywheels are extra heavy, the halves joined together by shrunk links on each side of the rim. Tripp's metallic packing is used on all rods. Oil is dripped to one receptacle and to an oil purifier. The engines are symmetrical in design and of extra heavy construction to withstand the unusual variation of load encountered in railway service. They have been subjected to several complete short circuits, and under all conditions have proven most satisfactory. An Allis flywheel air pump and condenser is used with each engine. The water cylinder being vertical, the valves are always covered with the minimum quantity of water to preserve a vacuum. A throttling governor regulates the amount of steam to the requirement, and the exhaust is discharged into its own vacuum.

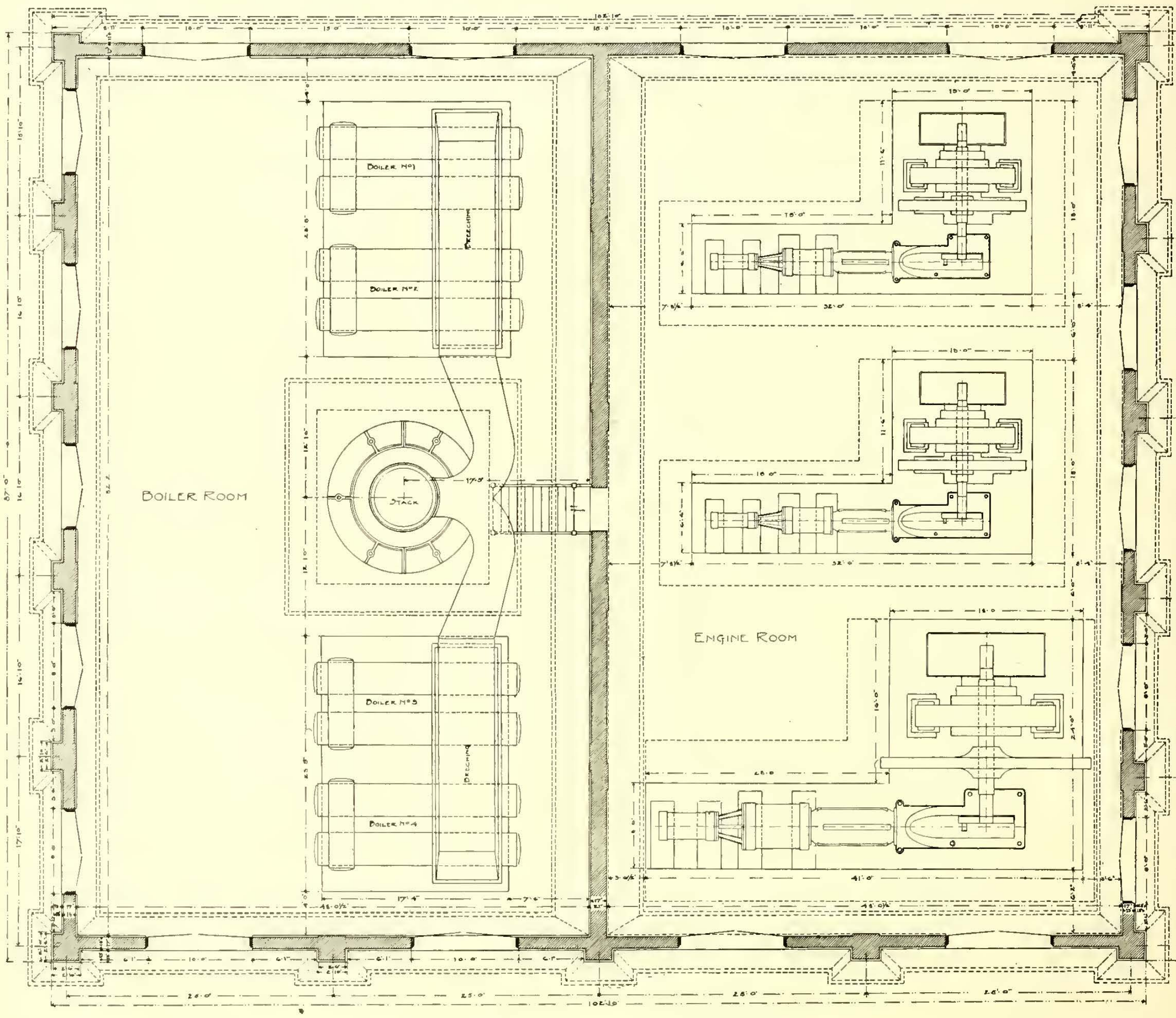
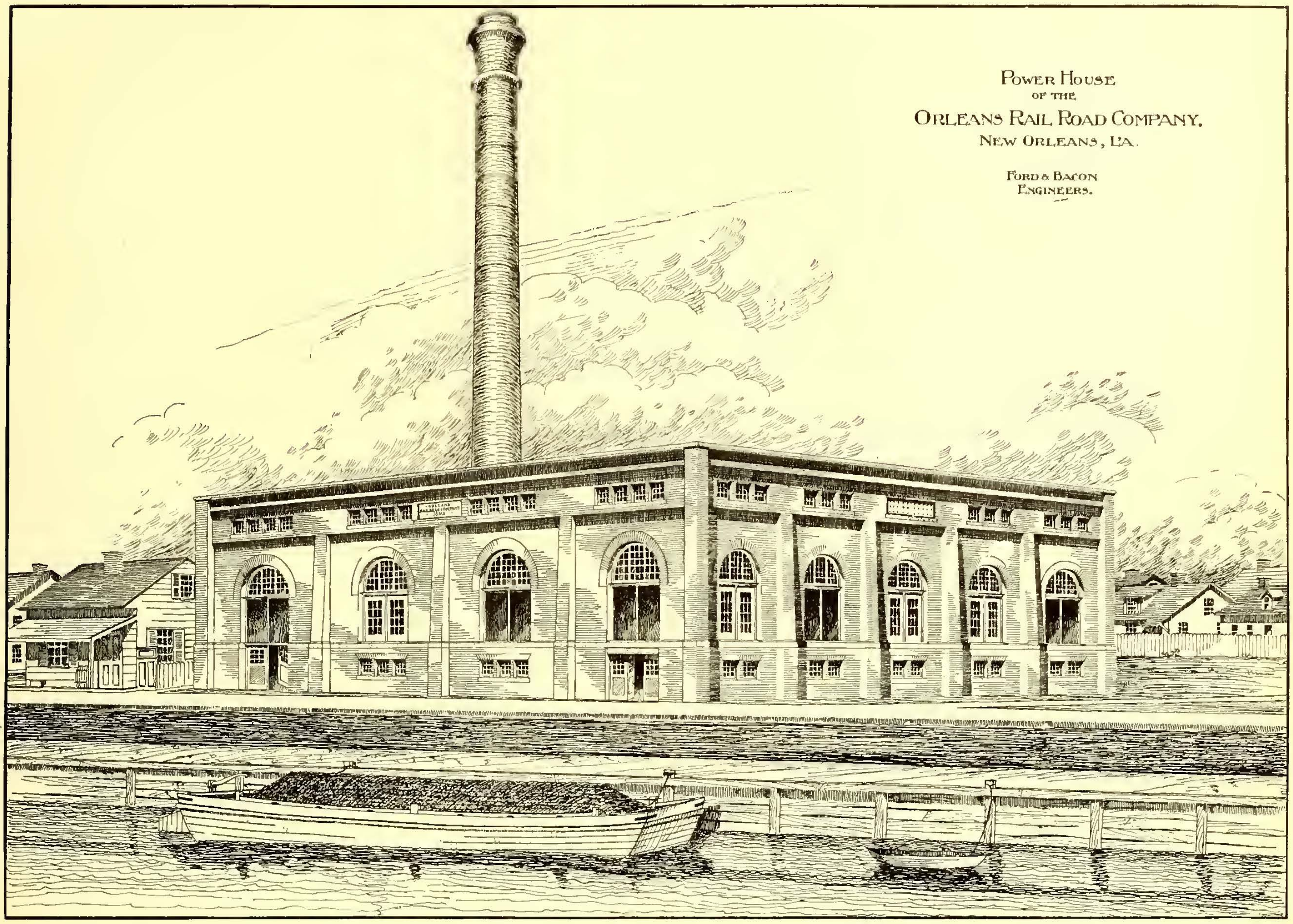


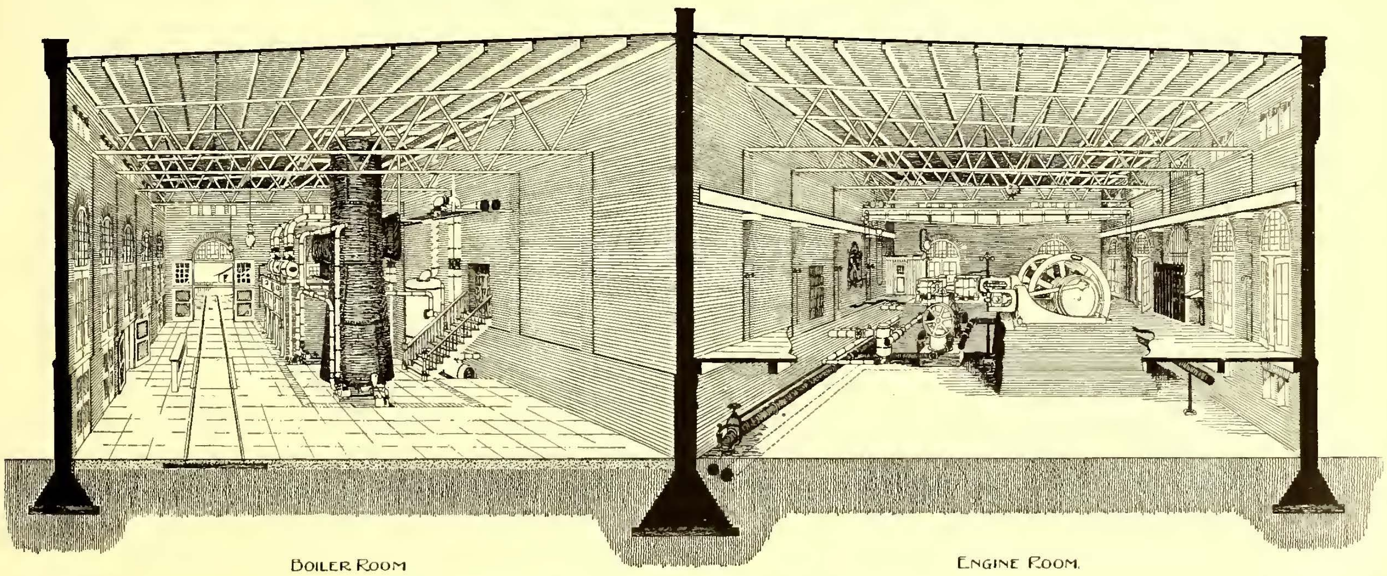
FIG. 10.—PLAN OF STATION AND FOUNDATIONS.

The generator plant is designed for the direct connection of one 400 k. w. and two 200 k.w. generators to the engines installed. The General Electric multipolar iron clad type is used. These machines, under severe conditions of overload, have met satisfactorily the requirements of the most rigid specifications. The switchboard is the standard black enamel slate board of the General Electric Company. There are panels for each generator, three double feeder panels, and blanks for future extension. All meters are of Weston make, and rheostats of the Carpenter enamel type. The feeders are led through the wall in a perforated stone slab, thence through an oak panel and run down the wall to the switchboard in brass armored interior conduit.

The pipe fitting consists of the high pressure live steam system, the condensing and exhaust steam system, the feedwater and purifying system, the drip and blow-off system, and the water piping system for fire protection.

The high pressure live steam and feed systems are entirely in duplicate to ensure the reliable operation of the all the time. In case of an accident to one pipe the other is forced during the short interval of repair. By this arrangement the superficial area of exposed live steam surface is reduced thirty per cent from the usual duplicate sys-





FIGS. 11 AND 12.—EXTERIOR AND SECTION OF STATION.

plant in case of accident to or leakage of a portion of the system. A novel system of duplication is used. Ordinarily, in duplicate systems, each pipe line is as large as would be installed in a single system, and but one pipe is used at a time, the other standing idle. In this system the combined area of both pipes equals the area of a single pipe of the ordinary duplicate system, and both pipes are used tem, where the leakage of valves in the idle main is always sufficient to keep it up to the full temperature of its companion. Again, the valves in an idle main usually become so tightly seated that when it is necessary to raise them quickly it is impossible to start them. These and numerous other practical advantages of the small duplicate system are readily apparent, and its cost is but slightly in excess of single piping instead of being twice as much. This duplicate system was devised and first placed in successful operation by George H. Davis, now of the firm of Ford & Bacon.

As shown in Figs. 12 and 14, duplicate leaders from each boiler connect with duplicate headers extending the full

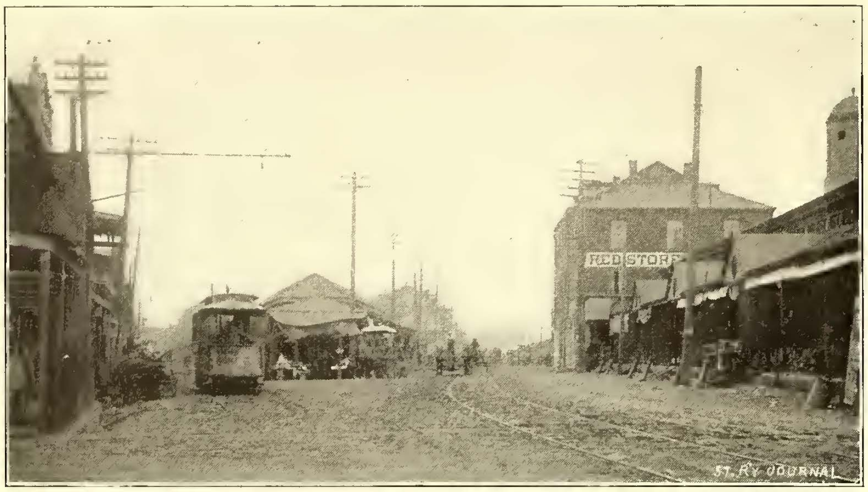


FIG. 13.—THE OLD FRENCH MARKET.

length of the boiler room along the party wall. From these, duplicate leaders drop down and through the party wall to each engine, converging at a Y into a Webster separator placed near the throttle valve. Copper bends connecting mains with engine leaders form the expansion pieces between engines and boilers. The live steam leads, as shown, are bent to a radius of over six diameters and cast fittings are avoided. All steam mains, receivers and separators are thoroughly dripped, and live steam drips returned to the boilers by gravity and by drip pump.

The canal water of New Orleans contains an appreciable percentage of salt, while the artesian well water flowing over decayed swamp vegetation is highly charged with carbonates. The Smith-Vaile open air heater in this plant purifies the feed satisfactorily as shown by weekly examinations of the boilers. The water piping is so arranged that

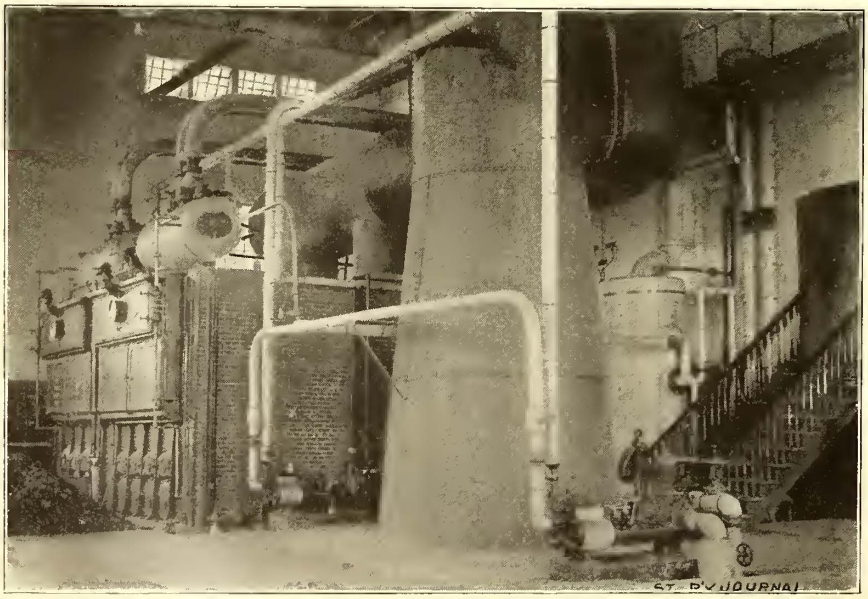


FIG. 14.—INTERIOR OF BOILER ROOM, SHOWING DUPLICATE PIPING.

either canal or well water can be used for condensing or feed, or a mixture of both. At present, well water is used for both purposes, and the feed is drawn from hot wells adjoining the condensers at a temperature of about 110 degs. F. The open air heater then raises it to above 200 degs. F., the carbonic acid gas being liberated and carried by the current of steam to an exhaust head in the roof.

Efficient protection in case of fire is afforded by a complete system of water piping for this purpose, which is connected to fire hose placed in boiler room, engine room and on the roof.

All live steam pipes are extra heavy with flange fittings throughout. All valves, flanges and fittings in live steam pipes greater than two inches diameter are of the Chapman high pressure standard. All smaller valves are of the Jenkins globe pattern. Condenser injection and discharge pipes are of flanged cast iron with Chapman low pressure valves. A Spencer damper regulator and a Pittsburgh alarm water column are placed in a convenient location in the engine room. The pipe covering consists of one inch of asbestos upon which is placed one inch of hair felt.

The entire piping construction was erected by the Benj. F. Shaw Company, and is the finest piece of work of this class in the South. A special description of the steam fitting of this plant will appear in a subsequent issue of the STREET RAILWAY JOURNAL.

The station contains a ten ton traveling crane with hand hoist furnished and erected by the Brown Hoisting Company.

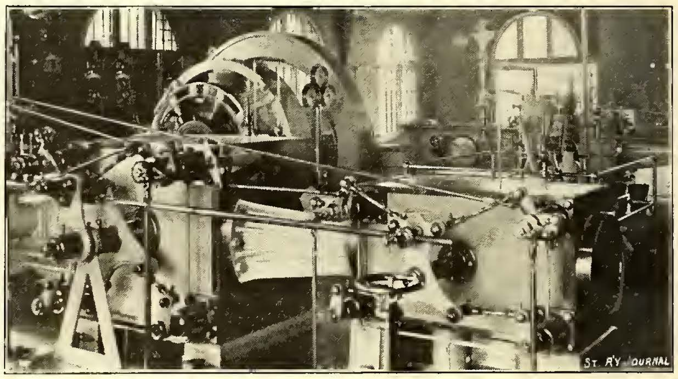


FIG. 15.—DETAIL OF SPECIAL VALVE GEAR.

The interior finish of the plant is neat and appropriate. In the engine room the pressed brick is salmon color laid with $\frac{3}{16}$ in. red mortar joints. The boiler room walls are painted white with black dado. The wood sheathing of the ceiling is natural finish varnished. The trusses, traveling crane and track are painted a light straw color. Engines, air pumps and generators are painted white enamel with simple gold stripes. The individual gauge boards are nickel in trefoil form with nickel stands and Crosby ten inch dial nickel gauges. The station gaugeboard is mahogany with Crosby ten inch dial nickel mounted instruments. Stair railings are in mahogany. The arc and incandescent lighting fixtures, the double railing surrounding condensers, the relief valves, indicator connections, lubricators, etc., are in nickel finish.

The Orleans power plant with equipment is considered by railway authorities to be one of the best and most carefully planned stations in the country, and for its size one of the most efficient. Its total cost with complete equipment is about $100 per horse power.

Plans and specifications for the entire construction and equipment were prepared by Ford & Bacon, engineers, under whose superintendence the various contracts were executed.

The officers of the company are: P. Cougot, president; James Pollock, secretary, and H. J. Malochée, superintendent. The construction committee of the stockholders comprises Paul Capdevielle, chairman, and Messrs. Koen, Cromwell, Limongi and Fitzpatrick.

The Manchester Street Railway Company.

One of the most recent electric railways in New England is that in Manchester, N. H. This city has a population of about 48,000, and is an important manufacturing center of the cotton industry. The Amoskeag Mills, the largest cotton mills in the world, are located here, as are also a number of other important mills of the same kind.

The railway is about eighteen miles in length, and was equipped last summer. It was originally a narrow gauge road, and passed into the hands of its present proprietors about six years ago. When electricity was decided upon, the managers first decided to retain the narrow gauge, largely with the idea of using the old rolling stock to a considerable extent, but also because of ease in track construction. After a careful review of the situation however a change to standard gauge was determined upon, and it is needless to say that the step has not been regretted. A part of the old rolling stock was built over for the new gauge, as described later.

Of the total length, ten miles are double track. Eight and a half miles are laid with ninety pound, nine inch girder rails; six miles with seven inch, seventy pound T rails; and five miles with fifty-six pound, five and a half inch T rails, all of the Johnson manufacture. The rails are laid on chestnut ties spaced two feet between centers. The ties for the girder rails are 5 ins. $\times$ 6 ins. $\times$ 6½ ft.; those under the T rails are the same dimensions, but one inch less in thickness. As the soil is sand no stone ballast was required.

The joints are made in the nine inch construction with

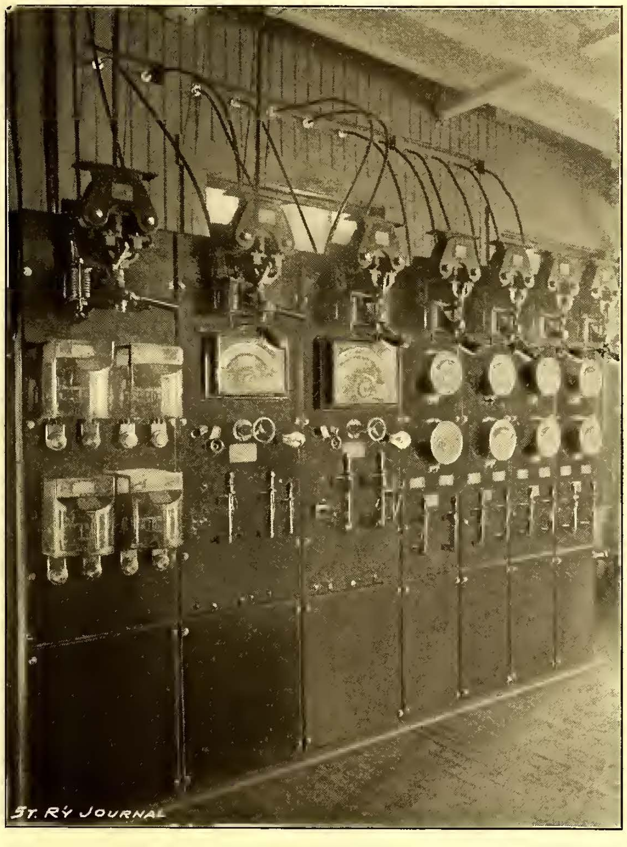


FIG. 1.—SWITCHBOARD WITH FOUR WATTMETERS—MANCHESTER

thirty-six inch, twelve bolt plates and in the seven inch construction with thirty-eight inch, eight bolt plates. With a five inch rail the ordinary guard plate connection is used. Johnson special work is employed. The rails are double bonded with Chicago bonds No. 00 copper wire, with supplementary connecting every third joint.

The overhead line uses side poles mainly. For a distance of about three-quarters of a mile however there is a handsome line of Morris-Tasker center poles, each pole weighing 900 lbs. The overhead construction uses Anderson switches and Medbery appliances.

The rolling stock includes seventy cars, the later ones

FIG. 2.—DOUBLE BRACKET CONSTRUCTION—MANCHESTER.

being of the Laconia make. All motor cars are equipped with G. E. motors. Some of the old cars are being used as trailers. To fit them for the present gauge a new sill was placed on each side outside of the old sill. With the box cars this brought the edge of the sill about even with the belt rail. As the main panel was not disturbed, the lower panel was made nearly vertical instead of concave. With the open cars, the difference in appearance is not so noticeable, the sill appearing as part of the side step. The cost of such construction was found to amount to about $40 per car.

The company does not own a power station, but purchases current from the local lighting station. The railway generators are of 300 k. w. and 200 k. w. capacity respectively, and were supplied by the General Electric Company. There are four feeders. The current supplied to two of these is measured by two wattmeters in series, and that to the other two by another group of two meters. The object of two meters in series is to permit one to check the other.

The price paid for current is 2¾ cents per watt hour, making the cost per car average, with eighteen cars in service, from $2.75 to $3.00 per day. The cars cover from 110 to 125 miles per day each.

The company has recently secured 225 acres in the neighborhood of the city, where a handsome park will be located.

THE City Electric Railway Company, of Decatur, Ill., has recently established a handsome transfer house near the center of the city where line connections are made. The house is octagonal in shape and cost about $3000.

THE operation of the Lenox Avenue line of the Metropolitan Street Railway Company, of New York, was continued without interference during the heavy snowstorm of Mar. 11. This was owing partly to the fact that a sweeper kept the road fairly clear from snow, though at times the snow was quite deep on the tracks. It is stated that throughout the storm no electrical trouble of any kind developed in the conduit.

OPERATION

Street Railway Repair Shops.

Ninth Paper—Repair Shops of the West Chicago Street Railway Company.

By W. Frank Carr.

The West Chicago Street Railway Company operates approximately 196 miles of the Yerkes system and practically controls, besides the West Division Railway, the Cicero & Proviso system of forty-five miles, the Ogden Street Railway of fourteen miles and the Chicago & Jefferson Urban Railway of eight miles. Of these roads 34 miles are cable, 215 electric and 14 horse.

It will be seen at a glance that the methods of repairs and maintenance of the rolling stock of such a road present a very interesting study. Machinery and tools must be kept at hand, store rooms must be ample, well arranged and stocked with all of the many supplies requisite for the renewals of the various kinds of equipment. It is under such circumstances that the management is taxed to keep the repair shops running on the most economical and conservative basis, keeping down that enormous expense which radical changes always entail, at the same time keeping pace with the times. Concentration is the rule here, the management evidently believing that thereby the force of men required is decreased and consequent expense of both operation and maintenance is materially lessened. By the changes made from the old system of "mule" power to the more modern method of propulsion, the number of car houses required for the proper handling of the rolling stock has been reduced, the vacated barns being used simply for storage.

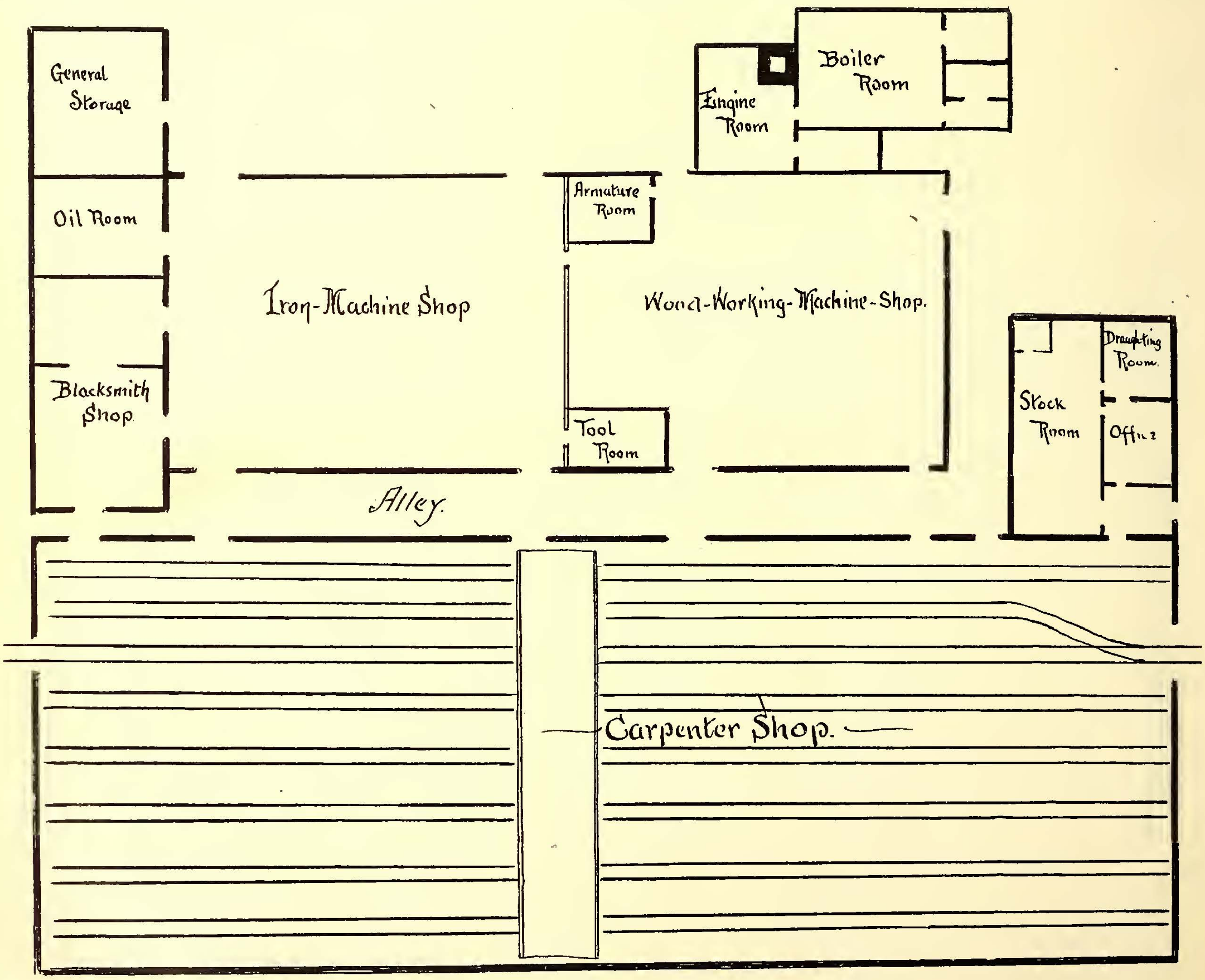


FIG. 1.—DIAGRAMS OF CAR AND REPAIR SHOPS—WEST CHICAGO STREET RAILWAY CO.

From the fact that many lines are still being operated by horses and furthermore that the electric lines have been in operation scarcely nine months, the system of repairs and maintenance is not as perfect as the management hopes to have it eventually. As the changes are perfected and

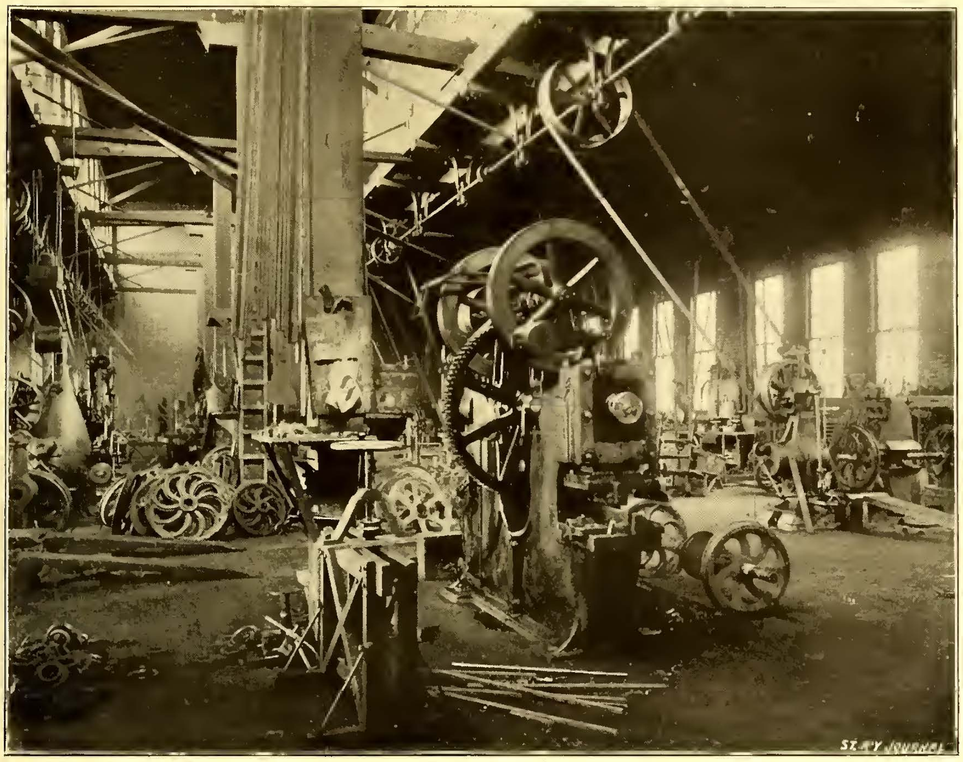


FIG. 2.—MACHINE SHOP.

electricity substituted throughout, implements now used for the electrical work will be replaced by others and the internal arrangement of buildings will be changed to provide better facilities for the handling of the new equipment. The car shops of the West Chicago Street Railway Company are exclusively employed for the repairs to car bodies and trucks, renewals of wheels and axles and machinery work entailed by such repairs, the manufacturing and repairing of the various parts of the grip mechanisms, the rewinding of armatures and fields, rebuilding of commutators, and the necessary power station repairs, such as require machine work. A very large amount of work for the construction departments has been turned out during the past year and a number of new cars built for various purposes.

The car shops are located at Fortieth Street and Madison Avenue, extending over three blocks of territory and comprise four brick buildings, the loop house, the machine shop, carpenter shop and the paint shop.

The loop house on Madison Street is a building 300 ft. × 330 ft. for the switching and storing of cars used on the Madison cable line, the loops of both the Madison cable and the Cicero & Proviso electric line passing through the house. Between the two loops a large, well lighted and warmed waiting room is located for the accommodation of patrons desiring to transfer from one to the other. In the center of the house, a large pit on the cable loop offers facilities for inspection of cables and grips. All rolling stock, new cars which are to be wired and mounted, or the old, requiring repairs are brought via Madison cable to the loop house and these by use of transfer tables and switches hauled to the car shops proper, a general plan of which is shown in Fig. 1.

MACHINE SHOP.

The machine shop is a building approximately 265 ft. × 72 ft., with an L 100 ft. × 35 ft. for the power plant. The main building contains a blacksmith shop, a machine shop and a wood working shop.

The power house is divided into a boiler room 50 ft. × 35 ft. and engine room 42 ft. × 30 ft. In the boiler room are four National tubular boilers 100 h. p. capacity each. The engine room is equipped with an electric light plant of two dynamos of respectively thirty-five and twenty-five arc lights run by a small simple automatic engine and a 125 h. p. Russell engine for the operation of the shop machinery. Rope transmission is used to the main shaft in the shops.

Fig. 2 gives a view of a portion of the iron machine shop taken from the south end. This room is supplied with the usual elaborate equipment of iron working tools necessary in the car shops of any large system of a similar character. Among the many machines here employed are wheel presses, one of which is seen to the right in the picture, power punch and shears seen in the center of foreground, drill presses, iron planers, vertical

FIG. 3.—CARPENTER SHOP.

drills, slotting machines, lathes and car wheel boring machines.

Machines which are of special service to the blacksmith department as well as the iron machine shop are placed at the end nearest the former. In the everyday experience of a shop of this kind many opportunities are present for the making of simple devices to facilitate the work. Such a device is exhibited in the center foreground of the cut standing on a riveting horse. It is simply a standard of iron through which works a vertical screw used for the renewing of bushings in trolley wheels. It is usually kept in that portion of the shop devoted to the repairs and renewal to trolley poles. Another labor saving device of great value is a suspended iron trolley, patterned after the traveling trolley used in packing houses for the shifting of beef. This is provided with chain blocks and runs from the armature room through the wood working room and the entire length of one side of the machine shop. Armatures requiring turning down of commutators are by the use of this contrivance easily carried to any one of the many lathes. The rapidity with which work can be turned out is illustrated by a job completed in latter part of last year. Beginning Nov. 23, there were turned out of this shop fifty-seven grips made in their entirety and many more repaired, all in twenty-eight days. This time might have been shortened but for the utilization of many of the old castings.

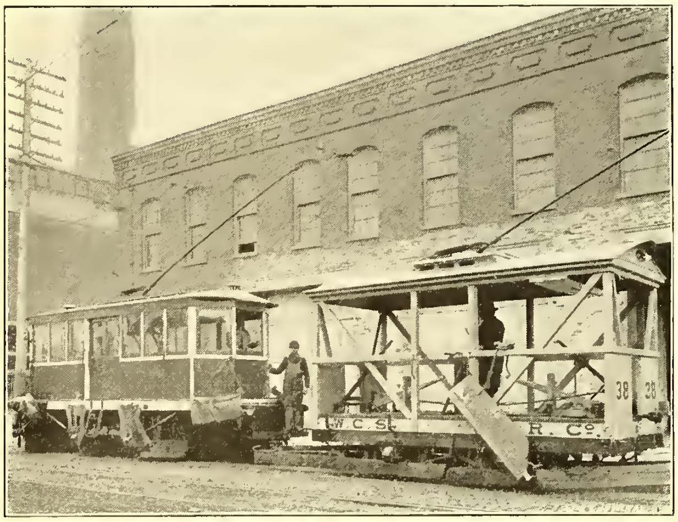


FIG. 4.—SNOW PLOW AND SWEEPER.

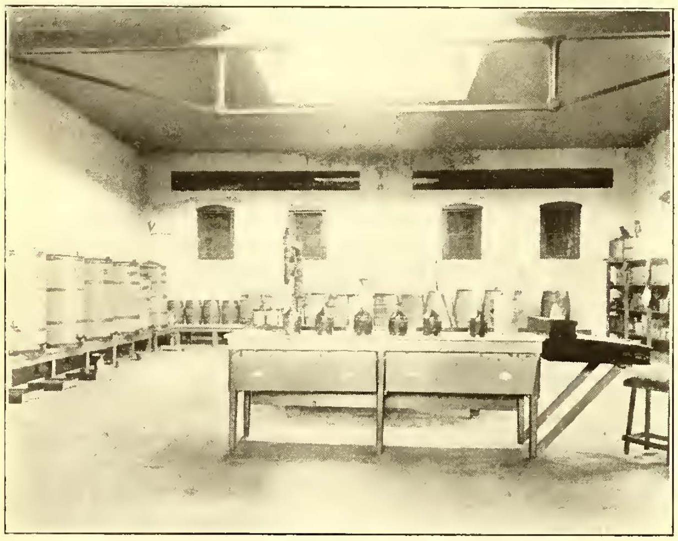


FIG. 6.—STOCK ROOM OF PAINT SHOP.

FIG. 7.—"HURRY-UP" WAGON.

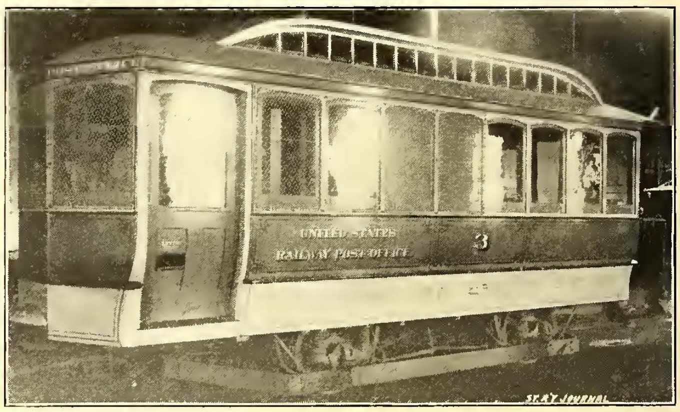


FIG. 5.—MAIL CAR.

CARPENTER SHOP.

The carpenter shop is a building 122 ft. × 330 ft., provided with transfer tables for the shifting of cars, and pit facilities for the inspection of operating mechanism, mounting of motors and the like. An interior view of the north end of this building is given in Fig. 3. A particular feature of this shop is the arrangement of windows so as to afford a great abundance of light. Trolley wires are strung over the tracks and arc and incandescent lights are plentifully distributed about the building. The illustration shows the shop full of summer cars going through the usual annual overhauling preparatory for summer service. From thirty to thirty-five cars can be handled at one time still allowing switching facilities. Portions of the room are divided off severally for pattern work, repairs to wagons, sweepers and plows, repairs to floor mats, gates and headlights, etc.

During the past year besides the keeping up of usual repair work incident to the operation and the equipping of the new rolling stock, the carpenter shop has turned out six snow plows and four mail cars of its own design. The snow plows have sixteen foot bodies, are provided with an equipment of two G. E. 800 motors both operated by one controller placed in the center of the body. Resistance boxes and lightning arresters are placed high and dry close to the roof of the car. They have been thoroughly tested during the past season and have proved entirely satisfactory to the company.

Fig. 4, shows snow plow No. 38 and with it a Brill sweeper which is equipped with two G. E. 800 motors for car propulsion and one G. E. 800 motor in the body of the car for the manipulation of the sweepers.

The mail car, a view of which is given in Fig. 5, is both convenient and economical in design and is an ornament to the system. The bodies are twenty-three feet over all, about thirteen feet of which is devoted to the service of Uncle Sam, the balance for the use of the general public. By dispensing with the platform and the utilization of the space for mail purposes a well lighted and roomy apartment is obtained. Three of these cars were turned out for the Government in thirty days.

PAINT SHOP.

The most northerly building of the car shops is the paint shop which in style of architecture is similar to that of the carpenter shop and, being isolated, every opportunity is offered for the obtaining of good light which is especially desirable in such a place. The style of lettering and finishing is a standard on all cars of the West Chicago Street Railway. The standard colors are a tinted white for body and lemon for the convex of the body and the dash.

Especial pride is taken in the stock room of the paint shop which good judges place in the front rank among such in the country. About $3000 worth of the best qualities of paint and varnish are carried in stock at all times. A general view is given in Fig. 7, though a larger part of the paint stock in the shelved portion of room is not included.

GENERAL MAINTENANCE.

As stated in an early part of this article, the car shops are exclusively for the repairs to car bodies, renewals of trucks and, in general, the manufacture of new parts of the equipments. The cars after being thoroughly equipped and prepared for operation are sent to the stations of the separate divisions and placed under the care and charge of division superintendents. Each station has a force of men for the general overhauling, the renewing and repairing of such parts of the equipment as the daily inspection shows to be required.

Pit facilities of each station are proportioned to the number of cars in daily use and are well lighted by incandescent lamps placed in the niches of the wall of the pit and heated by steam. All the necessary small tools such as wrenches, hammers, screw drivers, pliers, etc., are provided, also a small forge and drill with each station.

The usual force of a station for the inspection of the rolling stock consists of a day and night gang of three men each, one of whom, acting as foreman, is supposed to be thoroughly posted in the details of the equipment both electric and mechanical. At night a careful examination is made of the condition of wiring of cars and equipment of brushholders and brushes and of the controllers. New carbons are put in every night, grease cups are filled, bearings oiled, loose bolts tightened and trolley poles exchanged where necessary. The day force adjusts brake shoes, rods and chains, renewing them when necessary, overhauls trolley poles, replaces worn out bearings with new, and attends to all general repairing required in the electrical equipment. Extra cars at each station afford a rotation in their use thus allowing a thorough inspection and overhauling of the entire car and equipment at regular intervals.

Although the company's experience is limited to the severe seasons of the year, in face of the hard usage given the equipments this past winter, it is highly complimentary to the management that the operation and inspection of cars and motors is so well systematized that burned out motors are practically unknown.

All the work in the armature room thus far is done by two men. On account of the light work the armature room of the car shops, though well equipped with forms for winding fields and armature coils, a large bake oven and other facilities desirable for the overhauling and repairing of electric equipment, has not yet developed into a very large factor.

A not unimportant factor in the operation and maintenance of a cable and electric system is the wreck, or "hurry-up" wagon. This wagon is a product of the shops, is designed to carry the wrecking tools for removing obstructions on the tracks and is equipped with the necessary outfit for handling the wires of the overhead construction. A force of two men, a teamster and a lineman, on a day and night shift attend to all trouble calls. Wrecked cars are pulled off to one side and trolley wire breaks or other damage done to the overhead construction are temporarily repaired by the "trouble" men and permanent repairs follow later by the repair or construction gang.

A Study of the Causes Which Lead to Breakage of Gears and Pinions.

By Charles F. Uebelacker,

First Paper.—Theoretical Considerations.

The adoption of the single reduction type of street car motor seems to-day universal. The gearless motor has dropped almost as completely out of sight as its predecessor, the hydraulic gear. Our past four years' experience seems to point to the single train of spur gears, connecting armature and axle, as the most satisfactory device for combining in the same machine the desirable points of reliability, light weight and low cost.

This apparently necessary train of gears is undoubtedly the cause of some loss of power. The amount of this loss is, however, so small that we can well afford to stand it in view of the present low cost of motors. This item of power loss is far exceeded by the cost of renewals of gearing, even now, when scarcely a motor is on the road that is not provided with ample facilities for the constant and thorough lubrication of the gears. Figures in the writer's possession would indicate that about seven per cent of the total cost of maintenance of rolling stock should be charged up to repairs and renewal of gearing. Seven per cent does not look like a large item, but it mounts up to a very snug sum by the time a year has rolled by, and any reduction that can be made in it by careful selection of material and care in running will well repay the trouble and time spent.

The conditions under which gearing is used in street railway service are particularly severe. The speed is, at its maximum, quite high, frequently 1400 ft. per minute, with a pressure of 125 lbs. per square inch or thereabouts between each pair of interlocking teeth. More or less grit from the flying dust of the streets is continually working into the gear pans and occasions a grinding action which wears away the gear very rapidly as compared with service in a less exposed locality. Again, when the speed of the motors is low, as in starting or running up grade, the gear must transmit its maximum horse power at a comparatively slow circumferential speed. Take for instance a car and load weighing fourteen tons on a five per cent grade. The two gears must each transmit $840 \times \frac{33}{21} = 1320$ lbs. torque at a speed of say 560 ft. per minute. Even this moderate grade gives a strain well up towards the limit for cast iron gears of 5 in. face and 3 diam. pitch (the ordinary dimensions). 1320 lbs. would give us an ultimate fibre strain of about 2300 lbs. per square inch with a new tooth, and on a tooth worn down nearly to the limit, nearly three times this amount, or about 7000 lbs. per square inch. Wilfred Lewis estimates the safe working strain for cast iron gears at this speed (600 ft. per minute) to be 4000 lbs.!

All this is legitimate strain to be encountered on almost any road any day and many times a day. There are several ways in which the gearing is liable to encounter the undue strains. Ordinary practice permits an axle very perceptibly sprung to remain in service. This gives a double addition to the strain. There is a change in the distance between centers of gear and pinion and a movement out of parallel of the shafts supporting them as well. The conditions result from the wear of armature and axle bearings. The ordinary allowed wear of $\frac{1}{8}$ in. in axle and $\frac{1}{16}$ in. in armature bearings will permit the two shafts to assume an angle of $0° 18'$ with each other, amply sufficient to bring the whole strain on one end of the gear teeth instead of distributing it along their entire length.

In addition to the above abnormal strains, we have still another, the most severe of all, namely, reversing the motors with the car in rapid motion. Just what this strain can amount to it would be difficult to estimate. It is limited only by the adhesion of the wheels to the rails and under the conditions ordinarily obtaining when a car is reversed at full speed, sand is applied freely to one rail. Twenty per cent adhesion on a dry rail without sand is a fair figure. The application of sand will fully double this figure. If, then, we again suppose a car and load to weigh fourteen tons, one rail to be dry and the other sanded, we get $4200 \times \frac{33}{21} = 6600$ lbs. strain on the teeth of each gear! Is it any wonder that something gives way under a strain of this magnitude? 6600 lbs. on the gear means an ultimate fibre strain of 16,000 lbs. per square inch on a new pinion and 12,000 lbs. per square inch on a new gear, while, as stated before, the reduction of thickness in the teeth by wear will raise this ultimate fibre strain to fully three times the amounts named.

It becomes evident in view of the considerations enumerated above that the ideal material for gearing should combine the qualities of hardness and toughness. It should stand 60,000 lbs. per square inch tension and should show a good percentage of elongation before breaking. At the same time it should be a metal which pours freely and castings from it should be regular and sound. Under the tool it must cut perhaps not freely, but without special difficulty.

A gear must be of high grade workmanship if it is to give good service. Every irregularity in the cutting means additional wear. A maximum variation of 0.002 in. is readily attainable with milling machines and several makers produce gears whose teeth fall well within this limit.

To avoid undue expense in replacing gears careful consideration must be given to the location of the bolts, size of the bore and keyway. Here again (in bore and keyway) a variation of 0.002 in. gives the manufacturer ample allowance.

Determination of the qualities of a gear are difficult. It must be by the practical service test that it is finally judged. But as a method of determining the value of a new article the practical service test is open to many objections. How many roads can tell accurately the number of miles made by any equipment in a given time? Yet to make a comparison of results this is absolutely necessary. Again the conditions of service are never absolutely the same on two different equipments or, for the matter of that, on the two ends of the same equipment. The time which must elapse before results can be reached is another argument against the service test. It is *now* that we want to know the value of an article offered us, not six or eight months hence when the conditions of the market are entirely altered. It would seem, then, that service tests are mainly of value when made on a large scale and lasting over considerable time, and that we should have some simple way of predicting their comparative results. This is true not of gears only, but of all wearing parts.

That a gear should be sufficiently strong to stand the maximum strain to which it will be subjected is the first and greatest essential. To get at the amount of this strain, let us assume as before the maximum of 6600 lbs. to be transmitted. Just here, for curiosity, let us estimate the space in which a car and load weighing 14 tons and running say 18 miles per hour would be brought to rest by retarding force assumed. By substituting in the equation

$$S = \frac{W V^2}{64.4 f} \text{ when}$$

S = the distance (in feet)
V = " velocity (in feet per second) = 26.4
F = " retarding force at circumference of the wheels = 8400
W = " weight of load = 28,000 lbs.
We get S = 36 feet (nearly).

In addition, we should allow the motorman at least a second to go through the operation of reversing and applying sand. In this time the car would traverse about twenty-six feet more or the stop would be made in a total distance of sixty-two feet. Or, in other words, in assuming a strain of 6600 lbs. per gear we are allowing for a possible stop under conditions of high speed and heavy load in sixty-two feet without failure of the gearing. Now follow the strain down in detail to the consequent necessary dimensions of the gear tooth or, rather, to the necessary strength of the material with the dimensions of teeth which practice has made universal.

The ordinary gear has an involute tooth of 3 diam. pitch, an angle of obliquity of 14½° or 15° according to the make of the cutter used in milling the teeth. We have four conditions to meet, namely, new gear against new pinion, new gear against old pinion, old gear against new pinion, and old gear against old pinion. In the first case we have simply to take the theoretical dimensions and from them figure the strains.

Fig. I represents a tooth. In the case of the new gear and pinion the pinion tooth would be the weaker, of course. The following are usual dimensions:

14 Tooth New Pinion.	New Gear.
a = .250 in.	a = .271 in.
b = .523 "	b = .523 "
f = .500 "	f = .541 "
e = .594 "	e = .672 "

These dimensions are measured from the tooth and, of course, will not correspond exactly with those deduced theoretically. They represent quite accurately however the actual dimensions. It should be stated before going further that the dimension *e* is not the sum of the radial lengths of the addendum and dedendum but the distance from the top of the tooth to its weakest point. In view of the irregularities which exist in the cutting it would not be safe to assume the strain on a new gear and pinion as applied otherwise than at the extreme end of one tooth. A few days wear will undoubtedly bring them down to better contact so that an assumption on a worn gear and pinion of one-half the total strain at the end of the tooth would be sufficient.

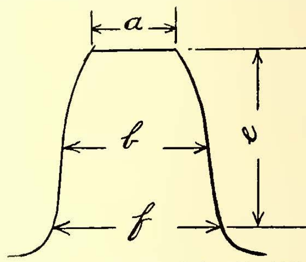


FIG. 1.—DIAGRAM OF GEAR TOOTH.

The lack of parallelism of the two shafts, again, will increase the strain. In a five inch face gear the allowable wear before assumed would indicate that a gear and pinion in contact at one end might be 0.023 in. apart at the other. Such an extreme case would not be possible in a new gear, as the back lash is not that much. Moreover, as the gear wears, the tooth wears off at one end more than the other, thus adapting itself to take the strain over its entire face. Then, too, there is a certain amount of spring in the teeth, especially if the gearing be steel, bronze, or malleable iron, and this permits the strain to distribute itself over more of the face.

Practical results, as might be expected from these considerations, show that cast iron gears or hardened steel pinions are very apt to break off the corners of teeth, while soft steel never fails in this way. Assuming then, that the pressure is applied along the entire top of one tooth and substituting in the equation

$$P = \frac{M}{I} y \text{ where}$$

P = stress per square inch in the ultimate fibre.
M = breaking moment in inch-pounds.
I = moment of inertia of the cross section.
y = distance from the neutral axis to the ultimate fibre,

We get for the new gear

$$P = \frac{4435}{.06} \times .270 = 19{,}957 \text{ lbs. per sq. in.}$$

and for the new pinion

$$P = \frac{3920}{.047} \times .250 = 20{,}851 \text{ lbs. per sq. in.}$$

Obviously it is more good luck than good management if we induce cast iron to withstand such strains as those. They are far beyond what we can expect of it.

(*To be continued.*)

Power Distribution for Electric Railroads.

By LOUIS BELL, Ph. D.

III. The Return Circuit.

The outgoing circuit of an electric railway has just been discussed in its more general relations. Before investigating the proportioning of the working conductors it is necessary to look into the return circuit. Up to this point it has been assumed that this is similar to the outgoing system as it is in the case of motor systems in general.

In nearly all electric railway practice it has been the custom to employ the rails and earth as the return circuit, since the former are good conductors and necessarily in contact with the car wheels, and the latter is as necessarily in contact with the rails.

In a few cases two running contacts are employed as in the double trolley system, some recent elevated roads, and the like, but in most instances the total circuit of any railroad consists of the outgoing system of copper conductors and a return circuit consisting of the rails and their environment.

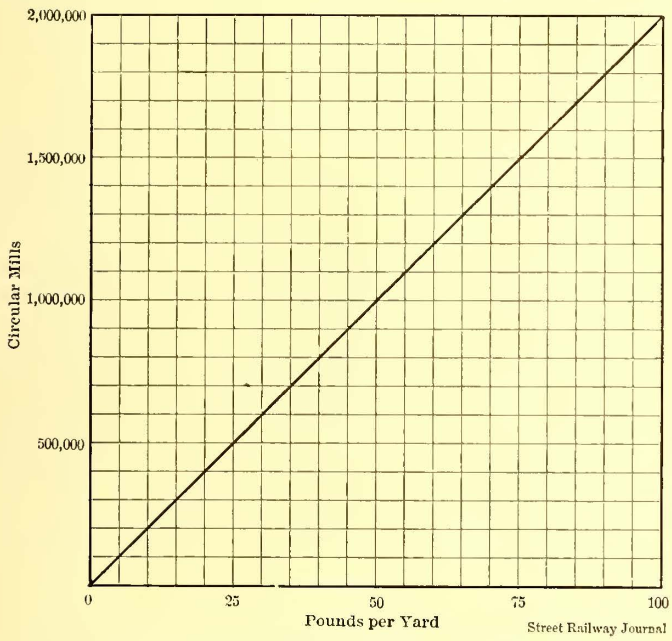


FIG. 17.—DIAGRAM SHOWING RELATION BETWEEN WEIGHT OF RAIL AND EQUIVALENT COPPER.

Now the conductivity of an iron or steel rail is computed with tolerable ease, but the rest of this heterogeneous system is most uncertain. It consists of bond copper, tarnished surfaces, iron rust, rock, dirt, dirty water, mud, wet wood and promiscuous filth near the surface, and deeper down all sorts of earthy material, and in cities various sorts of pipes for gas, water, etc.

In the early days of electric railroading the resistance of this strange assortment was assumed to be zero on the theory that the earth was the conductor concerned and was practically of infinite cross section. This was shockingly far from the truth and although data are rather scarce, we may properly take up the return circuit piecemeal and see what the actual state of things may be.

First as to the rails. Iron when tolerably pure is a very fair conductor. Weight for weight it is, comparing the commercial metals, just about one-sixth as good a conductor as copper. Now a copper wire weighing one pound per yard has an area of about 110,000 c. m.; hence an iron bar weighing one pound per yard is equivalent to nearly 20,000 c. m. of copper, a wire between No. 7 and No. 8 B & S gauge. This enables us at once to get the equivalent conductivity of any rail *neglecting the joints*. The result is somewhat startling, for since ordinary rail runs sixty pounds per yard or more, the conductivity of a pair of such rails is equivalent to about 2,400,000 c. m. of copper, in most cases nearly ten times the cross section of the outgoing circuit.

The resistance of a copper wire of 20,000 c. m. is roughly half an ohm per thousand feet. Hence the resistance of any single rail in ohms is, per thousand feet

$$R = \frac{.5}{W}$$ where W is the weight

per yard. Or since two rails form the track

$$R = \frac{1}{4\,W}$$

That is, if the rail used weighs sixty pounds per yard the track resistance is $\frac{1}{240}$ ohm per thousand feet. For convenience the relation between weight of rail and equivalent copper is plotted in Fig. 17.

These relations enable one to figure the drop in the track, *neglecting joints*, by the formulæ already given. For this purpose the distance in the formula should be, of course, the actual length of track, not the double length as when a return circuit of copper is figured. Thus one would separate the outgoing and return circuits and compute the drop in them separately. For simplicity it is however desirable to make allowance if possible for the return circuit, incorporating it in the constant of the formula so as to make but a single calculation.

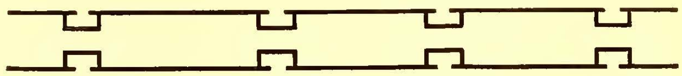


FIG. 18.

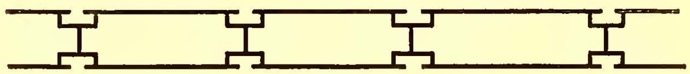


FIG. 19.

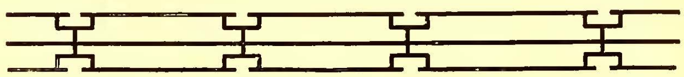


FIG. 20.

FIG. 21.

The figures just given emphasize with tremendous force the need of thorough bonding of the track in order to take advantage of its immense conductivity. In the early electric railways this was terribly neglected, the bond wires sometimes being as small as No. 6 and even of galvanized iron. Bonding is of very various character. Its most rudimentary form is shown in Fig. 18. In this case the bonds merely united the ends of adjacent rails, each line of rails being bonded separately. The improvement of Fig. 19 is quite obvious, for in Fig. 18 a single break compelled one rail to carry the return load. The cross bonding of Fig. 19 adds somewhat to the weight of copper required, but ties the rails together so that no single break can be serious and nothing save a break from both rails on the same side of the same joint can really interrupt the circuit. A very large amount of track has been so bonded, although at present the usual construction is shown in Fig. 20. The supplementary wire effectively prevents "dead rails." In modern practice the bond wires are often as heavy as No. 0000, and are generally tinned to prevent corrosion. All joints in the wire are soldered and the rail contacts made as perfect as possible. It is perfectly clear that the supplementary wire is of little value as a conductor compared with the rails, but it is of service in mitigating the effects of bad joints. In a few cases this supplementary wire is reinforced by a heavy copper conductor laid alongside the track and connected at intervals to the supplementary wire as shown in Fig. 21. If the joints made by the bonds and rail are very bad this extra copper may be of service, but good joints render it quite unnecessary. The value of the rails as conductors is so great that every effort should be made to utilize them to the fullest possible extent.

The seriousness of the joint question may be seen by a moment's reflection upon the data already given. There are about thirty joints per thousand feet of rail. This means sixty contacts per thousand feet between rail and bond, in addition to the resistance of the bond wire itself. Now, the resistance of a sixty pound rail per thousand feet is, as we have seen, only $\frac{1}{120}$ ohm, in decimals 0.0083. If there should be even one-ten-thousandth of an ohm resistance in each joint between bond and rail, the total resistance would rise to 0.0143 ohm per thousand feet. Add to this, the actual resistance of, say, sixty feet of bonding wire No. 0, and the total foots up to 0.0203 ohm, more than doubling the original resistance. If the joints were here and there quite imperfect, as generally happens, the true rail resistance might easily be increased far more.

One would be thought lacking in common sense who needlessly doubled the resistance of an overhead circuit, but in the rail circuit far more atrocious blunders are only too common. A few years ago it was frequent enough to find bond wire simply driven through a hole in the web of the rail and headed on the outside. Fortunately, the need of care here is now better realized and in the last few years the name of the rail bond is legion. Most of the contacts are modified rivets, not infrequently supplied with some sort of wedging device to ensure a tight contact. They are, most of them, good enough if properly applied, but a careless workman can easily destroy the usefulness of even the best bonds. A few of the many varieties in use at the present time were illustrated in the STREET RAILWAY JOURNAL for March, page 188. The bond contact proper is generally quite separate from the bond wire and is often given a greater cross section than the latter, to ensure an ample contact with the rail.

As to the real resistance of a bonding contact, experiments, as might be expected, vary enormously. The resistance of the bonding wire is, of course, determinate, but that of the contact is most irregular, varying with every kind and size of bond and with the thoroughness with which the mechanical work is done. No part of electric railway construction deserves more careful attention. Culling half a dozen values of contact resistance from various experiments we get the following table:

Single bond contact.
R = .0008 ohm.
" = .00045
" = .000005
" = .00028
" = .0001
" = .00006

As nearly as may be judged, the resistance of a single contact, carefully made, can be counted on to be considerably less than .001 ohm. With bond plugs of large surface well set, it would seem safe to count upon a resistance not exceeding .0002 ohm. per contact.

The bonding wires should be as short as can be conveniently handled. If the work is properly prepared for, there is no good reason to have more than a foot of wire in the bonding connection, although more is frequently used. As to size, there is little reason for using anything smaller than No. 000 or No. 0000. With about a foot of No. 0000 at each joint, and thorough contacts carefully made, the resistance of bonds ought to foot up about as follows per thousand feet.

66 bond contacts	= .0132
33 ft. 0000 wire	= .00165
Total	0.0148 ohm.

This is a little less than double the resistance of a thousand feet of sixty pound rail and corresponds well with actual tests of well bonded track. It is quite near the truth to assume that under average circumstances of good construction the bond wire and contact resistance will aggregate about twice the resistance of the rails themselves.

As regards the earth there is great misconception both as to its conducting power and the part it takes in modifying the rail and bond resistance which we have just been considering. Outside of the metals there are no substances that have even fair conducting properties. That is, all other so-called conductors are very bad compared even with a relatively poor conductor like iron. For example, carbon in the form of graphite or gas cake, usually considered a very fair conductor, yet has several hundred times the resistance of iron, while nitric acid and dilute sulphuric acid, the best conductors among electrolytes, have many thousand times the resistance of iron. The acid last mentioned has a specific resistance of about 0.4 ohm. for a cubic centimeter, while the resistance of a cubic centimeter of iron is only 0.00001 ohm. Water, even when dirty as it is found in the streets, would show a specific resistance of 1000 ohms or more. Earth, rock and other miscellaneous components of the ground are even worse, so that it is at once fairly evident that it would take an enormous conducting mass even of water to approximate the conductivity of a line of rails.

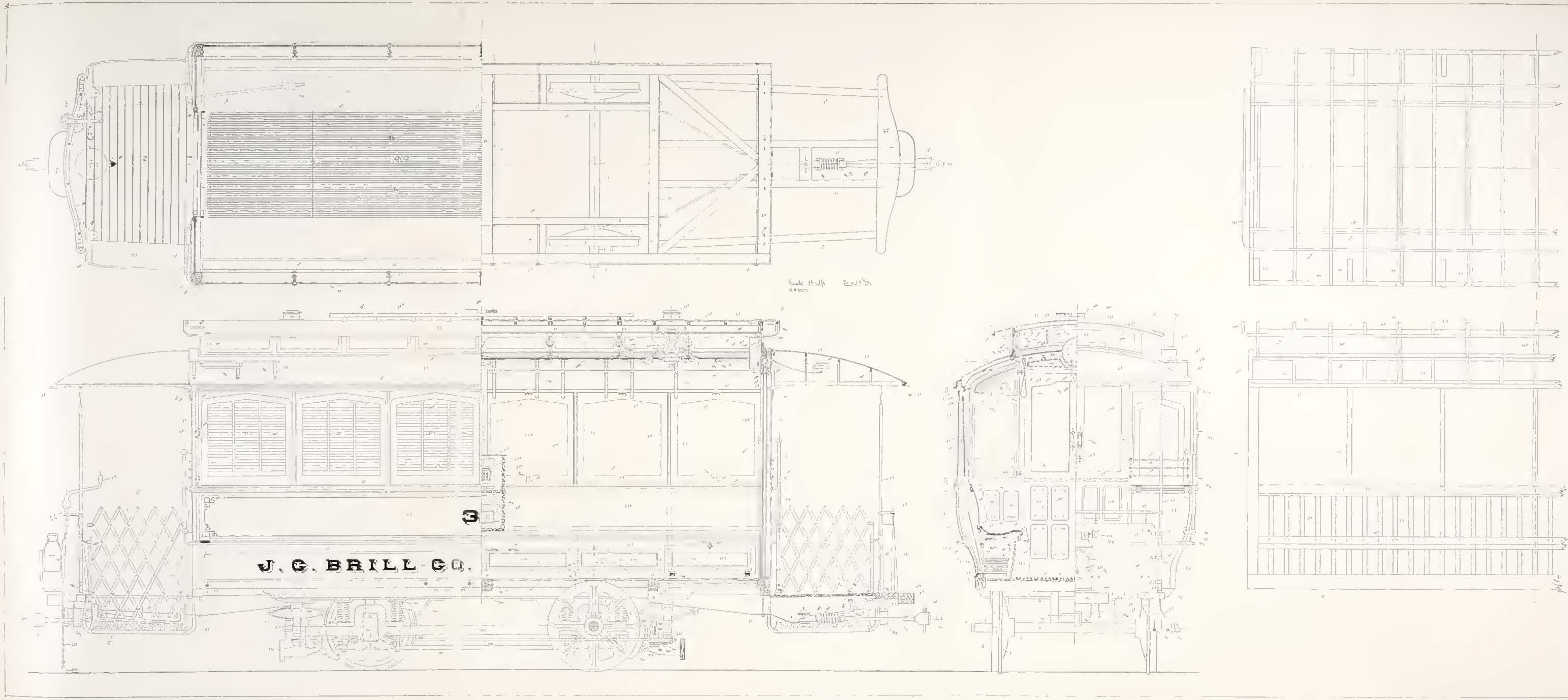
Even in theory the mass of earth really available for conducting purposes is somewhat limited, for if a current be passed between two earth plates, the current density decreases very rapidly as the lines of flow depart from the direct path between the plates. It has long ago been shown too, that when such a current is established between, let us say, a pair of metallic balls sunk in the earth, the resistance of the circuit does not vary much with the distance apart of the terminals, but depends greatly on the surface of the ground connections. Numerous experiments too have shown that the earth is so heterogeneous, so broken up into strata of varying conductivity, that the current flow takes place mainly along special lines, the general mass playing very little part in the action. If, for example, a ledge of rock is in the line between earth plates, save for possible crevices filled with water, it is practically a non-conductor.

At various times and places the value of a true earth return for railway and similar work has been thoroughly tried and has uniformly been found to be practically *nil.* In two cases the ground plates were sunk in considerable rivers which formed return circuits for lines in each case about four miles in length. The ground plates themselves were of ample area, in one experiment, several hundred square feet, and gave every opportunity for good contact with the water. The applied voltage in each set of experiments was 500 to 550. The resulting currents were insignificant and the resistance of the earth return proved in one case to be about 85 ohms, in the other but a few ohms less.

In another more recent experiment the terminal stations were about 3000 ft. apart. An attempt had been made to use an earth return for a motor circuit, with the usual result, and the failure led to investigation. The experiment was arranged as in Fig. 22. At A and B were carefully arranged ground plates in duplicate. One of each pair was sunk in a well, the other imbedded in a mass of iron filings in damp earth. At 1, 2, 3, 4, 5, stations 500 ft. apart, grounds were made by driving large iron bars deep into the earth. The voltages employed were variously from 60 to 150 volts direct current and alternating current from a small induction coil. The results were nearly coincident in all the sets of experiments and showed the following curious state of affairs:

Stations.	Res. ohms.	
A . . B	92.4	Ground plates alone.
A . . B	121.0	Well plates alone.
A . . B	66.8	Well and ground plates both.
A . . 1	201.6	
A . . 2	374.0	
A . . 3	92.	
A . . 4	506.3	
A . . 5	180.0	

The resistance is evidently not a function of the distance nor of anything else that is at all obvious. The only feature that is what might be expected, is the tolerably regular effect of putting both sets of earth plates in parallel as exhibited in the first three lines of the table. The resistances at the intermediate stations show how hopeless it is to predicate anything of earth resistance except that



NAMES OF PARTS.

1 Wheel
2 Spoke
3 Tread
4 Flange
5 Hub
6 Axle
7 Journal
8 Collar
9 Side sill
10 End sill
11 Truck sub-sill
12 Crossing
13 Cross-joint irons
14 Frame tie rods
15 Inside truss frame rod
16 Truss rod queen post
17 Queen post bearing plate
18 Turnbuckle
19 Floor
20 Floor strips
21 Wheel box
22 Side post
23 Window blind rest
24 Post parting strip
25 Window sash rest
26 Post moulding
27 Side post strap bolt
28 Corner post
29 Corner post strap
30 Corner post grab handle
31 Grab handle socket
32 Door post
33 Belt
34 Belt rail
35 Belt rail strap
36 Trap door
37 Trap door ring
38 Trap door hinge
39 Trap door support
40 Panel furring
41 Guard rail
42 Guard rail strap
43 Convex panel
44 Concave panel
45 Upper end panel
46 Lower end panel
47 Top rail
48 Side roof carlines moulding
49 Letter board
50 Water table
51 Body hand-rail
52 Concave panel corner iron
53 Panel washer
54 Roof board
55 Side roof
56 Side roof carline
57 Clear story of upper deck
58 Upper deck carline
59 Iron carline
60 Platform hood
61 Platform hood moulding
62 Platform hood iron
63 Platform hood guard
64 Platform hood carline
65 Platform hood bracket
66 Platform
67 Crown piece
68 Crown piece corner iron
69 Platform knee
70 Platform knee plate
71 Platform draught knee
72 Platform sub-sill
73 Platform step
74 Platform step iron
75 Platform step fender
76 Platform step latch
77 Platform safety gate
78 Safety gate holder
79 Dasher
80 Dasher post
81 Dasher post clips
82 Dasher post washer
83 Head support
84 Dasher rail
85 Dasher rail cap
86 Buffer
87 Buffer band
88 Radiating draught bar
89 Draught bar guide
90 Draught head
91 Drop pin
92 Draught spring
93 Draught spring casting
94 Key
95 Seat
96 Seat leg
97 Front seat rail
98 Back seat rail
99 Seat cane
100 Seat heating
101 Seat crossing
102 Seat front
103 Seat front rail
104 Seat front panel
105 Locker
106 Locker catch
107 Locker catch plate
108 Locker hinge
109 Seat back
110 Finished upper seat back rail
111 Lower seat back rail
112 Upper seat back rail
113 Window
114 Upper window rail
115 Lower window rail
116 Window stile
117 Window guard
118 Window sash lift
119 Window sash leather
120 Window sash leather plate
121 Window blind
122 Upper window blind rail
123 Lower window blind rail
124 Window blind stile
125 Window blind muntin
126 Window blind stop
127 Sand box
128 Sand box valve
129 Sand box lever
130 Sand box lever holder
131 Sand box connecting rod
132 Door stile
133 Upper door rail
134 Lower door rail
135 Door lock rail
136 Door muntin
137 Door panel
138 Door case top rail
139 Door sill
140 Sliding door stop
141 Sliding door handle
142 Sliding door hook
143 Sliding door sheave
144 Sliding door roller
145 Upper door track
146 Lower door track
147 Intermediate door track
148 Head piece
149 Trolley inspection steps
150 Trolley inspection end landing
151 Roof landing irons
152 Roof landing grab handle
153 Upper deck grab handle
154 Trolley board
155 Trolley board cleats
156 Trolley base blocks
157 Ventilator
158 Ventilator casing
159 Lower ventilator rail
160 Lower vent. rail and moulding
161 Lower vent. rail head lining mldg.
162 Upper ventilator rail
163 Ventilator cove rail
164 Ventilator muntin
165 Ventilator hood
166 Ventilator hood iron
167 Upper ventilator sash rail
168 Lower ventilator sash rail
169 Corner ventilator muntin
170 Ventilator sash pivot
171 Transom
172 Transom pivoted sash
173 Transom stationary light
174 Transom gallery
175 Transom head lining blocking
176 Corner transom muntin
177 Center transom muntin
178 Upper transom finish moulding
179 Transom casing
180 Advertising rack rail
181 Upper advertising moulding
182 Lower advertising moulding
183 Head lining
184 Crown moulding
185 Hand pole
186 Hand pole strap
187 Hand pole bracket
188 Hand pole tip
189 End lining
190 Fare board clock
191 Door sheave housing
192 End lining hinged sash
193 Hinged sash bar
194 Mirror
195 End lining panel
196 End lining panel bead
197 Signal bell
198 Signal bell cord
199 Pedal alarm gong
200 Alarm gong hammer
201 Alarm gong button
202 Corner lamp
203 Lamp-jack
204 Headlight
205 Headlight clip
206 Fare register
207 Fare register block
208 Car stove
209 Stove box
210 Stove pipe
211 Smoke jack
212 Roof collar
213 Stove box top plate
214 Stove box cross bar
215 Stove box slide bar
216 Brake handle
217 Brake pawl
218 Brake shaft
219 Upper brake shaft bearing
220 Lower brake shaft bearing
221 Brake shaft ratchet-wheel
222 Brake shaft chain
223 Brake shaft stirrup

KEY TO
TRUCK UNDER STR. RY. CAR.

301 Top plate
302 Axle box frame
303 Pilot iron
304 Spring post
305 Brake shoe hanger
306 Spring post brace
307 Spring post stay
308 Brake rod
309 Brake beam
310 Equalizing lever
311 Box
312 Brake shoe
313 Brake shoe holder
314 Spring post cap
315 Spring (spiral)
316 Spring (elliptic)
317 Box spring
318 Elliptic spring cap
319 Elliptic spring seat
320 Brake shoe hanger holder
321 Truss pipe lug
322 Pilot board
323 Spring seat
324 Brake cross iron
325 Brake beam casting

SKELETON OF AN EIGHTEEN FOOT CLOSED CAR, WITH NAMES OF PARTS.

it is too high to be of any practical use save for trivial currents such as are employed in telegraphy.

These experiments are in keeping with many others, all tending to show that unless on a very small scale the earth is nearly useless as an electrical conductor. As a conductor in parallel with a pair of heavy and well bonded rails, the earth is hardly to be seriously considered at all.

Imagine the stations A and B, Fig. 22, to be connected by a track consisting of a pair of sixty pound rails thoroughly connected and put in parallel with the circuit via the earth connections. At best this has a resistance of 66.8 ohms while that of the track should be at worst only a few tenths of an ohm. Following the ordinary law of derived circuits, it is clear that the current returning via the earth is only a minute fraction of one per cent of the whole. If the track could be continuously in good contact with the earth throughout its length somewhat more current might be coaxed into the earth return by taking advantage of all the fairly conducting streaks and strata. But in practice, track is so laid that it is not in good electrical contact with the earth as a whole. Fig. 23 shows in section a type of track construction which has been very widely used. The rail is laid upon a longitudinal stringer timber to which it is spiked firmly. The stringer is secured to the cross ties by angle irons. The ties are well tamped with clean sharp gravel which is packed around them and the stringer, and forms a foundation for paving of block

FIG. 22.

granite set closely in upon the rail. Here the material in contact with the rail and surrounding it for some space is very badly conducting except when the track is flooded.

Fig. 24 shows another track construction, which would appear to give even worse conduction between rail and earth than Fig. 23. The rails are here supported at each tie by cast iron chairs, without an intermediate stringer, and the ties are set in concrete, while rail and chair are surrounded by coarse gravel on which the paving is laid. In no modern track is the rail in contact with better conductors than hard wood, gravel or stone. Consequently

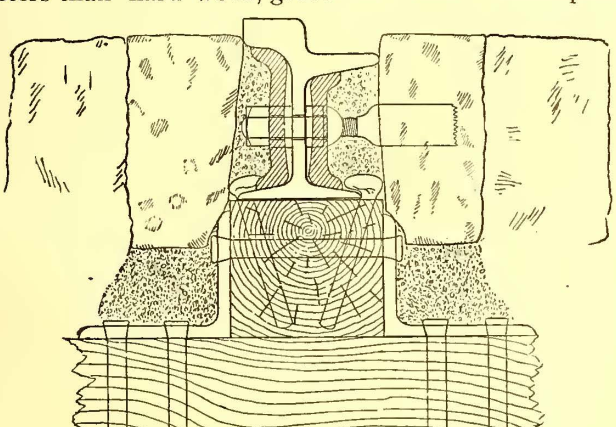


FIG. 23.

there is very little tendency for current to be shunted from rails to earth, unless the former are very badly bonded, for the paths in derivation are bad and there is little difference of potential between any two points of the track to impel branch currents of any kind. Of course, if one attempted to use the two rails as outgoing and return leads, the condition is wholly changed, for the full difference of potential then would exist between two neighboring rails and there would be a very large amount of leakage. In fact, if there is any considerable difference of potential between the rails or between them and any other conductor, there will be a perceptible flow of current, even through as bad a conductor as damp gravel if the path be not too long.

Thus it is that while ground plates along the track according to early usage are insignificant in modifying the conductivity of the return circuit, there may be, if the rails are poorly connected, very perceptible flux of current from the track to, for instance, a water main running parallel to it and but a few feet away. Fig. 25 shows this state of things. Let A B be the track and C D a water

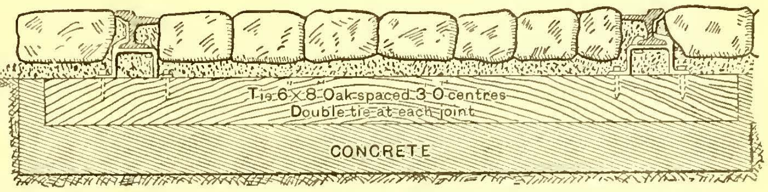


FIG. 24.

main half a dozen feet below the level of the track. The resistance between any points of A B and C D is at all times considerable, owing to the high specific resistance of the material between them, but the area between A B and C D in a long stretch of track is so enormous that if the fall in potential in A B is not very slight indeed, there will be a considerable flow of current into and along C D. To take a concrete example, let A B be twenty rods long, and suppose C D to be a foot in diameter and six feet distant from A B. The area of material in totally direct circuit

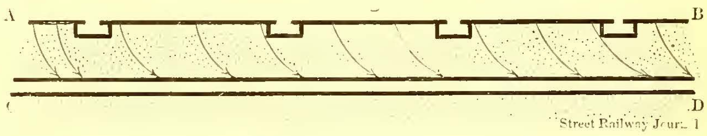


FIG. 25.

would probably be a strip 100 metres long and not less than a metre wide. Such a strip would contain a million square centimetres area and we then have to compute the resistance of a block of bad conductor a million square centimetres in section and perhaps averaging 200 cm. long. This we can regard as built up of a million strips, each one centimeter square and 200 cm. long connected in parallel. The total resistance would then be the resistance of one such strip divided by 1,000,000. In fact the resistances of these elements would be very various and the currents would flow in all sorts of irregular lines, but we are dealing here only with the average result. Suppose the material has a specific resistance of a thousand ohms per cubic centimetre, then the resistance of one element would be 200,000 ohms, but the whole mass would have a resistance of only one-fifth of an ohm; hence if there should be between track and pipe a difference of potential of ten volts, an amount sometimes exceeded in real cases, there would be within the distance considered a flow of fifty amperes between track and pipe.

As large pipes may weigh several hundred pounds per yard, it is clear that their conductivity cannot be neglected, although in most cases it has no noticeable effect on the resistance of the system. In any case, these extraneous metallic conductors cannot properly be counted as a part of the circuit, except under very unusual conditions, since flow of current to them is highly objectionable, as will presently be shown.

To sum up the matter of earth return, properly so called, the earth, so far from being a body of high conductivity, useful for eking out the carrying power of the rail return, is, for most useful purposes, to be regarded almost as a non-conductor. Its specific resistance is so high and irregular that it is of no value as part of the return circuit, while its conducting power in great areas comes into play only in an unpleasant and troublesome way. For all long lines of railroad and for many small street railway systems, the earth may be left entirely out of account, and in large street railway systems it is generally a source of anxiety. In the early days of electric railroading quite the opposite view was often held and roads were constructed accordingly. In reality the bonding was then so generally inefficient, that perhaps even the earth may have improved the general conductivity. Experience has shown however that the view here presented is the correct one, and the realization of it has done much to improve general practice. Possibly interference with telephone circuits did much to prolong faith in the earth as a conductor, but the telephone deals with millionths of amperes, which are quite insufficient for operating street cars.

Street Railway Rolling Stock.

By W. E. Partridge.

VI.—Car Posts.

Among the most important members of the car frames are the posts. In fact upon these come the most severe strains to which any part of the structure is submitted, except perhaps the sills. In the box, or closed car, posts are of two kinds, those for the corners and those between the windows, or the intermediate posts. The corner posts should have nearly as great a cross section as any timber in the car, the reason for this being that they are submitted to exceedingly severe strains, they have to receive a large number of bolts and fastenings and they are, at the same time, of such a curved shape as to be essentially weak when cut from straight timber. The general form of the corner post is seen in Figs. 1 and 2, while Figs. 3 and 4 show the form once common in the horse car. The accompanying engravings are made from photographs showing both sides of posts of different kinds, two views having been made wherever one side differed from the other.

The curious forms in which posts are found are the result of several diverse conditions. The first of these is the curved side of the car. This is, as we have seen in a former article, a necessity to secure strength against strains in all directions. At first sight it would seem that a bent timber would be more easily worked into the required shape and present greater strength, but there is another condition to be met, namely, that there must be, in every case, guides for the sash of the windows, and usually for the blinds as these must move up and down in nearly straight lines and cannot of themselves be curved to suit the curvature of the body. Wide raceways become essential, hence if the post be cut from a plank or a heavy stick of timber and sufficient width of raceway secured to allow the windows and blinds to slide into position behind the seats, the intermediate or window posts become little more than plank of considerable depth set on edge across the car. Although all of them are cross grained at their lower extremities, yet the depth of timber becomes so great that breakage of a post is not common at the point where it is seemingly the weakest.

A few builders looking to the economy of timber have cut down the sizes of their corner posts reducing them to mere four inch sticks. The result has been disastrous to the car. Although very light and pretty in appearance there was not a sufficient body of wood to obtain the necessary fastenings for the numerous rails, belts, panels and timbers which must be secured to them.

At the bottom the post must be fastened into the sills with as great a degree of security as is possible. This is done by means of the tenon shown in all of the engravings. A draw pin is usually driven through this, and additional security is obtained by one of several methods. The first and most generally adopted method is that of a strap or toe bolt. As shown in Figs. 5 and 6, the strap hooks into the post, the flat of the bolt is fastened by a couple of screws or bolts, and the shank takes a nut on the under side of the sill. This form of construction is almost universal with the window posts. See Figs. 10, 11, 12, etc.

Another method of construction is employed in some of the best shops in the country. It is to use a special malleable iron angle piece to hold the foot of the post to the sill. It has the additional advantage of increasing the stiffness of the construction, while at the same time it prevents the post from lifting or moving. Fig. 13 represents the malleable iron angle used by the Jackson & Sharp Company. With them it is employed not only on the foot of the posts, but also to secure the posts to the rails. In the end of the car there are four or more of these angles or knees. The Brill Company employs the bracket shown at the bottom of a post in Figs. 8 and 9. This has a web crossing the angle which insures great stiffness. The material used for these pieces is malleable iron, and they are frequently adapted to use in various portions of the car where the timbers are likely to experience open and shutting strains.

The function of the window post is like that of its larger neighbor, the corner post, a complex one. First and foremost it must hold the side of the car in shape, preventing it from coming inward. Its next office is to hold the

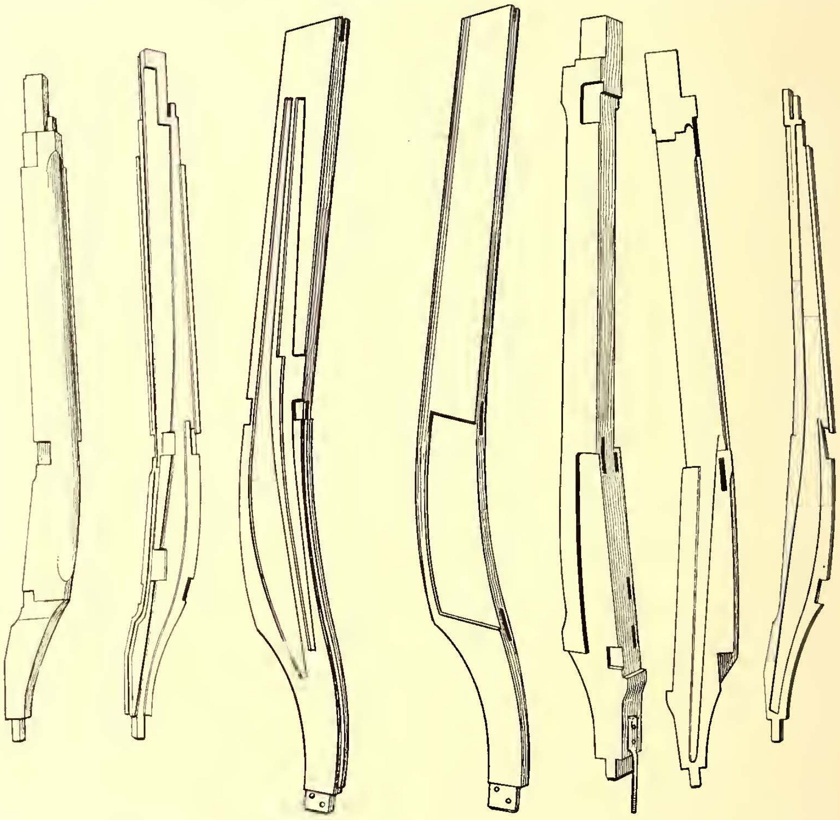


FIG. 1. FIG. 2. FIG. 3. FIG. 4. FIG. 5. FIG. 6. FIG. 7.

rails or belts which pass along the whole side of the car, and with the posts and ribs complete the frame. It must also carry the roof and the plate and form guides for the windows and blinds. Incidentally the posts form a support for the rear of the seat and the seat back. Theoretically, they should be thin and deep. They are so perfectly secured against side strains that the latter are rarely if ever considered in the framing of a closed car.

There are many details of construction which are of importance, and which contribute to the durability of the car. For example, in the posts, shown in Figs. 11 and 12, which are those of the Laconia Car Company, a wedge shaped piece is seen just at the middle of the post, which comes just at the bottom of the window and on the top of the window rail. A portion of the corner of the sash has to be removed in order to allow it to close entirely. The object of this is the seemingly trivial one of closing the angle in such a way that water will not stop at this point, but flow away. Where the rails come down squarely to the window belt, without this angle in the finished car, they are usually cut away so as to prevent the few drops of moisture finding lodgment at this point. The finish of the upper end of the window post is very varied. The two extremes of practice in fastening the plate to the post are shown in Figs. 12 and 7. Fig. 12 has a plain tenon, and is fastened to the plate by the draw pin. This is, perhaps, one of the commonest forms. The Jackson & Sharp Company employs an entirely different method. It uses what is practically a double tenon (see Figs. 1, 2 and 7), and the plate is not only mortised, but halved upon the post. The double tenon is also used upon the corner post.

Another neat detail of construction with the posts of this company will be seen in the method with which it applies the window rail. The outside strip which prevents the window from falling out is moulded, as usual, on the post itself. To prevent its being split away in case of ice or dirt at the window rail, this piece is continued downward a short distance, and the window rail mortised to take the projection. When the rail is put on to the post it is wedged upward into place, so that as the rail projects outside of the post this portion is protected from slipping.

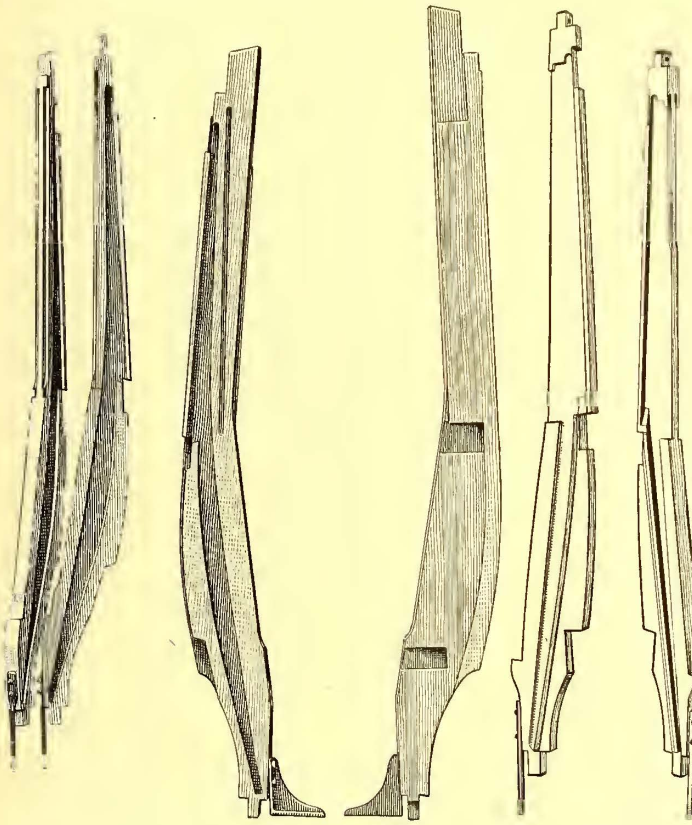


FIG. 8. FIG. 9. FIG. 10. FIG. 11. FIG. 12.

WINDOW AND CORNER POSTS.

The Brill Company's post, shown in Figs. 8, 9 and 10, has a single tenon. They halve the plate and letter board upon the post. The posts shown in Figs 3 and 4 are of the old horse car type, from one of the best makers in the country. The head of the post is left of full width, and a carlin is let into it. The head of this post is also recessed to take the end timber or door head and the upper end panel. Posts of this construction, even under the most adverse circumstances, have lasted in perfect condition for sixteen or twenty years. In tearing down one of these cars recently, the posts were found as firmly bedded in the sills, and as solidly connected to the plates and carlins, as on the day they were turned out of the shop. Usually posts of this style had a broad, tapering chamfer on the inside corner. This extended from the top of the window to the level of the seat back. It was used to save weight, the post being amply strong at this point.

The Wason Company uses a construction differing somewhat from any of those shown. Its plate is practically composed of three pieces, one upon the top of the posts with one on each side forming a sort of box, as the two side pieces are boxed upon the post. It succeeds with a very light construction in obtaining an unusual degree of strength. See Fig. 14, which is a diagrammatic view of the general arrangement of the timbers.

As the depth of the posts is increased the thickness can be reduced, but whatever thickness of window post may be used one thing may be regarded as certain, those parts should not be made too few in number. With the rage for large windows the number of posts has sometimes been reduced to four, and in a few instances to three on a side. Such a construction might possibly be practical if the end posts should be enlarged sufficiently to hold the roof and at the same time could be braced both across and lengthwise of the car in such a way as to completely support the top weight. With the heavy roofs which are now in fashion, with the additional weight of the trolley stand, this appears to be out of the question. While large windows may be desirable, durable cars are perhaps more profitable to the road, and it is better to sacrifice a little glass for the sake of making the posts practically secure both above and below.

Something might be said in regard to the materials for posts, but this is almost unnecessary, because ash is nearly, if not quite universally used for the purpose. It is light, strong, stiff and durable when kept dry. Oak has been proposed for posts, but it is heavy, though strong, and might be objectionable on account of its great elasticity. Long leaved Southern pine is stiff, strong and heavy. It is a more brittle wood than ash and, weight for weight, can hardly compare with it. Perhaps the principal advantage of ash is that it can be always obtained of good quality, sound and free from knots, and its strength can be depended upon with a certainty that is lacking in almost any other wood.

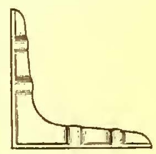


FIG. 13.

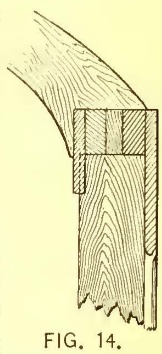


FIG. 14.

It should be noted that the modern tendency to straighten the post is not a desirable feature. The curved sides of the car impart a great deal of stiffness to the form, and for all work where the body must be supported on four wheels, stiffness of structure is an essential feature which, unfortunately, is not obtainable by trussing. In general, the post which has the fewest deep scores cut out of it will be the best. While the rails may be halved upon it, they should not materially diminish the cross section of the post, and their depth vertically, rather than their horizontal width, should be relied upon to give them strength. The belt or guard rail coming outside of the frame and panels provides a great additional strength and relieves the designer from the necessity of making a deep cut into his posts.

Something perhaps should be said in regard to door posts. These, however, are usually little more than the stiles of paneling. They possess little strength and depend for this largely upon the tie rod which goes through them.

Skeleton of Eighteen Foot Closed Car With Names of Parts.

The inset between pages 230 and 231 contains another valuable diagram similar to that published in the STREET RAILWAY JOURNAL for October, 1895, obtained by us through the kindness of the Brill Company, showing plan, elevation, end view and diagrams of framing of a single truck eighteen foot car. The names of all the parts of this car used in its manufacture are also given and will be of considerable use to those having occasion to order pieces to replace those broken or worn out in service.

IT is always a good plan to have illuminating gas in a station. The practice will prove useful in case of accident to the electric current. It is especially desirable to have one or two burners on the switchboard, and one of these should be kept lighted and turned down low. A sudden short circuit or accident to the machinery at night might leave the station in darkness at a time when the throwing of a switch would prevent the breaking of a flywheel, and the light would then prove very desirable.

LETTERS AND HINTS FROM PRACTICAL MEN.

Power Station Records at Trenton.

THE TRENTON PASSENGER RAILWAY COMPANY.
TRENTON, N J., Mar. 16, 1896.

EDITORS STREET RAILWAY JOURNAL:

Enclosed please find a table of information concerning our power station results during the past year. I cannot give you the cost as to horse power at our station as all our calculations are made on the mileage basis.

In regard to oil, we filter it but once. At present we are using Clarkson & Ford's "Banner A" cylinder oil and the Bosshardt & Wilson "Cardinal A" engine oil.

The item of "superintendence" is a division of the salary of our electrician between the respective departments of our road.

The cost of our station includes, in the winter time, the heating of our cars and in the summer time the lighting of our park, in which we have twenty arc lights.

We use, at the present time, bituminous coal. During a part of the year we used anthracite. You will find this indicated in the coal column. Our coal costs us $1.90 for anthracite buckwheat coal and $2.65 for bituminous. There is greater economy in handling the bituminous coal. In estimating the cost of coal per month we add twenty-five cents a ton for wastage, but every three or four months we take an account of stock of our coal to see if we have overestimated the waste. We took account of stock last year in April and in July and you will notice the drop in these months of the cost of fuel.

Our road is thirty miles long and we have few grades, but those we do have are very sharp, running as high as six per cent.

The figures that I give you in this table are absolutely accurate. They represent every penny spent at our power house during the year 1895.

Yours very truly,
HENRY C. MOORE, President.

POWER STATION RECORDS OF THE TRENTON PASSENGER RAILWAY COMPANY.

FOR THE YEAR ENDING DECEMBER 31, 1895.

Month	Car Mileage	Tons of Coal	Barrels of Cyl. Oil	Barrels of Engine Oil	Superintendence	Engineers	Oilers	Firemen	Helpers	Repairs of Engines	Repairs of Boilers	Repairs of Dynamos	Repairs of Piping	Repairs of Pumps	Fuel	Oil Waste and Packing	Light	Extra Labor	Cost per Car Mile
January	108,975	464 a		2	40.00	120.00	85.00	85.00	40.66	6.39	3.70	10.00			954.04	139.38	6		1.3
February	91,327	393 a	1	2	36.92	110.72	73.84	83.04	28.81	9.89	44.79				811.67	59.57	6		1.4
March	112,393	322 a 71 b	2	4	40.88	122.67	81.75	91.94	72.76	14.12	11.70	4.40		3.68	962.94	161.36	6	8.18	1.3
April	115,236	128 a 119 b	2	2	49.55	118.69	79.12	90.23	74.80	8.27	8.56	20.45			671.36	147.64	11.17		1.1
May	121,217	153 a 119 b	2	2	50.88	122.70	81.75	91.41	37.05	26.47	4.05	1.50	.67		703.53	90.30	11.98	16.75	1.
June	124,336	330 a	1	2	49.56	118.71	83.05	88.97	62.50	6.56	7.52	20.00	.10	3.28	728.50	102.45	6	8.15	1.1
July	134,928	18 a 262 b	2	3	50.87	126.61	86.85	91.93	33.75	9.59	3.70	.40		28.13	544.18	120.96	13.67	23.13	.8
August	132,540	278 b	3	4	50.88	122.67	86.84	91.94	38.75	23.82	73.13	.40	5.50		808.25	124.68	6	19.08	1.1
September	126,306	272 b	3	6	49.55	118.72	83.93	88.97	38.12	7.77	3.70	1.63	3.45		791.15	125.85	11.46	20.56	1.1
October	127,562	281 b			50.88	122.67	86.96	91.94	38.75	28.46	6.56		8.04		819.56	44.57	13.91	40.42	1.1
November	117,791	271 b	2	2	49.56	118.71	84.04	88.97	37.50	7.30	27.98	7.50	.92		786.88	103.85	6.28	19.88	1.1
December	121,308	314 b	1	1	50.87	122.68	86.85	91.94	38.75	7.50	24.70	26.03	1.25		911.95	95.53	12.10	26.85	1.1
Total	1,433,919	3,795	19	30	570.40	1,445.55	999.98	1,076.28	542.20	152.50	218.09	92.31	19.93	35.09	9,492.01	1,316.14	110.17	183.00	1.1

Operating Expenses of the Conduit Electric Road in Washington.

The following interesting operating statistics of the Ninth Street line of the Metropolitan Railroad Company, of Washington, which is in operation by the conduit electric system devised by the company's engineer A. N. Connett, are particularly valuable at this time. The figures cover the cost of propelling, heating and lighting cars and are for the month of January, 1896. The cars are run in trains of two, and are sixteen feet in length.

POWER STATION EXPENSES.

Engineers	$183.52
Firemen	121.50
Other labor	147.40
Tool repairs and renewals	45.45
Oil and waste	62.40
Water	(nothing)
Fuel	537.00
Engine repairs	58.03
Dynamo repairs	1.60
Boiler repairs	.60
Switchboard and wiring	19.27
Condenser	.30
Pumps	1.67
Miscellaneous	.30
Total	$1,179.04

CAR AND EQUIPMENT REPAIRS.

Miscellaneous labor	$ 66.43
Brakes and brake shoes	43.83
Controllers	28.84
Miscellaneous repairs	99.89
Plow repairs	125.37
Wheels and axles	34.80
Fenders	32.45
Miscellaneous car repairs	101.66
Car wiring	42.50
Tool repairs and renewals	11.69
Armature repairs	56.87
Field repairs	10.68
Journal brasses and bearings	43.47
Miscellaneous armature repairs	52.25
Snow sweepers and sand car repairs	12.37
Heater repairs	
Painting and varnishing	103.65
Miscellaneous	56.73
Total	$ 924.48

GENERAL RESULTS.

Motor car mileage	95,696
Train car mileage	95,696
Train mileage	95,696
Average cost per train mile	$ .0927
Cost of power per train mile	$ .0119
" " car and equipment repairs per train mile	$ .0096

Total kilowatt hours 113,355
" " " per train mile. 1,185
Coal per kilowatt hour. . . . . 3.9 lbs.

Power Station Records in Philadelphia.

The accompanying figures give the power station records of the Hestonville, Mantua & Fairmount Passenger Railway Company, of Philadelphia, for the last four months. The power station of this company was described in full in the STREET RAILWAY JOURNAL for October, 1894. In the steam equipment there are four Greene tandem compound condensing engines directly connected to four G. E. 400 k. w. generators running at one hundred revolutions per minute. There are eight Babcock & Wilcox water tube boilers of 250 h. p. each. Coal is received at a wharf adjoining the company's station and is conveyed by coal handling machinery to the boiler room. The price given for coal includes that of its transportation. The steam required for operating the feedwater pumps which take water from the river is taken from the boilers and the cost of generation is included in the figures given in the table.

The cars are equipped with electric heaters, which were put into regular service about the end of November or the first part of December. This was the principal reason for the large increase of coal consumption.

POWER STATION RECORDS OF THE HESTONVILLE, MANTUA & FAIRMOUNT PASSENGER RAILWAY COMPANY.

	Total K. W.	Total Coal, lbs.	Coal per K. W. lbs.	Coal per 24 hrs. lbs.	Cylinder oil per 24 hours, gals.	Engine oil per 24 hours, gals.	Waste per 24 hours lbs.	Cost per 24 hours. Coal	Cylinder Oil	Engine Oil	Waste	Labor	Total
November	337,331	1,478,400	4.35	49,280	5½	6½	11	$42.350	$2.20	$2.08	$ .610	$39.020	$86.26
December	431,119	1,859,200	4.31	59,652	7 1/10	8	14	51.250	2.84	2.56	.770	39.156	96.576
January	455,510	5,948,800	4.29	62,864	6½	7½	14½	54.022	2.60	2.40	.798	39.156	98.976
February	405,410	1,747,200	4.30	60,248	6	6½	17	51.757	2.40	2.08	.935	39.123	96.295

The figures on cost are estimated upon the following prices paid by the company for material:

Coal per ton of 2240 lbs. delivered in the fire room . $1.92½
Cylinder oil per gallon 40
Engine oil per gallon 32
Waste per pound. 05½

The Storage Battery as a Regulator of Voltage on Long Lines.

THE ELECTRIC STORAGE BATTERY COMPANY,
PHILADELPHIA, Mar. 12, 1896.

EDITORS STREET RAILWAY JOURNAL:

In your March issue, I notice a letter from Charles J. Myles, president of the Hamilton, Grimsby & Beamsville Electric Railway Company, asking for your opinion on the advantages to be derived from the application of a storage battery as an auxiliary to a long electric railway.

You state in reply, editorially, that the use of storage batteries in such a way would not be effective or economical, but fail to give a single reason for such a statement.

As a matter of fact, there is no more effective or economical way of meeting the difficulty under which Mr. Myles' road is operated than by the use of storage batteries. The use of boosters is only a palliative, and the other method you suggest, of running at high station voltage, so as to allow for drop in the long feeders and using resistance in short ones, I think any one who gave the subject any thought would condemn at once, as being contrary to all good business and engineering practice.

A storage battery installed at the end of the feeders enables the generating plant to be cut down to a capacity equal to the average load instead of the maximum, and the same thing applies to the feeder copper, as in many cases the feeder copper saved more than pays the cost of a battery. For this regulating work, in which the charge and discharge are for very short periods, the capacity of the battery installed can be very small, and the first cost is consequently very low, and in work of this class depreciation of the battery is very small.

I am satisfied that if you give the matter a little thought, and will work out for yourselves from data which is easily available, you will come to the conclusion that batteries instead of not being effective and economical for the purpose referred to, are really the only solution of the long distance electric railroad problem.

Very truly yours,
HERBERT LLOYD, Gen. Man.

[The conditions under which the Hamilton, Grimsby & Beamsville Railway is operating are peculiar. The road is eighteen miles in length and runs straight away through a farming and vineyard country. Its equipment consists of eight double truck cars, and trips are made hourly during the day. The station is operated with compound condensing engines and is located, we believe, somewhat near the center of the road. On such a road the fluctuations of power at the station and through the feeders would doubtless be very great, and the average load would be so much smaller than the maximum that any device, such as storage batteries, which are intended to take care of all fluctuations above the average load must necessarily be of large current capacity. It would be interesting to learn from our correspondent some details as to the required capacity and cost of a storage battery for this particular service. Storage batteries undoubtedly find a real field in regulating work of this general character, but we would like further information as to whether, under the specific conditions named, a sufficient commercial advantage can be shown.—EDS.]

Some Notes on Flat Wheels.

NEW YORK, Mar. 20, 1896.

Some important facts in regard to the influence which the use of sand has upon flat wheels have recently come to my knowledge. As the figures are of general interest, I give them, together with some additional calculations I have made. One very large electric road, where there are 450 cars in service reports as follows, from Jan. 1, 1896, to Feb. 20:

Wheels in for repairs 1162
Wheels replaced 212
Flatted wheels set aside for regrinding 960

On another road of a similar character, having 125 cars, but with fewer lines though a very heavy traffic, the figures from Jan. 1, to Feb. 26, were as follows:

Wheels in for repairs 52
Wheels replaced 44
Flatted wheels set aside for regrinding 8

Upon the basis of the same number of cars, the figures would be almost unrecognizable. The smaller road would have secured wheels at the rate given below, if its wear had been as heavy as upon the larger one:

52 for repairs would have been	322
44 fit to replace would have been	69
8 to regrind would have been	264

Had the wear on the larger road maintained the same proportion as the smaller, the figures would have been thus:

1184 for repairs would have been	187
212 " replacement would have been	158
950 " regrinding " " "	29

The larger road uses sand boxes and the men are free to use sand for any and all stops. The 950 wheels are those which are flatted by sand before their chills are so thin as to make regrinding unprofitable. On the other road the track is kept properly sanded by the use of sand cars. No sand boxes are used and the result is shown not only in the actual wear of wheels, but in the small proportions of those which are flatted, in such a way as to make regrinding profitable.

I ought in fairness to add that the smaller road has somewhat easier grades than the other. The difference is by no means as great as indicated by the figures. The ratio is practically as 29 to 265.

Another of the larger traction companies has greatly reduced its trouble from flat wheels by abandoning entirely the use of sand boxes and sanding the track with sand cars. In good weather only certain portions of the line are sanded. At times when the rails are greasy the whole line is sanded.

W. E. PARTRIDGE.

Repair Shops of the Steinway Railway Company.

LONG ISLAND CITY, N. Y., Mar. 13, 1896.

EDITORS STREET RAILWAY JOURNAL:

The accompanying diagram (see Fig. 1) will give you a good idea of our repair shops. As you will see, they are very restricted for the amount of work to be done. The general repair room, which is about thirty feet square, contains one pit and one floored track, each having a capacity of but a single car. Over the pit is arranged a stationary boom and over both tracks an overhead traveling crane. This crane is of the Yale & Towne design and is fitted with a two ton differential block and fall, and by means of this, an armature or other parts of motor can be taken from the pit track to any part of the shop which is necessary, as for example, to the winding horses, armature rack, or baking oven, etc., but not to the lathe. In order to reach this, a single rail, having a traveler carrying a block and fall, is arranged to transfer an armature to the lathe.

In this small room all repair to gears, gear cases, armatures, armature bearings, axle bearings, replacing of wheels, etc., must be done, in fact all machine repairs on an equipment of seventy-five motor cars, excepting repairs to controllers and brakes, which work is done in the sheds outside.

Separating the repair room from the winding room, is a low board partition over which armatures and field coils can be easily swung. The winding room is arranged with two winding horses for armatures, one hand lathe for winding field coils and a small baking oven. The latter is used almost altogether for drying out field coils, and is heated by means of a series of German silver resistance coils wound on a frame which slips in to the back of the oven. As this is properly ventilated, it gives a very convenient and satisfactory dryer for the coils. There is also a long, horizontal horse or rack, for storing armatures temporarily before and after repairing. All spare armatures are kept on this rack, as it has always been our practice never to allow armatures to be placed upon the floor, or rolled about over it.

Across from the so-called winding room is placed the power tools, which comprise one six foot Bradford lathe with eighteen inch swing, used for turning bearings, commutators, etc., one Kelly fourteen inch shaper for cutting keys, keyways, etc., one eighteen inch Pratt & Whitney drill

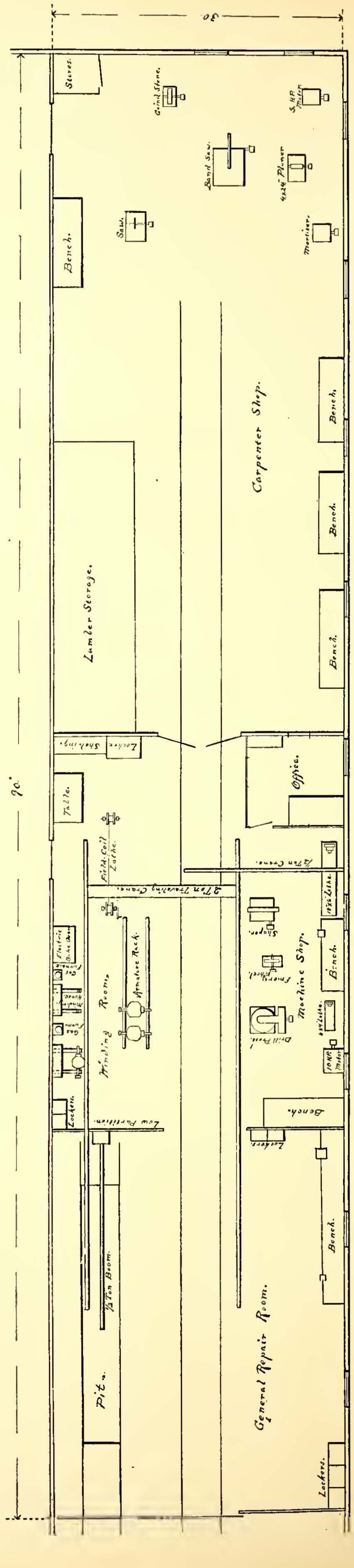


FIG. 1.—DIAGRAM SHOWING ARRANGEMENT OF MACHINERY, ETC., IN THE REPAIR SHOPS OF THE STEINWAY RAILWAY.

press, one Mann speed lathe, one twelve inch emery grinder and one ten horse power Eickemeyer series motor which furnishes power to an overhead shaft which drives the above tools.

The carpenter shop, a room added on at the back, is 30 ft. × 45 ft. has, but a single track and room for but one car, unless platforms and hoods are removed. This room contains one small circular saw, one band saw, one 4 in. × 24 in. planer, one mortising machine and one grindstone. These are driven by a five horse power Eickemeyer shunt motor. There are four ordinary carpenter work benches and one glue furnace. This room and equipment has been ample for ordinary carpenter repairs necessary.

Painting and varnishing is done in another room having a single track with space for two cars. The blacksmith work is confined to a small building removed some distance from the car and repair sheds. This is fitted out with the usual line of tools found in such shops.

Owing to unusually easy access to the car wheel factory and shops, the replacing of wheels on axles has never been undertaken by us. All wheels and axles are sent away for renewals; but for this a wheel press and a boring mill would have to be added to our above equipment of shop tools.

It may be interesting in connection with this question of repairs to give a detailed account of the repairs for one year upon a double motor equipment furnished us by the Walker Company.

The equipment in question was first put in service on our lines in December, 1894. It was immediately fitted out with patent adjustable track brushes and track scrapers, and through the several severe storms of that season was usually singled out from among the other cars for the task of opening and keeping open the lines, running in some instances day and night in this arduous work.

The Walker Company shortly began to send out a new form of controller, changing at the same time the details of car wiring. The equipment was changed in February, 1895, to conform to the later designs, the controllers, field coils and rheostat being replaced and other necessary changes made in the car wiring.

All apparatus installed on the car at that date is now in service, with the exception of a casting, of which I will speak later, and the equipment has been kept in thoroughly good condition by the following comparatively short list of repairs necessary during the last twelve months.

Beginning with May 1, 1895, the list includes every item for which, during that period, the car has been out of service and in the shops.

May 4.	New trolley wheel.
July 10.	Armature bearings rebabbitted.
" "	Three new controller contacts.
" "	Controllers dressed up.
" "	Lightning arrester and fuse changed for stand and fittings.
Aug. 16.	New set brake shoes.
" "	New trolley wheel.
Sept. 7.	Armature bearings rebabbitted.
" 18.	Controller dressed up—Four new tips.
Oct. 18.	" " "—Two new fingers.
" 24.	No. 1 motor taken off.
Nov. 13.	Commutator No. 2 motor dressed up.
" "	Controllers dressed up.
" 16.	New trolley wheel.
Dec. 19.	No. 1 motor put back on.
" "	Armature and axle bearings rebabbitted.
Jan. 1.	Controllers dressed up.
" 12.	" " "—three new fingers, five new tips.
Feb. 1.	New set brake shoes.
" 29.	New trolley wheel.
Mar. 15.	Armature bearings rebabbitted.

The cost for maintenance of electrical equipment of this car, for twelve months just past has been

Material.		Labor.	
4 Trolley wheels @ .75 . . .	$3.00	1 hour @ .22½ . .	$ .23
1 Commutator dressed.		1 " " " . .	.23
16 Armature bearings lined.			
15 lbs. babbitt @ .18.	2.70	60 " " " . .	13.50
2 axle bearings lined.		10 " " " . .	2.25
3 lbs. babbitt @ .18	.54		
6 Controllers dressed.		12 hours @ .22½ . .	2.70
12 Contacts @ .07	.84		
5 Fingers @ .20	1.00		
Total for material	$8.08	Total for Labor .	$18.91

Total for material and labor . . . . . $26.99.

There were no troubles with armatures, field coils, gears or pinions.

It will be noticed that on Oct. 24, one of the motors was taken off. This was on account of breaking of frame of motor by striking a heavy stone protruding from the pavement. This accident was in no wise the fault of the motor and has not been considered in the costs of maintenance. The car operated with a single motor from Oct. 24, to Dec. 19, when the motor was replaced and the equipment operated double.

The most noticeable features in the operation of these motors are: first, strength and speed. The motors start very slowly and accelerate in speed very gradually from notch to notch without the sudden jar or start sometimes noticed. The speed is such that a schedule of six miles an hour in the more crowded thoroughfares is readily made on the third, or series notch, while on the sixth, or parallel notch, with good voltage, seventeen miles per hour may be maintained.

Second, the entire absence for so long a period of all armature and field coil repairs, this being usually the most expensive item in street car maintenance.

Third, that which accounts, in a great measure, for the last, namely, an entire absence of grease, oil or moisture in the interior of the motor. This latter feature we have noticed particularly. The motors have been opened and inspected for the purpose after having been out thirty consecutive hours in driving snow, and after rains and running over flooded tracks, and at no time has there been any indication of moisture.

This feature we consider a very desirable one indeed, insuring, as it does, a uniformly reliable condition of the equipment, whether it be in fair or stormy weather, and tends to check, in a great measure, that aggregation of repair work so usual during stormy seasons.

Yours truly,
W. E. SHEPARD, Master Mechanic.

The Word "Momentum."

WILLIAMSPORT PASSENGER RAILWAY COMPANY.
WILLIAMSPORT, Pa., Mar. 12, 1896.

EDITORS STREET RAILWAY JOURNAL:

In Mr. Baylor's article last month on "Power Brakes on Electric Cars," I noticed the statement "doubling the weight of a moving body doubles its momentum, but doubling the speed multiplies the momentum by four."

If the author uses the term "momentum" in its accepted scientific sense, this statement is not true, because momentum varies directly with the weight and with the *first power* of the velocity. If the intention is to use "momentum" as synonymous with "kinetic energy," the relations specified are correct.

Yours truly,
G. E. WENDLE, Electrician.

Circuit Breaker Alarm.

The switchboard in the power station of the Hestonville, Mantua & Fairmount Passenger Railway Company, in Philadelphia, is equipped with a novel device for announcing the opening of any circuit breaker. Back of each circuit breaker is an ordinary spring switch connected in circuit with a primary battery and an electrical alarm bell. Should any breaker open the bell will ring continuously, attracting the attention of the dynamo tender in case he should not hear the noise made by the opening of the breaker.

LEGAL NOTES AND COMMENTS.*

EDITED BY J. ASPINWALL HODGE, JR., AND GEORGE L. SHEARER,

OF THE NEW YORK BAR.

Riding on Front Platforms.

That the danger of street car traffic is increased by the presence of passengers on the front platform is evidenced by many facts and by none more certainly than by the rule which is now being enforced by many street car companies of prohibiting passengers from standing there. But it is still the custom on nearly all horse car lines, and on a large number of trolley lines, to permit any one to ride there and to allow smoking there and nowhere else. So much for custom from which grows law. A question that has been oftentimes submitted to the adjudication of the courts is as to whether, when an accident occurs to a person riding on a front platform, he is or is not guilty of contributory negligence, by reason of the position he has taken. Probably no two states have enunciated all the rules which involve the question of contributory negligence in this regard, in precisely the same manner.

By reason of the multitude of cases which throng the New York reports, we find there a fuller and more complete set of propositions than in any other state, and the easiest way to present the entire subject is to give the rules as they are at present laid down in New York, and then give a few instances from other states showing a modification or a difference in the doctrines there laid down.

In New York, then, it is held that the mere fact that a passenger rides on the front platform of a car does not establish contributory negligence.—(Nolan v. Brooklyn R. R., 87 N. Y. 63. Vail v. Brooklyn R. R., 147 N. Y. 377.)

Under these and other decisions it is held that it is not necessary to show that the car was crowded to excuse his riding on the front platform, and even if a notice is printed in the car prohibiting riding on the front platform, he may ride there without being guilty of contributory negligence.

One question, which for a long time has been a matter of discussion both by the bar and by the bench in the lower courts, has just been decided by the Court of Appeals in the last cited case, to the effect, that the railroad law of 1850, which exempts railroads from liability for injuries received by a passenger while on the platform of a car in violation of posted regulations, was never intended to apply to street railroad companies—certainly not to horse railroad companies operated by horse power. The Court in that case stated that "the danger of passengers standing on the front platform of a steam car when in motion is great and obvious, while that to passengers on the platform of street cars is almost nothing, as is fully demonstrated by the practice of the general public and the companies themselves." This remark of the Court of Appeals is suggestive in connection with the sentence which opens this paper.

Another case in the Court of Appeals holds that there is no duty devolving upon a passenger who is upon the front platform of a car to look out for possible collisions with other vehicles.

And where an ice company was sued by an infant plaintiff, who had been riding on the platform of a car by the conductor's invitation, but in violation of the New York Statute of 1880, which provides that no minor child not a passenger shall be allowed on a car platform, it was held that these facts did not establish contributory negligence on the child's part.—Connelly v. Knickerbocker Ice Co., 114 N. Y. 104.)

The last cited case is interesting, by reason of the fact that the negligence in riding upon the front platform of a car was set up as a defense in an action brought by the owner of the colliding wagon.

It is not negligence *ipso facto* for a passenger riding on the platform of a street car to fail to hold on to the railing.—(Ginna v. Second Ave. R. R., 67 N. Y. 596.)

The few other cases in the Court of Appeals are leading cases, whose doctrines have been embodied and amplified in those already cited.

The almost numberless cases in the lower courts of New York have established one or two other propositions with some conflict of opinion, but generally to the following effect: if, added to the fact that there is room within the car, it appears that the street is in a dangerous condition, or that the track is badly laid or was in a slippery condition and the weather was stormy and the night dark, and this could be observed by the plaintiff, then contributory negligence not only may be found by the jury, but, as a matter of law, is so established as to cause a reversal of a judgment in favor of the plaintiff.—(Bradley v. Second Ave. R. R., 90 Hun. 419 and cases cited.) This case was decided in November, 1895, and the previous decisions are decided therein.

There is only one modification which it is necessary to make to the above statement of the law in the Bradley case, and which it is necessary to make in accordance with general principles of law. It must always be shown on the part of the defendant, where contributory negligence is relied upon as a defense, that if the plaintiff had been seated within the car he would not have been injured. For example—as an extreme case—however dark and stormy the night, whatever the condition of the track, and however inexcusable the plaintiff might be in standing upon the front platform, if the accident consisted in the explosion of a gas stove within the car which killed all the passengers and severely injured the plaintiff who was riding on the front platform, manifestly he has committed no act of contributory negligence of which the defendant can take advantage.

The decisions in New York then can be codified in the following rule: It is not *ipso facto* contributory negligence to ride on the front platform of a street car; but it is contributory negligence if the surrounding facts and circumstances of any particular case show that that is a position of especial danger, and if it appears that the accident has happened to plaintiff by reason of the risk which he thus knowingly took.

The courts, in the development of the law, are largely governed by the practice of the companies, as already suggested. The Supreme Judicial Court of Massachusetts says: "Neither the officers of street railroads nor the managers of the cars, nor the traveling public seem to regard this practice (standing on the platforms) as hazardous, nor does experience thus far seem to regard that it should be restrained on account of its danger.—(Meesel v. Lynn R. R., 8 Allen 234.)

The courts being so governed, and properly so, by custom, the increasing practice of prohibiting passengers on the front platform will undoubtedly modify the rules of the court if that practice becomes fairly universal.

There is some conflict in the authorities in other jurisdictions, as, for example, it has been held by the Supreme Court of the District of Columbia, that where there is room inside a street car with straps for holding on, to ride on the front platform constitutes contributory negligence.—(Andrew v. Capitol R. R., 2 Mackey 137.)

There is a distinction often drawn between sitting on

*Communications relating to this department may be addressed to the editors, No. 32 Nassau Street, New York.

the step of a car or even standing on it and standing on the platform of the car itself, and from many of the decisions it would seem to be that, since the platform is safer than the step, one must stand on the platform, or be guilty of contributory negligence; but the courts have been generally unwilling to go a step further and to declare that, because it is safer within the car than on the platform, the passenger must step within the car; this presumably on the ground that the difference in safety between the step and platform is so much greater than the difference in safety, under ordinary circumstances, between the platform and the interior of the car.

In one case a man standing on the front step of a horse car was bowing to his wife, and by the sudden jarring of the car was thrown to the ground and injured. The court very ungallantly held that the position and attitude of the plaintiff at the time of the accident convicted him of contributory negligence, and prevented his recovery.—(Ashbrook v. Frederick R. R., 18. Mo. App. 290.)

But where an open car is so crowded that there is no place to stand save on the side steps, and there are no seats vacant and no warning or objection from the conductor, the passenger is not guilty of contributory negligence, and this was held even where the plaintiff was a cripple.—(Topeka R. R. v. Higgs, 38 Kan. 375.)

A large amount of platform law relates to the boarding and leaving of street cars, and may hereafter be the subject of another paper. H.

EXCESSIVE DAMAGES.

NEW YORK.—In an action by a child eight years old, for personal injuries, it appeared that her face was cut open, resulting in a permanent scar, that she will always be unable to masticate food on one side of her mouth, that her collar bone and four ribs were broken, and that there was an injury to her pelvis. *Held*, that a verdict for $6000 was not excessive.—(Bennett v. Brooklyn Heights R. Co., 37 N. Y. Supp. 447.)

NEW YORK.—A verdict for $1500 for the death of a widow, 72 years old, in good health, strong and hearty, and who did the work for the family, consisting of herself, son and daughter, is not excessive.

Adams, J., dissenting.—(Walls v. Rochester Ry. Co., 36 N. Y. Supp. 1102.)

NEW YORK.—A verdict for $375 for death of a girl 3½ years old, intelligent, and in good health, should not be set aside as inadequate.—(Roger v. Rochester Ry. Co., 37 N. Y. Supp. 520.)

NEW YORK.—A verdict of $25,000 for a serious injury to the left arm, permanently impairing its usefulness to a great extent, causing much suffering, and necessitating an expenditure of $3500 for surgical and medical treatment, is excessive, no loss of earnings being shown, and it not being proved that there was any permanent injury other than that to the arm, though plaintiff testified that prior to the accident he was able to walk ten or twelve miles of a morning, and was a great reader, but that thereafter a walk of two or three miles made him very tired, and he could not read three pages before he got very tired, and he did not know what he was reading, and that he had become very irritable, whereas he was formerly very good natured.—(De Wardener v. Met. St. Ry., 37 N. Y. Supp. 133.)

NEW YORK.—A verdict for $8000 for personal injuries is excessive where it appears that plaintiff was thirty years old at the time of the injury; and that, before it occurred, he was healthy and able to perform any kind of heavy work, but that afterwards he was compelled to take lighter employment, at lower wages, and was constantly liable to annoyance and pain; and that his condition would so continue unless he submitted to an operation which was attended with some risk, and would cost $125, and lose him a month's time.

In such case an award of $5,000 will not be disturbed either as excessive or as inadequate.—(Bosworth v. Standard Oil Co., 37 N. Y. Supp. 43.)

TEXAS.—A judgment for $7500 is not excessive as damages to a man for the loss of all the fingers of his right hand, it being shown that he was an experienced switchman, forty-four years old, and earning from $80 to $90 per month.—(M. K. & T. Ry. v. Hauer, 33 S. W. Rep. 1010.)

TEXAS.—A verdict for $12,500 damages for personal injuries to a sound man thirty-two years of age, earning from $125 to $150 a month, is not excessive, when awarded to one who was scalded till the flesh came off his hands and lower parts of his arms, whose face and head were badly scalded, leg broken so as to necessitate amputation, and right arm partially paralyzed.—(T. & P. Ry. v. Johnson, 34 S. W. Rep. 187.)

WASHINGTON.—A judgment for $15,000 in favor of a child nine years old, for the loss of one leg, is not excessive. The Court say "We are aware that many courts have held, in similar cases, that the amount of this verdict was excessive, but we think it probable that if such injuries had happened to the judges themselves, or to members of their families, their views as to excessive damages would have undergone a radical change. The judgment will be affirmed." (Roth v. Union Depot Co., 43 Pac. Rep. 641.)

LIABILITY FOR NEGLIGENCE.

CALIFORNIA.—In an action against a street railway company for death of a passenger, it appeared that in passing a switch at the top of an incline the trolley had to be adjusted from the rear of the car; that there was but one person in charge of the car, whose position was in front, and that he, without stopping the car, went to the rear end, adjusted the trolley and got off to run to the front end, and that while running he fell and was unable to overtake the car which finally jumped the track and killed deceased. *Held*, that defendant was liable.—(Redfield v. Oakland Consolidated St. Ry. Co., 42 Pac. Rep. 822.)

GEORGIA.—The plaintiff's husband, an employe of the street railroad company, was killed by coming violently in contact with a post very close to the track, while he was riding on the front end of a car.

Although the evidence warranted a finding that locating the post so near the track was a negligent act, it did not show that so doing was violative of any duty due by the company to the deceased at the time he was killed, and therefore, this act was not, relatively to him, a negligent one. (Sundy v. Savannah St. R. R., 23 S. E. Rep. 841.)

NEW YORK.—Whether a passenger on an open electric street car, who, leaving his seat, went to the platform, where the conductor was standing, and, for the purpose of observing a fire, projected his head beyond the side of the car, so that he was struck by a tree, was guilty of contributory negligence, is a question for the jury. Hardin, P. J., dissenting.—(Sias v. Rochester Ry. Co., 36 N. Y. Supp. 378.)

NEW YORK.—Whether the conduct of an electric railroad company in raising a feed wire on its poles, resulting in the death of a passer-by, was negligence is not affected by the question whether that part of the avenue where the accident happened had been opened by legal proceedings, it being in public use as a public street.

While an electric railroad company was raising on poles a feed wire, a small boy, starting to cross the street stepped across the wire which lay in the gutter, just as it was suddenly, without any notice of its presence or intention to lift it, raised, with such force that the boy was thrown many feet in the air. *Held*, that the company was negligent.—(Devine v. Brooklyn Heights Ry., 37 N. Y. Supp. 170.)

NEW YORK.—Where plaintiff's testimony shows that, when he went on the railway track, the car by which he was injured was a sufficient distance away so he could have safely crossed, had he not fallen, it was proper to charge that, if the accident happened as plaintiff's witnesses testified, plaintiff was not negligent.—(Showe v. 3d. Ave. R. R., 36 N. Y. Supp. 463.)

NEW YORK.—In an action to recover for injuries received by plaintiff by being struck at a crossing by a cable car it is error to charge the jury that, in the absence of contributory negligence, if the gripman "failed to exercise due and reasonable care to warn crossing pedestrians of the car's approach, then the defendant is liable," it being conceded that plaintiff saw the car approaching before going on the track.—(Schulman v. H. W. S. & P. F. Ry., 36 N. Y., Supp. 439.)

NEW YORK.—In an action for injuries to plaintiff's intestate while crossing defendant's street car track, negligence and contributory negligence are questions for the jury, where it appears that intestate, on alighting from one of defendant's cars, passed behind it and attempted to cross the other track, when he was struck by an approaching car which was running at its ordinary speed, and there is no evidence that any signal or warning of its approach was given. Putnam, J., dissenting.—(Dobert v. Troy City Ry. Co., 36 N. Y. Supp. 105.)

TENNESSEE.—Evidence that one with a team at a street crossing, when within ten yards of a street railroad track, looked and saw a street car coming, seemingly 200 or 250 yds. away and thinking he had plenty of time to cross the track in front of the car, which was moving fast, immediately drove on at the rate of four miles an hour, and did not look at the car again until his front wheels were on the track when he heard it coming very fast and before he could get across, the car, which "was flying," struck the rear part of the wagon on the side, warrants a finding that he was free from contributary negligence.—(Citizens' Rapid Transit Co. v. Siegrist, 33 S. W. Rep. 920.)

WASHINGTON.—In an action to recover for an injury sustained by plaintiff, a child of tender years, by being run over by a street car, it was not error to refuse to charge that, if she attempted to cross the street and track without looking for approaching cars, she was guilty of contributory negligence and could not recover.

The opinion of a physician, based on the present condition of a plaintiff in an action for personal injuries, a child, as shown by her own testimony, is competent to show the probable results of the injury in the future.

Evidence is admissible to show the noise made by the cable of a street railway at the time a plaintiff started to cross, and was struck by a car and injured.

A judgment for $30,000 for personal injuries to a girl eight years of age is excessive, and will be reduced to $12,000, that being the amount fixed by a former jury.—(Mitchell v. Tacoma Ry. & Motor Co., 43 Pac. Rep. 528.)

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THE National Conference for Standard Electrical Rules has carved out for itself one of the most important works possible to undertake in the insurance field. This organization was formed in New York last month, by representatives of the principal national bodies whose members are engaged in electrical enterprises, and by delegates from the insurance, architectural and fire engineers' associations. The American Street Railway Association was represented by F. R. Ford. A considerable part of the difficulties which have heretofore been encountered between operating electric companies and the insurance boards has been caused by the number of different and divergent rules covering electrical wiring. There have been in this country no less than three different sets of rules for safe wiring, each of which has been followed to greater or less extent. These have been those published respectively by the National Electric Light Association, the Associated Factory Mutual Insurance Companies, and the National Board of Fire Underwriters. There have been also the rules of the English Board of Trade and those of the Phœnix Fire Insurance Company of London, each of which has, to a certain extent, been insisted upon. Where the same installation was inspected by representatives of two or more associations it has often occurred that work approved by one under its set of rules has been condemned by another. If these various rules can be so revised and changed as to permit of the adoption by the various interests of a common set, the Conference will have accomplished a great work. To electric railway companies especially will the determination of a standard set of rules for safe electric installation be of importance. The railway wiring rules have in the past been prepared by the insurance interests, largely without consultation with the assured, and have, in many instances at least, been considered arbitrary and unreasonable. They have been the subject of much complaint, but little satisfaction has been secured until now when, for the first time, the co-operation of the electrical interests has been requested in this work by the insurance companies. The members of the committee which was appointed to draw up a code of rules and report to the Conference next June, have asked for suggestions to aid them in their work. A letter from Mr. Ford addressed to the owners of street railway properties is published on another page. This letter gives the present rules of the National Board of Fire Underwriters, with a list of other points upon which discussion and suggestions are solicited.

THE cable system seems to be coming into use in England at about the time when America is gradually discarding it. It is a little surprising that this should be so and that the electric system, which has met with such universal favor in America, in Germany, France, Belgium, Holland and other continental countries should be introduced so slowly into the British Isles, particularly in view of its success and popularity in a few English cities. Of course, the primary cause of this sluggishness is the general British prejudice against overhead wires, and the popular belief, once common also in America, that there must be positive danger to life in a current which can do so great a work as to move a street car. Another perhaps even more powerful influence operating against both the cable and electric systems has been the short term franchises prescribed by English parliamentary law. American engineers are interested to know why such a city as Edinburgh (whose tramways are now under municipal control) should determine upon the cable instead of the electric system. It appears on investigation that English engineers have decided that it is feasible to use a much shallower conduit in their principal cities than has been found successful in America, and a system has been developed which makes the cost of a cable roadbed construction reasonably low—not far from $80,000 per mile of double track. These shallow conduits, eighteen inches in depth, are said to be giving entirely satisfactory results, and we are not, of course, in a position to question this, although it seems strange that with the tremendous inducements which have existed in this country for the building of shallow instead of deep conduits the latter have been everywhere decided upon. In such cities as Chicago and, perhaps, Philadelphia the reasons for deeper conduits are evident, as the climate is severe and the danger of the closing action of frost is very great, while the streets are not kept clean and a shallow conduit would be quickly choked up with mud and the debris of the street. But in such cities as New York and San Francisco, which have a mild and equable climate, the deep conduit has also been adopted, the smallest conduit being that of the Broadway railway in New York City, which is twenty-four inches in depth, and which is probably the finest piece of cable railway in the world. Here we have a beautifully clean street at all times and little snow or rainfall. An eighteen inch conduit would have saved millions of dollars in construction cost. Why was it not adopted? On Third Avenue a twenty-four inch conduit has also been used, though the elevated railway tracks are above the track and protect the street below to some extent. We shall be glad to find that the success with shallow conduits in England is permanent and decisive, but it seems to us a strange thing that American and English practice should be so widely divergent in a matter of such vital importance.

THERE has been much speculation on the part of foreign engineers as to the reasons which have led our street railway companies in Denver, San Francisco, Los Angeles, Philadelphia and St. Louis to throw away an enormous investment in cable roadbed and machinery, and to adopt the overhead wire electric system. The question is also asked by those who are puzzled at what is going on in this country "How can it be possible for even New York City managers to seriously consider adding the heavy expense of the engines, dynamos and motors of the electric system to the enormous expense of the cable conduits? Is it possible that there is actually thought of substituting underground wires for the Broadway cable line? Surely, here, if anywhere, is the ideal field for a cable plant." Now, the officers of our great street railway companies are not always disposed to take the public into their confidence and to explain in detail why such steps as these are found profitable, but as a matter of fact, the evidence is accumulating to such a degree as to be well nigh conclusive that our former ideas as to the comparative economy of electric and cable cars in streets of great traffic density will have to be revised. Electricity is master of the field. Electric cars on the same routes make more money per car mile than cable cars and, we think, can be operated in these days of cheap and good electrical machinery at as small a sum per car mile. These facts are not, perhaps, quite undisputed, but as we have said the weight of evidence is to this effect. Certainly were it not so we should not see all our manufacturers of cable machinery going out of business or turning over their factories to the production of electrical apparatus, nor should we see the actual throwing away of cable investments such as have been spoken of. There is one cause for this latter fact, however, which should not be lost sight of, and which will doubtless be the controlling reason why the underground electric system will displace the Broadway cable lines, if this should actually take place, and that is the necessity for uniformity of motive power on a large street railway system, a necessity which appears not so much, perhaps, in the economies of operation as in the necessities of traffic, since transfers from electric to cable cars or vice versa are always an annoyance to the public and thereby bring about a loss of gross receipts. After all, the greatest advantage of electricity over the cable lies in its power of indefinite expansion, at slight cost. Suburban areas will not be built up in advance of population if street railway managers have to pay from $80,000 to $100,000 per mile of road in doing it, and so long as English tramways aim to serve only the thickly populated districts they will fail to become the great agents for sociological improvement which the electric railways in this country have been and are.

THE earth return circuit is clearly shown by Dr. Bell, on another page of this issue, to be almost entirely worthless for electric railway currents. For telegraph or telephone lines where the currents employed are exceedingly small, the earth return is doubtless sufficiently good, but as the loss of voltage in any conductor is equal to the product of its resistance and the current passing through it, there will necessarily be a considerable loss where the current is large, even if the resistance in ohms appears to be small. The experiments of which Dr. Bell gives the results, show that the earth is by no means a conductor of low resistance, even where there is a considerable amount of water in the soil, and when in addition there are ledges of rock and masses of dry soil, the resistance is enormously increased. For this and other reasons as well, the importance of confining the return current to the rails is made evident, and this result is not difficult to accomplish with careful and reliable bonding, as the conductivity of the rails themselves is far greater than any amount of copper which could possibly be purchased without bankrupting a road. The fact that the bonds are out of sight is a reason why the most rigid inspection should be given to every detail in the process of bonding during construction, so that no opportunity should be given for a careless or lazy workman to slight this important process. It is not always sufficient to use double bonds with cross connections. The custom of reinforcing the rail circuit by track feeders run on poles or through underground conduits back to the negative bus bar of the station is coming to be general. Frequent tests should be made to determine whether or not the bond contacts are deteriorating. A useful auxiliary for this class of work is a testing, or potential wire put up on the poles over an entire street railway system. This wire can be as small as No. 10, can be of iron instead of copper and may be insulated only by some cheap weatherproof material. It is dead ended everywhere, and at the station a three-way switch is provided so that it can be connected at will with the positive or negative bus bars. By means of such a wire the fall in potential due to the overhead feeder system may be tested at any point and, by the second station connection, the ground circuits may also be tested. By this means additional overhead or track feeders may be run to the points of low voltage on the system and the presence of defective bonding in a stretch of track may be immediately detected.

The Equities of Patent Ownership.

AN armed truce in patent litigation has been declared between the General Electric Company and the Westinghouse Electric & Manufacturing Company, two great corporations manufacturing street railway and electrical apparatus.

Both companies are owners of innumerable patents obtained during the last fifteen years by purchase, by consolidation with other companies and by the original inventions of employes. Both companies have been spending enormous sums of money in endeavoring to sustain these patents in the courts and to thereby force each other, and outside manufacturers as well, to respect their special claims. The net result of all this litigation has been constantly lowering prices, wasted manufacturing profits and the throwing open to public use of a large proportion of the patents sought to be established. If an agreement to cease these hostilities could have been reached long ago, the stockholders of both companies would have been far richer collectively than is the case to-day, and the business wisdom of a "pooling agreement," by which each company licenses the other to use its patents, can hardly be questioned.

The patents now owned by the two companies may be divided, broadly speaking, into two classes—those which are good and will be upheld by the courts, and those which are practically worthless, on account of anticipations. All, or nearly all of the patents in both classes undoubtedly represent genuine and original inventions—genuine in that they have involved the creation, by a strictly inventive process of mind, of means for overcoming difficulties and attaining ends, and original in that the state of the art, whatever it might have been at the time of making the invention, was not known to the inventor himself. In other words, inventors do not often steal and patent a prior invention in cold blood, as it were, though they often unknowingly duplicate the work of other minds. It is because of this duplication that a large proportion of the patents granted are not sustained by the courts. This often involves a certain amount of injustice so far as an individual inventor is concerned, but in the interest of the public it is perhaps best to defeat every patent which cannot be proven absolutely *new*. A patent monopoly is so absolute and conveys such powers upon the possessors that it should not be granted lightly. The whole world is, as a matter of fact, banded against an inventor in an attempt to show anticipations which will make his inventions worthless.

Now a corporation, "combination," "trust" or "grinding monopoly" is entitled to fair play quite as surely as the humblest citizen, though it is often much more difficult to get it from the general public. The General Electric and Westinghouse Companies are entitled by law and justice to a monopoly in the manufacture of every piece of machinery protected by a good patent. There should not be the slightest sympathy felt for infringers who are knowingly and wilfully such, and who are simply taking the chances of remaining undisturbed for awhile. Enormous sums of money have been paid in the aggregate, and sometimes in individual cases, for these patents. Is it right that infringements should go unpunished?

The danger is, however, that an attempt may be made by such a "combination" to frighten away competition by instituting suits for infringement upon patents which belong to the second class above referred to as worthless because of anticipation. It is sometimes possible for a wealthy corporation to throw a weak competitor into insolvency by forcing upon it expensive litigation. In some cases suits are instituted but are not pressed to issue, and this method of fighting is one of the most difficult to meet. Our advice to "outside" manufacturers is to get the best legal opinions possible upon any patents, infringement of which is claimed. If these patents are pronounced valid we would advise abandoning the manufacture or entering at once into negotiations for the procuring of a license to manufacture under royalty. If it is believed, on the contrary, that the courts will finally hold them to be invalid, the wisest way would be, perhaps, for all manufacturers interested in any particular patent to jointly bear the expenses of whatever litigation may ensue.

How will the General Electric and Westinghouse Companies use their combined power? How will they deal with competitors? How will they treat their customers and would-be customers? Is every one's hand to be against them? These questions are being asked on every side—by competitors with anxiety, and by purchasers with a resolute determination to be prepared for action.

In the first place prices will undoubtedly be raised. This is not a hardship nor an injustice, if the increase be not excessive. The manufacture of dynamos, motors and electrical appliances of all kinds, once one of the most profitable industries in existence, is now one which is carried on at a smaller margin of profit perhaps than that of almost any other. Not one of the large companies is paying, nor can pay dividends upon its common stock, nor is earning a reasonable manufacturing percentage upon the actual capital invested. Sales are being made in far too many cases at actual cost. This condition of affairs cannot, and should not continue and purchasers can well afford to pay moderately higher prices for their goods.

The policy to be adopted by the two companies towards their competitors is not yet announced. If the former have learned wisdom from experience, they will not attempt to create for themselves an absolute monopoly of the electrical manufacturing business by closing the shops of all their competitors by means of suits for injunction. The instant this is done, new competitors will crop up on every hand. The great body of street railway purchasers, for example, will never submit to the necessity of purchasing their supplies at a single source. If competition is smothered elsewhere, they will turn their own repair shops into manufacturing establishments and produce substantially complete machines under the guise of "repairs," and if any interference is attempted, they will refuse to purchase any apparatus, patented or unpatented, from the "combination," except by some form of compromise. In our opinion, the gravest mistake that could be made by the two companies would be the arbitrary use of the great power which a patent pooling agreement legally gives them in a way which would excite the bitter animosity of purchasers throughout the country. We do not look for such a policy, but rather for one of wise conciliation through a system of licenses and royalties, which will bring a large revenue to their joint treasury and will make it necessary for the smaller manufacturers to raise their prices to a reasonable and not excessive point. This policy would bring friends and allies instead of enemies, would create profits instead of dissipating them in litigation and would prevent the competition of the purchasers, since the latter would not then be joined together in one common cause against injustice and attempted oppression.

CONSTRUCTION

The Design of Testing Stations for Street Railways.

By R. W. Conant.

The design of a testing station depends largely on the kind and amount of work to be done. The cost of the equipment will also influence the design and in any case the outlay should be justified by the results obtained. In this article, the subject matter will be confined to the design and use of a testing station, in connection with the installation and operation of underground feed wires. This field is a comparatively new one and it is therefore in this direction that investigation should tend. If it is deemed advisable in the operation of the railway, to keep power on the line at all times, at whatever cost, then we have an entirely different and more difficult problem with which to deal than if it were possible to shut down on any section, on which trouble might occur. The first method of operating is the one which will be considered as applying to the railways under consideration.

To keep power always on the line and the cars in continual operation, it is necessary that when a "blowout" occurs on any feeder, due to a ground, an attempt be made from the station to burn the ground off. This attempt is usually successful, as the trouble is generally caused by wire, not larger than a trolley wire, which is easily melted off. Should however a "blowout" occur on the underground cables there is no immediate means of knowing, whether the trouble is in the cables or on the overhead lines. It is the duty of the man in charge of the switchboard to hold in his feeders, and thus considerable energy is concentrated at the point of trouble. The amount of damage that is done depends almost wholly on the location of the fault and the judgment of the man in charge of the switchboard. If the fault happens to be at a pole, in proximity to ground wires, enough heat may be developed by the arcing to melt the pole, wreck the line and do other serious damage. Should the fault occur in a manhole, where the cables and ground wires are racked closely together, the burnout is likely to result in injury to the other cables.

Lead covered underground cables, whose insulation is an absorbent one, have a particular advantage over those otherwise insulated in regard to the detection of faults. In any underground cable, the lead is usually the main protection of the cable. The faults most likely to occur after such a cable has been successfully laid and working, are those produced by moisture. This may have access to the cable in various ways. It may penetrate the cable through a break in the lead, occasioned by rough handling during the process of laying, poor workmanship in making the joints, electrolysis, etc. Any moisture entering the cable will sooner or later cause a bad burnout if it is not detected and removed.

The peculiar advantage which an absorbent insulation has of giving warning of a developing fault is shown in Fig. 1. The heavy line read with the upper scale of abscissæ shows the values of the insulation resistance of cable No. 12 of the West End Street Railway, of Boston, from Apr. 24 to June 30. On Apr. 24, the cable tested 1450 megohms per mile. Its insulation resistance gradually decreased for five weeks, and on June 10 the cable tested 150 megohms per mile. During the three following days the insulation rapidly decreased and on the thirteenth it tested one megohm per mile. The cable was taken out of service on June 10, the insulation resistance being 150 megohms per mile. The fault was located, the cable repaired and put into service on the twenty-second, testing 400 megohms per mile. As will be noticed, the rate of decrease of the insulation resistance in this instance was quite slow. This rate will usually depend upon the amount of moisture in the ducts, together with its location with reference to the fault. In some cases the insulation resistance decreases much more rapidly than in the case cited above, hence the necessity of careful and frequent testing.

The method of locating a fault in a cable, as at present practiced in Boston, is as follows:

The cable is cut in two at the center, and the piece which tests faulty is likewise cut in two, and this process is continued until the fault is located as being in a length between manholes. This length is then drawn out and replaced by a new one. The entire cable is then spliced up, tested and if found all right, put into service. The number of cuts which it is necessary to make in locating a fault in a mile of cable, averages seven to ten. As the length which is drawn out is in some cases 400 ft. in length, it is not always possible to discover by inspection where the fault lies in this particular length. The ordinary electrical methods of testing, such as the Varley loop method, fails to locate the defect, on account of the extremely high resistance of the fault, together with the high conductivity of the copper of the cable. The following method has been devised to overcome this difficulty. The copper and lead of the cable are connected respectively to the terminals of the galvanometer. A steady deflection is produced, due to the galvanic action of the copper and lead at the defective point. The cable being stretched on the ground, an assistant proceeds along its length, starting at one end, lifts it and lets it fall at successive points about three feet apart. When the fault is reached, a variation in the deflection of the galvanometer occurs. This is due to the variation of pressure between the copper and lead, causing a change in the amount of current produced by the fault, acting as a galvanic couple. Faults which have baffled every attempt to locate them by ordinary methods have been located as described above.

A new method of locating faults in the cable taken as a whole is being developed and promises well. It requires the use of a pair of wires extending along the length of the cable, preferably those of the underground telephone system. Should this method prove a success it will materially simplify the location of faults and expedite the work of repairing a faulty cable.

The method adopted to follow closely the variations in the insulation resistance of the cables is a graphical one. A large sheet of cross section paper is used. On this the abscissæ represent days, and the ordinates megohms per mile. Each cable has its insulation resistance plotted from time to time as it is tested. The sheet therefore gives a continuous record of each cable. A modification of this sheet is shown in Fig. 1. The medium weight curve represents the average value of the insulation resistance of twenty-two cables from May to December, 1895. The upper dotted line on the diagram, reading with the left hand scale of ordinates, shows the temperature of the air at each day on which the cables were tested. The heavy line representing cable No. 12 has been described above. The effect of temperature on the cables is shown very clearly on this diagram. This may be seen by comparing the average insulation resistance line of all the cables with the temperature, a rise of temperature corresponding with a diminution of insulation resistance.

In the determination of the insulation resistance of a cable in a street railway system we meet with an entirely different problem than in the same determination in a submarine telegraph cable. The usual method used in determining the insulation resistance of the latter, i. e., direct deflection, is not at all suitable for use in testing underground railway cables. The reason of this is that enormous variations of potential of the conductor, which is being tested, are produced by the so-called earth currents. These earth currents are caused by the fluctuations of potential in the earth and lead sheath of the cable. The cars as they take the current raise the potential of the rails, earth and lead. This induces a static charge on the copper conductor, through the dielectric, in this case paper, of the cable acting as a condenser. This static electricity flows back through the copper conductor, thence to earth, through the galvanometer, with which the insulation resistance is being measured. The magnitude of this disturbance is quite commonly so great that when testing by direct deflection a cable whose insulation resistance is 400 megohms per mile, the spot of light will travel from one end of the scale to the other. This makes it almost impossible to even estimate the amount of deflection caused by the leak through the insulation of the cable. From this it will be seen that it is necessary to employ some other means for the determination of the insulation resistance. The method which has been found to be successful is the "Loss of Charge" method. When this is used, and proper precautions are taken in its application, it is found to check well with the results obtained by the direct deflection method. They are, of course, compared on a test where earth currents are not present. The formula for "Loss of Charge" method, which may be found in any standard text book on the subject, is as follows:

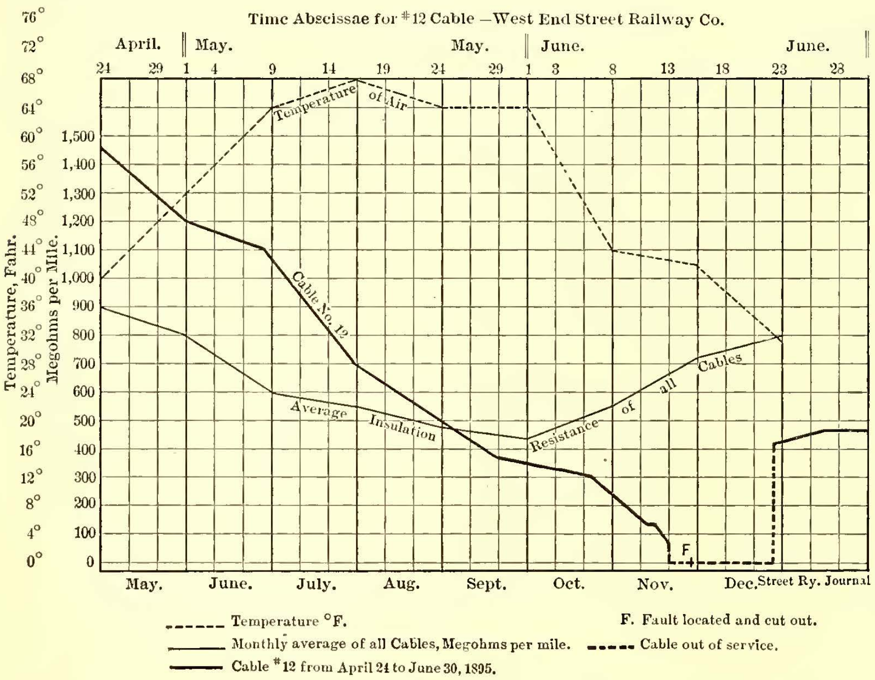


FIG. 1.—DIAGRAM OF TESTS.

$$R = \frac{26.06\ t}{K \log \frac{V}{v}}$$

where R is the insulation resistance to be determined; t the time in minutes (usually one) during which the cable is insulated and the charge allowed to leak out. K is the capacity of the cable in microfarads. V is the initial discharge deflection. v is the final discharge deflection after t minutes. An inspection of the formula will show that it is necessary to determine the capacity of the cable in applying this method. This may be determined by comparison with a standard condenser. In determining the insulation resistance of a cable by this means, the disturbances caused by earth currents are entirely avoided, as we are able, in this case, to reduce the sensitiveness of the galvanometer by using a shunt of high multiplying power.

The conditions which obtain in the practical application of the "Loss of Charge" method and some of the precautions necessary to be observed in its use may be now considered. Each cable is tested once a week. The testing is done at night, as it is at this time only that the cables can be spared from service. Eleven cables, or one-half the total number, are tested in one night. This requires that each cable shall not be kept out of service for more than thirty minutes. The cable having been subjected, during the previous week, to a pressure of 500 volts positive, the dielectric possesses considerable positive electrification. Unless this is removed from a cable before a test is made, the insulation resistance will appear to be many times greater than it really is. This is accounted for as follows: when testing by the "Loss of Charge" method, there is a period during which the cable is insulated, to allow the charge to leak out through its insulation. The absorbed positive charge, above referred to, will gradually soak out and recharge the cable, assuming, of course, that we are testing with the positive pole of the battery to core. This makes the final deflection due to the discharge of the remaining electricity higher than it should be and the insulation resistance therefore appears higher to this extent. Grounding the core for an hour or two would in a great measure dissipate this electrification and bring the cable to a neutral condition. which is, of course, the proper one for testing. The restriction as to time, mentioned above, precludes the possibility of this treatment and recourse must be had to other devices. The means adopted to neutralize the positive electrification is the application of 500 volts negative, to the core of the cable, sufficiently long to bring the cable to a condition practically free from positive electrification. This at first sight would seem an easy way in which to overcome the difficulty. It is found however that to properly neutralize a cable, ready to test, requires considerable experience. This is owing to the fact that a dielectric, after being subjected to successive stresses alternating in sign, will return free charges in the reverse order from that in which they were applied. Each cable is a subject for special treatment, which is dependent on its length, the character of the dielectric, together with its normal condition as regards insulation resistance. The length of time that the negative electricity should be applied to the cable, in order to neutralize it, increases as the temperature decreases. The duration of the application of the negative electricity will vary from one to twenty-five seconds. The cable is known to be sufficiently neutral for testing when, after being insulated for one minute and discharged through the galvanometer, it produces no deflection.

It has been necessary to enter somewhat minutely into the conditions which obtain in the special class of work which we are considering, in order to make clear the necessity and utility of the various instruments, which comprise a complete equipment of a testing station for street railways.

The location of the testing station should be chosen with reference to the following conditions: the ground upon which it is built should be free from vibration. If there is likely to be any trouble on account of unsteadiness, a cellar should be excavated and a pier sunk, on which the galvanometers are to be placed. The foundation walls of the building will then shield the pier from surface vibration. The station should also be at such a distance from the power house, feeders, or other sources of magnetic influence, that the galvanometers will not be materially affected by the magnetism. When this is not practicable, a properly constructed magnetic shield will be found useful.

The building may be of brick, fifteen or twenty feet square, one room in it being sufficient. The floor should be constructed so that it will support the weight of a reel of cable weighing about a ton. It is convenient to have a number of three inch pipes bricked into the upper portion of the walls. These will serve for ventilation and will allow the end of a cable, which is to be tested, to be brought directly to the instruments, through the wall of the building. This makes it possible to test a length of cable even though the weather be damp.

When large quantities of copper are purchased it is desirable to have some means of testing the conductivity of a reel. To do this with accuracy requires that the reel of cable be kept at a known uniform temperature. As the temperature of a paper or fibre insulated conductor changes very slowly, it has been found convenient to keep the reel at a uniform temperature for several days. It is placed in the test house where the temperature is maintained very nearly constant by means of a thermostat which regulates the supply of steam used for heating the house.

As the test house is not usually located at the terminus of the underground cables, it is necessary that leads be run from it to the ends of the cable. Two or three No. 6 underground conductors will usually be found sufficient for this purpose and will also have the advantage that considerable current may be carried by them when necessary. A flexible cord and clip at the cable end serves to connect the test leads with any cable which it may be desirable to test.

The following is a description of the instruments and appliances which have been found to answer the requirements of the testing station of the West End Street Railway Company, of Boston.

One hundred and fifty cells Le Clanché battery. These cells should be charged with a solution about one-fifth the strength of that ordinarily used. This prevents the salts creeping, and as the battery is always used in circuit with very high resistances, the solution will contain sufficient active material to produce all the current necessary. This battery should be placed on a highly insulated platform. Flexible leads are attached at various points throughout the battery. These leads are brought to a suspended frame over the instrument table, and have spring clips attached to them. This arrangement enables almost any strength of battery to be used. It may be said here that all connections which carry very little current and which require to be shifted occasionally, are made by clamping spring clips attached to flexible leads to flat strips of brass at such points as may be necessary. This method saves considerable time in changing connections.

A Thomson reflecting galvanometer, total resistance of about 10,000 ohms, with coils which may be connected differentially or not as desired. This galvanometer should be insulated by being set on a plate of some non-conducting material. If this is not attended to it is likely there will be considerable trouble from its action as an electrometer, the static potential between the coils and the mica vane deflecting the needle so that the spot of light is thrown off the scale. In case magnetic conditions, from any source, cause a disturbance of the needle the magnetic shield has been found to overcome the difficulty. To shield from the effects of 3000 or 4000 amperes at a distance of fifty feet with the usual variations of the current found on railway feeders, a cast iron shield about 4½ ins. thick and weighing 1300 lbs., has been found satisfactory. This shield is cast in the shape of a bell from a good quality of iron, and has a slit in it to allow the light to enter and be reflected from the galvanometer mirror. This shield may be seen in Fig. 2, suspended over the galvanometer. It is counterweighted and when lowered in position rests on a cast iron plate five inches thick.

The D'Arsonval galvanometer of about 2000 ohms resistance, is seen in the illustration at the right of the Thomson. This should be of the ballistic type with no damping arrangement. It is set up with its mirror at the same height as the Thomson and one lamp and scale is used for both instruments. The lamp and scale are attached to the triangular box resting on the standard at the back of the instrument table. This box turns in a horizontal plane and is easily shifted from one instrument to the other.

FIG. 2.—INTERIOR OF TESTING STATION—WEST END STREET RAILWAY CO., BOSTON.

The Thomson galvanometer is used chiefly for direct deflection measurements of insulation resistance and is a quicker working instrument than the D'Arsonval. It is also used in conductivity measurements, locating faults and such other work requiring the use of a differential galvanometer. The D'Arsonval galvanometer is used chiefly in the "Loss of Charge" method of measuring insulation resistance. It is used in comparison of potentials by the condenser method and all other work requiring the use of a ballistic galvanometer.

The shunt which is used to vary the sensibility of these galvanometers, is constructed according to the method described by Ayrton and Mather in the *Electrical World* of Apr. 21, 1894. An ordinary portable, plug-in Wheatstone bridge of about 10,000 ohms total resistance, is used for this shunt. This is seen on the instrument table at the extreme left. The shifting contact on the shunt is a spring clip which fits over the contact blocks of the bridge. The combination of the Ayrton shunt and D'Arsonval galvanometer form an extremely accurate and handy testing set.

The Wheatstone bridge for measurement of resistances seen in the foreground on the galvanometer pier, is the regular Anthony pattern, of first quality. The resistance coils range from .1 to 10,000 ohms.

Just behind the bridge may be seen the two standard resistances. They are supported within a glass jar filled with petroleum. The resistances are .1 and .01 ohm, capable of carrying currents of 10 and 100 amperes respectively. A vertical tube containing a propeller serves to keep the liquid in motion and to distribute the heat generated by the current, and so keep an even temperature.

Next to the Ayrton shunt may be seen a double key which serves as a short circuiting key to the galvanometers and is so arranged that by letting both keys up it disconnects the shunt and gives the galvanometer full sensitiveness. Connected with this key is the galvanometer plug reverser; from thence connection is made with the Rymer-Jones battery reversing key. To the latter are clipped the leads to the battery. The insulated terminals at the right, to which are attached the test leads, also connect with the reversing key. In addition to the instruments already mentioned, there are on the instrument table a ⅓ microfarad condenser, .1 megohm wire resistance, a pair of Clark cells and a carbon megohm.

Ten incandescent lamps over the pier, in connection with the contact circle at the end of the instrument table, form a detector circuit. Previous to taking a test on a cable the detector circuit is connected with the cable and the contact circle handle is turned. If the cable is grounded the front row of lamps will light. If it is charged from the railway circuit to a dangerous extent, one or more lamps in the rear row will light, the number depending on the voltage on the cable. Everything being in a normal condition however all of the lamps will burn at about half candle power.

A convenient acquisition to the testing room is a locker with space for voltmeters, ammeters and other portable instruments, samples of cable, faulty portions of cable, etc.

A lamp rack for testing lamps is found to be a paying investment. This in connection with a photometer room enables continual tests to be made on lamps for life, efficiency and constancy.

It is necessary for certain kinds of testing, such as conductivity measurements, to use considerable current at low voltage. This is secured by means of a wire rheostat, connected with the 500 volt railway circuit. Its coils are immersed in and kept cool by running water.

The chief business of the test house is to follow closely the variations in the insulation resistance of the underground feeders and to detect any faults when they occur before they lower the insulation resistance to a dangerous point. In order to test the cables in a reasonable length of time it is necessary that everything be arranged to work in the quickest possible manner consistent with accuracy.

The process of testing a cable is as follows: it is first cleared out, or its positive electrification neutralized, as has been above described. Six tests are then taken, three with positive electrification and three with negative. The manipulation of the instruments in making these tests is as follows: the ballistic constant is first obtained by noting the deflection produced by the condenser when charged to full voltage of the testing battery and discharged through the ballistic galvanometer. The cable is then connected with the galvanometer circuit in place of the condenser. A throw of both levers of the battery reversing key to the left charges the cable with full positive potential from the testing battery. Depressing the short circuit key of the galvanometer and throwing the right hand lever of the battery reversing key to the right gives the initial discharge deflection from the cable used as a condenser. A throw of the right hand lever to the left again charges the cable, the duration of this charge being about one second. This lever is then placed in the middle position which insulates the cable and the electricity is allowed to leak out during a period of one minute. In the meantime the galvanometer spot is brought to rest and part of the calculation for the capacity, etc., is made. After the specified time has elapsed the galvanometer short circuit key is depressed and the reversing key lever again thrown to the right, which gives the final discharge deflection. This is used in the calculation of the insulation resistance by means of the formula already given. The value of the insulation resistance, which is obtained from the first deflection with positive electrification, is the one used in plotting out the regular chart. The second and third deflections should show a gradual increase; if they do not it is well to inspect the cable more closely.

The device employed for bringing the galvanometer spot to rest consists of three buttons, one each of zinc, carbon and iron. The iron button is attached to one of the galvanometer terminals, while both the zinc and the carbon buttons are attached to the other terminal. All are within easy reach of the operator. In using these, a finger of the left hand is placed on the iron button and by touching either the zinc or the carbon botton with the other hand, the galvanic action will cause the spot to move either way, as desired. By this method, when using the ballistic galvanometer, the spot may be brought to rest in a few seconds, while without some such device as many minutes would be required.

An underground telephone system, in connection with the testing station is a valuable adjunct to the maintenance of underground feed cables. It will diminish the time required for testing, as well as facilitate the location and repair of faults in the power cables, when they occur.

In conclusion, I may say, that the West End Street Railway Company has had in service, since March, 1895, 132,000 ft. of paper and fibre insulated, 500,000 c. m. lead covered, underground cable. Up to the present time there have been no burnouts on the underground system due to a fault in the cable. Eleven faults have been detected, located and the cables repaired.

English Methods of Cable Track Construction.

BY ALEX. MCCALLUM.

From certain articles which have appeared in American technical papers upon the recent cable railways in Great Britain, it is evident that there is a misapprehension of the differences between American and English methods of cable track construction. The latter is in use at present in London, Edinburgh, Matlock, and is now being installed in the Isle of Man. An enormous extension of it is just beginning to be built in Edinburgh, and Newcastle promises to follow. The only example of the American method is that in Birmingham, and there both first cost and working expenses are not so encouraging as on the lines constructed on the English system. This system is the result of a conviction that the expensive deep American conduit is impracticable in Britain, and it is the outcome of years of study, experiment, and experience on the part of W. N. Colam, M. I. C. E., while Dick, Kerr & Company, Ltd., the well known tramway engineers and contractors, have attained great perfection in carrying out such work. It has now reached such a stage of development and has been so tested by eight or nine years of experience that it can be absolutely affirmed to be not only cheap to build, but thoroughly reliable. It does not, of course, necessarily follow that it would be equally suitable for cities in the northern United States, but it certainly leaves little to be reasonably desired in England or Scotland. It may be that it would not stand the intense frosts of North American winters without closing of the slot, but if not it could doubtless be strengthened without materially increasing the cost.

The system is distinguished from that generally used in American practice by the smallness of the conduit, the form of the slot rails, the type of grip and the method of supporting the track rails. First, as to the conduit. This is composed of concrete, with embedded yokes about three feet six inches apart. Measured from the top of the slot rail or surface of the paving to the bottom of the inside of the tube the depth is only nineteen inches. Beneath this is six or seven inches of concrete, giving a total depth of about twenty-six inches. At the yokes the depth to the bottom of the cast iron is twenty-three inches and three inches more of concrete gives an extreme depth as before. The full width of the yoke is twenty-one inches, the internal diameter of the conduit being nine inches, with six inches of iron web on either side. At the vertical sheaves employed on straight runs the depth to the bottom of the concrete is increased to two feet nine inches, but this depth is only reached for a length of two feet two inches, giving ample room for the fourteen inch sheaves. The external width is twenty-seven inches. On curves where horizontal sheaves are used the total depth of excavation remains at twenty-six inches, but the internal width is increased to twenty-two inches, and the external to the outside of the concrete to two feet eight inches. The bottom level of the drain pipe is about four inches lower than the base of the concrete, or thirty inches below the top of the slot rail. This additional four inches of excavation however need only be about six inches wide. The yokes weigh about 125 lbs. each, against 300 lbs. or 400 lbs. in American practice. They do not extend outwards to support the rails, but have vertical sides, measuring across twenty-one inches alike at top and bottom. They do not stop short at the bottom of the slot rail as in America, but are carried right up to the surface of the street between the paving blocks, their upper parts having no flanges so as to allow of this being done. The top of the slot rails is therefore flush with the top of the yokes, and the former are firmly bolted to the latter not merely at the base as in America, but also near the top. Hence there is enormous security against closing of the slot.

It will be seen that the excavation necessary consists merely of the cutting of a trench between the place for each pair of track rails to a depth of twenty-six inches below the top of the level of the setts and twenty-one inches wide. Only at the vertical pulleys does this depth require to be increased to thirty-three inches. Taking into account the fact that the paving blocks are six inches deep, that below them even for a horse tramway there is an inch of fine concrete and six inches of ordinary concrete, or thirteen inches for the three, it will be seen that the additional excavation work over and above laying a horse line consists simply of digging a trench thirteen inches deep by twenty-one inches wide between each set of track rails. In America on the other hand, the usual practice requires excavation to a depth of four feet or more from the street surface. This excavation also requires to be made the full width of the track, or more, and sometimes it is made across the full breadth of the double track including the space between each pair of lines, amounting in all to thirteen feet or fourteen feet across. The great width of the yokes in order to support the track rails explains the necessity for such an enormous amount of lateral work. It would be unfair perhaps to compare the English conduit with that on such exceptional roads as those on Broadway and Third Avenue in New York, but the case may be taken of two comparatively modern specimens of cable construction as typical. One is the Columbia Railway in Washington where the conduit is thirty-one inches deep inside and four feet three inches from the top of the slot rail to the bottom of the concrete, while it is seventeen inches wide internally. The other is the Olive Street road in St. Louis where the tube measures thirty-four inches deep inside, four feet one inch outside and eighteen inches wide internally. The accompanying diagram shows the English conduit and yoke in section superimposed on a section of the St. Louis yoke and tube. Both are drawn on the same scale.

The type of grip used is radically different from that employed in America. In the first place the lower jaw is movable and not the upper as is often the case in America; secondly the grip is arranged so that it can pick up the cable at any part of the road without the aid of gipsies, and third it lifts the cable about three inches above the carrying sheaves, instead of six inches or more as is often the case in the United States.

The abolition of the iron guard inside the conduit at curves, and of the grinding of the grip shank upon it is made possible by the form of the slot rails. The bottom member of the rail is set back, which allows a friction roller on the grip shank to take the lower vertical plane to the right or left, according to the direction of the curve. All the wear and tear and the awkwardness arising from lifting the cable several inches on curves is also abolished, as the deflection of the rope caused by the grip is only horizontal instead of both horizontal and vertical. On the straight runs the tops of the cable sheaves are about twelve inches below the street surface, so that with a lift of three inches by the grip the work is done only about nine inches below the top of the paving stones and close under the bottom part of the slot rails. One other important matter about the slot rails is that their sides are vertical, so that heavy wheel traffic over the paving blocks immediately adjoining has no tendency to close the slot.

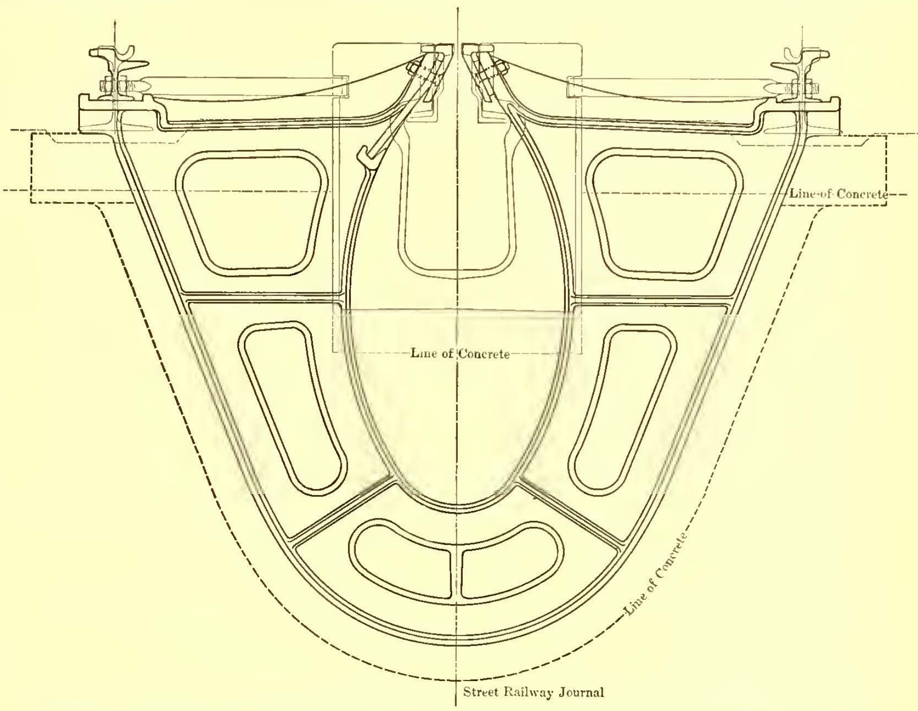


DIAGRAM SHOWING RELATIVE SIZE OF ENGLISH AND AMERICAN CABLE CONDUITS.

Dealing next with the track rails, these are laid as for horse or steam tramways direct on a concrete foundation. The yokes do not come near them, but they are tied to gauge by light tie rods bolted at one end through the web of the rail and at the other to the side of the yoke. The consequence is that the yoke is strengthened against slot closure and that vibration from ordinary wheel traffic is not conveyed in the same direct way to the yokes and slot as in the case of American construction. Economy in repairs is thus secured.

It will thus be seen that the street construction is of a comparatively simple and economical type, and thus far it has given every satisfaction. It should have been mentioned, though perhaps it is scarcely necessary, that small hatches only are provided in the street above the sheaves to allow of access for oiling and repairs and these are paved with ordinary stones. Street railway men can easily perceive that the amount of interference with underground pipes is comparatively very small in carrying out this method of construction, as all pipes more than fourteen inches from the road surface may be allowed to remain. As to the absolute cost, it is well known that tramway lines, double track, composed of heavy steel girder rails on concrete foundations, along with a roadway paved with granite blocks cannot for horse or steam traction be laid in England for less than about $40,000 per mile. The cable conduit on the method above described costs about as much more, making some $80,000 per double track mile. Should special obstructions from large underground pipes be encountered so near the surface the cost would, of course, be greater. Providing a power station with engines, boilers and machinery and a car shed will cost a sum, varying per mile according to the length of the lines equipped, but for a fair sized installation $100,000 per double track mile is about enough for street work, buildings, machinery and all equipment for a two minute service of cars. A horse tramway with a two minute service costs practically the same money owing to the large number of horses required and the extensive buildings and land necessary.

An ounce of fact is worth a ton of theory, and on the question whether such cable tramways will pay in cities of moderate size we have an example in Edinburgh. There the existing cable lines occupy three miles of street on which gradients up to one in eleven occur. The district is a quiet one, and the average interval between cars has been about five minutes, though recently a four minute headway has often been run. Further, the speed allowed is only six miles an hour. Yet this short line with its necessarily high general charges costs only about fifty-five per cent of the receipts to work, and on the actual cost of construction returns a dividend of about ten per cent per annum. No separate accounts of the London cable line have been published, but the expenses are much lower owing to the fact that a two minute service is required. It will be apparent from the above that the conversion of the horse lines in Edinburgh to the cable system, as they carry a much heavier traffic than the present cable road, cannot but be attended with substantial profits, even after taking into account the present capitalization of the horse lines which is a very moderate one. The same remark applies also to Newcastle.

As I have in a previous article indicated, there is the more opportunity for this economical method of cable construction in England because besides the objection to overhead wires it is being found that for a fairly heavy traffic the necessity of putting all feeder wires underground and the care and expense necessary to fulfill the stringent regulations of the Board of Trade in regard to electric tramways will cause electric lines to approximate very closely in first cost to cable roads for a frequent service, while operating expenses at the low speeds which are compulsory will also militate against such wholesale adoption of electricity in the central parts of larger towns as that with which Americans are familiar.

During January the records of the Baltimore City Passenger Railway Company show a generation of power at 3.129 lbs. of coal per kilowatt, running non-condensing.

Car House Construction in Boston.

The recent additions to its rolling stock made by the West End Street Railway Company, of Boston, and mentioned in our last issue, has compelled the company to erect a number of new car houses. In all, accommodations for 391 additional cars have been supplied by the company since last October. All the new car houses are built upon the same general plan, and embody in their construction certain principles which the long experience of the company has found to be desirable. The plans followed are in some respects novel so that a study of the drawings of one of the recent car houses will be of interest. Those shown are of

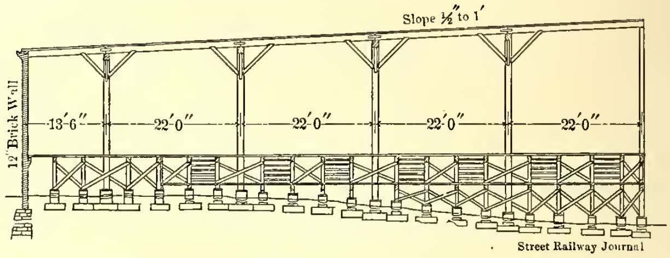


FIG. 1.—HALF CROSS SECTION THROUGH PIT ROOM.

a new car house built by the company at the corner of Washington and Cephas Streets.

Walls and Roof.—The building has twelve inch brick walls with granite sills and is covered with a "mill roof" of plank and heavy timbers. The foundations are of brick with 8 in. × 8 in. hard pine posts supporting 8 in. × 10 in. hard pine girders. The floors are three inch spruce plank.

Monitors.—The monitors are at right angles to the tracks instead of the usual construction which is to have them parallel to the tracks, or extending lengthwise of the building. The object of this is to secure better light and prevent the cars on the side track standing in the shadow of the cars standing on the middle tracks.

Entrance Curves.—These are usually laid with tram rail mounted on a 5 in. × 8 in. stringer. While not so durable as the girder rail and of course not so desirable for ordinary street construction, this form of rail is considered quite as desirable for car house entrance curves when the price is considered. The cost is only about one-third that of girder rail construction. When a car enters the car house it is going at a slow rate of speed and has no passengers so that there is but little strain on the track. Moreover there is practically no teaming over such places. When laid on its own property T rails are used.

In the car house illustrated, the entrance curves are all under cover, a single track entering through each of the two doors at the front of the car house. This method has not been adopted in all the recent car houses, but was employed here from the fact that the space in front of the house was limited and did not admit of the curves being laid in the streets. As the special work is all under cover there is no expense in keeping it clear of snow in winter.

Wash Room.—The proper place for this is considered to be in the middle and as near the front of the building as possible. It is so arranged that it can be kept warm in winter.

Offices, Waiting Rooms, etc.—The offices and the conductors' and motormen's rooms are along the side wall of

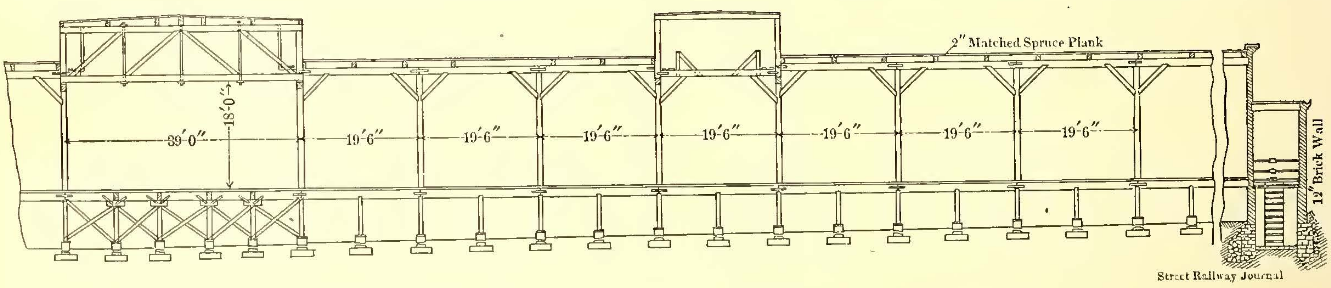


FIG. 2.—HALF LONGITUDINAL SECTION OF NEW CAR HOUSE—BOSTON.

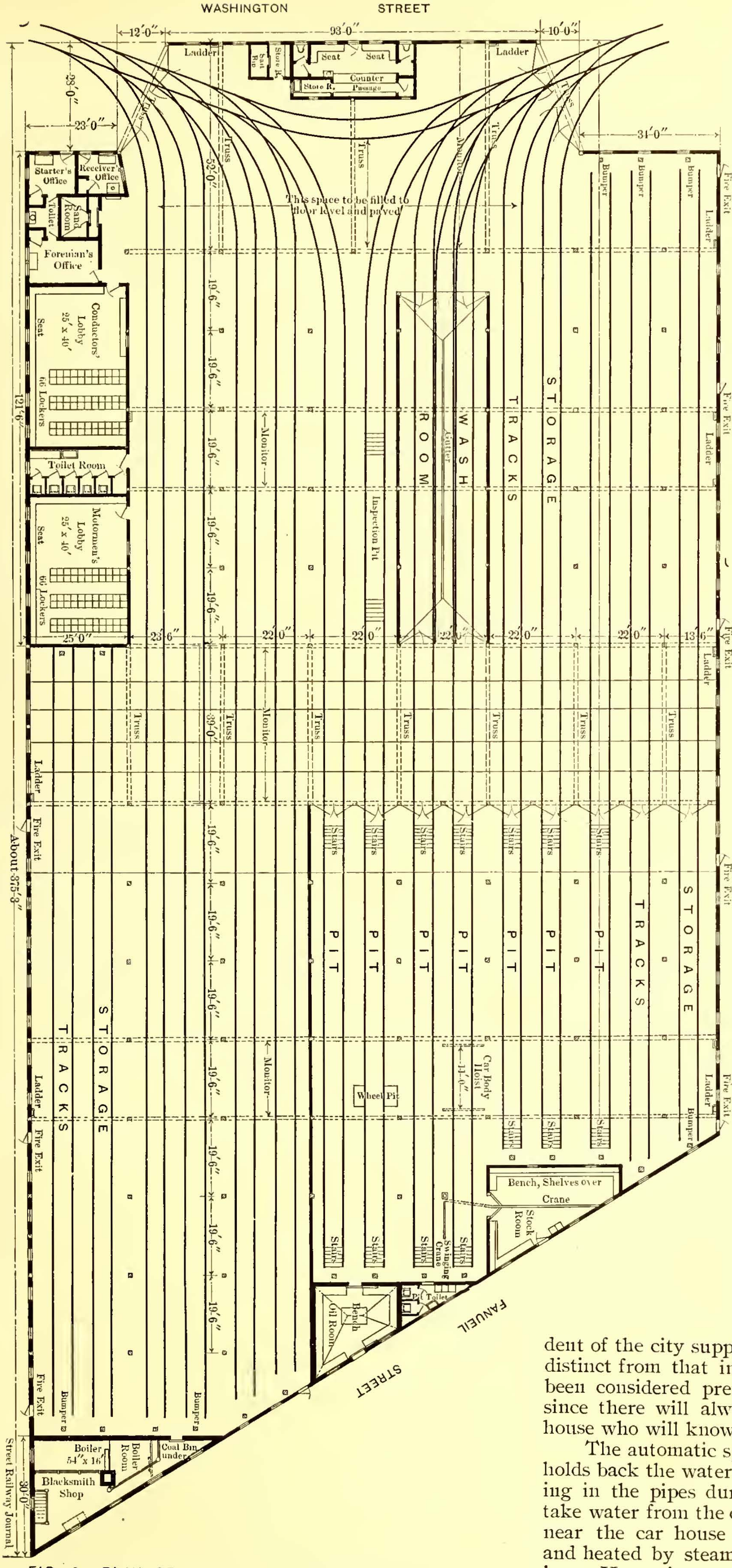


FIG. 3.—PLAN OF A NEW CAR HOUSE—WEST END STREET RAILWAY CO., BOSTON.

the building. The latter are kept entirely distinct from the rooms for the repair men, which are at the rear of the building. It has also been considered desirable to give the motormen and conductors separate rooms. These are on the ground floor, commodious and fitted with lockers for the different men. The passengers' waiting room, in the car house illustrated, is in the front of the building. This room is of the usual construction with benches, and adjoining it are the salt bin and storage room which should be easily accessible from the street.

Boiler Room.—The boiler room and blacksmith shop are separated from the rest of the house by a brick wall twelve inches thick and connect with the main car house by sliding doors, tinned. The oil room is similarly enclosed and its floor sloped to the center at a grade of ½ in. to the foot. It is fitted with center and side benches.

Stock Room.—The stock room, also in the rear of the building, is fitted with traveling hand hoist by which supplies can be received and delivered to a swinging crane which controls two pit tracks.

Pits.—The pits have stairs at each end, and over one are two ten inch I beams spaced eleven feet apart, fitted with hoists, by which a car body can be lifted clear of the truck. Another pit is fitted with removable rail sections of about eight feet in length, whereby after a car has been jacked up its wheels can be lowered into the pit by a pit jack.

The portion of the building containing the pits, with two additional tracks for storage, can be shut off from the rest of the building by doors and can be warmed in winter. In the opinion of the managers of the company this is an important point, as it is thought that repairs can be made much more quickly and to better advantage in a comfortably warm room than in a cold one.

Fire Precautions. — The car houses are fitted with automatic sprinklers and there is a regular fire drill which the men are taught and which they practice at intervals. The pressure of the sprinkling system is supplied by a rotary pump, directly connected to an electric railway motor, making it independent of the city supply. The wiring for the motor is kept distinct from that in the car house. A railway motor has been considered preferable to any other kind of power since there will always be plenty of men about the car house who will know how to operate it.

The automatic sprinkler pipes are filled with air which holds back the water, so that there is no trouble from freezing in the pipes during winter. The electric pump can take water from the city mains or from a large tank located near the car house holding from 20,000 to 40,000 gals., and heated by steam pipes in winter to keep it from freezing. Hose pipes are carried to the roof which is reached from the ground floor by a large number of ladders, so that water can be turned on from a dozen or more streams. The whole apparatus can in most cases be put in operation and the roof streams manned inside of thirty seconds from the time the alarm is given.

Street Railway Roadbed.

By MASON D. PRATT.

IV.—Track Fastenings. Joints.

Rails cannot be made, like wire, in any length desired; nor could they be shipped or handled conveniently in lengths of over sixty feet, the length of the longest rails laid to-day. The usual lengths are thirty, thirty-two and forty feet.

There must be some good connection between these separate rails when laid, to insure a continuity of track surface, and the question of joints—good joints—should be given equal importance with that of good rails. As a matter of fact, the joint has received fully as much consideration as the rail, since the advent of the electric motor. What constitutes a good joint? Simply, a fastening which, when properly applied to the abutting rail ends, will hold them in as good line and surface as the body of the rail.

It is a well established fact that rails laid in paved or macadamized streets and covered to their full depth, as is usually the case on street railways, may be "butted," i.e., laid without any opening between the ends for expansion. This can be done without danger from the effects of changes of temperature. This fact simplifies to a great extent the problem of making a good joint; for any opening, even as small as ⅛ in., will cause a "pound" on the passage of a wheel. The jar resulting from this pound will cause nuts, clips and other fastenings to loosen in time, and consequently produce a defective spot in the track.

There is a considerable strain produced in a line of rails by the changes of temperature*, but there is no appreciable movement because the whole effort is absorbed by the elasticity of the metal, and the vice-like grip of the pavement and surrounding material.

Rails are usually "hot-sawed", i. e., sawed to length as they come from the rolls at a bright red heat, and as it is quite impossible to thus make a perfectly smooth and square cut, the practice is to slightly undercut them. The amount of this undercut is about $\frac{1}{16}$ in., leaving an opening at the base of about $\frac{1}{4}$ in. when the heads abut. The most common form of joint is that formed by two plates in the shape of shallow channels, placed one on either side of the rail, and taking a bearing on the inclined surfaces of the head and base. They are held in position by bolts passing horizontally through both plates and the rail. The bolts used are called track bolts, and have a button head. That portion of the shank next the head, for a distance equal to the thickness of the joint plate is of oval form, and as it fits a hole of the same shape, the bolt is prevented from turning when the nut is being put on. The nut is either square or hexagonal. Where there is room for it to turn, the square nut is preferable in giving more bearing against the joint plate, and a better grip for the wrench. The hexagonal, or "hex," nut is used where there is less clearance, as is often the case on angle joints on T rails and on the deep girder rails where there are two rows of bolts; for in these latter cases it is desirable to get the bolt as close as possible to the edge of the plate.

*The coefficient of expansion for steel due to a change in temperature of 1° F. is .00000688 (Ganot). The rate of elongation of a bar of rail steel when subjected to a tensile strain within its elastic limit is, according to the average of a large number of tests made by the Pennsylvania Steel Company, about .00006 in. per 1000 lbs. per square inch. Dividing the temperature coefficient by the latter, we get 114.6 lbs. as the strain per square inch, produced in a rail due to a change of 1°, provided the ends are rigidly held and that there can be no lateral or vertical bending when compression takes place. Assuming a change in temperature of 100°, we get a strain of 11,460 lbs. per square inch, which is about one-fifth of the elastic limit, and one-ninth of the ultimate strength of rail steel. As a matter of fact, however, rails are not usually laid with the entire end surfaces abutting perfectly, and there is some chance for a small movement by compression of the small ridges produced by the saw. Then again, it is highly improbable that a rail will be under no strain at one of the extremes of temperature, but that the point of no strain will be at an average temperature. So that under these considerations, it is not probable that the strain in a rail will ever exceed one-third the figure given above, or about 4000 lbs. per square inch—a strain which is absolutely without danger of any kind.

The most essential feature of a joint is that the plates shall have as much bearing as possible. There is little gained in making any of the flanges wider than others, for a joint is like a bridge in this respect, that the weakest part determines the strength of the whole. That portion of the rail which generally determines the width of the joint plate flanges is under the head, and whatever width of bearing may be obtained here should be used at the other points. It is extremely important that the joint plates should fit the rail and that when drawn up by the bolts, the bearing surfaces shall be in contact with the rail with a uniform pressure over their entire surface. In order that the plates may not bend under the strain of the bolts, and destroy this bearing, they are always made convex. This is a proper feature, but even an arch, when not of sufficient thickness to carry its load will fail, as have many joint plates by being pulled in against the web of the rail. Fig. 80 clearly shows the result of such action. The bearing instead of being distributed over a surface is concentrated along a line. The effect of this is to rapidly wear away the parts of the rail and joint in contact, and thus loosen the joint. One cause for this lies in the increased size of the bolt used, without increasing the thickness of the plates proportionately. Larger bolts are used, because of their tendency to remain tight, due to the frictional resistance of a largely increased thread area.

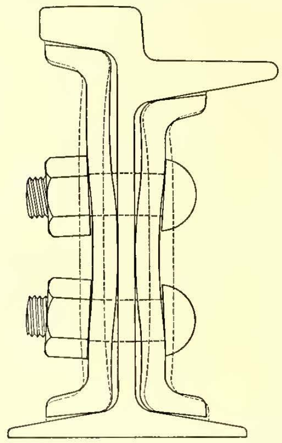


FIG. 80.—BUCKLED JOINT PLATES.

(Original position is shown by dotted lines.)

Plain or channel plates for 6 in. rails should be not less than $\frac{9}{16}$ in. thick at the center, those for 7 in. rails ⅝ in., and for 9 in. rails not less than ⅞ in. Even with these heavy plates there is danger of their being bent in sufficiently to destroy the fit unless some care is exercised in tightening up the bolts. Plates of less thickness than those given above have ample vertical stiffness and in order to prevent this inward bending on deep girder rails having a double row of bolts, the writer devised the "ribbed" plate, shown in Fig. 81. (See also Figs. 49, 54, 64 and 67 in the STREET RAILWAY JOURNAL, February, 1896.) The 8½ in. rail (Fig. 64) was the first section made having this type of joint. It was laid on the Atlantic Avenue Railroad in Brooklyn, N. Y., in 1892-3. With this center bearing it is readily seen that bending is prevented and the true bearing of the joint plate flanges insured, even when bolts are tightened up to the limit of their strength.

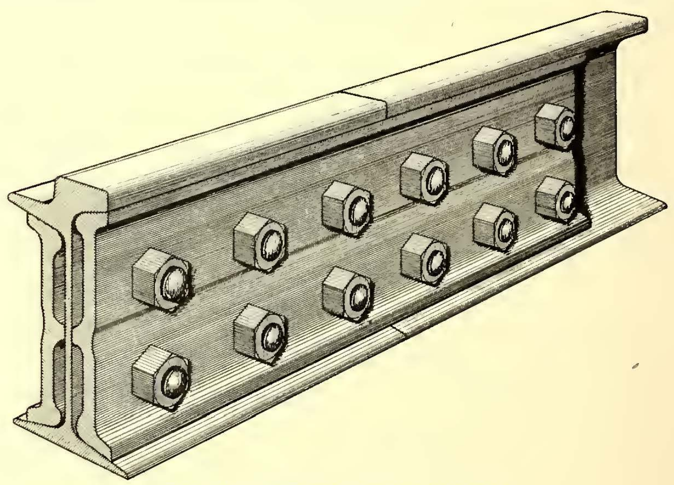


FIG. 81.—RIBBED JOINT PLATES.

In this connection it might be well to explain how rolled joint plates should be applied. Rails fresh from the mills are covered more or less with a thin coat of black oxide of iron. Much of this falls off during the process of straightening, loading and unloading; but there is always some adhering to the rail when placed in the track. This, to my mind, is one of the worst enemies of the joint, for after the latter is applied and the track is used the jar of passing wheels reduces this scale to a thin powder. This powder, working its way out from between the rail and joint plate, leaves the latter loose, or well started in that direction. This coating of oxide or "scale" is also found on the joint plates. Therefore the first thing to do is to remove it from the bearing surfaces, which may be done with a light hammer, a file or a scraper. By the time the

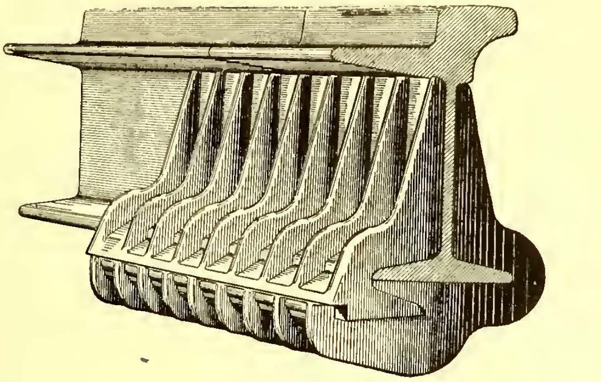


FIG. 83.—WHEELER RAIL JOINT.

rail reaches its destination this scale will be found only in patches, and probably the first tool mentioned is the best for the purpose as it easily crumbles off after a few light blows on the spot. This is a matter which I believe to be of considerable importance, and yet is often, if not always, overlooked.

The next step is to place the plates in their proper position and putting in all the bolts, screw them up only sufficiently tight to hold the rails snugly. Care should be exercised here as well as at each subsequent operation, to see that the plates go on evenly. After the spiking has been done and the track surfaced, all bolts should be gone over carefully, pulling every nut up tight. This may be done most effectively with a two foot wrench; and while pulling on the wrench, tap the *head* of the bolt with a one pound hammer. A few blows on the plates and on the head of the rail with a light sledge during this proceeding will have a beneficial effect. Again, after the track is finally lined and surfaced, every bolt should be gone over with wrench and hammer. A final inspection before filling in will do no harm.

If plain channel joints have been used, too much care cannot be exercised in drawing up the bolts, not to bend the plates, for they will do more good when bearing evenly against the rail flanges, even if the bolts are not as tight as they might be.

Channel joints are used from 20 ins. to 38 ins. long and with four to twelve bolts. The bolts should be either 7/8 in. or 1 in. in diameter. The writer is of the opinion that for 6 in. and 7 in. rails the joint should be 26 ins. to 36 ins. long, 5/8 in. thick and have six or eight 1 in. bolts; on rails deeper than 7 ins. a joint of about the same length, or even shorter, with two rows of six bolts each. Plain channel bolts should be 7/8 in. thick; "ribbed" plates may be 1/2 in. and the bolts 1 in. in diameter. The spacing of the bolts is a matter about which there seems to be a large diversity of opinion, but that in which the length of plate is divided evenly will give as good results as any.

Nut locks are frequently used on street railway tracks; but while admitting that there are many excellent devices intended to hold the nuts up to their work which may be of service on exposed tracks, it is my opinion that their use is an unnecessary expense on tracks that are covered in. In these cases there is quickly formed a coating of rust which, with the grip of the surrounding gravel and sand, holds the nut as in a vice, and if the joint becomes loose it is from other causes.

The joint made as above described and properly applied on rails of seven inches and over will give very satisfactory results. The deeper the rail, however, all other things being equal, the better the joint is apt to be, for with the stiffer rail the tendency to a movement between the parts of the joint is lessened. With the nine inch girders as laid to-day this movement of track is practically nothing.

There are many forms of the bolted and keyed joints, some of which possess considerable merit, and the question of their use is one to be settled by the manager in each case. We give below descriptions of a few of the most important ones.

The girder joint (Fig. 82) is of that class of joints which grip the base of the rail. In addition to this it performs another office—that of a chair—and is therefore best adapted to rails of six inches and less in height, although they are used on seven inch rails to some extent. There is no doubt that joints of this type would be used much more extensively than they are but for the fact that solid deep rail track can now be bought for about the same price as the shallow and lighter rails with chairs. The girder joint is not so well adapted to deep rails; first, because it does not hold the rails in strict alignment, and second, because the ties are thrown so far below the surface.

The Wheeler rail joint (Fig. 83) is made of malleable cast iron in two parts, and is without bolts. One of the parts, the larger one called the "housing," has a bearing surface extending under the entire width of the base of the rail, and has formed under this shelf a tapered pocket which receives a wedge formed in the lower side of the other part. The housing is provided with lugs engaging holes in the rail web which prevent its slipping from a central position when the wedge portion is driven home. The whole is well braced by ribs. The manufacturers say: "There is no attempt to assist the web in holding up the rail head as we believe all T and tram rails are or should be stiff enough to carry the traffic, and are as stiff at the ends as at any other portion of the rail length, and that the province of a rail joint is to prevent motion of rail ends by keeping the bases and webs in perfect alignment and immovable, thus insuring a permanent alignment and surface of the head and tram." And the advantages claimed for the joint are:

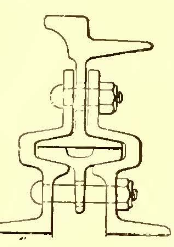


FIG. 82.—GIRDER JOINT.

"A solid, unbroken base or shelf upon which the foot flanges of the meeting rails rest.

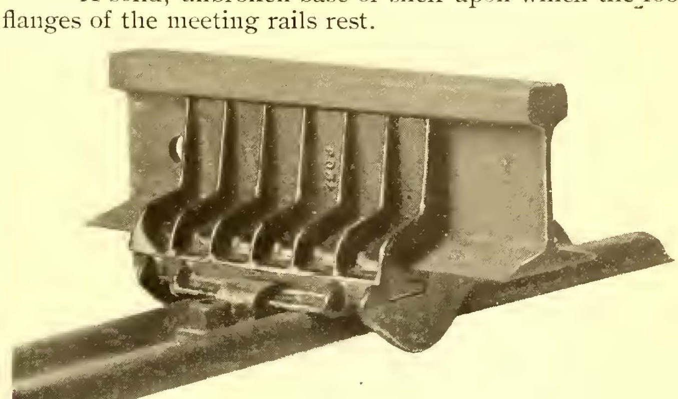


FIG. 84.—WHEELER RAIL JOINT.

"A firm grasp of the rail over the entire surface of the foot flanges and web.

"Simplicity of design, two pieces against twenty-six in twelve bolt splice bar joint.

"Elimination of the weakness of splice bar joint, viz., bolts and nuts and consequent avoidance of necessity of tearing up pavement for joint repairs and replacing same.

"Economy in applying joints, two to four Wheeler joints having been applied while one splice bar joint was being bolted up."

These joints have been used very effectively in old track—replacing the light "straps" which amounted to almost no joint when attacked by the electric motor. Extending as they do below the rail there is considerable stiffness in them. Being castings it is impossible to obtain as good a fit as with rolled joints, and that they will keep tight longer, if as long, as the bolted joint, properly applied, is open to question.

The Weber joint (Fig. 85) is peculiar in having, in addition to the two well-fitting channel joints, an angle which has one leg extending under the rails. The space between the vertical leg and one of the joint plates is filled with a piece of sound Georgia pine. The bolts pass through the two plates, the rail, the pine filler and the angle. Of course, such a joint is more expensive—first cost considered—than the ordinary joint; but it is claimed that the addition of the angle not only stiffens the whole joint greatly, but also maintains the rails in good surface. The elasticity of the pine filler keeps the whole joint tight by taking up all loosening effect of wear. The Weber joint has made a remarkable record on open track where it not only maintains a good surface when applied to new track, but on old track with "low" joints it has brought the rails up to line and surface which it is not possible to attain with the ordinary angle joints.

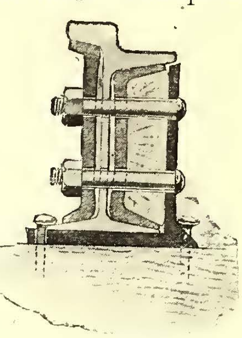


FIG. 85.—WEBER RAIL JOINT.

With the knowledge of the fact that rails may be laid with butted joints naturally comes also the question, Why not such a joint as will make the track practically two continuous rails? There are two methods now in use, which endeavor to reach this end, namely, the processes of electrically welding the rail ends together and that of "cast welding."

The former process consisted in fusing a piece of metal on each side of the web at the joint by passing through them, when held tightly against the rail, a current of low voltage and great volume. Some attempts, I believe, were made last year to unite the rails ends directly. The process of electric welding is not welding in the ordinary sense, but a melting of the separate pieces together. To do this properly with steel requires the expenditure of about fifty horse power per square inch. The operation is completed so quickly that a few inches from the point of melting steel the rail is quite cold. The heated portion on slowly cooling passes through an annealing process and leaves a distinct line of demarkation between two conditions of steel—which is also a line of weakness. This was proven by a considerable percentage of breakages taking place at this point, when the track became subject to the strains produced by changing temperature. The apparatus used is necessarily cumbersome and expensive, and it is questionable if the results attained are commensurate with the expense.

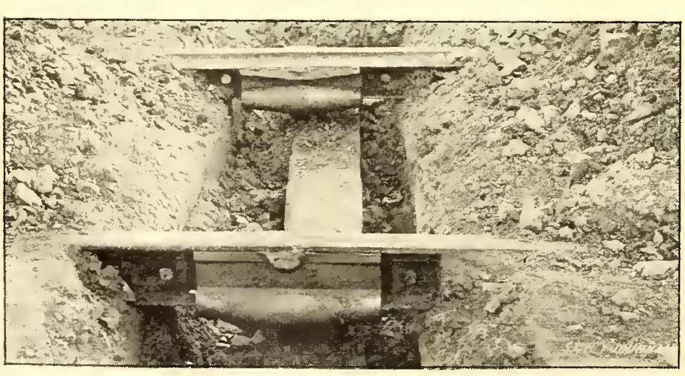


FIG. 86.—CAST WELDED JOINT.

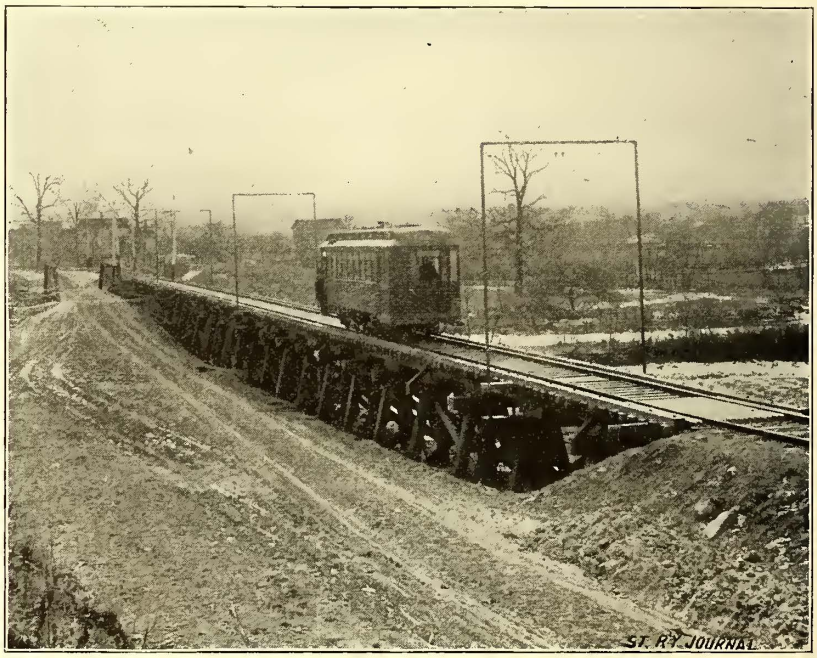
The "cast welded" joint consists simply in a mass of cast iron poured around the abutting rail ends uniting through holes in the web. It is possible to make a very close union between the cast iron and the rail, and with the proper amount of iron a very strong and substantial joint can be produced.

A Recent Interurban Line in Ohio.

One of the most recent lines in Ohio is that along the Mahoning Valley, extending from Youngstown to Girard and Niles. The officials of this company are C. F. Clapp, president, R. G. Sykes, vice president, John E. McVey, secretary, and A. A. Anderson, treasurer and general manager.

The company was incorporated in November, 1894. The line was completed to Girard and put in operation on Oct. 5, 1895, and was completed to Niles Nov. 4. The distance from Youngstown to Girard is five miles and that from Girard to Niles is five miles. The line serves a population of nearly fifty thousand people.

The track is laid with sixty-seven pound T and sixty-eight pound girder rail. Owing to the nature of the country through which the line passes considerable heavy grading was necessary, and four pieces of trestle work having a total length of 1700 ft. The trestles are built in a most substantial manner of Georgia pine. There is also one bridge span of seventy feet, the abutments of which are laid in Portland cement. The span is formed by two six foot deck plate girders. The trolley wire on these trestles is carried on pipe poles with cross pipe girder, as shown in the engraving. A portion of the road is built over ground purchased outright, giving perpetual right of way, and a fifty year franchise has been granted over the greater portion of the remaining distance between Girard and Niles.



CROSSING A TRESTLE ON THE MAHONING VALLEY RAILWAY.

There are four thirty-two foot vestibuled cars built by the Barney & Smith Company, two Pullman and two Gilbert cars. All are mounted on McGuire trucks and are equipped with G. E. 1200 motors.

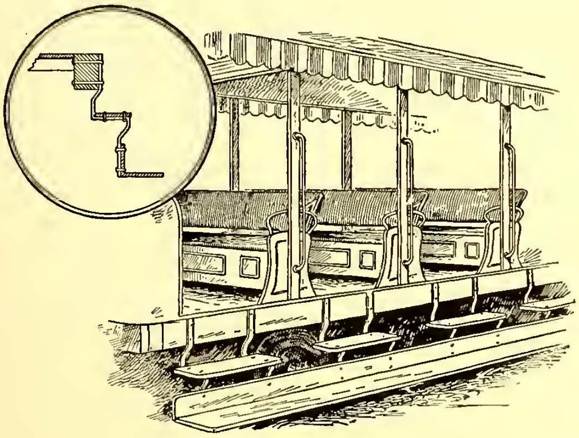
At present this line is being operated from the power station of the Youngstown Street Railway Company in Youngstown, but a modern power house is to be erected in Niles, O., during the coming spring. It is also the purpose to consolidate the company with the Youngstown Street Railway Company in the near future. The consolidated companies will probably extend their lines to other cities in the Mahoning Valley.

The West End Street Railway Company, of Knoxville, Tenn., will erect a new station.

·SCIENCE·ENGINEERING· ·INVENTION·

Car Step for Open Cars.

The accompanying engraving shows an ingenious method of making open cars more accessible, invented by J. A. Miller, of New Haven, Conn. It is practically the addition of another step to the entrance of each aisle of an open car. This permits the running board of the car to be lowered to about twelve inches above the rail. The auxiliary step is placed ten inches above the running board and



CAR STEP FOR OPEN CARS.

is supported by iron hangers. The step is six or seven inches in width and eighteen inches in length, thus filling the distance at the end of each aisle. As many open cars are fitted for high suburban speed with thirty-three inch wheels, the use of the auxiliary step will prove very convenient to many passengers.

Another claim made for the step is that when used by conductors it will permit them to lean much further into the body of the car after nickels. There is also much less liability to accident in getting on and off cars.

The Electric Railways of Geneva.

An electric railway has been put in operation in Geneva by the General Tramway Company of Switzerland. This tramway, which traverses the most densely populated districts of the city, opens direct communication with the aristocratic quarter of the city and extends from the Plateau de Champel on the one side, as far as the village Petit-Saconnex on the other side. The speed of the cars is limited to five miles per hour in the center of the city, and twelve and one-half miles per hour in the outskirts. The cars will run on fifteen minutes headway, and will make twenty-five round trips a day. Six cars will take care of the normal traffic and will make an average of 560 car miles per day.

The power station is located on the River Rhone. The generators are six-pole machines, and are directly connected to horizontal Picard turbines. Each dynamo is rated at 150 k. w.

The trolley wire is of galvanized steel in the center portions of the city, in order to obtain maximum strength; on the rest of the distance it is of copper. Tubular steel poles of a height of twenty-two feet are used, and are set in the ground to the depth of five feet. Two types of rails are used. In the central portions of the city it is of the Marsillon section, the rails being laid on ties. On the rest of the distance the rails are of the Phœnix type. They are in lengths of thirty-six feet. The maximum grade is five and one-half per cent. and the minimum radius of curves is eighty-three feet.

The cars are of the double deck type, and hold thirty-two passengers each. They measure in length nineteen and one-half feet, and weigh, equipped, ten thousand pounds each. The electrical equipment includes a single reduction motor of fifteen horse power.

We are indebted for the foregoing description to *L'Elettricita*.

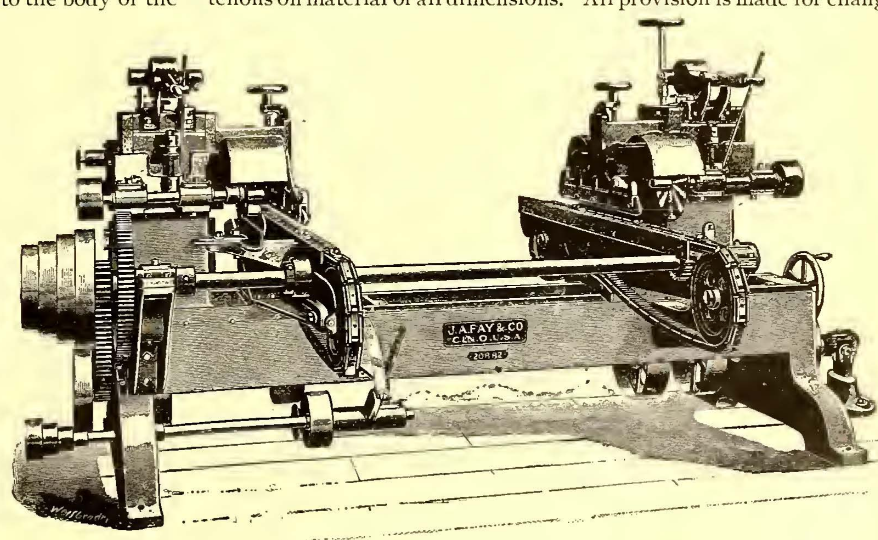
A New Double Tenoning Machine.

The illustration represents a new tenoning machine designed for cutting tenons on both ends of material, coping both ends and cutting off to exact dimensions at one operation.

The claim is made that it is the only double tenoner that will tenon both ends of wide and short material at the same time and have the tenons absolutely perfect. It will tenon material from six inches to fifty-four inches between shoulders and to twenty inches in width and a piece seven inches thick can be passed between the heads. It is estimated that this machine will do the work of three single machines and when required for tenoning longer material the makers are prepared to construct them.

The framing is very heavy, well braced and with wide base. The housings are mounted on the bed, one of them adjustable for different lengths of material, and they support all the principal working parts. The mandrels that carry the tenoning heads are $1\frac{7}{16}$ ins. in diameter, made of the best cast steel, are lead ground and run in long self oiling bearings. The mandrel slides have a vertical adjustment on the housings and the upper mandrels have a lateral adjustment to permit cutting a tenon longer on one side than the other. The driving pulleys are located between the bearings and have adjustable bindings to keep the belt tight, with the mandrels in any position. The mandrels that carry the saws are located on the opposite sides of the housings in advance of the cutter heads and have independent vertical and lateral adjustments. The coping attachment is located back of the tenoning heads and is mounted on adjustable slides and driven from independent countershafting supported on the machine.

The feeding mechanism is constructed on a new and ingenious principle, automatic in its operation, and will produce accurate tenons on material of all dimensions. All provision is made for changing the angle of the cut and length of tenon. There are four changes of feed, varying from fifteen feet to forty-five feet per minute. This machine is built by J. A. Fay & Company.

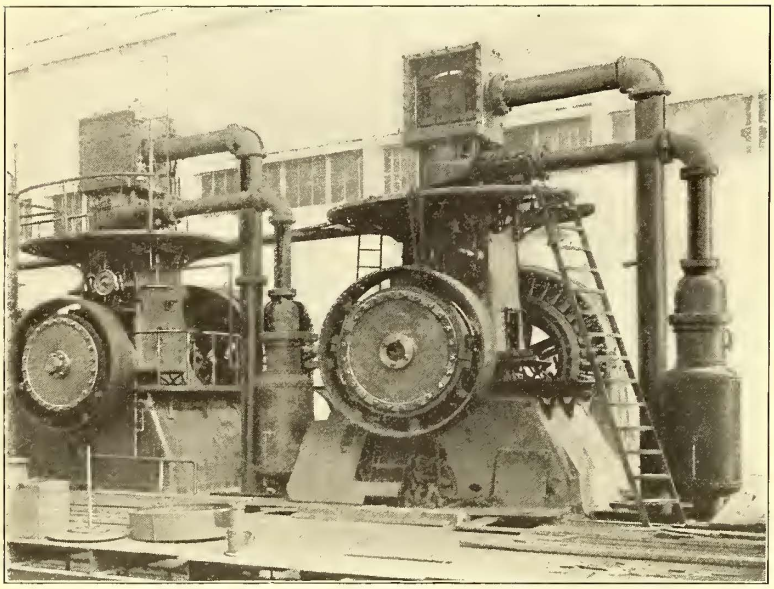


DOUBLE TENONING MACHINE.

A COMPANY headed by Tom L. Johnson is said to be planning a system of electric railways to connect all the important towns in Central Ohio. The prospective lines so far favorably considered will aggregate over 400 miles.

A Combined Separator and Steam Receiver.

The fall of pressure that takes place between the boiler and the engine, due to the fact that the volume of steam necessary for one stroke of the engine has to be drawn from the boiler through a long and sinuous pipe during the short period of admission which in an ordinary Corliss engine is only one-fifth to one-quarter of the stroke,



VERTICAL ENGINES WITH COMBINED SEPARATOR AND RECEIVER.

has always been a source of annoyance to engineers. This reduction of pressure, as shown by indicator cards, generally amounts to from five to ten per cent of the boiler pressure.

Using very large steam pipes reduces the loss only in a measure, while open to the objection of increased cost, greater difficulty in keeping the joints tight, especially under high pressures, and greater liability to accidents. In view of this it has become the practice in large plants to place a large reservoir or receiver close to the engine; thus insuring a free supply of steam at substantially full pressure during admission, the boiler having ample time during expansion to again restore the pressure in the receiver.

These considerations have led the Goubert Manufacturing Company, manufacturer of the Stratton steam separator, to design a combined separator and steam receiver. The making of the two appliances into one, while insuring a supply of perfectly dry steam at full pressure to the engine, economizes space and makes a much neater appearance, as well as lessens the number of joints that would be necessary if two different apparatus were used. The large experience and manufacturing facilities of this company for high pressure work are a guarantee that nothing but good and tight work with a safe and efficient apparatus will be furnished.

The Goubert Manufacturing Company has already supplied these combined separators and receivers to a number of large power plants. Among them may be mentioned the United Electric Light & Power Company, of New York; West End Railway Company, of Boston, and Nassau Electric Railroad Company, of Brooklyn.

The accompanying engraving shows two of four of these Stratton combined separators and steam receivers connected to 1200 h. p. Westinghouse engines at the new power house of the first mentioned company on East Twenty-eighth Street, New York. According to the engineer of this company, the separators remove practically every trace of entrained water, while the receivers keep a constant supply of steam right at the throttle, which is not affected in pressure by the pulsations of the engine to an extent of over one-half of one per cent. Several tests have been made to ascertain the drop in steam pressure between the boilers and the receivers, but even when the engines were loaded no appreciable drop could be found.

Brake Experiments in Chicago.

A trial of the improved Prouty-Noble brake was made on the lines of the Chicago City Railway Company, Mar. 18. Through the courtesy of Supt. M. K. Bowen, a motor and trail car equipped with these brakes were run special over the Clark Street line of the company from Washington to Sixty-ninth Street. A number of officials of the Chicago City Railway and several prominent street railway and electrical experts were given an opportunity of witnessing the operation of the new brake. The principle of the Prouty-Noble brake consists in utilizing the momentum of the car by winding the brake chain on a friction operated spool on the car axle as previously described in the STREET RAILWAY JOURNAL. With the improved construction one or more trail cars can be perfectly and easily controlled by the motorman and with but a slight movement of and pressure on the brake handle. Another new feature is the placing of the shoes so as to operate on the inside of the wheels, and of applying them by direct toggle action as applied on locomotives. This arrangement permits of the hanging of the shoes so that they will under no circumstances cling to or ride the wheels, and is furthermore uniform in its operation and quick in applying and releasing the shoes. The tests made were on very slippery track, but were considered very satisfactory.

Boston Standard Long Car.

The accompanying engraving shows one of the recent double truck cars built for the West End Street Railway, of Boston, by the Laconia Car Company, and mounted on the Baker swivel truck, the characteristics of which are short wheel base and simplicity of construction. This truck has been adopted as standard for double truck cars by the West End Company. It was designed by the company's master mechanic and is manufactured at the Laconia Car Company's works.

BOSTON STANDARD LONG CAR.

The following are some of the principal dimensions of the car: Length of body over panels, 25 ft.; length of car over platform, 32 ft. 11 ins.; length over bonnets, 33 ft. 1 in.; width of bottom over panels, 6 ft. 8 ins.; width between seat rails, 3 ft. 5 ins.; the width of roof at plates all over, 7 ft. 9½ ins.; width of body over posts, 7 ft. 6 ins.; height, bottom of sill to top of trolley plank, 8 ft. 9½ ins.; height from step to platform, 13 ins.

The Works of a Large Car Company.

The Wason Manufacturing Company is one of the oldest establishments in the United States engaged in the manufacture of cars. It began with the building of freight cars by T. W. Wason in 1845. Car building of all kinds was then in its infancy and passenger work was only another form of coach or omnibus building. It is said that independence of his employer's political ideas was the turning point in determining Mr. Wason's career. He lost a good position, settled in Springfield, and taking a contract for a car on one of the local roads, now the Connecticut River road, had his business career settled. From 1846 when the firm was T. & C. Wason to 1853 when the firm of T. W. Wason & Company was established there were great improvements in the works. At that time, George C. Fisk became interested in the establishment, and for many years

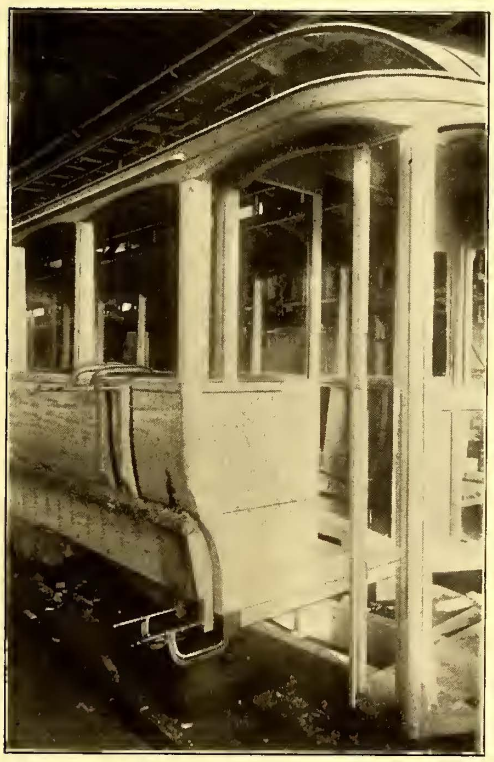
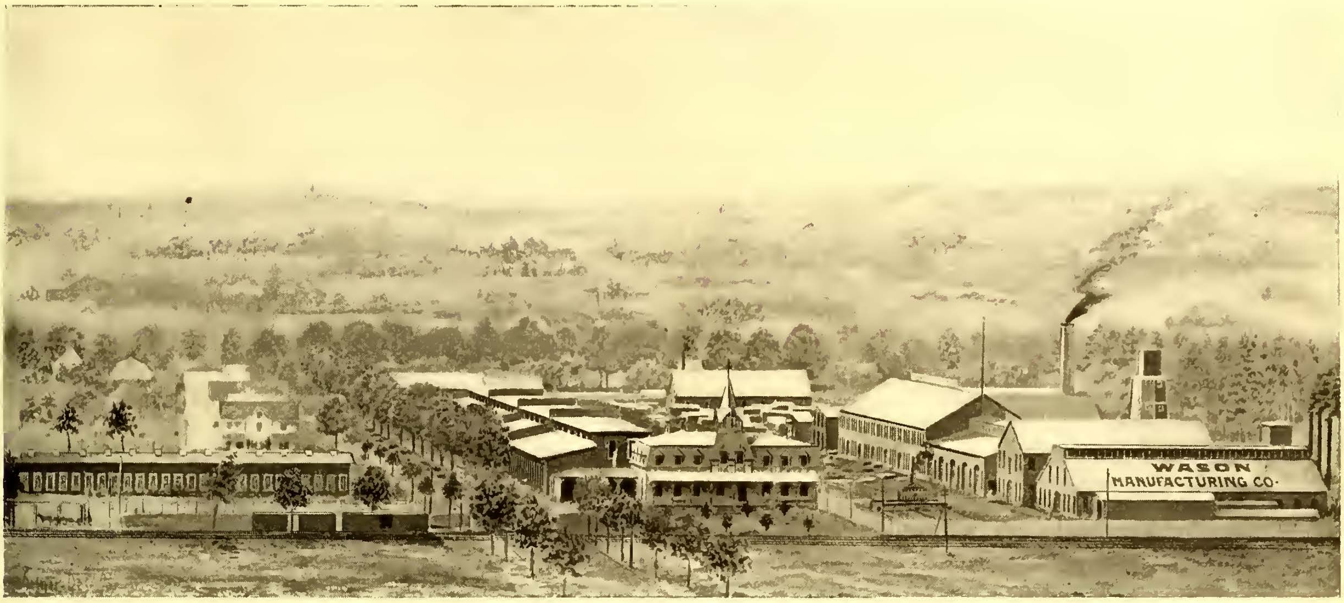


FIG. 2.—METHOD OF PUTTING PANELS IN PLACE.

FIG. 3.—SIDE VIEW OF VESTIBULE.

past has been the president and manager of the company, in which he has had forty-three years of continuous service. The company under its present name was organized in 1863. The old works were in the center of the city of Springfield and in later years became insufferably crowded. In 1871 H. S. Hyde and Geo. C. Fisk purchased a large tract of land at Brightwood, about two miles from Springfield. This tract of land is on the bank of the Connecticut and extends on both sides of the Connecticut Valley Railroad. It is about seventy acres in extent and the company occupies about seventeen acres. When the shops were built this land was supposed to be ample for all possible contingencies, but even this generous provision has not been altogether sufficient.

The works were laid out by Mr. Fisk, who with the general manager, W. H. Paige, made a study of most of the shops then in existence. Through the center of the plot of land runs a transfer



WORKS OF THE WASON MFG. CO.

table of unusual size, the track upon it being forty-five feet in length. The three tracks for the table traverse the whole length of the grounds, a distance of more than 1000 ft. Originally, as designed by Mr. Paige, this table with its engine and platform, which is seen in the center of the yard near the office building, was driven by a chain fixed at each end. Experience has shown that the chain was not necessary, and a simple bearing wheel running on the center rail and driven by a chain from a sprocket wheel on the engine shaft moves the table with the greatest accuracy and covers the seventy tracks which run at right angles across the works quickly and with great accuracy.

The building in front is that devoted to the offices, drawing room, reading room, store rooms and other departments intimately connected with the office work. The passenger erecting shop just behind the office is 117 ft. × 75 ft. The foundry is 170 ft. × 62 ft., and has a deck roof. Here are the 80,000 lb. Howe track scales, several cupolas capable of melting some forty tons per day. The wheel casting house is 40 ft. × 28 ft. The wheel capacity is about 100 wheels per day. The machine shop is 96 ft. × 45 ft., the lower story being devoted to heavy and the upper story to light work. Connected with the machine shop is a smith shop 100 ft. × 45 ft., and having an extension which is used as an iron room. This shop has twenty-six side fires. The paint shop beyond the erecting shop is 500 ft. × 75 ft. It has space for thirty-two passenger cars. The wood working shop is a building 200 ft. × 62 ft., two stories high. The upper floor is devoted to upholstering, varnishing and trimming. One of the features of this building which was new at the time it was put up and which has been of material advantage ever since, was the fact that every piece of machinery rested on a foundation which was independent of the floor. The floor itself was not laid directly upon the ground as has been a very common practice in buildings of this character, but was raised far enough to allow a circulation of air beneath it. Wherever it became necessary to locate a machine the floor was cut and a foundation made directly on the soil.

There is also a lumber shed 420 ft. × 40 ft. wide and two stories high. The trucks for passenger and other cars are built in a shop

60 ft. × 45 ft. On the left of the engraving is seen a large new shop which has been erected more recently, an overflow from the original plot of land.

One of the points of interest about the works is the lumber yard to which Mr. Fisk has devoted a great deal of attention. In fact, the quality of lumber has been one of the hobbies of the company for years, Mr. Fisk, the president, having spent an unusual amount of time and a great deal of labor and expense in experimenting with various means for drying lumber and for putting it in the best possible condition for use. He has also done much toward having timber of all kinds tested to ascertain its suitableness for various purposes. In this matter he was one of the first men to demonstrate the usefulness of Oregon pine. His experiments in oak are numberless and he is constantly testing.

The Wason Manufacturing Company has been known for a great many years as the builder of a high grade of steam cars. The company has also for many years engaged in the manufacture of street cars, and if we remember rightly built for the West End road, of Boston, the first street car having a monitor or raised deck roof. This was trussed from the corners of the car to the center of the roof in a most peculiar way. Apparently the builders expected that the sides of the roof would fall inward. It was a very handsome car for 1857 and attracted much attention. The extensive use of the bob-tailed car was carried so far and so completely covered with patents, that the company for many years after their introduction confined themselves exclusively to steam car work. However with the introduction of heavier cars and the demands made upon them, they a few years ago re-opened the street car department and have been since that time manufacturing cars for street railway service. Recognizing the fact that workmanship was one of the three essentials for a durable street car, the president took unusual pains in organizing the department which is kept entirely distinct from the steam work.

The accompanying engravings show some of the special features of its standard car for electric railway work. The first feature that attracts attention is the careful and effective method employed for holding the panels in position against the ribs while the glue is setting. This is shown in principle in Fig. 2, which also gives an illustration of the end of a standard car in the white. The method is to secure with several bolts at the level of the belt rail a heavy padded rail the whole length of the side of the car. This is done after the panels have been tacked on. When this is in place a brace is put on at every rib, which hooks at one end under the rail, and at the other end is held fast by a screw clamp, as shown. Each panel is treated by itself, though in the engraving both upper and lower panels have braces and clamps in position for the purpose of illustrating the principle. These were put in place to show the method, the panels

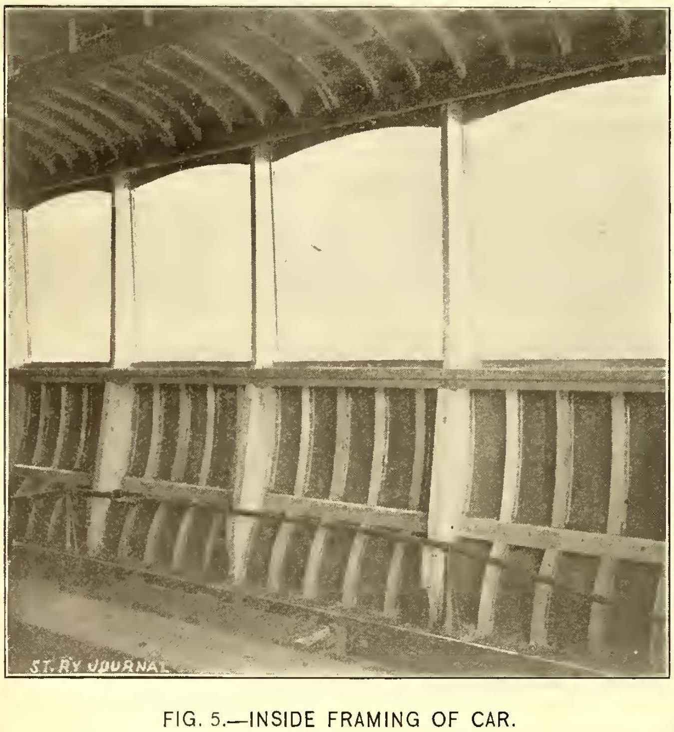


FIG. 5.—INSIDE FRAMING OF CAR.

having been glued and clamped some time previously. The marks of the pressure show very plainly on the lower or curved panel. The system is one which effectually brings the inside surfaces of panel and rib into contact. The amount of curvature given to the side of the car is somewhat greater than usual, a very desirable feature since it materially increases the stiffness of the structure. This is best seen in Fig. 5, which represents the inside of the car. The reader will notice that the stands or posts for the truss rod are not of the usual form, but of fixed length, as high as can be carried beneath the seat. The posts themselves from the window rail down are heavier than usual, having more width on their inside edges.

The ribs are closely spaced. The rails are chamfered so as to throw off dirt, and blocking is placed upon the sill so that dirt cannot remain in contact with the panels and collect water. The inside window rail forms part of the framing of the car and is secured to each post by three screws and is also gained in place.

The construction of the plate is another feature that should be noted in Fig. 5. Instead of being a single piece of wood into which the posts are mortised, it really consists of three pieces. One of these is the letterboard, another a thin plate occupying the usual position and having the post mortised into it, and the other member an inside rail which is halved on to the posts like the window panel or letterboard. These three pieces are glued and screwed

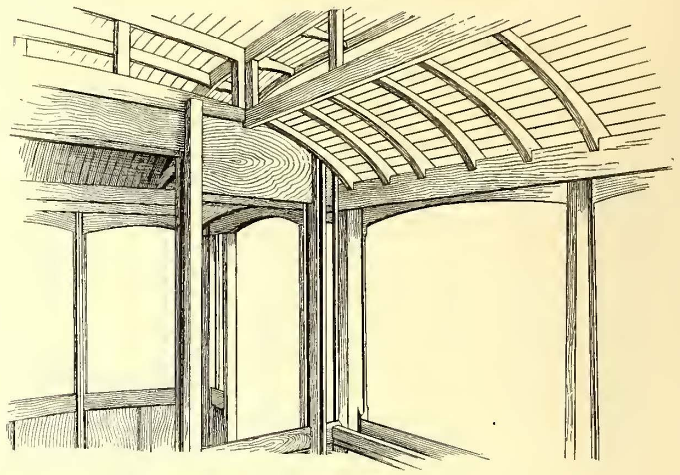


FIG. 4.—INSIDE OF END OF CAR.

firmly to each other and to the posts and form an exceedingly stiff, strong and very light member. The construction also appears in Fig. 4, which shows the inside of the end of the car and illustrates the exceedingly strong double corner posts which are used. The plate may be very properly considered as belonging to the box variety and is at the corner of the car, not only strengthened by the inner post, but is reinforced by what would be termed the lintel of the vestibule, which continues from the inner post to the vestibule corner post. (See both Figs. 2 and 6.)

Coming to the corner posts, best seen on the outside in Fig. 2, we find that the upper members of the car frame at the corner and the vestibule are made into one piece by carrying the upper outside finishing strip entirely around the corner of the vestibule past the car corner, past the first window post in a single piece of bent wood. This long splice is also covered by the drip rail. The finish on the corner opposite the door is seen in Fig. 3. Incidentally it should be noted that these cars are finished with a door on one side only of the vestibule, a construction which in itself materially increases the strength of the car and at the same time gives a stronger support to the vestibule. The construction of the vestibule is best seen in Fig. 6. It is practically a prolongation of the car body, the upper part of it taking the raised roof and plates as integral portions. The great depth of the vestibule roof timbers with the way in which the posts are secured into them makes this practically as strong as any part of the car body. The end timber of what would be the platform is made in several strips and is supported by four platform timbers of the usual fashion. The horizontal resistance to collision or butting is secured by an oak or hard pine platform floor 1¾ ins. in thickness, which is driven in solidly to take a bearing against the end sill of the car. The end sill itself is of oak measuring 8 ins. × 8 ins. It is the practice of the company to put these sills in of two 4 in. × 8 in. pieces laid horizontally. The object in doing this is to secure a perfect dryness of the wood. An 8 in. × 8 in. stick is seasoned with the greatest difficulty, while a 4 in. × 8 in. stick can be obtained readily perfectly dry. The result is that this made sill is stronger and stiffer than the solid stick.

The lower plate of the raised deck is a single piece of yellow Douglas fir (Oregan pine). The lightness of this timber and its strength make it peculiarly suitable for these long sticks which must, if possible, be both light, strong and stiff.

The iron work upon these cars is somewhat peculiar and very interesting. It is best seen by reference to Fig. 3, which shows the end of the car and the side of the vestibule opposite the door. In Fig. 6, the method of putting on one of the corner irons and the window strap is shown, and in this figure the peculiar form of the corner panel iron is best seen. It has, in the form of a strap, a flat plate on the end of the car and a flange which turns up against the inner corner post. It is formed of a single piece of malleable iron. The other straps in Fig. 3 run around continuously, but at the inside angle of the vestibule are covered by malleable plates. The dash, or front of the vestibule, is a single plate of iron secured, as shown, under the corner of the car and taking a bearing against a casting which takes the truss rod. It gives a very firm support at the right place.

There may be doubts in the minds of some in regard to the theory of the platform, and whether it should be made just as strong as the car, some advocating its use as a mere buffer or breaking piece which shall give way before the car body is injured. With the vestibule however a large number of builders and experienced car users have reached the conclusion that it should be made as strong as the car frame itself, and if provided with a sufficient buffer iron should stand all the hard usage to which the car can be subjected without absolute destruction. It is upon this theory that the Wason Company has designed and built its vestibules, and there seems to be no reason for doubting the soundness of its judgment in this matter. With a car which is to be carried on double trucks the additional end weight is not a serious matter, since its overhang is but small and it is easily carried without any tendency to galloping or pitching at any speed.

The finish of the vestibule without sheeting beneath the iron presents some advantages, and in case of a slight collision the damage is much more easily repaired than when a considerable amount of splintered sheeting has to be taken off and replaced. In this respect however it is not theory, but the result of experience which must decide the question of the most desirable construction.

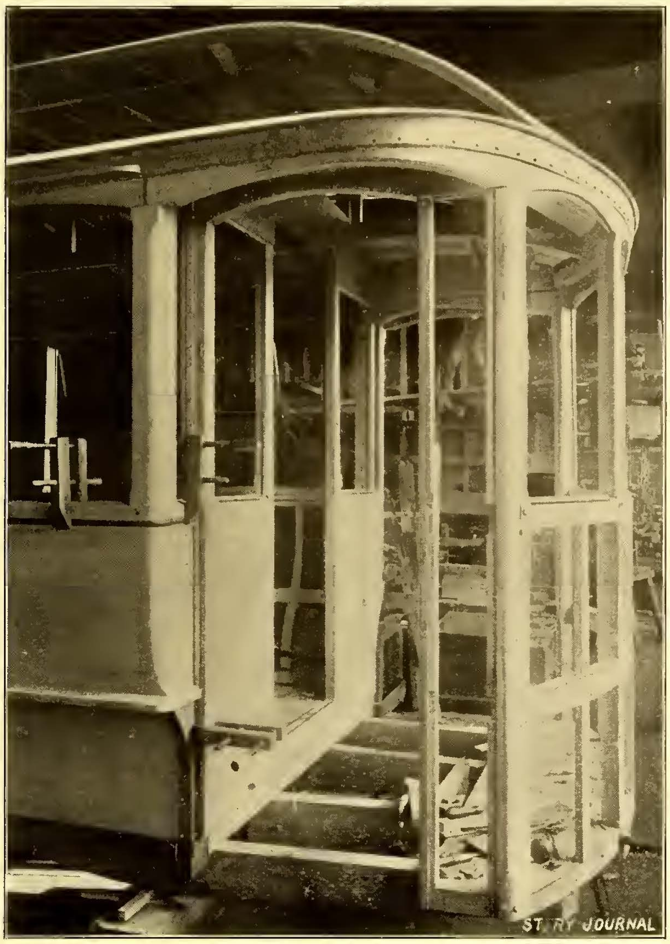


FIG. 6.—VESTIBULE UNDER CONSTRUCTION.

A New Method of Testing Rail Bonds.

A novel method of testing all the rail bonds of an electric line was recently tried with success by J. K. Brooks, superintendent of the Niagara Falls & Lewiston Railroad Company. The method was suggested by Harold P. Brown with whose plastic bonds the line is equipped.

Two large double truck cars were placed twenty feet apart and on their projecting bumpers was laid a strong wooden beam 21 ft. long and 6 ins. × 8 ins. in section. This was firmly lashed in place with ropes; the drawbars were then joined together and a strain put on their springs with a block and tackle so as to take up any lost motion between the cars and the beam.

This arrangement left just twenty-eight feet between the rail contacts of the rear wheels of No. 1 car and the front wheels of No. 2 car. These trucks were then connected by an insulated wire in which was interposed a very low reading voltmeter. A high reading voltmeter was placed between trolley and rail and an ammeter put in series with the motors. Then the motors of No. 1 car were started and brake set on car No. 2 until one hundred amperes were required to run the cars at about three miles an hour. It is evident that as the train moved away from the power house, the low reading voltmeter would indicate the drop in pressure due to the resistance of the rails and joints between the cars.

The rail joints are placed in the center of the opposite rail, and therefore during a movement of two feet the rear truck of No. 1 car and front truck of No. 2 car were on the same rail, while there was a joint between them on the other rail.

During the next thirteen feet there was a joint in each rail. The consequent variation in the voltmeter's reading represented the increase of drop due to one joint. At its lower point, which would be held for about one-half second, the reading represented the drop due to twenty-eight feet of unbroken rail, in parallel with a similar length of rail having one joint and a pair of bonds. For the next 3¼ seconds the reading would be higher since there was a joint in each rail. Knowing the drop per foot of rail with a given current, the readings were easily verified by calculating the total drop and comparing it with the indications of the high reading voltmeters on the car at end of line and at the power house. This is believed to be the first time that a test has been made of each bond on an electric railway.

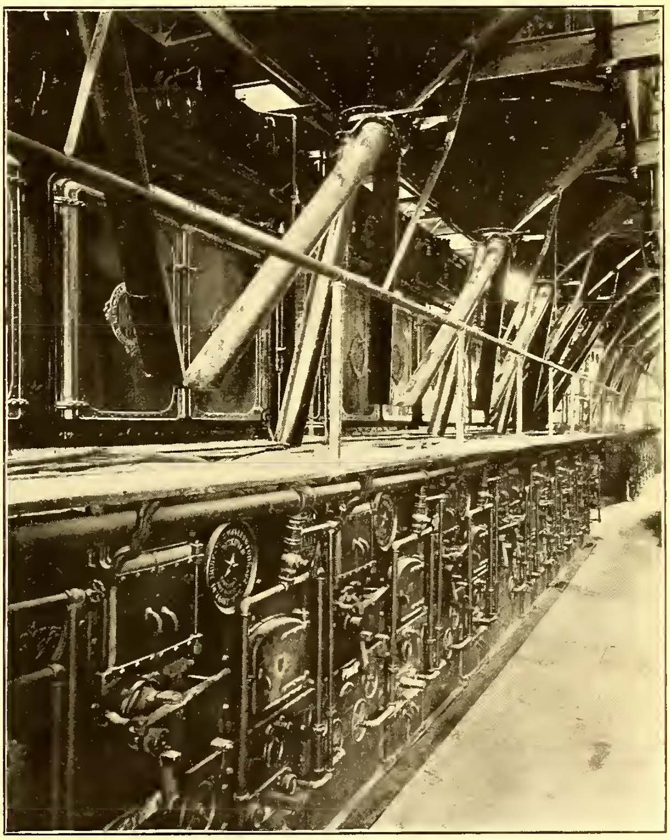
The results showed that the drop on each joint with 100 amperes was but .005 volt or one-eighth that of a copper rod 8 ins. long and .42 in. in diameter.

Boiler Room of the North Chicago Railway.

One of the latest of the electric railway power houses to be completed in Chicago is that of the North Chicago Railway. This station furnishes power for the electric lines of the company and as well that required for operating the Union Elevated loop and part of the Lake Street Elevated. The accompanying engraving shows the boiler room, which is equipped with ten Standard water tube boilers of 400 h. p. each and Murphy mechanical stokers.

The coal is thrown from the cars in front of the building into a hopper and is carried by a conveyor to an elevator which raises it to the top of the hoppers, where a distributing conveyor carries the coal to the various hoppers as it is required. The ashes from the furnaces are discharged into the basement into steel cars, where an elevator raises them into a hopper from which they are discharged into a railway car or barge.

The design of the whole plant is to make it automatic in every respect, and this has been accomplished in a marked degree. After the coal has been shoveled from the cars, no manual labor is required for the operation of the plant, as the handling of the coal and ashes is entirely accomplished by machinery and was installed by the Link Belt Machinery Company.



BOILER ROOM OF NORTH CHICAGO RAILWAY.

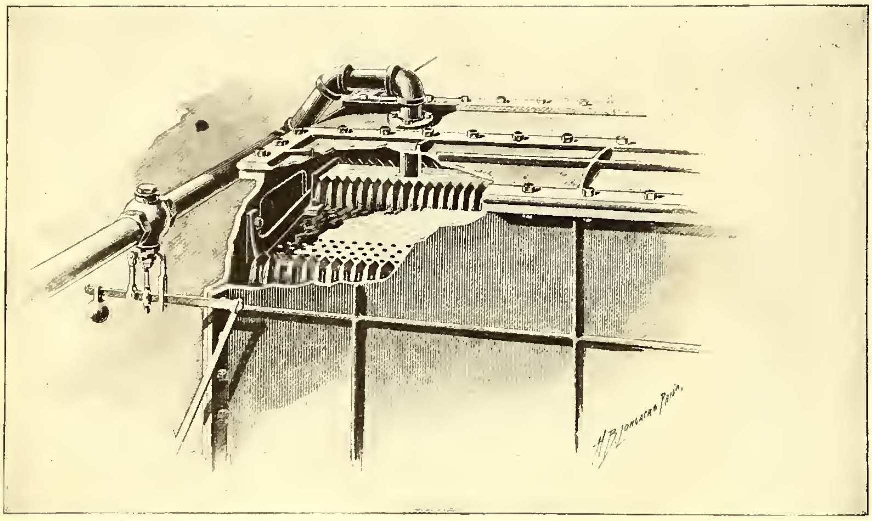
The entire boiler is suspended from the steel beams independent of the brickwork and so arranged that the walls may be repaired without disturbing the boiler. Ample provision is made for repairing and cleaning the boilers, and the steam and water drums are of sufficient size to permit a man to work in them with comfort.

The Canadian Electric Railway & Power Company has been incorporated at Toronto, Can., by Castle Smith, London, Eng.; James Kerr Osborne, Lyman Melvin Jones, George W. Beardmore, William Herbert Cawthra and Edmund Bristol, of Toronto, and Edward F. Fauquier, of Ottawa, Can., to construct and operate electric railways between Montreal, Brockville, Kingston, Belleville, Toronto, Hamilton, London and Windsor and to build branch lines not to exceed twenty-five miles in length. Capital stock $1,250,000.

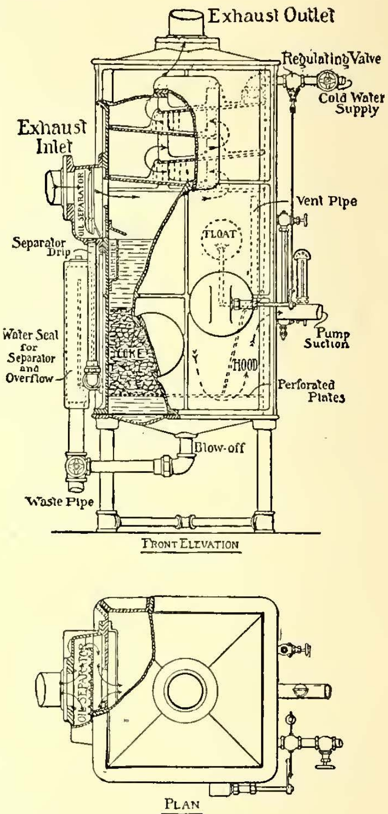
Improvements in Open Heaters.

The relative merits of open and closed feedwater heaters have been discussed by engineers for a long time, since each type has many advocates. The Harrison Safety Boiler Works, are bringing out in their 1896 pattern of open exhaust heaters, known as "The Cochranes," appliances which are claimed to overcome the defects of former open heaters, and to be superior in efficiency and durability to closed heaters.

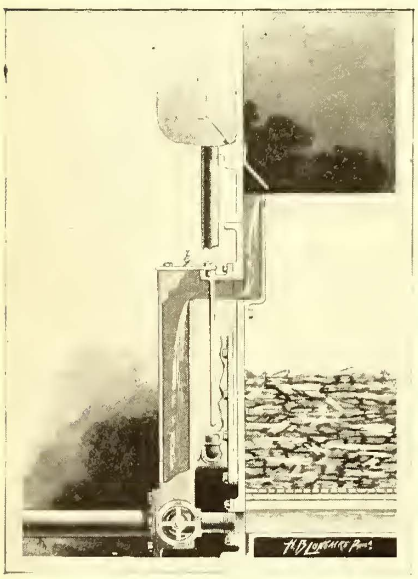
Briefly considering the two types, the points of superiority urged for the open heaters are as follows: That the quantity of water that can be heated is not limited by the number of square feet of surface intervening between the steam and water through which the heat must be passed, the only limit in open heaters being the amount of exhaust steam and cold water that can be brought together; that all of the condensed exhaust is saved and utilized; that open heaters give opportunities for purification which are not possible with the other type owing to the constant circulation which prevents settling, and to the fact that deposits on heating surfaces, either from oil or from scale, impair the efficiency for heating; that the one is operated at about atmospheric pressure, while the other is operated under boiler pressure, increasing the liability of closed heaters to leak or to collapse.



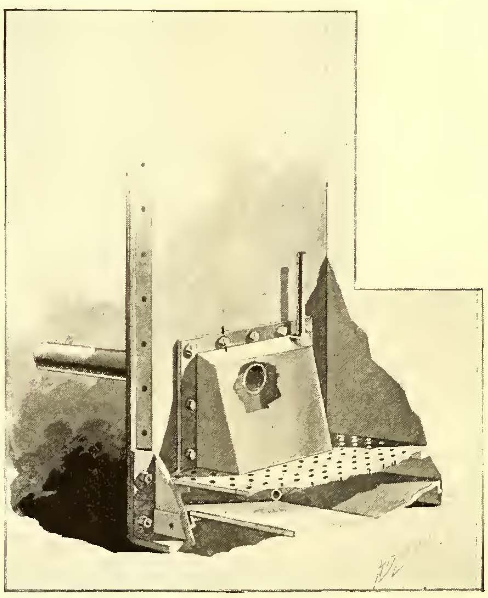
METHOD OF INTRODUCING COLD WATER IN HEATER.



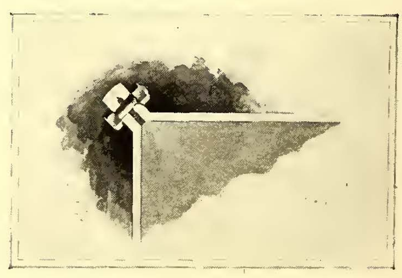
PLAN AND ELEVATION.
(Single row of trays.)



WATER TRAP FOR SEALING OVERFLOW.



VENTED HOOD FOR PROTECTING PUMP SUCTION.



DETAIL OF JOINT CONSTRUCTION.

The general design and construction of the Cochrane heaters, which are built of cast iron, copper and brass, instead of wrought iron or steel, which latter metals are more liable to corrode than cast iron, etc., are shown by the accompanying engravings.

The cold water supply, which is taken in at the top of the heater, is controlled by a regulator which limits the amount admitted to that required to supplement the condensed exhaust. In its passage through the heater the water flows over thin perforated trays, dropping through the holes or falling over the lower edges of the trays, which are notched, upon the trays immediately below. On the other hand, the exhaust steam after being first passed through the oil separator forming part of this heater, enters the steam chamber and passes up through the heater to the exhaust outlet, imparting during all the time of its passage through the heater, its latent heat to the incoming water. All steam condensed mingles, of course, with the cold water supply, adding to this latter an important percentage of perfectly pure water, thereby raising the standard of purity of the feedwater.

After leaving the trays, the water is held in the lower part of the heater where, being at rest at a temperature close to that of the boiling point, it has an opportunity to deposit those impurities which are precipitated at that temperature. The water drawn off from the lower part of the heater is first obliged to pass down through a filtering bed of coke, thence upward under a vented hood to the pump suction opening.

As will be seen, the entire design of the heater is such as to facilitate the deposit of the impurities in places and on material which can be readily cleaned and removed. The trays though removable can be cleaned in place, though a slight incrustation upon them would not affect the efficiency of the heater, because the heat of the steam is imparted to the water through direct contact, without depending on the transmission of heat through a metallic surface. Most of the deposition however takes place in the settling chamber, while the water is at rest after the heating has been accomplished. Cracked coke, in pieces not exceeding one inch in diameter, has been found a most desirable material to place here for collecting and detaining the impurities. This material is cheap, easily obtainable and easily handled since after a period, depending upon the quality of the feedwater, it can be removed and burned in the furnaces.

The details of the heater, such as sealing of the cold water supply pipe so as to prevent a water hammer effect, the supply regulating valve, the oil separator, the ventilation of hood, the water scaling of the overflow without having any kind of a valve, the method of making the joints, the method of staying the heater, etc., have all been carefully studied and worked out, though they cannot be fully described here owing to lack of space.

These heaters have been adopted in a number of stations, including the two new stations of the Columbia & Maryland Railway Company, the high speed line now being built between Baltimore and Washington.

Engine Averages for Three Years.

The following figures give the coal consumption of an Allis cross compound engine, 22 ins. × 40 ins. × 48 ins., with two Reynolds eighty-four inch vertical boilers for a period of three years. They are taken from the records of the Stevens Linen Works, Webster, Mass.

	1893.	1894.	1895.
Average I. H. P. for year.	381	393	396
H. P. hours " "	1,042,221	893,792	1,076,134
Engine coal " "	1,831,700	1,493,243	1,775,720
Average coal per I. H. P. per hour for one year.	1.76	1.67	1.65

The engine indicated A. M. and P. M. average was taken for the daily record. The boilers were used exclusively for engine, and figures of coal include all night banking.

Work on the Metropolitan and Northwestern Elevated Roads, Chicago.

One of the principal engineering features of the Metropolitan Elevated Railroad, Chicago, is the special track work which is probably the most complicated and extensive ever constructed for similar service. The line is a four track road with branches, and being an electric road, uses a contact or third rail. The accompanying engraving shows a view of a four track combination crossover east of Marshfield Avenue Station. The problem at this point was to arrange a crossover so that trains could go from either one of the four tracks to any one of the other three without going backwards, the crossover taking up as little room in the tracks as possible. The manner in which this was accomplished is clearly shown in the cut. Another feature at this point was to provide for the contact rail when crossing the main tracks. As the contact rail is some few inches above the main track rail, the parts between the rails of the main tracks are hinged so as to drop out of the way when the main tracks are used. A duplicate of this system is also used on the viaduct over the Pennsylvania Railway yards.

Another complicated piece of special work was at the Logan Square terminal yard.

In making this work, the best railway construction was followed as far as possible, adapting the same to the comparatively short radius curves that are used. Eighty pound T rail was used throughout. All of the crossovers and special work for this extensive system was constructed and put in by the Paige Iron Works.

SPECIAL WORK AT MARSHFIELD AVENUE STATION—METROPOLITAN ELEVATED RAILWAY.

It now looks as if Chicago's fourth elevated road, the Northwestern, will be in operation inside of another ten or twelve months. By the terms of the contract the superstructure is to be completed not later than next September. The line will use the elevated loop downtown, cross the river at Wells Street and extend in a general northerly direction about seven miles to Wilson and Evanston Avenues in Sheridan Park. Most of the foundations have been built and work on the superstructure is progressing at the rate of about 200 ft. per day, and with the advent of better weather this progress will be largely increased, provided there is no delay in getting material. The present bridge over the Chicago River at Wells Street is not considered strong enough for the new road and a new bridge will be built at once, the road crossing on top of it.

From downtown north the road will be double track for a distance of about 1½ miles and the balance of the line will be a four track structure so as to permit of an express service. Express stations will be located about a mile apart and local stations an average of three blocks from each other. Both local and express trains will stop at express stations. On the four track portion of the line the two outer tracks will be for local trains and the two inner ones for express trains, and at the express stations the platforms will be between each of the local and express tracks, so that passengers may transfer from one train to the other by taking two or three steps across the platform, no transfer slips or other annoying feature being used. By this arrangement passengers getting on at local stations may ride to the first express station and transfer to an express train with the slightest possible inconvenience. The platforms at local stations will be outside of the tracks.

Thirteen acres of ground have been purchased at the northern terminal for the use of machine shops, car sheds, station rooms and offices. The road will connect at this point with the Chicago North Shore Street Railway, an electric line that extends to Rogers Park, Edgewater and Evanston, and it is the intention to bring the cars of the North Shore line up to the level of the elevated line by means of an incline, so that passengers may transfer without going up or down stairs.

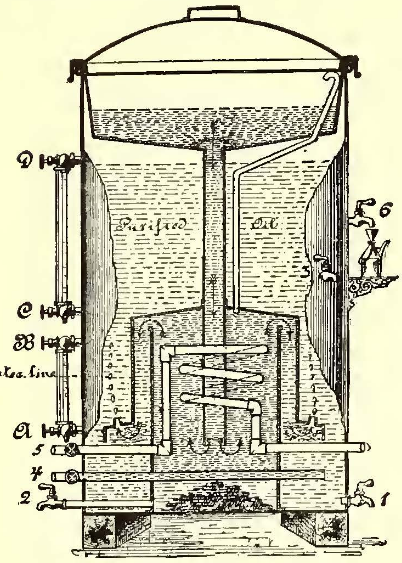
The Northwestern Elevated will be operated by electricity from the start. Before its completion the downtown elevated loop extending on Fifth Avenue on the west, Harrison Street on the south, Wabash Avenue on the east, and Lake Street on the north, will undoubtedly be in operation, the Lake Street portion of it being already completed and the foundations are mostly built in the ground for the balance of the structure. This road will also be operated electrically, and as the Lake Street Elevated is nearly ready to change from steam to electricity it is a safe prediction that Chicago will have four electrically operated elevated roads in operation by the close of the present year. This is exclusive of the lines of the South Side Rapid Transit Railroad Company, locally known as the "Alley L" which is still being operated by steam.

The power station of the Northwestern Elevated will be located near the corner of Fullerton and Southport Avenues, convenient to the C. M. & St. P. road, with sidings connecting with the same for the purpose of handling coal with the least possible expense. The equipment of the power station will be 7000 h. p. divided into three units of 2000 h. p. each and one unit of 1000 h. p., all direct connected. The car equipment will consist of thirty-seven motor cars and 113 trailers or regular passenger cars, each seating forty-two persons. Eighty pound T rail will be used and power will be taken from a third rail quite similar to the plan of the Metropolitan Elevated. It is estimated that some 35,000 tons of steel will be used in the construction of this road. The cost of the road will be about $7,000,000 which it is claimed has been provided for by the sale of stock almost exclusively in Chicago and without the issue of any bonds.

THE Fairmount Traction Company has been incorporated at Richmond, Va., by Samuel H. Pulliam, John H. Dineen, William T. Heckler, William J. Westwood and F. C. Brauer, Jr., of Richmond, to build and operate street railways. Capital stock, $100,000.

Purifying Oil.

The right to manufacture the Perfection oil purifier, which has a wide reputation among steam users, has been secured by the Q & C Company. The device is already in use in the stations of many street railway companies as well as in other places where much oil is used. The general construction of the purifier is shown in the accompanying engraving. The interior cylinder of the purifier is heated through steam pipes, 4 and 5, the water and the oil to be purified is poured in the pan at the top, the purified oil is drawn off from faucet 6, the water at faucet 1, and the debris at faucet 2. Faucet 3 is used only in case the surface of the oil falls below No. 6. As will be noticed the filter illustrated filters the oil through water only, dispensing entirely with waste and other filtering compounds. This constitutes its main difference from other types. The method is said to insure the very best results under all conditions, and as well to make the process of cleaning the device very easy and simple. The company has indorsements from a large number of users, demonstrating the claims made in this direction.



OIL PURIFIER.

A New Car Fender.

The accompanying illustrations show a new type of fender designed by R. Mayolini, of New York City. The aim of the inventor has been to produce a fender with cushioned front and sides, which would approach the ground at its lower edge as closely as possible, while its upper edge would not extend higher than the corresponding portion of the car dash. Another aim of the inventor was to produce a fender which could be readily transferred from one end of the car to the other. The fender is constructed for this purpose in two spring sections which when curved, brought together and locked completely guard the front of the car, presenting a practically unbroken and at the same time a yielding surface to any obstruction with which it might come in contact.

In the illustrations, Fig. 1 shows a perspective view of one style of the fender attached to a car. Here the fender is made of four plates of thin and very light but strong sheet steel, thus giving strength and rigidity to the fender as a whole, while at the same time allowing enough elasticity to the whole structure to prevent a dangerous or even severe shock when any obstacle that may happen to be on the track comes in contact with the fender.

FIG. 1.—CAR FENDER—STEEL CONSTRUCTION.

Fig. 2 shows another perspective view, in which the fender is constructed of stout wooden plates of such thickness that it can easily be bent to the desired form, while at the same time being sufficiently strong to withstand any shock likely to be encountered. This is also sufficiently flexible to afford a yielding surface for obstacles which come in contact with it.

The sketch shown in Fig. 3, represents a top view of the first fender with its two halves unlocked and ready to be removed for transfer to the opposite end of the car. The locking device is extremely simple, while the method of attachment to the car is fully as simple and ingenious. This is shown clearly in Fig. 1. The device is so simple that the removal of the fender from one end of the car and its attachment to the other is a matter of very small consequence. It can easily be accomplished by the motorman or gripman at the end of the line. The ease with which the fender can be removed and the small space it occupies after removal make it possible to store the cars in a car barn without requiring additional space.

The extreme front end of the fender, as shown in Fig. 1, is thoroughly cushioned, so as to afford additional safety to persons who might be struck by that part of the fender, since there would be less flexibility from the fender as a whole if a collision should take place at this point.

In pointing out the merits of this type of fender, the inventor claims that nearly all persons struck by moving cars are either just stepping upon the track from one side or are just leaving it at the other side. In the former case, the approach of the car has not been noticed, while in the latter case a person who has noticed the approach of the car and the impending danger, would be making an immediate effort to get out of the way, and would thus be just leaving the track if struck at all. In either of these situations the fender here illustrated, it is claimed, will strike the person in such a way as to injure him if at all to the least possible extent, because of the flexible character of the materials used in its construction. A person thus struck would be thrown from the track in either case, so as to be out of the way of the moving car.

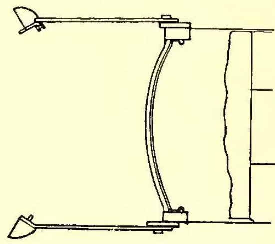


FIG. 3.

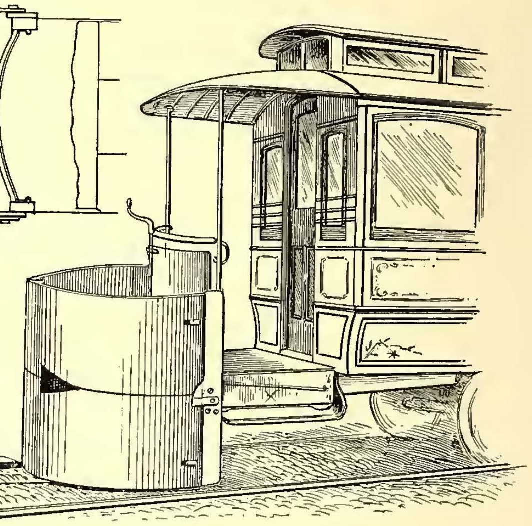


FIG. 2.—CAR FENDER AND PLAN VIEW WHEN OPEN.

The general appearance of the fender gives the idea of ample protection, great strength and flexibility. At the same time it is easily handled and does not add materially to the cost of car equipment.

Electric Patent War Over.

For nearly a year past the General Electric and Westinghouse companies have been endeavoring to come to an arrangement that would reduce the expensive patent litigation between them, which, it is said, has cost the two companies in the aggregate $6,000,000 in legal expenses and for service of experts.

Up to a short time ago efforts to reach an agreement have been unsuccessful, but recently the matter was taken up afresh, and at meetings of the directors of the two companies held last month an arrangement was reported and ratified.

It has been agreed that after certain exclusions the General Electric Company has contributed 62½ per cent and the Westinghouse Electric & Manufacturing Company 37½ per cent in value of the combined patents, and each company is licensed to use the patents of the other company, except as to the matters excluded, each paying a royalty for any use of the combined patents in excess of the value of its contribution to the patents. The patents are to be managed by a board of control consisting of five members, two appointed by each company and a fifth selected by the four so appointed.

The especial incentives which led to the arrangement at this time were the recent decisions in favor of patents of the General Electric Company controlling the overhead system of electric railways, the approaching trials on a number of other important General Electric patents on controllers and details of electric railway apparatus and systems and other electrical devices, and the equally strong position of the Westinghouse Company in respect to power transmission, covered by the patents of Nikola Tesla, together with its other patents in active litigation, some of which are of great importance.

Rolling Stock for South Africa.

The accompanying engravings illustrate the exterior and interior of one of a number of twenty-two foot double deck cars recently built by the J. G. Brill Company for the new electric railway in Cape Town, South Africa. The seating capacity is sixty-four passengers, thirty-two below and thirty-two above, and the seats, which are of the Hale & Kilburn type, are all arranged transversely, as shown in the engravings.

The cars are finished inside in ash and cherry, natural finish, and are handsomely varnished. The inside of the lower deck is ceiled with three-ply veneer handsomely decorated. The car is fitted with double sashes, the top sash being stationary and the lower sash arranged to drop. Both platforms are fitted with stairways and suitable projections for accommodating the motorman, controller and brake apparatus outside of the step landing. The cars are mounted on Eureka maximum traction pivotal trucks and are equipped with Westinghouse No 38, 50 h. p. motors.

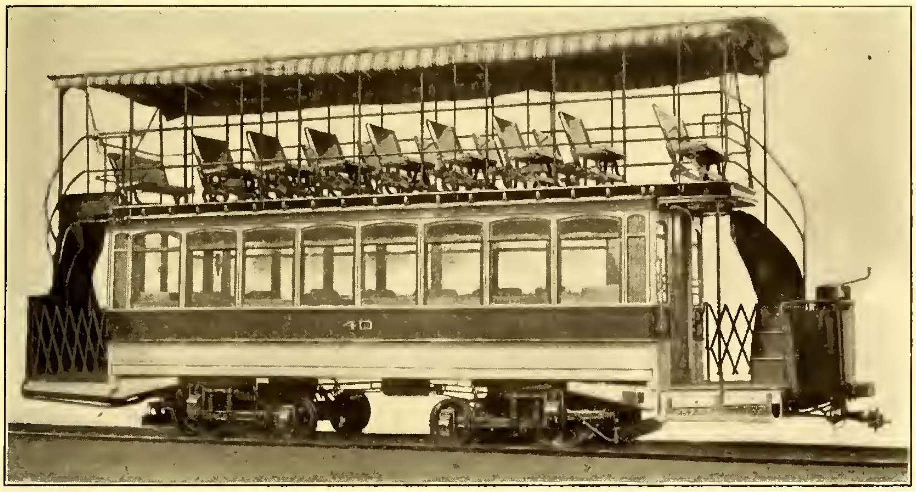


FIG. 1.—DOUBLE DECK CAR FOR SOUTH AFRICA.

The roof seating arrangement is somewhat novel in that the seats are transverse, the usual practice being to have two rows of seats longitudinal to the car body and back to back, with an aisle on both sides. By the method adopted the seating capacity of the roof is materially increased. The J. G. Brill Company will also supply two other types of cars to this road, one a single truck double deck car, seventeen feet six inches in length, with seating capacity for fifty passengers. The car is identical in finish as the longer car and is mounted on Brill 21 C non-pivotal electric motor trucks. The third type of car is practically the same as the one just mentioned, except that it was fourteen feet six inches long, with seating capacity for forty-four passengers.

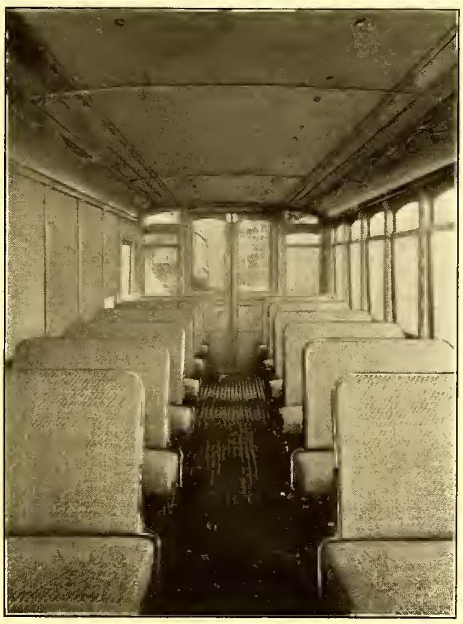


FIG. 2.—INTERIOR OF CAR.

The power station of the company will contain American apparatus, which is also being supplied by the Brill Company. It will have three 300 h. p. vertical tandem compound condensing engines built by the Philadelphia Engineering Works and connected to Westinghouse multipolar generators of 300 h. p. Heine boilers, Barr pumps, Green economizers and Hoppes live steam purifier. The pipe work was all designed in the office of the J. G. Brill Company and was bent to shape by Best, Fox & Company. The traveling crane for the engine room is from the works of Alfred Box & Company.

An Ingenious Method of Making Armature Coils.

In times past there has been a great deal of trouble found in railway motor armatures with the wires leading from the armature bobbin to the commutator lugs. These were originally made, years ago, of solid wire which would quickly break off owing to the vibration of the car. Then came an improvement in the form of a flexible cable which was soldered to the end of the solid armature wire just inside of the bobbin and was connected at the other end with the commutator lug. This prevented the breaking of the leads, but another trouble was sometimes caused through the heating of the armature wire and the melting of the soldered joint between the flexible and the solid wire. For a long time this was submitted to by builders. It did not seem wise to use a flexible cable for regular armature windings because in using such a cable made up of round wire, the conductivity is cut down to about twenty-five per cent for a given diameter of armature cable, and the space for copper in the armature slots is so precious that such a loss could not well be borne.

The Walker Company has now solved this difficulty in a neat and ingenious way. A flexible cable is used in making up the armature bobbins and this cable is brought down to the commutator without joints of any kind. In order to maintain its conductivity and still to use the slot space in the core to the best advantage, the cable is made out of enough of the round wires to give the proper conductivity and is then passed through a die so as to bring it down to approximately the diameter of a solid wire. The round copper wires imbed themselves in each other in such a manner as to fill up the interstices, while the flexibility is still maintained without sensible diminution. The size of a machine for a given output is thus practically the same for a cable of this kind as for a solid wire.

The company has been very successful in making square, rectangular and flat armature conductors of this style as well as round. In large generators the plan has been used to advantage by weaving small wire into a flat ribbon and then rolling it or drawing it through a die. Not only is flexibility provided for by this method, but the eddy currents which are formed in solid wires are largely prevented and the heat developed in the armature is therefore reduced.

Changes in the Sterling Company.

Owing to increase of business, the managers of the Sterling Supply & Manufacturing Company, of New York, have decided to extend their manufacturing facilities and have increased their capital stock to $100,000, all of which is fully paid. The company will be continued under the same management as heretofore. The office of president and general manager will continue to be filled by J. H. Carson, who originated the business of the company, and who retains a controlling interest in it. Perry Tiffany is a new member of the company and has been elected its vice-president. He is a gentleman of large business experience and resources, and as he will devote a large portion of his time to the interests of the company his connection with it will result in a large increase in its strength and business. The office of secretary and treasurer is well filled by Joseph M. Stoughton.

The company was started four or five years ago as manufacturer of only a few specialties, but has had a continuous growth, both in business and in the favorable regard felt for it by its customers. This has been largely due to the personal efforts of its president, Mr. Carson, who has been the active manager, and who has secured for it the right to manufacture a number of important specialties which have been most favorably received. The business of the company is at present on the increase, and its managers report the outlook as very satisfactory. Orders for brakes are being received from a number of cities, among the latest companies to adopt the brakes being the Buffalo Railway Company. The register business is always an active one, and there seems to be no falling off in orders. In this department the company has now on hand orders for several hundred registers to be delivered within the next sixty or ninety days.

THE Yosemite Valley & Merced Railway Company, of Yosemite, Cal., has been incorporated by O. D. Baldwin, president; James Cross, vice-president; Theodore Reichert, secretary; A. L. Stetson, general manager; G. A. Wulkap, traffic manager, and C. F. Preston, general attorney. The American Bank & Trust Company is treasurer.

STREET RAILWAY NEWS

The Annual Convention of the Texas Street Railway Association.

The annual convention of the Texas Street Railway Association occurred in Galveston, Mar. 17 and 18. The attendants included representatives from most of the prominent street railway companies in the state. Among the subjects discussed were the following: "Track Repairs," "Overhead Construction," "Fire Insurance," "Treatment of Ties with Preserving Compounds," "Stimulation of Traffic by Parks," etc. After the conclusion of the business meeting, the delegates enjoyed a drive about the city and afterwards a dinner at Woolam's Lake.

The officers for the ensuing year were elected as follows: president, Col. W. H. Sinclair, Galveston; vice-president, C. F. Drake, Austin; secretary, C. L. Wakefield, Dallas. Executive committee: the officers and G. B. Hendricks, Fort Worth, and A. H. Hayward, Houston. The next meeting will be held in Austin, the third Wednesday in March, 1897.

Electric Line Between Baltimore and Washington.

Work on the electric railway between Baltimore and Washington is being pushed forward rapidly by the builders, the Baltimore & Catonsville Construction Company. The plans contemplate the construction of a line thirty-seven miles in length between the two cities. The entrance into Baltimore will be over Saratoga Street bringing the cars to the center of the city, and in Washington over North Capitol Street. It is hoped to compete in point of time with the steam railroads, whose trains now make the distance between the two cities in forty-five minutes. To accomplish this will require the operation of trains at some parts of the line at a speed of sixty miles per hour. This will involve the introduction of new problems in overhead construction and train operation. The constructing engineer of the company is S. W. Huff, and the consulting engineer Dr. Louis Duncan.

There will be two stations, for which the contracts have already been awarded. Each will be located at a distance from one of the terminals of about one-fourth the entire length of the line. The equipment will include McIntosh & Seymour engines, Westinghouse generators with boosters, Campbell & Zell boilers, Davidson pumps and condensers, Cochrane heaters and Green economizers. The cars will be run in trains of two cars each, weighing about fifty tons per train. The operating company, the Columbia & Maryland Railroad Company, controls in Washington the Belt Railway and the Eckington & Soldiers' Home line. These latter companies are about experimenting in Washington with a compressed air motor, manufactured by H. K. Porter & Company. Whether the Baltimore cars will enter the city on the tracks of these lines, and what motive power they will use inside the city of Washington, are questions which have not yet been decided.

Orders in New Orleans.

The Canal & Claiborne Railroad Company, of New Orleans, La., has completed its plans for electrical equipment, which will be carried out in charge of Ford & Bacon. Seventy-five pound sixty foot Johnson girder rails will be used and the contract for the special work has also been awarded the Johnson Company. The cars which will be built by the American Car Company will have twenty foot bodies with four foot platforms and will be equipped with cross cane seats and General Electric motors. They will be mounted on Baltimore trucks. The power station will be at the river front and will contain two 450 h. p. tandem compound condensing Allis engines direct connected to General Electric generators. The boiler house will be fitted with Edgemoor water tube boilers.

The Oakland & Livermore Valley Railway Company, of Oakland, Cal., has been incorporated by E. P. Vandercook and Rod. W. Church, of Oakland, Cal.; H. H. Pitcher, of Livermore, Cal.; and Geo. D. Metcalf and A. D. Wilson, of Berkeley Cal., to build and operate a cable or electric railway in Oakland. Capital stock, $3,000,000.

SPECIAL CORRESPONDENCE.

National Conference on Standard Electrical Rules.

203 Broadway, New York, Mar. 24, 1896.

Editors Street Railway Journal:

At the recent formation of the National Conference on Standard Electrical Rules, at which the American Street Railway Association was represented, the street railway interests have been for the first time consulted with regard to the various electrical rules now enforced by the insurance companies. The following committee was appointed to formulate a new code of rules to be submitted to the next meeting of the National Conference, June 25 and 26:

Francis B. Crocker, chairman, representing American Institute Electrical Engineers; Wm. J. Hammer, ex-officio president National Conference on Standard Electrical Rules; Frank R. Ford, American Street Railway Association; William H. Merrill, National Board of Fire Underwriters; Alfred Stone, American Institute of Architects; E. A. Fitzgerald, Underwriters' National Electric Association; William Brophy, National Electric Light Association; E. V. French, Associated Factory Mutual Insurance Companies.

The undersigned, as representing the American Street Railway Association, has been requested to secure suggestions from the members of the association and from all other street railway companies, engineers and allied manufacturing interests, with respect to such changes or additions to the present rules as may seem advisable. The importance of this work, in its bearing upon street railway construction and the opportunity now offered to street railway interests for the first time to participate in a movement in which they are so vitally concerned, should not be overlooked. The Committee on Rules depends upon the active co-operation of all parties at interest in order to secure a full presentation of all changes that might be beneficial in the formulation of a new code.

The present rules relating to electric railways are as follows:

Rules for Safe Wiring Electric Railways.

"37. All rules pertaining to arc light wires and stations shall apply (so far as possible) to street railway power stations and their conductors in connection with them.

"38. Power Stations:—

Must be equipped in each circuit as it leaves the station with an *approved* automatic "breaker," or other device that will immediately cut off the current in case the trolley wires become grounded. This device must be mounted on a fireproof base, and in full view and reach of the attendant.

Automatic circuit breakers should be submitted for *approval* before being used.

"39. Trolley Wires:—

a. Must be no smaller than No. 0, B. & S. copper or No. 4, B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

b. Must be well insulated from their supports, and in case of the side or double pole construction, the supports shall also be insulated from the poles immediately outside of the trolley wire.

c. Must be capable of being disconnected at the power house, or of being divided into sections, so that in case of fire on the railway route the current may be shut off from the particular section and not interfere with the work of the firemen. This rule also applies to *feeders.*

d. Must be safely protected against contact with all other conductors.

"40. Car Wiring:—

Must be always run out of reach of the passengers, and must be insulated with a waterproof insulation.

"41. Lighting and Power from Railway Wires:—

Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, nor shall the same dynamo be used for both purposes, except in street railway cars, electric car houses, and their power stations.

"42. Car Houses:—

a. Must have the trolley wires properly supported on insulating hangers.

b. Must have the trolley hangers placed at such a distance apart that in case of a break in the trolley wire, contact cannot be made with the floor.

c. Must have cut-out switch located at a proper place outside of the building, so that all trolley circuits in the building can be cut out at one point, and line circuit breakers must be installed, so that when this cut-out switch is open the trolley wire will be dead at all points within 100 ft. of the building. The currents must be cut out of the building whenever the same is not in use, or the road not in operation.

d. Must have all lamps and stationary motors installed in such a way that one main switch can control the whole of each installation (lighting or power), independently of main feeder switch. No portable incandescent lamps or twin wire allowed, except that portable incandescent lamps may be used in the pits, connections to be made by two approved rubber covered flexible wires, properly protected against mechanical injury; the circuit to be controlled by a switch placed outside of the pit.

e. Must have all wiring and apparatus installed in accordance with rules under Class B.

f. Must not have any system of feeder distribution centering in the building.

g. Must have the rails bonded at each joint with not less than No. 2 B. & S. annealed copper wire; also a supplementary wire to be run for each track.

h. Must not have cars left with trolley in electrical connection with the trolley wire.

"43. GROUND RETURN WIRES:—

Where ground return is used it must be so arranged that no difference of potential will exist greater than five volts to fifty feet, or fifty volts to the mile between any two points in the earth or pipes therein."

At the meeting of the National Conference a number of topics were suggested that might advantageously be incorporated into new rules. Some of these are here presented for the consideration of street railway interests merely as an indication of general lines upon which there may be necessity for revision, and with the hope that they may evoke a very general expression of opinion from all concerned:

Increased protection of lighting circuits.
Method of grounding generators.
Double insulation for trolley wires with iron pole construction.
Car wiring in moulding and interior conduit.
Automatic magnetic circuit breakers for cars.
Electric brakes.
Electric car heaters.
Use of lights from railway circuits in buildings operated by street railway companies, such as amusement pavilions, repair shops, waiting rooms, etc.
Rail bonding.
Arc lamps on railway circuits.

It has been suggested that the new rules should cover very fully the subjects of car wiring and outside construction. They should deal not only with construction objectionable from the standpoint of fire hazard, but also with respect to personal danger.

All suggestions should be forwarded at an early date in order to secure full discussion, as the committee has but a limited time in which to consider and report upon recommendations to the Conference.

Very truly yours,
FRANK R. FORD.

An Important Organization.

When the announcement was made some three years ago that the Walker Manufacturing Company which had been, since 1883, engaged in the production of cable machinery, heavy castings and other large machine work involving a high degree of technical and engineering ability, had determined to engage in the manufacture also of dynamos, motors and other appliances for electric railway and lighting work, the prediction was made that, owing to exceptional manufacturing facilities and location, the company would become a serious rival to the other great electrical manufacturing establishments. This prediction has been fully verified, and the Walker Manufacturing Company has built up a large and profitable business and has achieved a reputation in this new field of the highest rank.

The growth of this branch of the business has been so large as to make it necessary to give up nearly all the general machinery work of the company, and the immense shops in Cleveland have been for the last year devoted almost exclusively to the manufacture of large generators and railway motors. The company's electric lighting business has been kept back by the rapidly expanding railway work, and the necessity for enlarging the shops, or of making other arrangements for manufacturing on a still greater scale has been forced upon the company's directors.

With this in view, and also with the idea of forming a strong and permanent organization with ample capital and with the ability to engage in electrical engineering work of the highest class, there has been formed under the laws of New Jersey a new company entitled "Walker Company," with a capital stock of $2,500,000. This company has purchased the entire plant, patents and property of the Walker Manufacturing Company, of Cleveland, the Standard Electrical Company, of New York, and the Consolidated Electric Company, of Boston. The Standard Company is the owner of a large number of valuable patents.

The Standard Company owned an excellent three story factory, 200 × 150 ft., well equipped with machinery, and this building will be made the "Factory No. 2" of the Walker Company. To it have been removed all the machinery of the Consolidated Company and some of the machinery of the Walker Company. It will henceforth be devoted to the manufacture of arc lamps, switchboards and switchboard material, electrical instruments, brush holders and a large part of the brass work and detail appliances of the Walker Company. This factory will be in charge of Charles N. Black, now superintendent of the Brush factory, in Cleveland, who has been very successful in arc lighting work, having designed and manufactured the larger sizes of the Brush dynamos which have been recently put upon the market by that company.

"Factory No. 1," the present Walker shops in Cleveland, which cover ten acres of ground, will be devoted to heavy electrical work. These shops without further extensions will have a capacity for turning out about 200,000 h. p. of railway and lighting generators, 75,000 h. p. of motors and 15,000 h. p. of arc lighting dynamos. The company will build the largest types of arc light dynamos, and will enter at once upon alternating work. It is now testing its first elevated railway motors, which are to be installed in a few weeks on the cars of the Lake Street Elevated Railway Company, of Chicago, and it will be a formidable competitor for all work of this character. The Walker railway generators are among the finest machines turned out to-day, the 800 k. w. size, of which eight are now going through the shops and several are in operation [See STREET RAILWAY JOURNAL, January, 1896, page 3], being especially adapted for heavy railway work. Designs are completed for a 1500 k. w. generator, and construction under order will soon be commenced.

A number of wealthy and prominent bankers, capitalists and street railway owners have become financially interested in the company and will lend great strength to the new organization.

Patent Decision.

An interesting and important decision was rendered last month by Judge Townsend, of the U. S. Circuit Court for the District of Connecticut, upon the Van Depoele patent No. 495,443, for the under-running electric railway trolley system.

A few months ago Judge Townsend rendered a decision sustaining the validity of this patent upon final hearing in a suit against the Winchester Avenue Railroad Company. Shortly thereafter, further infringement suits were brought against the Billings & Spencer Company, of Hartford, and the Kelsey Electric Railway Specialty Company, of New Haven, manufacturers of trolley bases. Judge Townsend has just decided these suits in favor of the Van Depoele patent and granted motions for preliminary injunctions after full argument on both sides.

The decision is especially important because the Court holds that the supply of essential or characteristic parts of the trolley system is a contributory infringement, and will be enjoined by the courts, even though the defendants may not supply or use the patented combination or system in its entirety. The Court further held that an unlicensed maker of trolley bases could not be permitted to supply such bases even to railroads which had been originally fully equipped by the General Electric Company.

A large number of prior decisions were referred to by the Court, where rulings of a similar nature have been made, which establish the general doctrine that any supply of parts amounting to the intentional promotion of the act of infringement by others will be restrained by injunction, and that the full scope of the Van Depoele patent cannot be avoided in this way, even if the parts so supplied or used are not claimed by themselves alone as specific and separate features of the patented invention.

In order that the scope and subject matter of the Van Depoele patented claim may be understood we append a copy of three claims of the patent.

"6. In an electric railway, the combination with a suitable track and a supply conductor suspended above the track, of a car provided with a swinging arm carrying a contact device in its outer extremity and means for imparting upward pressure to the outer portion of the arm and contact, to hold the latter in continuous working relation with the under side of the supply conductor, substantially as described.

"12. In an electric railway, the combination with a car, of a post extending upward therefrom, and carrying a suitable bearing, an arm or lever carrying at its outer end a suitable contact roller and pivotally supported in said bearing, and provided at its inner end with a tension spring for pressing the outer end of the lever carrying the contact wheel upward against a suitable suspended conductor, substantially as described.

"16. An electric railway, the combination of a car, a conductor suspended above the line of travel of the car, an arm pivotally supported on top of the car and provided at its outer end with a grooved contact wheel engaging the under side of the suspended conductor, and a tension spring for maintaining an upward pressure contact with the conductor, substantially as described."

Postponement of Electric Tramway Rights in Dublin.

A bitter warfare has been waged in Dublin during the past year between the Dublin United Tramways Company, which operates the principal system of the city, and the Dublin Southern District Tramways Company, which operates a suburban line and which has been for some time attempting to secure entrance into the city proper to develop a competing system. Both companies are applicants for electric privileges and it will be remembered that several of the directors of the Dublin United Tramways Company made an extended tour in this country some months ago, for the purpose of studying American electric railways and obtaining the best system possible for their purposes. There has naturally been a great deal of public discussion of this important question in Dublin, and the problem has been complicated by a desire on the part of the Dublin Council to exact heavy rentals from both companies in consideration of the grant of franchises. The matter finally came to a head on Mar. 3, when at a meeting of the Council, the whole matter was postponed for six months in order that the citizens may get further light upon the questions involved.

One of the incidents of the discussion of the Council was a speech by the Lord Mayor opposing the grant of electric rights on the ground that it would be destructive to the country, as the farmers of Ireland had nothing to fall back on except the raising of oats and breeding of horses, and "the result would be that in Dublin your beautiful Corn Exchange would be closed and your hay market abandoned."

San Francisco Notes.

Work on the Mt. Tamalpais electric road has been begun in earnest. It has been found to be perfectly feasible to ascend the mountain without encountering anything steeper than seven per cent. and a pure trolley proposition will be carried out. The power house will be located at the center of the route.

Last July the Portland General Electric Company, of Portland, Ore., installed 2500 h. p., of triphase 6000 volt long distance transmission apparatus in its immense water power central station at Oregon City fourteen miles from Portland and connected part of this equipment with two 600 h. p. rotary transformers in the substation at Portland designed to produce a continuous current at from 500 to 550 volts. This 500 volt current was planned to be sold to the various electric street railway companies in competition with the Union Power Company whose method of supplying the lines in Portland with current on the three wire system was fully described in the JOURNAL of May, 1893.

The Union Power Company had 1300 h. p. of engines, used sawdust for fuel and sold current for $6 per horse power per month. The Portland General Electric Company has now absorbed the Union Power Company and all the power for the cars is in future to be furnished from the former company's substation, the latter company's plant being given up.

The Market Street Company began in the latter part of February the foundation for another of its latest adopted power units consisting of a Union Iron Works vertical 1500 h. p. triple expansion condensing engine with a 400 k. w. Siemens & Halske generator on each end of the shaft. This will make a station capacity of 3200 k. w. There is still room for two more of these units and the station when completed will have a rated generator capacity of 4400 k. w.

Still another style of street car is reported. The Piedmont Railway Company, of Oakland, has recently constructed some combined cable and electric cars. They are twenty-nine foot double truck combination cars, that is, have an open section at both ends and closed section in the middle, the passengers and motorman in the open section being protected by a glass front. On the front truck, of four feet six inches wheel base, is mounted the usual cable grip while on the rear truck, of five feet three inches wheel base, are located two G. E. 800 motors. The traffic is such that the use of the cable is justified only on Sundays. On this day the cable grip will be used. During the week the car, if run at all, will be run by electricity. When the company has more cars the cable is to be abandoned altogether. By means of a loop and a switchback it is arranged that the cars always run in the same direction. It is found that when thus run the front truck cleans the track for the rear or propelling truck. The motors also being located on the rear truck are almost directly under the center of gravity of the car when on heavy grades and therefore in the best possible position for traction.

The Haywards & San Leandro Railroad Company has recently equipped one car to run at forty miles per hour; two G. E. 800 motors were used with a reduced gear ratio and thirty-three inch wheels. The speed was easily attained upon the day of the test. This company has decided that on Mar. 1 it will abandon its express business and confine itself exclusively to passenger traffic.

The Alameda, Oakland & Piedmont Company is arranging to equip one car with two G. E. 2000 motors as an electric locomotive to be used to haul a number of trailers for excursion work, to a popular resort on one of its branch lines. As this work is to be done at considerable distance from the power house, a "booster" is to be used to raise the voltage at the distant end.

The San Diego Cable Railway was sold at action Mar. 11, for $55,000, and the purchasers announce their intention of immediately changing the road into an electric system. The road originally cost $200,000 to build and is eleven miles in length.

Personals.

Mr. C. L. West has been appointed superintendent of the Irondequoit Park Railway Company, of Rochester, N. Y. Mr. West was until recently superintendent of the North End Street Railway Company, of Worcester, Mass.

Mr. J. F. Hill, has resigned his office as controller of the Montreal Street Railway Company with which he has been connected for the last four years. Upon his retirement the employes of the company presented him a gold watch and chain.

Mr. J. T. Whittlesey, formerly superintendent of the motive department of the Brooklyn Heights Railroad Company, of Brooklyn, N. Y., has been appointed chief engineer, *vice* Mr. M. G. Starrett, who has resigned to accept the position of assistant chief engineer of the Metropolitan Street Railway Company, of New York.

Mr. Paul Winsor formerly assistant general manager and chief engineer of the West End Street Railway Company, of Boston, Mass., has resigned his position with that company a short time ago. Mr. Winsor's connection with the company extended over a period of four years during which time he took an active part in the actual operation and construction of the road. He is at present devoting his attention to the problem of the operation of heavy trains by electricity for certain steam railroad companies.

Mr. Chas. Davis, president of the Davis & Egan Machine Tool Company, Mr. Thos. P. Egan, president of the J. A. Fay & Egan Company, and Mr. Thos. McDougal, general counsel for the Laidlaw-Dun-Gordon Company, have been summoned before the Ways and Means Committee of Congress to give information relative to the effect of reciprocity treaties on the export trade in iron, steel and wood working machinery and to confer with it as to the best methods of encouraging and enlarging the export to trade in these products.

Mr. L. J. Hirt was tendered a complimentary banquet by the officers and employes of the Metropolitan Street Railway Company, of New York, Mar. 31, upon the occasion of his withdrawal as assistant chief engineer of the company. About 125 guests were present and toasts were responded to by Messrs. Vreeland, Crimmins and others, who referred in most complimentary terms to Mr. Hirt's services. Souvenirs of a piece of the Lexington Avenue cable mounted in the form of a paperweight, with programme giving a portrait of Mr. Hirt, were presented each guest, and at the close of the evening a handsome piece of silverware was given Mr. Hirt, as a testimonial of the esteem in which he was held by his friends in the Metropolitan Street Railway Company.

Obituary.

NAT. W. PRATT, the well known steam engineer and president of the Babcock & Wilcox Company, died last month at his home in Brooklyn, N. Y. Mr. Pratt was born in Baltimore in 1852, and comes from an old American stock. He inherited mechanical tastes from his father, William Pratt, who during the war was superintendent of the Burnside Armories in Providence, R. I.

In 1870 N. W. Pratt entered the employ of Babcock & Wilcox. Here his energy and engineering ability won the confidence of his employers. In 1881, when the Babcock & Wilcox Company was organized as a corporation, he became treasurer and manager of the new company, and in 1893, upon the death of George W. Babcock, was elected president. As illustrating his versatility it might be mentioned that in 1884 he was appointed the consulting engineer of the Dynamite Gun Company. Under his designs and patents the first successful dynamite gun was built. It was with this gun, eight inches calibre and sixty feet long, that the experiments in throwing aerial torpedos were conducted at Fort Lafayette, N. Y.

He possessed the rare qualification of uniting engineering knowledge with inventive genius and extraordinary business qualifications, and to his efforts is largely due the success achieved by the Babcock & Wilcox boilers throughout the civilized world. He was noted not only for his sound business judgment and remarkable energy, but also for his generosity and kindness of heart. Even his business opponents admired him for his singular aggressiveness as applied to business and by all with whom he came in contact he was admired.

He was a member of the American Society of Mechanical Engineers, the American Institute of Mining Engineers, American Naval Institute and Engineers' Club, of New York.

Street Railway Construction.

Albany, N. Y.—The Railroad Commissioners of New York State have granted a franchise to the Albany, Helderberg & Schoharie Electric Railway Company to construct an electric railway from Albany to Schoharie Court House, a distance of thirty miles. The road will be built through the most thickly populated sections of Albany and Schoharie Counties. President, J. W. Van Valkenburg; chief engineer, George Yost, both of 73 State Street, Albany.

THE bill of H. T. Andrews requiring the elevated railway companies of New York City to light their cars by gas or electricity has been passed by the House by a large majority. The bill gives the company three years in which to equip its cars as required.

Brooklyn, N. Y.—The Nassau Electric Railroad Company, has been granted permission to extend its lines in Church Lane, Eighty-sixth Street, Fifth Avenue, Fourteenth Avenue and Bath Avenue.

THE Long Island Electric Railway Company has filed with the Secretary of State a certificate of extension of route in the villages of Jamaica, Far Rockaway and Hempstead.

Cleveland, O.—The Cleveland, Painesville & Eastern Railroad Company will extend its lines from a point on the lines of the Lake and Cuyahoga Counties to Painesville, a distance of fourteen miles. C. W. Wason, 616 Garfield Building, Cleveland, is president of the company.

Davenport, N. Y.—Dr. Churchill, of Stamford, N. Y., is the promoter of an electric railway from Stamford to Davenport.

Harrisburg, Pa.—The Harrisburg Traction Company will probably extend its lines to Rockville during the summer. F. B. Musser is superintendent and purchasing agent.

Hull, Que.—At a meeting of the stockholders of the Hull Electric Company, the following officers and directors were elected: President, W. J. Conroy, vice-presidents, R. H. Conroy and Chas. Magee; directors, F. A. Magee, James Gibson, J. M. McDongall, E. Seybold and Theophile Vian. The company has obtained a site for its power station, and water power will be used in the generation of electricity. Estimated cost of plant, not including placing of dynamos and other electrical apparatus, $25,000. Five sixty inch special American turbine water wheels will be used. Power will be used in operating electric railways and in furnishing lights.

Mexico, Mex.—On Mar. 5, the Mexico City railway lines comprising about 160 miles of track, were sold to C. F. Meck, of New York, for $7,500,000 (Mexican); Mr. Meck immediately resold them to Henry Butters, of San Francisco, who represents a company of London capitalists. An amount equal to the purchasing price of the lines will be expended in equipping them with electricity and in making other improvements.

Montreal, Can.—The Montreal Park & Island Railway Company will extend its lines to St. Vincent de Paul and to St. Rose. The people of those towns are very desirous of having electric railway connections with Montreal and have offered strong inducements to the company to build the line. The Town Council of Lachine has granted the company permission to build and operate its lines in the town, with exemption from taxation for thirty years. The line will be built at once, and the Outremont line will also be extended to St. Laurent during the summer.

Quincy, Mass.—A petition signed by 475 of the property owners of Milton has been presented to the Quincy & Boston Street Railway Company asking it to extend its lines from Mattapan, the present terminus, to the lines of the Norfolk Suburban Street Railway Company. J. R. Graham, president of the Quincy & Boston, said that the company is willing to build if franchises are granted.

Sing Sing, N. Y.—The Ossining Electric Railway Company will extend its lines to Pleasantville, a distance of five miles.

Woonsocket, R. I.—The Woonsocket Street Railway Company will relay its tracks in the First Ward with heavier rails and will equip the lines with electricity.

AMONG THE MANUFACTURERS.

The General Electric Company was awarded last month a contract for the equipment of twenty motor cars on the Brooklyn Bridge. These cars will be used for switching purposes and for operating the bridge during the hours of the night when the cable is not running.

The Badger Manufacturing Company, of Milwaukee, has just issued an interesting little handbook giving many facts, figures and formulas in connection with electric railway construction. It is compact, handy and useful to any one interested in this class of work.

The Kensington Engine Works, Ltd., of Philadelphia, Pa., has recently sold three 100 h. p. return tubular boilers of 125 lbs. working pressure to Haddon Hall Hotel, Atlantic City, N. J.; also a 200 h. p. feedwater heater of special design to the Atlantic Refining Company, of Point Breeze, Pa.

The Southwark Foundry & Machine Works, of Philadelphia, Pa., has published a very attractive catalogue descriptive of the Porter-Allen engines. The catalogue is very handsomely printed, bound and illustrated, and gives views of the various types of engines manufactured by the company.

Merchant & Company, of Philadelphia, have recently published a tasteful catalogue printed in colors on the art of roofing and entitled "Overhead." The pamphlet is, of course, descriptive of the metal tiles of Merchant & Company and is illustrated with handsome reproductions of well known buildings covered with this material.

The Paige Iron Works, of Chicago, has just issued a new pamphlet illustrating and describing some very interesting and complicated pieces of special track work construction built by this company. The Paige Company is doing a large amount of work for electric roads throughout the country and is just completing its contract for the entire special work of the Metropolitan Elevated, Chicago.

George H. Carey, New York, who deals in all kinds of railroad equipment and supplies, makes a specialty of steel relaying rails. He tells us that he has special facilities for enabling him to make prompt shipments at the very lowest prices. Mr. Carey is one of the oldest and best known railway supply dealers in New York, and his experience of twenty-five years in this line of business commends him to intending purchasers.

Alfred G. Hathaway, of Cleveland, O., writes us that he has recently made a large shipment of his appliances to Cape Town, South Africa, through the J. G. Brill Company. He also advises us that he is having a good sale for the Murray anti-friction brake, and has recently shipped a large order to the Missouri Railway Company, of St. Louis. He is also equipping a number of cars of the Cleveland City Railway Company with this brake.

The Bradford Belting Company, of Cincinnati, manufacturer of the Monarch insulating paint, reports an excellent demand for this paint. The company is preparing to exhibit at the coming Electrical Exposition on 43d Street, New York, and we understand will distribute a very attractive souvenir. Every attendant at the Exposition should secure one of these without fail from the popular representative of the company, E. P. Morris.

The American Engine Company, of Bound Brook, N. J., announces that Frank H. Ball, the well known steam engine designer, has assumed the management of its business, and will at once add to its present line of steam and electrical machinery a full line of his celebrated engines, specially designed for direct connected electrical work and adapted to dynamos of the company's manufacture, thus making complete and symmetrical units.

The Consolidated Car Fender Company, of Providence, is now equipping the cars for the Hartford Street Railway Company, Hartford, Conn., the Central Railway & Electric Company, New Britain, Conn., the Plainfield Street Railway Company, Plainfield, N. J. and Toledo Electric Railway Company, Toledo, O. The company has also just finished the equipping of the cars of the Staten Island Electric Railway Company, New Brighton, S. I.

Gleyre Brothers, of St. Louis, manufacturers of the Trendley brake, report business for the past month as very satisfactory. They are receiving very flattering reports from different companies who are testing their brakes, and feel assured of a continued increase in their output. W. H. Walbraum & Company, Philadelphia, Pa., have been appointed agents for the states of Pennsylvania, Ohio and Indiana, and will hereafter take care of the business for that territory.

The Rail Bond Cap illustrated on page 188 of the March issue of the STREET RAILWAY JOURNAL is known as the Paulsen cap and is supplied by other companies than that whose name was mentioned in connection with it. The Central Electric Company, of Chicago, is selling a large number of these caps and writes us that it is on an equal footing with any other supply company in the sale of this cap and that it is meeting with great success in placing the cap on the market.

Wendell & MacDuffie, of New York, have recently received an order for two Taunton sprinklers, of 2700 gals. capacity each, from the Steinway Railway Company. The increasing sales of and many inquiries for the Taunton sprinkler speak volumes for its growing popularity. H. P. Hill, formerly with the Diamond Electric Company, has been engaged by Wendell & MacDuffie to handle the output of the Warren Electric Company of Chicago, and other electrical specialties.

The W. & S. Hydraulic Machinery Works, of New York, report an excellent business in its various specialties. The hydraulic jacks of this company are the result of over three years spent in the manufacture of this important tool, and the 1896 catalogue which is just published gives the company's latest improvements. The catalogue, which is larger than former issues, shows that the company is manufacturing additional sizes in its standard machines as well as several new designs. The catalogue also illustrates and describes the company's double screw hoists and various forms of screw and rack jacks.

The Hunter Automatic Fender has been extensively adopted at its home in Cincinnati and is apparently making a good record as a life saver. The reports of the Cincinnati Street Railway show that on Feb. 10, 14 and 15, three persons were struck without being seriously injured. In one instance the conductor reports that "the fender bumper struck a man and the life saver picked him up with his body endways, feet first. His injury was trifling, as he resumed his journey."

The National Switch & Signal Company, of Easton, Pa., has been awarded the contract for installing an interlocking plant for the Lake Street Elevated Railroad, Chicago, at Avers Avenue, which is a junction point. This plant includes the installation of the automatic torpedo signals and other appliances for the protection of traffic. The company has also been awarded the contract for interlocking the crossing of the Northwestern Coal Railway Company with the Omaha line at Superior, Wis.

The Dorner & Dutton Manufacturing Company, of Cleveland, O., writes us that G. G. Arthur, who for a number of years has conducted a large hardware business, has purchased a large interest in the Dorner & Dutton Manufacturing Company and will devote his time to the business of the company, having the title of vice-president and secretary. The company with its increase of capital will be able to put in additional new machinery and be enabled to take good care of its largely increasing trade.

C. O. Mailloux, of New York, consulting electrical engineer, has removed his offices to the American Tract Society Building, No. 150 Nassau Street, where, with additional space, a larger staff of assistants, and otherwise improved facilities, he will continue his practice as consulting electrical engineer. Mr. Mailloux makes a specialty of advising, assisting and serving architects, builders and owners, in connection with plans, specifications, supervision, tests, etc., for electric plants, installations and outfits of all kinds.

The Keeler & Hansell Company, of New York, is the title of a new firm which will manufacture springs of all kinds. The company is composed of W. H. Hansell, formerly manager of the street railway department of the Charles Scott Spring Company, and the members of the firm of Keeler & Cook, spring manufacturers. The business heretofore carried on by the latter firm will be continued by the Keeler & Hansell Company at the old address, 166 Elm Street, New York. The Philadelphia office will be located at 378 Bourse Building.

The Fulton Truck & Foundry Company, of Mansfield, O., manufacturer of the new rail joint illustrated in our last issue, is ready to supply this new joint on demand. Through a typographical error in the description in our last issue one reference was made to this joint as a "bond." The inventor of the joint, W. E. Haycox, president and general manager of the Fulton Truck & Foundry Company, does not claim any special merits for the device as an electrical connector between the rails, but as a substitute for the ordinary joint plates.

The Metropolitan Electric Company, of Chicago, reports recent large sales of P. & B. tape and compound. The spring construction has begun rather early. These goods are found to be as reliable as of old. The Metropolitan Electric Company is fortunate in having this agency, and has increased the business West, since it has been in its hands, very considerably. The company is also having some splendid orders for ship core carbons, another speciality of the Standard Paint Company, for which the Metropolitan Electric Company is Western agent as well.

C. E. Loss & Company, of Chicago, have been awarded the contract for the complete construction of the lines of the Englewood & Chicago Electric Street Railway in the City of Chicago. The line extends from Sixty-third Street to Harvey Street, comprising with lateral lines about fifty-four miles of roadbed construction, at a total cost of about $600,000. Work is to be completed about June 1, on twenty-five miles and the balance about Aug. 15, 1896. Eighty-three pound girder rails are to be used throughout. All material has been ordered and work was started on Mar. 1.

The Ohio Brass Company, of Mansfield, O., is reporting remarkable success with the use of the Walker trolley ear. The company has recently sent us a copy of a letter from J. C. French, general manager of the Sioux City Traction Company, of Sioux City, stating that this company has had this trolley ear in use exclusively for the past two years, and considers it the only trolley ear possessing a straight line underneath accompanied with no thickening of the lower portion. The ear also has the advantage that it requires no soldering and can easily and quickly be placed in position.

The Siemens & Halske Electric Company, of America, has opened Eastern offices at 100 Broadway (American Surety Bldg.), New York City. The company writes us that its isolated plant business for New York City, Brooklyn and Long Island City will continue to be carried on by Chas. D. Shain, greater New York agent, at 136 Liberty Street. For the New England States, New York State (outside of greater New York), Pennsylvania, New Jersey, Delaware, Maryland, Virginia, and West Virginia, requests for estimates should be addressed to the Eastern offices of the company at the new office at 100 Broadway.

The National Air Brake Company is the title of a new company with headquarters at 15 Cortlandt Street, New York, for the manufacture of air brakes for street railway cars. The compressor can be bolted to the floor of the car or the channel bars on the truck and is automatically cut out of action by a special design of governor when the pressure in the reservoir reaches a certain amount. The compressor is automatically cut into service again when the minimum pressure is reached. The average power required to operate the brake is claimed not to exceed 1/8 h. p. per mile operated in street service with the average number of stops.

The Bi-Metallic Electric Transmission Company, of New York, reports that a great deal of interest is being taken by the electrical fraternity in its bi-metallic wire. This wire, as its name implies, is composed of two metals, copper and steel being usually employed, the object being to secure strength with conductivity. The steel forms the center of the wire and the outer layer of copper provides for the conductivity. The use of this wire for trolley systems has a number of advantages, not only on account of the strength, but from the fact that kinks or bends in the wire are less likely and that the diameter of the trolley wire can be reduced when side feeders are also employed.

The Falk Manufacturing Company, of Milwaukee, has just moved into its new shops which it is equipping with the very best and latest patterns of machine tools at a cost of several thousand dollars. The building is 60 ft. × 160 ft., two stories, and the arrangement throughout is thoroughly modern and complete. The establishment will be devoted exclusively to the building of the Falk portable cupolas, tools and appliances necessary for the company's system of cast-welding rail joints. A railroad switch extends the whole length of the building which enables the company to load its machines at its own doors for transportation to any part of the country. The company has just issued an interesting pamphlet on its cast-welding process.

Eugene Munsell & Company, of New York, importers and wholesale dealers in India and amber mica, are sending to the trade a large sample card, showing a variety of forms of mica for electrical installation, stamped solid mica segments for all the standard railway motors, mica washers, etc. At the top of the card appears the company's name and address, in heavy bold type, as importers of pure India mica for electrical insulation, and the statement that the mica can be furnished in amber quality. The lower part of the card is given up to a list of agencies in the principal cities. The company is in a position to furnish mica in both India and amber quality; in the sheet, or cut to any size or pattern; mica segments gauged to thickness for all the standard railway motors.

The Hoppes Manufacturing Company, of Springfield, O., reports the following recent orders for feedwater purifiers and heaters secured through its Western office, St. Louis, Mo.: the St. Louis Dressed Beef Company, 750 h. p. purifier and 800 h. p. exhaust heater; the Christy Fire Clay Company, St. Louis, Mo., 400 h. p. purifier and 400 h. p. exhaust heater; the John E. Liggett Building, two purifiers of 100 h. p. each and also 200 h. p. exhaust heater. The following St. Louis concerns have also placed orders for various sizes of exhaust heaters: J. W. Peters & Company, 150 h. p.; Laclede Laundry Company, 100 h. p.; Globe Furniture Company, 150 h. p.; Leroi Furniture Company, 150 h. p.; Central Lead Company, 300 h. p.; Liggett & Myers Tobacco Company, 75 h. p.

The Providence Steam Engine Company, of Providence, R. I., builders of the Improved Greene engine reports that notwithstanding the general times its shops are full of work. The company's engines, which are especially adapted for direct connected railway work, are proving most satisfactory where they have been installed. Recent contracts for this line of work cover one 500 and one 350 h. p. tandem compound engines for the Suburban Railroad Company, Chicago; two 750 h. p. tandem compounds for the Second Avenue Traction Company, Pittsburgh, Pa.; two 400 h. p. simple engines for the New London Street Railway Canpany, New London, Conn.; one 300 h. p. simple engine for the Hampton & Old Point Railway, Hampton, Va.; two 700 h. p. for the Washington, Alexandria & Mt. Vernon Railroad Company, Washington, D. C.

The Stillwell-Bierce & Smith-Vaile Company has the contract for the complete water power plant to be installed at the Lachine Rapids in the St. Lawrence River. This power is second only to Niagara Falls in importance and is owned by the Lachine Rapids Hydraulic & Land Company, Ltd., of Montreal. The initial development will amount to 10,000 h. p. The work of construction has already begun, and the company expects to be prepared to furnish power before the close of this year. The company has contracted with the Stillwell-Bierce & Smith-Vaile Company, of Dayton, O., for sixty-six large size Victor turbines of the latest pattern and all the connecting machinery needed for transmitting the power of these turbines to the electric generators. This is probably the largest order for turbines ever placed at one time, and will certainly add to the enviable reputation already enjoyed by the Victor turbine.

The Stirling Company, of Chicago, reports business booming, and actual sales as well as inquiries larger than in any corresponding period in the history of the company. Prominent among the company's recent sales are the following: Detroit Railway Company, Detroit, Mich. (2d order) 2500 h. p.; Passau Lighting Company, 600 h. p.; People's Power Company, Moline, 500 h. p.; Suburban Electric Light & Power Company, East Orange, Ind., 125 h. p.; Betz Brewery, Philadelphia, Pa. (2d order), 400 h. p.; Suburban Railroad Company, Chicago, Ill., 750 h. p.; Cleveland & Elyria Railroad Company, Cleveland, (2d order) 450 h. p.; Akron, Bedford & Cleveland Railway, Cleveland, (2d order) 700 h. p.; Cincinnati, Newport & Covington, (3d order) 500 h. p.; New Albany Water Works, New Albany, Ind., 200 h. p.; Houston Ice & Brewery Company, Houston, Tex., 300 h. p.; Eagle Iron & Steel Company, Ironton, O., 200 h. p.

The Manufacturers Advertising Bureau, Benj. R. Western, proprietor, which has been located for a number of years at 111 Liberty Street, New York City, will remove about April 15, to more commodious quarters at 126 Liberty Street. This concern is widely and favorably known throughout both this country and abroad.

It takes entire charge of the newspaper work and advertising for manufacturers who desire this very important department of their business conducted with the greatest convenience and profit. The bureau handles almost exclusively concerns who advertise in the trade journals, Mr. Western being a recognized expert in advertising media of this character, and has established a reputation for commercial integrity and scrupulous attention to the interests of its clients, of which it may well feel proud. A large number of the leading machinery concerns in this country now entrust their advertising to the care of this institution. It is because of a growing need for better facilities to transact its business that the change from 111 to 126 will be made.

Warren Webster & Company, of Camden, N. J., report their works as being very busy manufacturing apparatus for the Webster vacuum system of steam heating, which is meeting with very satisfactory results. The firm has secured orders for equipments of the system from the following prominent concerns: Bullitt Building, Philadelphia; Cheney Bros., South Manchester, Conn.; Pope Manufacturing Company, Hartford, Conn.; Pullman Atwood Company, Waterbury, Conn.; Winchester Repeating Arms Company, New Haven, Conn.; Excelsior Needle Company, Torrington, Conn.; H. L. Judd Company, Wallingford, Conn.; Silk Exchange Building, New York; Syndicate Building, New York; Lord's Court Building, New York; St. Charles Hotel, Atlantic City, N. J. The firm is also doing a large business in the sale of its vacuum feedwater heaters and purifiers. T. L. Webster mentions the following among other orders: 2500 h. p.. Illinois Steel Company; 650 h. p. Galveston Water Works. The company is also manufacturing a special heater for the United States Sugar Refinery at Camden, for heating 25,000 gals. of water per hour. This heater is an adaptation of the standard Webster heater especially fitted for the work that it is intended to do.

H. Gore & Company, of Boston, Mass., pavers, street railway builders and Sicilian rock asphalt paving, write us that the following is a list of some of the street railway companies for which the firm has done work: West End Street Railway Company, of Boston, Mass.; Lynn & Boston Street Railway Company; Quincy & Boston Street Railway Company; East Middlesex Street Railway Company, of Malden, Mass.; North Woburn Street Railway Company, of Woburn, Mass.; Worcester Consolidated Street Railway Company; Brockton Street Railway Company, of Brockton, Mass; Dighton, Somerset & Swansea Street Railway Company, of Taunton, Mass.; Taunton Street Railway Company; Union Street Railway Company, of New Bedford, Mass.; Globe Street Railway Company, of Fall River, Mass.; Pittsfield Street Railway Company, of Pittsfield, Mass.; Burlington Street Railway Company and the Burlington & Winooski Street Railway Company, of Burlington, Vt.; Fair Haven & Westville Street Railway Company, of New Haven, Conn.; Stamford Street Railway Company; Biddeford & Saco Street Railway Company; Bangor Street Railway Company. Of the above companies there are some who have awarded all their work for the past seventeen years to H. Gore & Company.

H. E. Collins & Company, Pittsburgh, Pa., sole sales agent for the Cahall vertical water tube boiler, manufactured by the Aultman & Taylor Machinery Company, Mansfield, O., reports the following sales of Cahall boilers made within the last few days: 1000 h. p. for the Pittsburgh Plate Glass Company, Kokomo, Ind.; Brown & Company, Pittsburgh, 100 h. p.; Jones & Laughlins, Ltd., Pittsburgh. 500 h. p. The boilers for the Pittsburgh Plate Glass Company are of the standard direct fired type; those for Jones & Laughlins will be equipped with the chain grate stoker, and that for Brown & Company is of the waste heat type. Daniel Webster, for fifteen years associated with the Babcock & Wilcox Company, has resigned his position with that firm, his resignation to take effect Mar. 1, and has formed a business connection with the Aultman & Taylor Machinery Company. Mr. Webster for the last twelve years has held a prominent position in the manufacturing and construction department of the Babcock & Wilcox Company. Although the Cahall boiler has demonstrated its advantages as a steam generator, still there are many cases where lack of head room or other reason prevents the adopting of anything but a horizontal water tube boiler. The Aultman & Taylor Company has therefore decided to immediately engage in the manufacture of water tube boilers, and Mr. Webster will have entire charge of this department. Aultman & Taylor expect to be ready to begin delivering this type of water tube boiler by June 1. H. E. Collins & Company, of the Bank of Commerce Building, Pittsburgh, Pa., general sales agents for the Cahall boiler, will act in the same capacity for the new type.

The Berlin Iron Bridge Company, of East Berlin, Conn., reports its works as very full of orders and that the entire plant is running with a full force of men. The company reports contracts lately completed as follows: new casting shop and machine shop for Randolph & Clowes, Waterbury, Conn.; new car house, engine room and boiler house for the Bergen County Traction Company, at Fort Lee, N. J.; a new steel tube plant, including power house, accumulator house, coal storage, etc., for the Pope Manufacturing Company, at Hartford, Conn., two bridges for the American Sugar Refining Company, at New Orleans, La.; new power house and boiler plant for the Hackensack Gas & Electric Company, at Hackensack, N. J.; a large foundry for the Bagley & Sewall Company, at Watertown, N. Y.; a large machine shop for the Granger Foundry & Machine Company, at Providence, R. I.; an iron bridge cousisting of five spans of 200 ft. for Penobscot County, Me.; a new car shed building for the Third Avenue Railway Company, at Harlem River, N. Y.; three large buildings for the Standard Oil Company, at Constable Hook, N. J.; a new forge shop for Pratt & Whitney Company, at Hartford, Conn.; a new storage house for Bradley & Hubbard, Meriden, Conn.; a new tube plant for the Coe Brass Manufacturing Company, at Torrington, Conn.; a large extension to a producer house for the Solvay Process Company, at Syracuse, N. Y. The company has recently published a handsome calendar upon which is printed some notable installations made by the company. It is printed in colors and contains a view of the works. The calendar is designed to keep the name of the company before users of structural work and is for distribution.

The McGuire Manufacturing Company, of Chicago, after passing through a phenomenally successful season in its stove and sweeper departments, is now running a full force day and night, working on orders for its well known trucks, and as the company has five months' work ahead the year promises to be a prosperous one. The following are the late truck orders: Chicago City Railway Company, Chicago; Chicago General Railway Company, Chicago; Calumet Electric Street Railway Company, Chicago; Central Railway Company, Peoria, Ill.; Cincinnati Street Railway Company, Cincinnati, O.; St. Charles Street Railway Company, New Orleans, La.; Norwalk Street Railway Company, Norwalk, Conn.; Pasadena & Pacific Railway Company, Los Angeles, Cal.; Jasper County Electric Railway, Carthage, Mo.: Dartmouth & Westport Street Railway Company, New Bedford, Mass.; Interstate Consolidated Street Railway Company, Attleboro, Mass.; Toledo Traction Company, Toledo, O.; Mahoning Valley Electric Railway Company, Youngstown, O.; Mt. Adams & Eden Park Inclined Railway Company, Cincinnati, O.; Holmesburg, Tacony & Frankfort Railway Company, Tacony, Pa.; Los Angeles Railway Company, Los Angeles, Cal. The company has completed shipment of the "L" trucks for the Lake Street Elevated Railway. The Brooklyn Bridge Railway has had a sample pair of these trucks running on trial for the past month and the directors, after rigid investigation and thorough trials, have decided to purchase sixteen equipments, exact duplicates of the trial equipment in every particular. The McGuire Company asserts that long cars and double trucks are rapidly rising in favor and cites as proof the fact that a large number of its orders now on hand are duplicate orders for double trucks. The demand for the company's ratchet brake handles is very large and increasing daily. These handles are made in both malleable iron and bronze.

The American Electric Heating Corporation, is the title of a new company with head office at Boston, organized to control the business of a number of older electric heating companies. The board of directors will consist of J. Murray Forbes (president), Charles A. Morss, Jr., Edward C. Perkins, Charles L. Edgar, of the Edison Electric Light Company; Charles Francis Adams, 2d; Everett Morss, A.B. Smith, George U. Crocker, Ambrose Eastman, of Boston; S. S. Wheeler, of the Crocker-Wheeler Electric Company; and Arthur M. Dodge, of New York, and H. B. Scott, of Burlington, Iowa. The concerns absorbed by the American Company are: The Western Electric Heating Company, St. Paul, Minn.; the Central Electric Heating Company, New York; the New England Electric Heating Company; the Burton Electric Company, Richmond, Va.; the Carpenter Electric Heating Manufacturing Company, St. Paul, Minn.; the Dewey Electric Heating Company, Syracuse, N. Y,; the Rich Electric Heating Company, Mt. Vernon, N. Y.; as well as several others which have not been active in the business for some time, but which owned valuable patents. The American Corporation also owns the patents covering the enamel process, which has already proved of great value in rheostats, and is believed will be of equal importance in many other devices. During the past season many thousand car heaters were sold by the company. While much of the product has been very satisfactory, that which is not so will receive immediate attention, and several improvements are in hand which will prove to be desirable additions. This especially applies to cooking apparatus, car heaters and special industrial devices. The policy of this company, it is stated, is to furnish the best that the state of the art will permit, and the company has an able corps of practical men to insure this. It begins business with ample capital and with a list of stockholders and a board of directors composed of substantial and conservative business men. The manufacturing will be concentrated at Cambridgeport and the head office is at 611 Sears Building, with agencies in New York and Chicago. James I. Ayer, ex-president of the National Electric Light Association, is the general manager.

Trade Catalogues.

We have received during the month the following trade catalogues:

GENERAL CATALOGUE. Published by the Southwark Foundry & Machine Company, Philadelphia, Pa. 48 pages. Board covers. Illustrated.

PRICE LIST OF IMPROVED HYDRAULIC JACKS, SCREW AND LEVER JACKS, etc. Published by the "W. & S." Hydraulic Machinery Works, New York. 44 pages. Illustrated.

THE COCHRANE HEATERS. Published by Harrison Safety Boiler Works, Germantown Junction, Philadelphia, Pa. 56 pages. Illustrated.

OVERHEAD. Published by Merchant & Company, incorporated. Philadelphia, Pa. 20 pages. Illustrated.

SOMETHING ABOUT WESTINGHOUSE ENGINES. Published by the Westinghouse Machine Company. Pittsburgh, Pa. 16 pages. Illustrated.

List of Street Railway Patents.

U. S. PATENTS ISSUED FEBRUARY 25, 1896, TO MARCH 17, 1896, INCLUSIVE.

FEB. 25.

BRAKE APPARATUS FOR RAILWAY VEHICLES.—F. Chapsal, Paris, France. No. 555,075.

A pneumatic brake comprising a distributor, an auxiliary reservoir and brake cylinder, an electric valve connected to accelerate the action of the brake, an electric circuit controlling it, and a commutator in said circuit operated by the distributor for stopping the action of the electric valve as soon as the distributor has acted.

CAR FENDER.—R. S. Flint, Troy, N. Y. No. 555,083.

Consists of a movable fender frame and operative mechanism for imparting to the frame a forward movement, a valved sandbox, a wheel brake, and operating connections between the fender frame, sand box valve and brake, whereby all are simultaneously operated by the frame operating mechanism.

CAR FENDER.—W. Leonhardt, Baltimore, Md. No. 555,103.

A car fender supported upon a rocking lever having the pivotal support of the lever on one side thereof (toward the front of the car) and the point of attachment of the fender on the opposite side.

LIFE SAVING DEVICE FOR RAILWAY PURPOSES.—W. H. Mattin, Los Angeles, Cal. No. 555,177.

DEVICE FOR PREVENTING MOTION ON CARS—A. E. Flattick, St. Louis, Mo. No. 555,238.

Consists of a suitable body, a car truck, supporting springs for the car body, a toggle joint connected respectively to the car body and truck, and a yielding connection between the end of one of the members of the toggle joint and one end of the car body.

TROLLEY WHEEL SWITCH.—P. A. Williams, Decatur, Ill. No. 555,-145.

CONDUIT ELECTRIC RAILWAY.—C. M. Bridges, Seattle, Wash. No. 555,208.

CONTACT DEVICE FOR ELECTRICALLY PROPELLED VEHICLES.—E. B. Reichel, Germany. No. 555,263.

A horizontally extending frictional contact device, with a central revoluble contact.

UNDERGROUND CONDUCTOR SYSTEM FOR ELECTRIC RAILWAYS.—C. T. Schwieger, Berlin, Germany. No. 555,266.

CAR FENDER.—Uriah Dietz, Bangor, Pa. No. 555,283.

FENDER FOR STREET CARS.—R. W. Gibson, New York, N. Y. No. 555,316.

A main guard having a slack, chain-like front rail, and a catch to normally sustain the slack of the chain-like front.

CAR SIGNAL.—E. Nelson, New York, N. Y. No. 555,391.

ELECTRIC MOTOR FOR STREET CARS.—H. M. Neer, Springfield, O. No. 555,392.

Consists of an outer casing and an inner supporting frame, track wheels having stub axles extending through said casing and a motor supported on said frame, universal joints between said stub axles and motor shaft, and springs between said casing and axles.

CAR FENDER.—C. M. Pratt, Towanda, Pa. No. 555,400.

SECTIONAL CONDUCTOR FOR ELECTRIC RAILWAYS.—W. H. Baker, Pawtucket, R. I. No. 555,470.

MAR. 3.

CLOSED CONDUIT ELECTRIC RAILWAY.—C. Anderson, Leeds, England. No. 555,487.

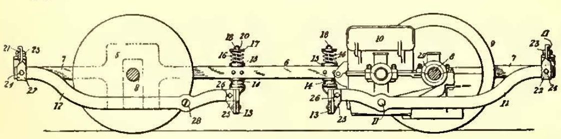
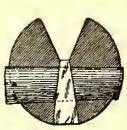
CAR TRUCK AND ITS GEAR.—Edgar Peckham, New York, N. Y. No. 555,526.

CAR BRAKE.—Edgar Peckham, New York. No. 555,527.

ADJUSTABLE LIFE AND WHEEL GUARD.—Edgar Peckham, New York, N. Y. No. 555,528.

MOTOR HANGER FOR MOTOR CARS.—Edgar Peckham, New York, N. Y. No. 555,529.

The combination with an electric motor pivotally connected at one end to the axle of the truck, of longitudinal motor hangers pivotally connected between their ends to the sides of the motor and supported at each end from the frame of the truck.

PAT. NO. 555,529. PAT. NO. 556,602.

CAR TRUCK.—Edgar Peckham, New York, N. Y. No. 555,530.

An end portion of the side frame comprises a yoke structure, an attaching flange at one side thereof and a truss extension at the other side, the horizontal member of which is provided in the under surface of its outer end with a spring seat or socket, the whole formed integrally.

TROLLEY POLE AND CONNECTION.—C. H. Einson, Pittsfield, Me. No. 555,571.

TROLLEY PROTECTOR FOR FIREMEN.—J. P. Barrett, Chicago, Ill. No. 555,634.

Consists of a support adapted to be placed between the trolley conductor and the track, a contact device provided at the upper end of the protector for engaging the trolley conductor, and a shoe or shoes electrically connected with said contact devices, carried at the lower end of the support and adapted to engage one or both of the rails.

AUTOMATIC LIFE GUARD FOR CARS.—C. M. Beebe, Elmira, N. Y. No. 555,753.

CAR FENDER.—J. Kerrigan, Philadephia, Pa. No. 555,777.

Consists of a trap movably mounted, connections therefrom to a ratchet and pawl mechanism, a stationary frame having a movable member mounted thereupon, and means for actuating the latter when said trap is struck.

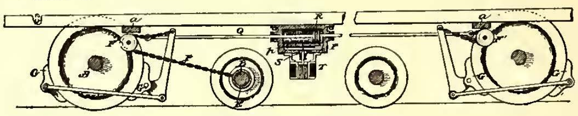
ELECTRIC PROPULSION SYSTEM FOR CARS.—G. H. Melotte, Marsh, Pa. No. 555,783.

A trolley wire so strung as to cross the path of the trolley at definite intervals in alternate directions and a trolley of such a length as to be in contact with one or more of such crossings.

BOND OR CONNECTOR FOR ELECTRIC RAILWAYS.—A. Bournonville, Philadelphia, Pa. No. 555,846.

Formed of a bar having a body half round or segmental in cross section and an end reversed on itself forming a divided head which is adapted to be spread apart.

WHEEL GUARD FOR STREET CARS.—J. W. Darley, Baltimore, Md. No. 555,852.



PAT. NO. 555,862.

ELECTRIC RAILWAY BRAKE.—J. C. Henry, Westfield, N. J. No. 555,862.

CAR BRAKE.—G. L. Root, Ottawa, Can. No. 555,890.

MAR. 10.

ELEVATED RAILWAY.—H. L. Boyle, Grand Rapids, Mich. No. 555,921.

An elevated railway track comprising a superstructure provided with hangers depending therefrom, and track rails consisting of a series of hinged links or plates supported by said hangers.

CONDUIT RAILWAY SYSTEM.—O. A. Enholm, New York, N. Y. No. 555,937.

A yoke formed integral with a switch box which opens in its lower part into the conduit.

TRAVELING CONTACT DEVICE.—M. D. Law, Washington, D. C. No. 555,958.

CAR FENDER.—D. Leib, Columbus, O. No. 556,061.

ELECTRIC CAR LIGHTING SYSTEM.—A. H. Armstrong, Schenectady, N. Y. No. 556,079.

ELECTRIC RAILWAY.—H. C. Reagan, Philadelphia, Pa. No. 556,210.

A feed wire and contacts rotatably mounted thereon, said feed wire forming an axis for said contacts.

ELECTRIC UNDERGROUND TROLLEY RAILROAD.—G. D. Burton, Boston, Mass. No. 556,321.

A casing for an electric conduit comprising an inner and an outer shell, the inner shell being provided with a lining of non-conductive material, and a non-conductive filling between said shells.

ELECTRIC RAILWAY.—E. M. Boynton, West Newbury, Mass. No. 556,320.

Consists of a single rail supported railroad car with a railroad structure having one supporting rail, conducting and guiding devices and an induction motor placed in a car and supplied with a multiphase current from said conducting devices.

MAR. 17.

CAR FENDER.—T. Stein, Philadelphia, Pa. No. 556,381.

A car fender having slotted hangers, a shaft mounted on said hangers, slotted arms on said shaft, and a frame with arms provided with pins moving in said slots, and arms having rollers moving on said hangers.

STREET CAR BRIDGE FOR PROTECTION OF FIRE HOSE.—S. B. Sweeny, Zionsville, Ind. No. 556,382.

Curved rails, supports of unequal length and cross bars provided with sockets to receive the upright portion of supports to form a bracing.

STREET CAR FENDER.—C. A. Thomas, Philadelphia, Pa. No. 556,384.

Consists of a projecting pivotally attached rectangular frame adapted to have upwardly swinging movement, swinging links attached to the front of said frame reaching upward and yieldingly supporting a folding receiving frame covered with yielding material.

ELECTRIC RAILWAY SYSTEM.—B. E. Osborne, Auburn, N. Y. No. 556,516.

UNDERGROUND CONDUCTOR FOR ELECTRIC RAILWAYS.—Geo. Westinghouse, Pittsburgh, Pa. No. 556,602.

Composed of two like halves fastened together by means of conducting devices and having adjacent faces separated by a clear space.

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.

FINANCE

Street Railway Receiverships in the United States.

The table on this page is a careful compilation of information regarding forty-nine street railway corporations in the hands of receivers at the present time. Every effort has been made to make this list complete and accurate, and special letters of inquiry have been sent to every company represented with a view to obtaining the latest information possible.

The distribution of these companies by sections shows that seven are in the Eastern States, twenty-one in the Central, sixteen in the Western and five in the Southern States. The total mileage is 609, which represents about five per cent of the street railway mileage of the country. The total number of cars operated is 1127, which represents about two per cent of the number of cars in service in the United States.

Twenty-seven of the forty-nine roads operate less than ten miles of track, fourteen operate between ten and twenty-five miles, seven between twenty-five and fifty miles, and one over fifty miles. From this it appears that nearly eighty per cent of the roads are small properties, and this is also shown even more clearly from inspection of the names themselves, the only important companies represented being the following: Chicago & South Side Rapid Transit Railroad Company, Cincinnati Inclined Plane Railway Company, Houston City Street Railway Company, Lincoln Street Railway Company, Portland (Ore.), Consolidated Street Railway Company, San Francisco & San Mateo Railway Company, Seattle Consolidated Street Railway Company, Syracuse Street Railway Company and Tacoma Railway & Motor Company.

LIST OF STREET RAILWAY COMPANIES IN THE HANDS OF RECEIVERS.

NAME OF COMPANY.	Date of Receivership	Funded and Floating Debt.	Length of Line, Miles.	Number of Cars.	Gross Receipts*	RECEIVER.
Adrian (Mich.) City Elec. Belt Ry. Co.	Jan., 1894	$ 42,297*	2.8	4		F. E. Snow.
Adrian (Mich.) St. R. R. Co.		36,000	3.0	7		F. E. Snow.
Ann Arbor & Ypsilanti (Mich.) St. Ry. Co.	Feb., 1896	100,000*	9.0	11		William F. Parker.
Asbury Park (N. J.) & Belmar St. Ry. Co.		75,000	2.0			William L. Dayton.
Asheville (N. C.) St. R. R. Co.	Feb., 1885	300,000	7.0	14	25,285	J. E. Rankin.
Augusta (Ga.) Ry. Co.	Sept., 1895	448,500	26.5	52		D. B. Dyer.
Chattanooga (Tenn.) & No. Side St. Ry. Co.	Feb. 3, 1896	90,000	3.5	4	5,826	T. J. Nicholl.
Chicago (Ill.) & So. Side Rapid Transit R. R. Co.	Oct., 1895	10,500,000	18.6	181	711,686	M. Hopkins.
Cincinnati (O.) Inclined Plane Ry. Co.		500,000	16.0	42		Brent Arnold.
Denison (Tex.) Rapid Transit Ry. Co.		Unknown	6.5	6		R. S. Legate.
Denison (Tex.) St. & Belt Line Ry. Co.		75,600	6.0	11		R. S. Legate.
West End St. R. R. Co., Denver, Col.	Nov., 1893	300,000	10.3	17		G. E. Randolph, C. E. Sweetland.
Union St. Ry. Co., Dover, N. H.	1894	100,000	14.0	19	25,712	G. E. Macomber.
Dubuque (Ia.) Light & Traction Co.	Dec., 1894	385,000	10.5	19		J. Balch.
Eau Claire (Wis.) St. Ry., Light & Power Co.		Unknown	6.0	8		G. B. Wheeler.
Great Falls (Mont.) St. Ry. Co.		150,000	8.7	11	26,650	W. D. Dickinson.
Hammond (Ind.), Whiting & E. Chicago Elec. St. Ry. Co.	Mar., 1896	100,000	12.0	9		Hobart M. Godfrey.
Harvey (Ill.) Transit Co.	Jan., 1895	115,000	3.0	3		Chicago Title & Trust Co.
Houston (Tex.) City St. Ry. Co.	July, 1895	1,387,000	40.0	47	222,808	J. H. Kirby.
North East St. Ry. Co., Kansas City, Mo.		290,000	8.1	10		Robert Gillham.
Lima (O.) Elec. St. Ry. Co.	Mar. 11, 1896	100,000	7.0	7		John N. Hutchinson.
Lincoln (Neb.) St. Ry. Co.	Jan., 1895	1,460,000	55.0	90		B. D. Slaughter.
Logansport (Ind.) Ry. Co.	June 23, 1895	Unknown	5.5	5	*a* 17,500	D. D. Fickle.
Madison (Wis.) City Ry. Co.	Feb. 26, 1896	150,000	8.0	13		F. W. Oakley.
Middletown (O.) & Madison St. R. R. Co.	Dec. 9, 1893	42,000	2.0	2	*a* 3,900	D. B. Bundy.
Mobile (Ala.) & Spring Hill Ry. Co.	July 6, 1895	200,000	7.0	4 to 8	24,000	J. H. Wilson.
Muskegon (Mich.) Ry. Co.	Jan., 1895	240,000	15.0	33		F. A. Nims.
New Albany (Ind.) Ry. Co.	Mar., 1894	230,000	7.0	27		J. MacLeod.
East Oakland St. Ry. Co., Oakland, Cal.	Apr., 1894	250,000	6.0	11		J. C. Johnson.
Highland Park & Fruitvale R. R. Co., Oakland, Cal.		200,000	10.5	8		F. J. Woodward.
Olympia (Wash.) Light & Power Co.		147,000	4.0	5		H. Stevens.
Suburban Traction Co., Orange, N. J.	Dec. 6, 1894	*a* 654,000	10.0	10 to 22	54,000	Watson Whittlesey.
South Jersey St. Ry. Co., Point Pleasant, N. J. *c*	Oct. 21, 1895	105,000	2.5	5		Halsted H. Wainwright.
Portland (Ore.) Consolidated St. Ry. Co.	Dec., 1894	800,000	32.0	79	170,977	G. F. Paxton.
Richmond (Ind.) City Elec. St. Ry. Co.	Mar., 1894	150,000	11.0	24		A. D. Titsworth.
St. Cloud (Minn.) City St. Car Co.	*b* Apr. 1, 1896	125,000	10.0	6	9,600	E. E. Clark.
St. Paul (Minn.) & White Bear Ry. Co.		215,000	11.5	13		F. A. G. Moe.
Salem (Ore.) Consolidated St. Ry. Co.	Dec. 5, 1895	260,000	8.0	9	45,994	F. R. Anson.
San Francisco (Cal.) & San Mateo Ry. Co. *e*	May, 1894	1,100,000	27.0	37		S. Bennett.
Union Elev. Ry. Co., Saratoga, N. Y.	Mar., 1896	131,920	10.1	17	20,670	Charles D. Haines.
Grant Street Elec. Ry. Co., Seattle, Wash.	Aug. 20, 1894	137,000	5.5	4	24,000	W. J. Grambs.
Seattle (Wash.) City Ry. Co.		1,000,000	5.0	27		W. A. Underwood, 40 Wall St., New York City.
Seattle (Wash.) Consolidated St. Ry. Co.		880,000	14.4	20		M. F. Backus.
South Dakota Rapid Trans. & Ry. Co., Sioux Falls, S. D.	Apr., 1895	75,000	7.4	5		F. H. Files.
Syracuse (N. Y.) St. Ry. Co.	Mar. 6, 1896	2,236,000	28.5	79	152,027	Edward B. Judson, Jr., W. Judson Smith.
Tacoma (Wash.) Ry. & Motor Co.	Jan., 1895	1,500,000	48.0	31		G. W. Bird.
Watertown (N. Y.) & Brownsville St. R. R. Co.	Dec. 1, 1895	110,000	9.0	24		J. A. Lawyer.
Superior Rapid Transit Ry. Co., West Superior, Wis.	Jan. 28, 1896	250,000	26.5	37		S. T. Norvell, F. W. Oakley.
Winona (Minn.) City Ry. Co.	Feb. 18, 1895	100,000	4.0	4	20,000	Seward B. Livermore.

* Latest obtainable. *a*. Approximate. *b*. Takes possession. *c*. Advertised to be sold on Mar. 21, 1896. *e*. Advertised to be sold on Mar. 16, 1896.

STOCK AND BOND QUOTATIONS.

Notice.—These quotations are carefully revised from month to month by local bankers and brokers, and closely represent the market value of the different securities as tested by individual sales. Few of these, however, are actually quoted on city exchanges, and accuracy in the range of prices cannot, therefore, be vouched for.

Securities.—Active securities only are quoted in these tables, and the bond issues described do not necessarily constitute the entire funded indebtedness of the different properties. For a full and detailed description of all the securities, see AMERICAN STREET RAILWAY INVESTMENTS, published annually on March 15th.

Abbreviations.—The following abbreviations are used: M. mortgage; Gen. M. general mortgage; Cons. M. consolidated mortgage; deb. debentures; convert. convertible; in esc. in escrow; g. gold; guar. guaranteed; bds. bonds; int. interest; + in addition; auth. authorized; incl. including; cert. indebt. certificates of indebtedness; in tr. in trust; n nominal.

Company. STOCKS AND BONDS.		Issued.	Due.	Quotations. 1896. High.	Low.	Mar. High.	Low.	Closing
ALBANY, N. Y.*—Local quotations to Mar. 13.								
Albany Ry. Co., Stock	100	1,250,000	.....	136½	135½	135½	135½	140 a
Cons. M. 5% bds. (incl. $112,000 in esc.).		500,000	1930	109	105½	....	....	....
Deb. 6% (convert.) bds		200 000	1901	....	....	....	....	....
Wat. T'p'ke & R.R. Co.'s 2d M. 6% bds.		150,000	1919	113½	111	....	....	....
Wat. Turnpike & R. R. Co., Stock.	100	240,000	......	....	....	....	....	....
1st M. 6% bds. (int. guar. by Alb'y Ry.		350,000	1919	114	113½	....	....	....
BALTIMORE, MD.*—Local quotations to Mar. 14.								
Baltimore Traction Co., Stock	25	5,750,000	......	1 ½	16¼	18	17⅛	17¼
1st M. 5% bds		1,500,000	1929	112½	110½	112½	112½	....
No. Balt. Div. 1st M 5% bds		1,750,000	1942	110½	107⅛	109	108	. .
Ext. and Imp. 6% bds		1,250,000	1901	106½	102½	106½	102½	....
City & Suburban Ry. Co., Stock	50	4,000,000	......	50	45½	46	45½	....
Gen. M. 5% g. bds		3,000.000	1922	112	109	111	109	....
Baltimore City Pass. Ry. Co., Stock	25	2,500,000	......	72	66½	67	66½	....
1st. M. 5% g. bds		2,000,000	1911	115	114	115	115	115
Central Pass. Ry. Co., Stock	50	300,000	......	72½	68	....	....	....
Cons. M. 5% bds. (+ $151,000 in esc.).		549,000	1932	112	111	112	112	112
1st M. 6% bds		151,000	1912	110	110	....	....	....
BOSTON, MASS.*—Local quotations to Mar. 18.								
West End St. Ry. Co., Stock, {common	50	9,085.000	......	70	64	70	67	67¼ b
{preferred 8%.	50	6,400,000	......	91	88	91	89	....
Deb. 5% g. bds		3,000,000	1902	105	103	105	104½	104¾
Deb. 4½% g. bds		2,000,000	1914	105¼	104	104¾	104	104 b
North Shore Traction Co., Stock. {common	100	4,000,000	......	....	....	....	....	....
{preferred 6%.	100	2,000,000	......	83	80	....	....	....
Lynn & Boston R.R.Co.'s 1st Cons. M. 5% g. bds. (+ $1,677,000 in esc)		3,702,000	1924	....	....	....	....	....
BROOKLYN, N. Y.*—New York quotations to Mar. 17.								
Brooklyn Heights R. R. Co.								
1st M. 5% bds		250,000	1941	....	....	....	....	....
Brooklyn City R. R. Co., Stock	10	12,000,000	......	172½	159	172½	166	171
1st Cons. M. 5% bds		6,000,000	1941	113	109	112	111½	111½
Brooklyn, Q. Co. & Sub. R. R. Co.								
1st M. 5% g. bds. (+ $350,000 in esc.)		3,150,000	1941	102	98	100½	98½	99⅝
1st Cons. M. 5% g. bds		2.500.000	1941	80	80	....	....	80 a
Brooklyn Traction Co. Stock. {common	100	6,000,000	......	11	7	11	7½	9
{preferred 6%	100	3,000,000	......	55	43	55	43	46
Atlantic Ave. R. R. Co.								
Gen. M. 5% bds		759.000	1909	107½	105½	107	105½	106
Cons. M. 5% bds. (+ $1,034,000 in esc.).		1,966,000	1931	108	105	107½	106	106½
Imp. M. 5% g. bds		1,500,000	1934	82½	71	82½	75	80
B'kl'n, Bath & W. E. R. R. Co.								
Gen. M. 5% bds. (+ $552,000 in esc.)		448,000	1933	85	75	75	75	75
Coney Isl. & B'kl'n R.R.Co., Stock	100	1,000,000	......	....	....	....	....	....
1st M. 5% bds		300,000	1904	....	....	....	....	....
Cert. Indebt. 6%		200.000	1910	....	....	....	....	....
B'kl'n City & Newt'n R.R.Co. Stock	100	1,000,000	......	....	....	....	....	160 b
1st Cons. 5% bds		1,900.000	1939	111½	109	111½	110¾	111
BUFFALO, N. Y.*—New York quotations to Mar. 17.								
Buffalo Ry. Co., Stock	100	5,370,500	......	80	68	78	69	76
1st Cons. M. 5% bds. (+ $1,457,000 in esc.)		3,543,000	1931	106¼	100	106¼	103¾	106
Crosstown St. Ry. Co.'s 1st M. 5% bds.		2,200,000	1932	104	100	....	....	....
CHARLESTON, S. C.*—Local quotations to Mar. 14.								
Enterprise St. R. R. Co., Stock	25	250,000	......	....	....	....	....	6
1st M. 5% bds.		50,000	1906	....	....	....	....	101
Charleston City Ry. Co., Stock	50	100,000	. . ..	....	....	....	....	70
1st M. 6% bds		100,000	1915	....	....	....	....	112
CHICAGO, ILL.*—Local quotations to Mar. 18.								
Chicago & So. Side R. T. R. R. Co. Stock	100	7,500,000	......	7	4½	5½	4⅝	5⅛
1st M. 5% bds		7,500,000	1929	60	59	....	....	....
Exten 5% bds		3,000,000	1933	42	37	....	....	....
Chicago City Ry. Co., Stock	100	9,000,000	......	315	275	280	275	286
1st M. 4½% bds		4,619,500	60 d.	100½	100	100½	100	100
Lake St. Elev. R. R., Stock	100	10,000,000	......	24¾	18½	23⅜	21¼	22½
CHICAGO, ILL.—Continued.								
Met. W. S. Elevated Ry., Stock	100	11,500.000	......	47	12½	11½	14	14
1st M. 5% bds		12,500,000	1942	68	65	66	66	66
North Chicago St. R. R. Co., Stock.	100	5,500,000	......	308½	247	254	247	247
1st M. 5% bds		2,413 000	1906	104	103½	103½	103½	103½
Cert. Indebt. 6%		500,000	1911	....	....	....	....	....
No. Chi. Cy. Ry. Co.'s 1st M. 6% bds		500,000	1900	....	....	....	....	....
" " " " " 2nd M. 4½% bds		1,850,000	1927	....	....	....	....	....
" " " " " Deb. 6% bds		550,000		102½	98	102½	100	102¼
North Chicago City Ry. Co., Guar. Stock	100	500,000	......	....	....	....	....	....
West Chicago St. R. R. Co., Stock	100	13,189,000	......	114	100	108	101¼	103¼
1st M. 5% bds		4,100,000	1928	102	100	101½	101½	101½
W. C S. R. R. Tunnel Co.'s 1st M. 5% bds.		1,500,000	1909	....	....	....	....	....
Deb. 6% bds		4,000.000	....	100	97	98¼	97¾	98
Chi. W. Div. Ry. Co.'s 1st M. 4½% bds.		4,040,000	1932	101	101	....	....	....
Chi. Pass. Ry. Co.'s 1st M. 6% bds		400.000	1905	109	108	....	....	....
" " " " Cons. M. 6% bds		600 000	1929	....	....	....	....	....
Chicago W. Div. Ry. Co., Guar. Stock	100	1,250,000	....	600	600	....	....	....
CINCINNATI, O.*—Local quotations to Mar. 18.								
Cincinnati St. Ry. Co., Stock	50	11,000,000	....	113¾	111½	113¾	113	112½
1st M. 7% bds		50,000	1896	....	....	....	....	....
1st M. 4% ext'n'd bds		100,000	....	....	....	....	....	....
" " 5% " "		150,000	....	....	....	....	....	....
Mt. Adams & Eden Park Inclined Ry., Stock	50	2,500,000	....	112	109	109½	109	109½
1st M. 6% bds		50,000	1900	....	....	....	....	....
" " 6% "		100,000	1905	....	....	....	....	....
Cons. M. 5% bds		531,000	1906	....	....	....	....	....
Cincinnati, Newport & Covington St. Ry. Co., Stock	100	3,000,000	....	36½	34	36¼	34	....
Cons. M. 5% g. bds. (incl. $500,000 in esc.)		3,000,000	1922	99½	97	99½	97½	99¼
So. Cov. & Cin. St. Ry. Co 1st M. 6% bds.		250,000	1912	....	....	....	....	....
" " " " " " " 2nd Cons. M. 6% g. bds. (incl. $250,000 in esc.)		400,000	1932	....	....	....	....	....
COLUMBUS. O.*—New York quotations to Mar. 17.								
Columbus St. Ry. Co., Stock	100	3,000,000	....	50½	44½	50	48½	49½
Cons. M. 5% g. bds. (incl. $780,000 in esc).		3,000,000	1932	100	93½	98½	95	97½
Crosstown St. Ry. Co.'s 1st. M. 5% g. bds. ($90,000 in esc.)		500,000	1933	95	88	88	88	88
COVINGTON, KY.*—(See Cincinnati.)								
DETROIT, MICH.*—Local quotations to Mar. 14.								
Detroit Citizens' St. Ry. Co., Stock.	100	1,250,000	....	100	100	100	100	100
1st M. 6% bds. (+ $1,150,000 in esc)		1,150,000	....	100	100	100	100	100
Fort Wayne & Belle Isle Ry. Co., Stock	100	250,000	....	250	225	250	225	250
1st M. 6% g. bds. ($60,000 in tr.)		340,000	....	100	100	....	....	....
Wyandotte & Detroit River Ry. Co., Stock	100	200,000	....	110	100	110	100	100
Rapid Ry. Co., Stock		250,000	....	110	100	100	100	100
1st M. 5% bds		300,000	....	96	90	94	90	93
The Detroit Ry., Stock		1,000,000	....	....	....	....	....	....
1st M. 5% bds		1,800,000	1925	....	....	....	....	....
HARTFORD, CONN.*—See New Haven.								
HOBOKEN, N. J.*—See Newark.								
HOLYOKE, MASS.*—Local quotations to Mar. 12.								
Holyoke St. Ry. Co., Stock	100	250.000	....	210	190	200	190	220
Springfield St. Ry. Co., Stock	100	1,000,000	....	215	205	210	210	210
Northampton St. Ry. Co., Stock	100	225,000	....	195	185	185	185	185
INDIANAPOLIS, IND.*—New York quotations to Mar. 17.								
Citizens' St. R. R. Co., Stock	100	5,000,000	....	40	21	28½	21	26
Cons. M. 5% g. bds. (incl. $1,000,000 in esc.)		4,000,000	1933	90	79	85	79	80
JERSEY CITY, N. J.*—See Newark.								
LOUISVILLE, KY.*—Local and New York quotations to Mar 17.								
Louisville Ry. Co., Stock. {common	100	4,000,000	....	53	46	53	50	53
{preferred 5%	100	2,000,000	. . .	102½	95	102½	99	102½
Cons. M. 5% g. bds. (incl. $1,263,000 in esc.)		6,000,000	1930	109½	105	109½	106½	109¼

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Company. STOCKS AND BONDS.		Issued.	Due.	Quotations. 1896. High.	1896. Low.	Mar. High.	Mar. Low.	Mar. Closing
LYNN, MASS.*—See Boston.								
MINNEAPOLIS, MINN.*—New York quotations to Mar. 17.								
Twin City Rapid Transit Co. Stock. {com..	100	15,000,000	....	25	23	25	23	25
{pref. 7%		1,500,000	....	100	100	....	....	100 a
Minn. St. Ry. Co.'s Cons. M. 5% g. bds. (+ $960,000 in esc.)		4,040,000	1919	98	91	95	91	93
St. Paul City Ry. Co.'s Cab. Cons. 5% g. bds. (incl. $680,000 in esc.)		4,298,000	1937	93	85	88½	85	86½
St. Paul City Ry. Co.'s Deb. 6% g. bds.		1,000,000	1900	....	....	....	....	....
MONTREAL, CAN.*—Local quotations to Mar. 13.								
Montreal St. Ry. Co., Stock	50	4,000,000	....	226	206½	220½	215¼	218½
1st M. 5% bds		300,000	1908	....	....	....	....	....
2nd M. 4½% bds		700,000	1922	....	....	....	...	....
NEW ALBANY, IND.*—See Louisville.								
NEWARK, N. J.*—New York and Philadelphia quotations to Mar. 17.								
Consolidated Traction Co., of N. J., Stock	100	15,000,000	....	25	20	25	20	25
1st M. 5% g. bds		11,711,000	1933	85	78¾	83⅜	80	82½
North Hudson Co. Ry. Co., Stock	25	1,000,000	....	....	....	....	....	....
Cons. M. 5% bds. (incl. $620,000 in esc.)		3,000,000	1928	....	....	....	....	....
2nd M. 5% bds		350,000	1928	....	....	....	....	....
Deb. 6% bds		500,000	1902	....	....	....	....	....
NEW HAVEN, CONN.*—Local quotations to Mar. 12.								
Fair Haven & Westville R. R. Co., Stock	25	600,000	....	53	53	53	53	55
Winchester Ave. R. R. Co., Stock	25	400 000	....	25	25	25	....	....
1st M. 5% g. bds		500,000	1912	103	102	103	103	103
Deb. 6% bds		100,000	1909	101	100	100½	100	100½
New Haven St. Ry. Co., 1st M. 5% bds.		600,000	1913	102	102	102	102	102
Hartford St. Ry. Co., Stock	100	200,000	....	219	215	....	....	....
H'd & W'th's'fl'd H. R. R. Co.'s deb. 5% bds		1,344,000	....	102	101	101	101	101
NEW ORLEANS, LA.*—New York quotations to Mar. 17.								
New Orleans Traction Co., Stock, {common..	100	5,000,000	....	20	15¼	17⅝	16½	17¼
{pref. 6%...	100	2,500,000	....	70	60½	66	60⅛	65
N. O. City & Lake R. R. Co.'s 1st M. 5% g. bds. ($423,500 in esc.)		3,000,000	1943	102	99	100	100	100
Crescent City R. R. Co.'s Cons. M. 5% g. bds		2,350,000	1943	95	90	90	90	90
New Orleans & Carrollton R. R. Co., Stock	100	1,200,000	....	127½	123	127½	126½	127
1st M. 6% bds		250,000	1897} 1906}	....	....	....	....	....
2d M. bds		350,000	1905} 1907}	....	....	....	....	....
Canal & Claiborne R. R. Co., Stock.	40	240,000	....	48	46	48	48	48
1st M. 6% bds		150,000	1912	....	....	....	....	102½
Orleans R. R. Co., Stock	50	185,000	....	46	42	45	42	44
1st M. bds		18,000	....	114	111	112½	112	112½
St. Charles St. R. R. Co., Stock	50	594,350	....	68	63	65	63	64
1st M. 6% bds		150,000	1912	....	....	....	....	....
NEWPORT, R. I.*—See Providence.								
NEW YORK, N. Y.*—Local quotations to Mar. 17.								
Metropolitan Traction Co., Stock	100	30,000,000	....	108½	92	108	102	105½
Metropolitan St. Ry. Co., Stock	100	13,500,000	....	....	....	....	....	....
B'y. Surf. R. R. Co.'s 1st M. 5% bds		1,125,000	1924	114	110	113	110	111
" " " " " 2nd M. 5% bds		1,000,000	1905	105	102	105	103½	104¾
So. Ferry R. R. Co., 1st. M. 5% bds		350,000	1919	107½	106	106½	106½	106½
Lex. Ave. & P. F. Ry. Co.'s 1st M. 5% bds.		500,000	....	114	110	114	111	113
Broadway & Seventh Ave. R. R. Co., Guar Stock	100	2,100,000	....	197	188	193	188	191
Cons. M. 5% g. bds. (+ $4,850,000 in esc.)		7,650,000	1943	116	113	115	113	113½
1st M. 5% bds		1 500,000	1904	107½	107	107½	107	107½
2nd M. 5% bds		500,000	1914	111	108¾	110½	108¾	109
Sixth Ave. R. R. Co., Guar. Stock	100	2,000,000	....	220	195	199	195	196
Ninth Avenue R. R. Co., Guar. Stock	100	800,000	....	161	160	161	160	161
Twenty-third St. Ry. Co., Guar. Stock	100	600,000	....	308	305	306	305	305 b
1st M. 6% bds		250,000	1909	115½	115	115½	115	115
Deb. 5% bds		150,000	1906	104	102	104	104	104
B'y. Surf. R. R. Co.'s 1st M. 5% bds		375,000	1924	114	110	113	110	111
42nd St. & G'd. St. Ferry R. R. Co., Guar. Stock	100	748,000	....	322	310	322	318	320
1st M. 6% bds		236,000	1909	116	115½	116	115½	115½
Cent. Pk., No. & E. Riv. R. R. Co., Guar. Stock	100	1,800,000	....	165	160	165	165	165
Cons. M. 7% bds		1,200,000	1902	115	113	115	114	115
Bl'cker St. & Fulton Ferry R. R. Co.	100	900,000	....	30½	28⅝	30	28⅝	29½
1st M. 7% bds		700,000	1900	111	108½	109½	108½	109
Third Avenue R. R. Co., Stock	100	9,000,000	....	186	172	182	176	179
1st M. 5% g. bds		5,000,000	1937	121	116	120	119½	120
Second Avenue R. R. Co., Stock	100	1,862,000	....	168	150	168	160	167
Cons. M. 5% bds		1,600,000	1909	108¾	107½	108½	108	108
Deb. 5% bds		300,000	1909	104½	102	104½	103½	103½
Eighth Avenue R. R. Co., Stock	100	1,000,000	....	360	323	340	333	336

Company. STOCKS AND BONDS.		Issued.	Due.	Quotations. 1896. High.	1896. Low.	Mar. High.	Mar. Low.	Mar. Closing
NEW YORK—Continued.								
Cert. Ind'bt. 6%		1,000,000	1914	110½	110	110½	110	110
42nd St., M. & St. N. Ave. Ry. Co., Stock	100	2,500,000	....	68	52	60	52	57
1st. M. 6% bds		1,200,000	1910	117	113	116	114	115
2nd M. inc. 6% bds		1,500,000	1915	71	65	71	68	67
Dry Dock, E. B'y. & Battery R. R. Co., Stock	100	1,200,000	....	172	161	168½	161	166½
Gen. M. 5% g. bds		885,000	1932	114	113	114	113½	113½
Cert. ind'bt 5%	100	1,100,000	1914	103	100	103	101	102
Central Crosstown R. R. Co., Stock	100	600,000	....	200	190	200	200	200
1st M. 6% bds		250,000	1922	120	118	118½	118½	118½
Christopher & 10th St. R. R. Co., Guar. Stock	100	650,000	....	155	150	155	150	152½
Union Ry. Co., Stock	100	2,000,000	....	104	95	101	98	99½
1st M. 5% bds		2,000,000	1942	105	100	104	101	103½
Westchester Elec. R. R. Co.'s 1st M. 5% bds		500,000	1943	100	99	100	100	100
NORTHAMPTON, MASS.*—See Holyoke.								
PATERSON, N. J.*—New York and Philadelphia quotations to Mar. 17.								
Paterson Ry. Co., Stock	100	1,250,000	....	29	22	29	27	28
Cons. M. 6% bds. (inc. $250,000 in esc.).		1,250,000	1931	101	94	101	98	100
PHILADELPHIA, PA.*—Local quotations to Mar. 16.								
Union Traction Co., Stock			....	15¾	10	15¾	14¾	....
Philadelphia Traction Co., Stock	50	15,000 000	....	72¼	62	72¼	68⅜	....
Coll. Tr. 4% g. bds		1,053,000	1917	....	....	....	....	....
Continental Pass. Ry. Co., Guar. Stock	50	1,000,000	....	129	128½	129	....	....
1st M. 6% bds		350,000	1909	....	....	....	....	....
Empire Passenger Ry. Co, Stock	50	600,000	....	152	150	....	....	....
1st M. 7% bds		200,000	1900	....	....	....	....	....
Phila. City Pass. Ry. Co., Stock	50	475,000	....	176	170	170	....	....
1st M. 5% bds		200,000	1910	....	....	....	....	....
Phila. & G'ys Ferry Pass. Ry. Co., Guar. Stock	50	308,750	....	85	83	84¾	....	...
Ridge Ave. Pass. Ry. Co., Guar. Stock	50	420,000	....	250	240	241	....	....
13th & 15th Sts., Pass. Ry. Co., Guar. Stock	50	334,529	....	233	223¼	230	....	...
1st M. 7% bds		100,000	1903	....	....	....	....	....
Union Pass. Ry. Co., Guar. Stock	50	925,000	....	205	201	201	....	....
1st M. 5% bds		500 000	1911	...	....	....	....	....
2nd M. 5% bds		250,000	1910	....	....	....	....	....
W. Phila. Pass. Ry. Co., Guar. Stock	50	750,000	....	225	222	225	....	....
1st M. 6% g. bds		246,000	1906	....	....	....	....	....
2nd M. 5% bds		750,000	1926	....	....	....	....	....
Frankford & S'thw'k P. C. Pass. R. R. Co., Guar. Stock	50	1,875,000	....	325	320	325	....	....
Lombard & So. St. P. R. R. Co.'s 1st M. 5% bds		150,000	1901	92	90	90¾	...	....
West End P. Ry. Co.'s 1st M. 7% bds		132,100	1905	....	....	....	....	....
Citizens' Pass. Ry. Co., Guar. Stock	50	192,500	....	280	271	27 ½	....	....
2nd & 3rd Sts. Ry. Co., Guar. Stock	50	848,160	....	227	225	226	....	....
Lehigh Ave. Ry. Co., Stock	50	599,950	....	52	51	....	....	....
People's Pass. Ry. Co., Stock {common....	25	740,000	....	....	....	....	....	....
{preferred...	25	277,402	1905	....	....	....	....	....
1st M. 7% bds		219,000	1905	....	....	....	....	....
Cons. M. 5% bds		246,000	1912	....	....	....	....	....
Germantown Pass. Ry. Co., Guar. Stock	50	572,800	....	130	120	121	....	...
Green & Coates Sts. P. P. Ry. Co., Guar. Stock	50	500,000	....	131	127	130	....	....
1st M. 6% bds		100,000	1898	....	....	....	....	....
Hest'v'e, Mantua & F'r'm't P. R. R. Co., Stock	50	2,500,000	....	49½	46	47½	....	....
PITTSBURGH, PA.*—Local quotations to Mar. 18.								
Citizens' Traction Co., Stock	50	3,000,000	....	56½	55	56½	56½	57½a
1st M. 5% bds		1,250,000	1927	....	....	....	....	....
Pittsburgh Traction Co., Stock	50	2,500,000	....	....	....	....	....	....
1st M. 5% bds		750,000	1927	....	....	....	....	....
Duquesne Traction Co., Stock	50	3,000,000	....	36¼	32⅜	36¼	35½	36 b
1st M. 5% bds		1,500,000	1930	104½	102½	104½	102¾	104½
P'h'gh, Allegheny & Manch'r Tr. Co., Stock	50	3,000 000	....	38½	38	38	38	38½a
Gen. M. 5% bds		1,500,000	1931	107	106	107	106	106½
P'b'gh Union P. Ry. Co.'s 1st. M. 5% bds.		100,000	1901	....	....	....	....	...
Federal St. & P. V. R. R. Co., Stock	25	1,400,000	....	19⅜	18	18⅝	18	....
Gen. M. 5% bds.. (new)		1,250,000	1931	102¼	102¼	102¼	102¼	....
P'h'gh & Birmingham Tr. Co., Stock	50	3,000,000	....	16¾	15½	16¼	15¾	....
Gen. M. 5% g. bds		1,500,000	1929	97½	96	97	97	98½a
Central Traction Co., Stock	50	1,500,000	....	28½	26	28½	27	....
1st M. 5% bds		375,000	1929	....	....	...	....	...
P'h'gh & West End P. Ry. Co., Stock	50	1,500,000	....	....	....	....	....	....
1st. M. 5% bds		450,000	1922	....	....	....	....	....
PROVIDENCE, R. I.*—Local quotations to Mar. 16.								
United Traction & Electric Co., Stock	100	8,000,000	....	50	50	50	50	50
1st M. 5% g. bds		8,000,000	1933	100	100	100	100	100
Newport St. Ry. Co. 1st M. 5% bds		50,000	1910	100	95	100	95	100

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Company. STOCKS AND BONDS.		Issued.	Due.	Quotations. 1896. High.	Low.	Mar. High.	Low.	Closing
ROCHESTER, N. Y.*—New York quotations to Mar. 17.								
Rochester Ry. Co., Stock	100	5,000,000	....	32	27	28	27⅛	28
Cons. M. 5% g. bds. (incl. $1,000,000 in esc.)		3,000,000	1930	106	100	103½	101	102
2nd M. 5% g bds. (incl. $750,000 in esc.)		1,500,000	1933	85	85	....	....	85b
ST. LOUIS, MO.*—Local quotations to Mar. 14.								
St. Louis R. R. Co., Stock	100	2,000,000	....	144	130	131	130	130
1st M. 5% bds		2,000,000	1900 / 1910	100	99	100	100	100
Citizens' Ry. Co., Stock	100	1,500,000	....	92	71	72	71	72
1st M. 6% bds		1,500,000	1907	107	106	106	106	106
Cass Ave. & Fair Grounds Ry. Co., Stock	100	2,000,000	....	60	54	55	54	55
1st M. 5% bds		1,911,000	1912	99	97	98	97	97
Union Depot R. R. Co., Stock	100	4,000,000	....	160	128	130	128	131
Cons. M. 6% g. bds		1,150,000	1918	111	109	111	110	110½
Benton. Bellef'ne Ry. Co.'s 1st M. 6% bds		300,000	1896 / 1911	101	100	100	100	100
Mound City R. R. Co.'s 1st M. 6% bds.		400,000	1900 / 1910	104	103	104	103½	104
Jefferson Ave. Ry. Co., Stock	100	112,000	....	127	126	127	126	126
1st M. 5% bds		250,000	....	102	100	102	101	102
Missouri R. R. Co., Stock	100	2,300,000	....	208	200	205	200	200
1st M. 6% bds		500,000	1907	101	100	100	100	100
Lindell Ry. Co., Stock	100	2,500,000	....	140	131	132	131	132⅛
1st M. 5% bds		1,500,000	1911	104½	103	104	103	102
St. Louis & Suburban Ry. Co., Stock	100	2,500,000	....	36	32	36	35½	31
1st M. 5% bds. (incl. $600,000 in esc.)		2,000,000	1921	98	94½	98	97	98
Inc. 6% bds		300,000	....	....	....	....	....	....
People's R. R. Co., Stock	100	1,000,000	....	22	10	11	10	11
1st M. 6% bds		125,000	1892 / 1902	101	100	....	....	....
2nd M. 7% bds		75,000	1902	101	100	....	....	....
Cons. M. 6% bds. (incl. $200,000 in esc.)		1,000,000	1899 / 1904	75	75	....	....	...
Fourth St. & Arsenal Ry. Co., Stock	50	150,000	....	20	18	19	18	19
1st M. 6% bds		50,000	1898 / 1903	100	100	100	100	100
Southern Electric Ry. Co., Stock, common	100	700,000	....	42	40	....	....	....
Southern Electric Ry. Co., Stock, preferred 6%	100	800,000	....	85	84	....	....	....
Cons. M. 6% bds (incl. $200,000 in esc.)		500,000	1909	107	107	....	....	....
St. L. & E. St. L. E. R. Co., Stock	100	250,000	....	....	....	....	....	....
1st. M. 6% bds		75,000	1905	102½	102	....	....	...
Baden & St. Louis R. R., Stock	100	50,000	....	....	....	....	....	....
1st M. 6% bds		250,000	1913	100	99	....	....	....
SAN FRANCISCO, CAL.*—Local quotations to Mar. 14.								
Market Street Ry. Co., Stock	100	18,616,782	....	47¼	44	47¼	44¼	47¼
M'ket St. Cable Co.'s 1st M 6% bds		3,000,000	1913	123	121	123	123	123
Omnibus Cable Co.'s 1st M. 6% bds		2,000,000	1918	119½	119	119½	119½	119½
Park & Ocean R. R. Co.'s 1st M. 6% bds.		250,000	1914	....	....	....	....	....
Park & Cliff House R. R. Co.'s 1st M. 6% bds		350,000	1913	103	102½	103	103	103
Powell St. R. R. Co.'s 1st M. 6% bds		700,000	1912	....	....	....	....	...
Ferries & Cliff House Ry. Co.'s 1st M. 6% bds		650,000	1914	....	....	....	....	....
Geary St., P'k & O. R. R. Co., Stock	100	1,000,000	....	101	101	101	101	101
1st M. 5% bds		671,000	1921	106	101	....	...	101
Cal. St. Cable R. R. Co., Stock	100	1,000,000	....	....	....	....	....	...
1st M. 5% g. bds		900,000	1915	110¼	109¾	110¼	110¼	110¼
Sutter Street Ry. Co., Stock	100	2,000,000	....	....	....	....	....	....
1st M. 5% g. bds		900,000	1918	110¼	109¾	110¼	110¼	110¼
Presidio & Ferries R. R. Co. Stock	100	1,000,000	....	7½	7½	....	....	....
Oakland, S. L. & Haywards Ry. Co. Stock	100	1,000,000	....	....	....	....	....	....
SPRINGFIELD, MASS.*—(See Holyoke.)								
TORONTO, ONT.*—Local quotations to Mar. 13.								
Toronto Ry. Co., Stock	100	6,000,000	....	77½	66½	77½	73¾	....
WASHINGTON, D. C.*—Local quotations to Mar. 18.								
Capital Traction Co.		2,000,000	....	77¼	69	73	69	69
Metropolitan R. R. Co, Stock	50	750,000	....	107¼	97	107¼	102	107
Coll. Tr 6% conv. bds		500,000	1901	116	110	116	114	116
Belt Ry. Co., Stock	50	500,000	....	30	15	30	30	30
Cons. M. 6% bds. (inc. $50,000 in esc.)		500,000	1921	84	78	80	78	78
Eckington & Soldiers' Home Ry. Co., Stock	50	352,000	....	18	14	18	15	15
1st M. 6% bds		200,000	1896 / 1911	101	99	100	99	100
G'getown & Ten'town Ry. Co., Stock	50	200,000	....	25	14	25	25	25
Columbia Ry. Co.	50	400,000	....	60	50	60	55	60
1st M. 6% bds		500,000	1914	116½	112½	116¼	113	116
WORCESTER, MASS.*—New York quotations to Mar. 18.								
Worcester Traction Co., Stock, common	100	3,000,000	....	16½	12	16½	15½	16½
Worcester Traction Co., Stock, pref. 6%	100	2,000,000	....	90	80	90	86½	89
Worcester Cons. St. R. R. Co.			....	....	...	....	....	....
1st. M. 5% bds		150,000	....	103	100	103	103	103
Deb. 5% g. bds		500,000	....	99	99	99	99	99

* See foot note on preceding pages.

New York and Philadelphia quotations of Brooklyn, Buffalo, Columbus, Indianapolis, Louisville, New Orleans, New York City, Paterson, Rochester and Worcester. Securities furnished by Gustavus Maas, 26 Broad Street, New York.

New Corporations.

Augusta, Ga.—Charles Estes, Wm. E. McCoy and C. V. Walker, of Augusta, and Gordon Gairdner, Eugene F. Vedery, Jas. P. Vedery, Jos. B. Cumming, Bryan Cumming, Wm. Lyon Martin and Colden Rhind, of Richmond County, have applied to be incorporated as the Augusta Belt Railway Company to construct and operate a street railway from Augusta to Harrisonville, a distance of three miles. Capital stock, $25,000.

Cassville, Mo.—The Cassville & Western Railroad Company has been incorporated by John M. Bayless, J. R. Tinsher and M. M. Bayless, of Cassville; T. H. Miller, of Aurora, Mo., and W. E. Clarke, of Topeka, Kan., to build and operate a railway from Cassville to Exeter, a distance of five miles. Capital stock, $50,000.

Denver, Col.—The West Creek Electric & Toll Road Company has been incorporated by B. B. Clawson, Arthur O. Williams and Sidney Williams, of Denver, to build and operate a toll road and an electric railway between South Platte Station and the town of Pemberton, Col. Capital stock $100,000.

Detroit, Mich.—A company composed of H. C. Burke, Jas. T. Keena, A. E. Riopelle and Chas. W. O'Brien has been organized to build an electric railway from Detroit to Monroe and Toledo. Franchises have been secured as far as Monroe.

Elkton, Md.—The Cherry Hill, Elkton & Chesapeake City Electric Railway Company has been incorporated by J. C. Price, R. A. Duhamell, John Banks, T. Taylor Reynolds, C. H. Smith, of Elkton; Manly Drennen, Frank H. Mackie, George S. Woolley and Wm. J. Smith, to build and operate an electric railway between the towns of Cherry Hill and Chesapeake City, a distance of nine miles, to carry both freight and passengers. Frank H. Mackie has been elected president, and C. H. Smith, of Elkton, secretary of the company.

Evanston, Ill.—The Evanston Traction Company has been organized to build electric railways in Evanston. Capital stock, $15,000. Thomas Craven, of Evanston, is interested.

Fawn Grove, Pa.—A large number of citizens of the towns of Fawn Grove, Stewartstown and Delta met in Fawn Grove recently and elected R. W. Anderson, president, and C. W. Shaw secretary, of a company whose purpose is to build an electric railway between the above named towns.

Franklin, N. Y.—The Ouleout Electric Company has been incorporated by H. McGonegal and James C. Holden, of New York; Walter F. Randall, of Syracuse; Fred. C. Ward, of Franklin, and H. S. Sewell, of Walton, Delaware Co., N. Y., to build and operate an electric railway from Franklin to Sidney.

Gloversville, N. Y.—Reports state that a company has been organized by Chas. King and Richard J. Ansell, of Johnstown, N. Y.; Alvah J. Zimmer and Robert J. Williams, of Gloversville, to construct and operate an electric railway to Bleecker Mountain. Capital stock, $60,000.

Kansas City, Mo.—The Brooklyn Avenue Railway Company has been incorporated by Wm. J. Smith, Jas. Lillis and Wm. T. Johnson, of Kansas City, to operate street railways.

New Albany, Ind.—The New Albany & Evansville Electric Railway Company has been organized by I. H. Taylor, of Richland, and P. A. Atkinson, of Midway, to build an electric railway between New Albany, Leavenworth, Cannelton, Tell City, Troy and Evansville.

Pine Bluff, Ark.—The new owners of the Citizens' Street Railway Company are contemplating equipping the road with electricity.

Port Medway, N. S.—A company has been incorporated to build an electric railway in Queens County. Franchises and rights of way have been secured, and land has been purchased in Port Medway for the terminal station. F. W. Wade, of Bridgewater, N. S., can give further information.

Quebec, Can.—J. W. Brown, of Baltimore, president of the Maryland Trust Company, F. O. Blackwell, J. Spear and W. J. McCracken, of New York, are considering the forming of a company to build electric railways in Quebec and to take over the property and franchises of the Quebec, Montmorenci & Charlevoix Railway Company.

Salisbury, N. C.—The Salisbury Electric Company has been organized to construct an electric railway in Salisbury. The officers are: President, W. Smithdeal; vice-president, R. L. Wright; treasurer, W. L. Kluttz.

Salt Lake City, Utah.—The Salt Lake & Ogden Railway Company has been incorporated by C. K. Bannister and E. M. Allison, Jr., of Ogden, E. W. Duncan, J. S. Critchlow and Causten Browne, Jr., of Salt Lake City, to build an electric railway from Ogden to Salt Lake City, a distance of forty miles. Power will be supplied by the Pioneer Power Company, of Ogden. E. W. Duncan has been elected treasurer of the company.

Superior, Wis.—The directors of the Superior-Cloquet Electric Railway Company met recently and elected the following officers: President, Michael S. Bright; vice-president, Chas. J. Wallace; secretary, Geo. B. Hudnall; treasurer, John A. Bardon; chief engineer, C. E. Bissell.

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.
AUGUSTA, Me.						
Augusta, Hallowell & Gardiner R. R. Co...	12 m. June '94	88,307	25,641	12,665	9,894*	2,771
	12 " " '95	40,520	24,324	16,196	9,848*	6,349
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
ALTOONA, PA.						
The Altoona & Logan Valley Elec. Ry. Co..	12 m. Dec. '94	73 128	33,217	39,911	32,248*	7,663
	12 " " '95	83,292	41,158	42,135	33,564*	8,570
City Pass. Ry. Co. of Altoona................	12 m. Dec. '94	50,303	40,302	10,000	4,300*	5,700
	12 " " '95	56,527	46,146	10,381	4,051*	6,330
BALTIMORE, MD.						
Baltimore Traction Co....................	12 m., Dec. '94	1,012,319	623,040	389,279	359,243*	30,037
	12 " " '95	1,179,191	639,707	539,485	413,097*	126,387
City & Suburban Ry. Co...................	12 " June '94	605,123	409,363	195,760		
	12 " " '95	751,720	546,970	204,750		
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 City 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 " Jan. '95	6,084	3,868	2,216		
	1 " " '96	6,927	5,451	1,476		
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 " Feb. '95	7,033				
	1 " " '96	9,242				
Binghamton, Lestershire & Union Ry. Co.	1 m. Feb. '96	1,143				
	2 " " '96	2,388				
BOSTON, MASS.						
West End St. Ry. Co...	12 m. Sept. '94	6,823,879	4807,083	2,016,796	725,064*	1291,732
	12 " " '95	7,746,171	5633,163	2,113,008	746,963*	1366,044
Lynn & Boston R. R. Co.................... North Shore Traction Co	12 m. Sept. '94	1,238 410	746,304	492,106	379,029*	113,077
	12 " " '95	1,381,389	784,392	59,997	391,681*	205,316
	1 " Jan. '95	85,257	57,774	27,484		
	1 " " '96	89,070	66,957	22,113		
	4 " " '95	371,795	253,675	118,120		
	4 " " '96	393,423	273,223	120,200		
BRIDGEPORT, CONN.						
Bridgeport Traction Co	12 m. Dec. '94	144,447				
	12 " " '95	298,883	151,697*	147,186	75,000	72,186
	1 " Feb. '95	16,653	13,532	3,121		
	1 " " '96	21,271	14,698	6,573		
	2 " " '95	35,428	26,933	8,495		
	2 " " '96	43,167	27,870	15,297		
BROCKTON, MASS.						
Brockton St. Ry. Co.	12 m. Dec. '94	225,614	144,547	81,067		
	11 " " '95	273,383	171,576	101,807		
	1 " Jan. '95	17,153	10,488	6,665		
	1 " " '96	19,657	13,537	6,120		
BROOKLYN, N. Y.						
Brooklyn Elev. R.R. Co	12 m. Dec. '94	1,730,848	1041,095	689,754	831,093*	d141339
	12 " " '95	2,082,937	1158,219	924,718	859,447*	65,271
Brooklyn Traction Co.	1 m. 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*	d14,830
	12 " " '95	130,928	79,394	51,535	61,150*	d9,616
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*	d52,913
	12 " " '95	625,537	415,255	210,282	339,068	d128786
	6 m., Dec. '94	348,969	213,351	135,618	167,644*	d32,026
	6 " " '95	362,162	230,425	131,737	169,134	d37,396
Brooklyn Heights R.R. Co............	12 m., Dec. '94	3,509,016	2143,567	1,365,448	1468,553	d 103105
	12 " " '95	4,076,117	2682,614	1,393,504	2102,061	d706758
Coney Island & Brooklyn R. R. Co.........	3 m., Sept. '94	115,805	62,260	53,545		
	3 " " '95	134,760	61,766	72,994		
	9 " " '94	252,546	162,528	90,018		
	9 " " '95	310,386	182,429	127,957		
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	1,714,163	877,123	837,040		
CHESTER, PA.						
Chester Traction Co...	1 m. Jan. '95	11,393	5,628	5,765		
	1 " " '96	12,497	5,853	6,644		
CHICAGO, ILL.						
Chicago City Ry. Co...	12 m., Dec '94.	4,264,618	2838,684*	1,425,934	207,878	1218,057
	12 " " '95	4,476,824	2807,726	1,669 098	300,389	1368,709
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	1347,326	1,218,292	465,648	
	12 " " '95	2,780,487	1311,607	1,468,8?0	471,251	752,644
West Chicago R. R. Co	12 m., Dec. '94	4,181,237	2518,627	1,662.610	859,471	997,629
	12 " " '95	4,201,477	2267,195	1,931,282	902,016	803,139
						1032,266
Chicago & So. Side R. T. Co....................	1 m., Jan. '95	63,354	51,016	12,338		
CINCINNATI, O.	1 " " '96	65,871	43,039	22,832		
Cinn. Newport & Cov. Ry. Co...............	12 m., Dec. '94	497,950	370,606	127,344		
	12 " " '95	624,034	418,710	205,324		
	1 " Jan. '95	39,435	31 264	8,171		
	1 " " '96	46,700	34,582	12,118		
CLEVELAND, O.						
Cleveland Elec. Ry. Co......................	1 m., June '94	148,812	101,455	47,357		
	1 " " '95	135,063	76,870	58,193		
	6 " " '94	607,577	407,254	200,323		
	6 " " '95	691,197	457,424	233,773		
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 " Feb. '95	40,253	21,608	18,645		
	1 " " '96	46,188	25,766	20,422		
	2 " " '95	85,898	46,090	39,808		
	2 " " '96	97,611	52,806	44,805		
DENVER, COL.						
Denver Cons. Tramway Co........................	12 m., Dec. '94	753,483	445,684	307,798	244,172*	63,625
	12 " " '95	716,039	441,283	274,756		
	1 " Jan. '95	55,696	35,895	19,801		
	1 " " '96	54,540	34 221	20,319		
DETROIT, MICH.						
Ft. Wayne & Belle Isle St. Ry. Co.	6 m., June '95	116,945				
Citizens' St. Ry. Co...	6 " " '95	386,575				
Rapid Ry. Co............	5½ m. Dec. '95	30,356	15 586	14 770	6,875	7,895
Detroit Ry......	3 m, Jan. '96	113,738	70,818	42,920		
DULUTH, MINN.						
Duluth St. Ry. Co.......	12 m, Dec. '94	208,1?5	111,105	97,000		
	12 " " '95	213,229	95,329	117,900		
	1 " Jan. '95	15,703	10,328	5,375		
	1 " " '96	15,840	9,075	6,765		
FALL RIVER, MASS.						
Globe St. Ry. Co........	12 m., Sept. '94	248,106	147,352	100,754	75,284	25,470
	12 " " '95	269,786	159 090	110,696	76,479	34,217
FINDLAY, O.						
Findlay St. Ry. Co......	12 m., Dec. '95	29,798	20,308	9,490	7,415	2,075
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		
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
	3 " Dec. '94	22,410	14,492	7,918		
	3 " " '95	23,994	14,155	9,839		
GLENS FALLS, N. Y.						
Glens Falls, Sandy Hill & Ft. Edward St. Ry. Co........................	12 m, June '94	43,206	33,414	9,792	9,538*	253
	12 " " '95	50,173	33,793	16,380	9,579*	6,801
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..	1 m., Dec., '94	10,067	5,894	4,173		
	1 " " '95	10,546	5,085	5,461		
	12 " " '94	97,202	50,605	46,597		
	12 " " '95	119,588	67,979	51,609	39,297	12,312
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
HOUSTON, TEX.						
Houston City St. Ry....	12 m., Oct. '95	222,808	149,205	73,603	70,204*	3,399
JAMESTOWN, N. Y.						
Jamestown St. Ry. Co.	3 " Sept. '94	34,461	18,023	16,439	4,929*	11,510
	3 " " '95	39,411	19,439	19,972	6,871*	13,101
	9 " " '94	68,412	47,621	20,791	14 724*	6,057
	9 " " '95	74,092	51,630	22,462	15,989*	6,473
JOHNSTOWN, PA.						
Johnstown Pass. Ry. Co	12 m. June '94	90,197	50,626	39,571	19,028	20,543
	12 " " '95	94,926	52,009	42,917	19,844	23,073
KANSAS CITY, MO.						
Metropolitan St. Ry. Co	1 m, Jan. '95	120,124	84,185	35,939		
	1 " " '96	129,502	83,626	45,876		
	8 " " '95	1,178,439	728,870	449,569		
	8 " " '96	1,218,430	699,822	518,608		
KINGSTON, N. Y.						
Kingston City R. R. Co......................	12 m. June '94	46,467	29,038	17,430	9,398*	8,032
	12 " " '95	50,230	31,404	18,826	9,576*	9,249
LAWRENCE, MASS.						
Lowell, Lawrence & Haverhill St. Ry. Co	12 m., Sept. '95	269,740	205,816	63,924	73,423*	d 8,498
	12 " " '95	403,530	262,935	140,595	84,081*	56,514
LEBANON, PA.						
Lebanon & Annville St Ry. Co.................	12 m., June '94	39,903	30,005	9,898	6,341*	3,557
	12 " " '95	42,963	27,534	15,429	8,137*	7,292
LONG ISL. CITY, N. Y.						
Steinway Ry. Co. of Long Island City......	12 m, Dec. '94	215,135	114,127	101,008	85,044*	15,964
	12 " " '95	304 103	169 115	131 ?88	106,834*	28,154

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 " Jan. '95	4,705	4,668	37		
	1 " " '96	4,570	4,486	84		
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
MANCHESTER, N. H.						
Manchester St. Ry. Co.	12 m., June '94	81,627	76,906*	4,721	3,302	1,419
	12 " " '95	82,923	87,594	d 4,670		
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 " Jan. '95	152,031	75 077	76,954		
	1 " " '96	158,913	75,202	83,711		
MONTGOMERY, ALA.						
Montgomery St. Ry. Co	12 m., Dec. '94	35,216	21,724	13,492		
	12 " " '95	50,645	27,915	22,730		
	1 " Jan, '95	3,505	2,164	1,341		
	1 " " '96	3,688	2,069	1,619		
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 " Feb. '95	66,924				
	1 " " '96	87,394				
	5 " " '95	383,793				
	5 " " '96	572,851				
NEW BEDFORD, MASS						
Union St. Ry. Co	1 m., Dec. '94	13,381				
	1 " " '95	16,008				
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*	12,621
	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		
New Haven & Centreville St. Ry. Co.	1 m., Dec. '94	2,742				
	1 " " '95	4,909				
West Shore Ry. Co.	1 " " '94	336				
	1 " " '95	334				
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., Sept. '94	951,528	620,508	331,020		
	12 " " '95	1,327,756	752,158	575,598		
	1 " Jan. '95	92 659	58,493	34,166		
	1 " " '96	106,484	56,539	49,944		
	2 " " '95	192,725	109,151	83,574		
	2 " " '96	227,857	121,026	106,831		
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	1,157,344	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.	3 m., Dec. '95	1,990,079	956,265	1,033,814	595,560	438,254
	9 " " '95	5,562,651	2,714,927	2,847,724	1,707,882	1,139,842
Manhattan Ry. Co.	3 m., Sept, '94	2,083,310	1,250,635	832,675	660,228	172,447
	3 " " '95	2,148,530	1,319,129	829,401	766,790	62,611
	9 " " '94	7,371,408	4,089,329	3,282,079	1,960,568	1,321,511
	9 " " '95	7,167,493	4,125,757	3,041,736	2,141,776	899,960
Second Avenue R.R. Co	12 m., June '94	1,018,133	794,765	223,368	131,885*	91,483
	12 " " '95	957,463	734,915	222,548	129,428*	93,120
	3 " Dec. '94	226,925	184,502	42,423	33,462*	8,961
	3 " " '95	219,423	177,190	42,233	32,150*	9,083
	6 " " '94	512,143	374,355	137,788	78,631*	59,157
	6 " " '95	495,969	364,858	131,111	72,767*	58,344
D. D., E. B. & Bat'y R. R. Co.	12 m., June '94	655,558	464,068	191,490	175,894	15,596
	12 " " '95	730,033	532,245	197,788	136,093	61,695
New York & Harlem R. R. Co.	3 m., Sept. '95	197,628	136,712	60,916	10,100	50,816
42d St., Man & St. N. Ave. R. R. Co.	3 m., Sept. '94	165,855	132,388	33,467	30,717*	2,750
	3 " " '95	161,121	133,972	27,149	30,700*	d 3,551
	6 " " '94	337,756	261 020	76,736	61,405*	15,331
	6 " " '95	326,773	265,914	60,859	61,400*	d 541
Union Ry. Co.	3 m., Sept. '94	136,588	67,172	69,416	37,674	31,742
	3 " " '95	136,125	74,570	61,555	32,427	29,128
	9 " " '94	364,974	189,974	175,000	118,165	56,835
	9 " " '95	345,292	198,225	147,067	95,323	51,744
Westchester Elec. R.R. Co.	3 m., Sept. '94	28,655	20,588	8,067	6,957	1,110
	3 " " '95	38,512	22,818	15,694	7,428	8,266
	6 " " '95	68,738	42,331	26,407	14,818	11,589
NORRISTOWN, PA.,						
Schuylkill Val. Trac. Co	1 m., Dec. '94	3,165				
	1 " " '95	4,120				
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
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 " Feb. '95	16,125	11,453	4,672		
	1 " " '96	22,142	12,994	9,148		
	2 " " '95	35,396	24,406	10,990		
	2 " " '96	45,479	26,347	19,132		
PHILADELPHIA, PA.,						
People's Traction Co.	12 m., June '94	1,044,159	673,479	370 680		
	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		
PORTSMOUTH, O.						
Portsmouth St. Ry. & Lt. Co.	1 m., Dec. '95	2,595	1,395	1,200		
	12 " " '95	36,752	16,532	20,220		
ROCHESTER, N. Y.,						
Rochester Ry. Co.	12 m., Dec. '94	782,520	448,304	334,216	269,045*	65,171
	12 " " '95	862,916	510,943	351,973		
SAGINAW, MICH.,						
Union Ry. Co.	1 m., Dec. '95	9,827	5,819	4,008		
	12 " " '95	127,617	68,957	58 660		
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
SARATOGA, N. Y.,						
Union Elec. Ry. Co. of Saratoga	1 m., Sept. '95	11,554	6,301	5,253		
	9 " " '95	99,578	52,703	46,875		
SCRANTON, PA.,						
Scranton Trac. Co.	12 m., June, '94	247,768	140,080	107,688	105,796*	1,892
	12 " " '95	270,700	142,278	128,422	119,858*	8,564
	1 " Feb '95	16,440	12,550	3,890		
	1 " " '96	24,429	13,081	11,348		
	8 " " '95	173,862	107,709	66,152		
	8 " " '96	218,445	107,758	110,687		
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. '95	245,805	145,934	99,870	93,965*	5,905
TERRE HAUTE, IND.						
Terre Haute Elec. Ry. Co.	1 m., Dec. '94	8,354				
	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.	12 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 " Jan. '95	70 537	43,082	27,455		
	1 " " '96	74,377	43,138	31,239		
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. RR.	12 m., Dec. '94	149,105	90,754	58,351	29,844*	28,508
	12 " " '95	160,282	105,296	54,986		
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 " Jan. '95	17,242				
	1 " " '96	21,456	12,136	9,320		
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 " Jan. '95	28,446	17,355	11,091		
	1 " " '96	38,858	18,435	20,423		
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 " Feb. '95	25,947	23,466	2 481		
	1 " " '96	34,168	26,505	7,663		
	5 " " '95	150,823	118,226	32,597		
	5 " " '96	186,686	139,100	47,586		