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CINCINNATI AND ITS STREET RAILWAYS.

Cincinnati is the city of the double trolley, full grooved girder rail, and of vestibuled cars. There are also other characteristic features pertaining to the street railway systems of the city, which will have attention later on.

Although the employment of the girder rail, and the use of the vestibules were compulsory, and in the face of earnest protest by the managers of the Cincinnati Street Railway Company and the Mount Adams & Eden Park Inclined Railway, their employment has been attended with less difficulties than was originally supposed, while they have developed a number of commendable features, so that the management has now come to regard them favorably, and has ceased all opposition to their introduction. In fact, the double trolley, having been adopted with misgivings, has so worked its way into the favor of the management that, in answer to a direct question on the subject, John Kilgour, general manager of the two systems, informed us that had he the introduction of electric traction in a city like Cincinnati, or, in fact, any of the large cities of the country, he would in all cases employ the double trolley.

The advantages are that both arms of the circuit are more equally balanced than where a track return is employed, and that it avoids the necessity of the tearing up of the streets, and for making repairs to bonds and return connections. Most of the difficulties experienced with the double trolley in the early history of these lines have been overcome, and, with the exception of the fact that the overhead construction is a little more complicated and unsightly, and that it requires a little more attention on the part of the conductor to handle the trolley poles at switches and crossings, there are no serious difficulties that have not been overcome.

The principal difficulties which were first encountered were those of providing overhead crossings and switches, to prevent short circuits at the crossing of positive and negative wires. These have been overcome in an ingenious manner, as will be seen from the accompanying illustrations of switches and crossings (Figs. 2 and 3). In case of double turnouts, it has been found better to provide a second set of trolley wires for one track, rather than to attempt the insulation of the crossings, in which case it is necessary for the conductors, on entering some of the curves, to transfer the trolley poles to a different set of wires. This is readily done, however, as the poles have a considerable reach to the right or left, and on some streets the cars of the different systems pass over the same tracks, with a different set of overhead conductors for each system, in which case four wires are required. At one or two of the points in the system, notably on Walnut Street, cars equipped for both the double and single

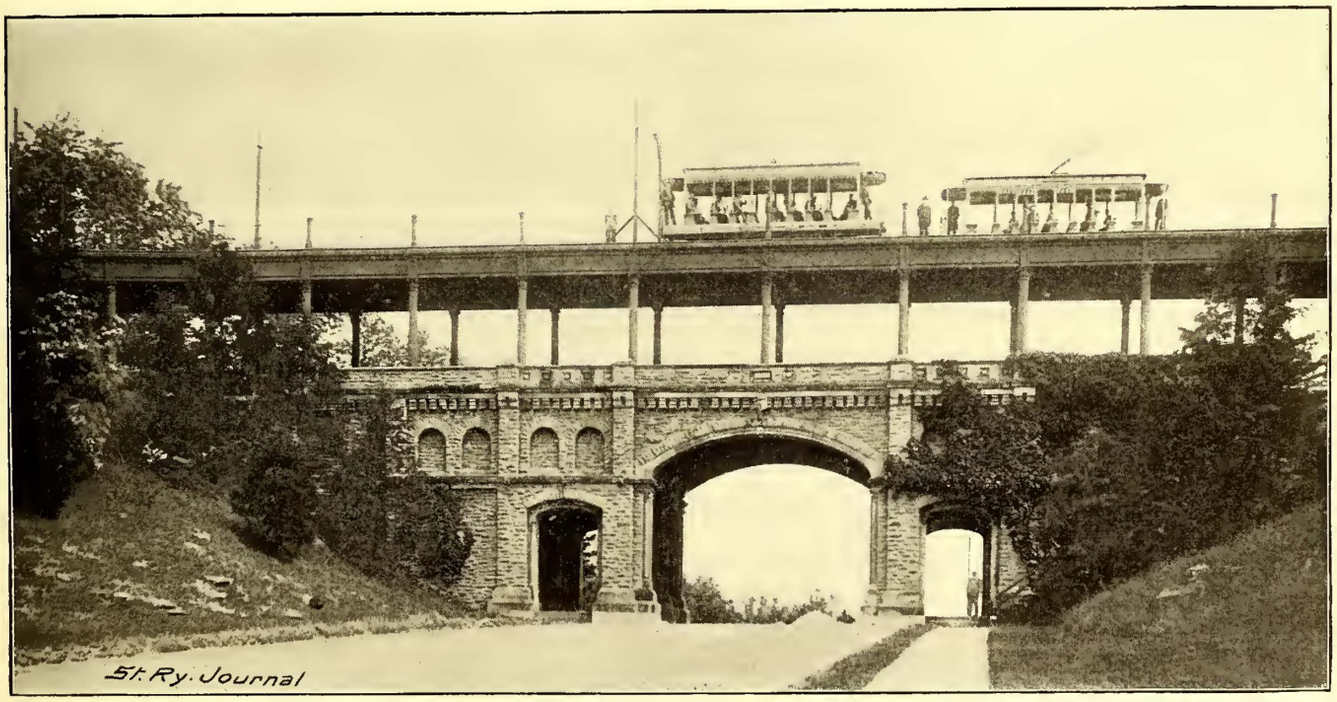


FIG. 1.—EDEN PARK VIADUCT—MOUNT ADAMS & EDEN PARK INCLINED RAILWAY, CINCINNATI.

trolley pass along the same tracks without any difficulty, the wires of the single trolley system being mounted to the left of those for the double system. It will be noted from the illustrations that there are certain dead parts at the switches, over which the cars pass by momentum, and then, again, that the current is carried past these dead points by insulated cables above the switches.

The ordinary sized span wires are employed for supporting the two trolley wires, but the side poles are placed a little nearer together than usual, being spaced 100 ft. apart. Owing to the presence of soot in the atmosphere, from the employment of soft coal in the manufacturing establishments, the employment of galvanized iron for span wires is not permissible, as the soot causes it to rust

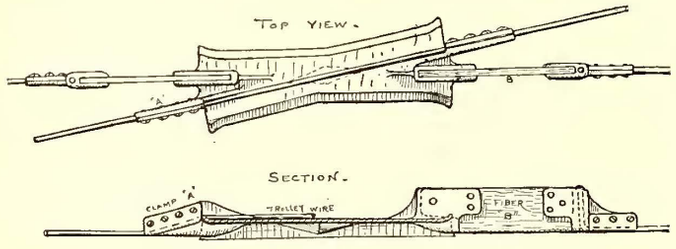


FIG. 2.—SLIGHT ANGLE INSULATED CROSSING.

out in the course of six months, so that it is necessary to employ silicon bronze for span wires.

The causes that originally led up to the adoption of the double trolley in Cincinnati, were that after thoroughly investigating the subject, the management was convinced of its superiority; and second, the fact that most of the business streets of the city had recently been paved with granite blocks and asphalt, and a city ordinance prevented the tearing up of the streets for the repairing of tracks, or renewing of water pipes for five years, so that in a measure it became an agreeable necessity for the Cincinnati Street Railway Company to employ the double trolley. The company is now congratulating itself on the fact that it is able to operate so successfully with the two wires, and is not uneasy over the question of the destruction of water and gas pipes by electrolytic action, which is now disturbing some of the street railway companies of the country.

The cost of the installation for double overhead construction is somewhat more than that for the ground re

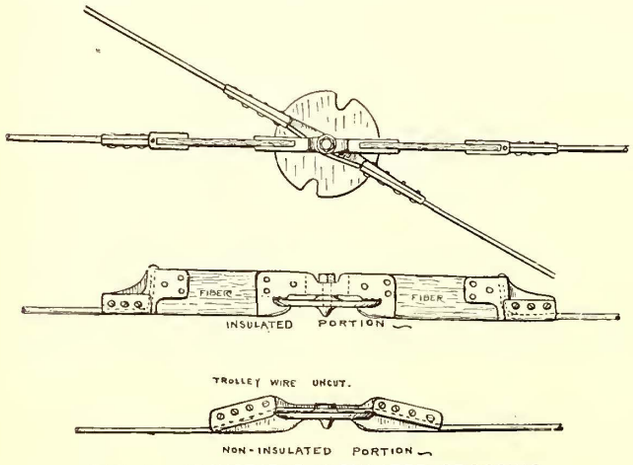


FIG. 3.—ADJUSTABLE INSULATED CROSSING.

turn, where the rails alone are depended upon, but not more than where a good return ground wire is provided. It is necessary, of course, to provide that the feed wires on both arms of the circuit balance.

The trolley poles or masts, as will be noted from the accompanying engravings, are attached to a single stand on the roof of the cars. With a single base the wheels do not adjust themselves as readily to spreading wires as they do where a double base is provided, as was described in our last issue in connection with the cars of the Covington system, which operate on a double trolley on the Cincinnati side of the river, but there is less danger from short circuiting in the case at the single base, as the poles cannot come in contact with each other.

The introduction of the grooved girder rail first came about through the demands of the citizens of Avondale two years since, when it was proposed to extend one of the lines through this suburb, and although the company protested it at length yielded to the wishes of the citizens, and demands of the local engineer, and a full grooved girder rail was provided. This differs somewhat from the English type of the grooved rail, and is locally known as the Stanley rail, having been designed by H. J. Stanley, the city engineer of Cincinnati. Where the streets are paved, and kept in clean condition, the grooved rail has proved very acceptable both to the public and the street railway company. Where the rail is laid carefully to gauge, and the wheels properly mounted, it is not observed that it requires very much more power to operate the cars than over a side bearing rail, but it is not adapted to macadamized streets, nor streets that are left habitually dirty. With these conditions the experience that has been had with the grooved rail in New York, and other cities, is being repeated, that where dirt accumulates in the groove, traction is from 30 to 40 per cent. greater than with a side bearing, or T rail. The experiment in Avondale led to the adoption of the same type of rail in all the new construction throughout Cincinnati. With this rail the pavement, whether it be of brick, asphalt or granite, is laid flush with both sides of the rail, so that vehicles do not follow the tracks, as is the case with other types of rail. This avoids blockading the cars, and there is very little tendency for wagon tires to cut into

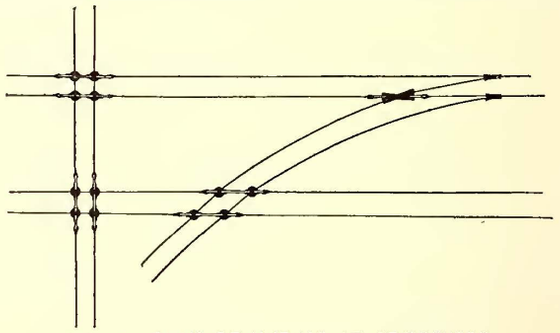


FIG 4.—PLAN OF WIRING AT CROSSINGS.

the pavement along the edge of the rails, and the rail is not distorted by heavy loads, resulting in a great saving in track repairs.

To comply with the requirements of an Ohio state law, for the employment of vestibules on all electrically propelled cars for winter service, the Cincinnati Street Railway Company last winter provided most of its closed cars with vestibules. The ordinary construction of these additions is shown in the accompanying illustrations. Generally only one end of the cars is vestibuled, and an opening is left on one side. As a general thing the motormen take kindly to the vestibules, as they provide protection to a considerable degree in cold and stormy weather. In case, however, the cars are to be run backwards, the conductors find it very difficult to handle the trolley poles through the vestibule window.

All of the tracks of the Cincinnati Street Railway Company's system make a loop at the city terminal, and all touch or encircle Fountain Square. Turntables or loops are also provided at the suburban ends of the lines, so that the cars are turned and always run in the same direction.

Cincinnati is now a city of 340,000 population, and there are numerous suburban cities, or villages, to which the street cars cater, and which are shown on page 417.

Cincinnati Street Railway Company and Mt. Adams & Eden Park Inclined Railway Company.

The majority of the mileage in Cincinnati is controlled by the Cincinnati Street Railway Company, and the Mt. Adams & Eden Park Inclined Railway, which are both virtually under the same management, and are locally known as the consolidated system. Of these systems John Kilgour is president and general manager, James A. Collins secretary, and John Harris and John C. Weaver superintendents. Mr. Harris has been engaged

in the street railway business in Cincinnati for twenty-eight years, having entered the service of the Cincinnati Street Railway Company in 1866 as stable boss, in the stables which were originally located where the Government building now stands, and in all these years he has not loss a day on account of ill health.

During the last year, as has already been stated in these columns, all the franchises of these companies were renewed, and grants for a number of extensions secured. In granting the new franchises and extensions, the conditions imposed were perhaps more burdensome than those required by any other city of the country. Under the old franchises the companies were required to pay two and a half per cent. of the gross receipts into the city treasury, and to pay an annual car license of $56 per car. By the new conditions, which are to go into effect as soon as the remaining horse car lines are all electrically equipped, and which it is expected will be accomplished before the end of the present year, the company is required to pay 5½ per cent. on gross receipts, and to pay an annual car license of $4 per foot, inside measurement, for each car, so that it is estimated the entire payments to be made by the consolidated system into the treasury will amount to at least $110,000 per annum. This payment, however, is in lieu of all expenses for street paving, except repairs which the company is required to make whenever it tears up a pavement for any cause, but it is not required to furnish new material for paving. The entire amount received from the street railway companies is set apart in a fund "to be applied to the cleaning and repairing of the streets wherein the tracks of such company exist."

It is also required in the new conditions that a general system of transfers be provided, so that when the extensions are completed transfers without extra charge will be issued at 125 points, including trips in both directions.

The extensions which are now in process of construction will aggregate about sixty miles. The company is also engaged in reconstructing most of the lines in the business portion of the city, embracing about fifteen to twenty miles. This re-construction includes the horse car

FIG 5.—CLOSED CAR—CINCINNATI STREET RAILWAY.

tracks, and a considerable portion of the electrical construction on which a fifty-two pound girder was originally employed. Some of this construction has been in service only about six years, but has failed to such an extent that it was necessary to renew it. Other portions have been in service for only a year or two, but with the requirements for new paving new rails are included, and the whole system is being rebuilt.

In the process of construction the pavement is removed, and the surface excavated to a depth of twenty inches. The foundation is then rolled with a steam roller having a weight of 250 lbs. per lineal inch of surface measure. The oak ties, 6×7 ins., × 8 ft., with joint ties 6×12, are then placed with two foot six inch centers. The rails are then spiked direct to the ties and the tracks surfaced up and supported on wooden blocks. A foundation of concrete six inches in depth is then placed under the ties, and the space between the ties filled with concrete and tamped. In case asphalt or brick is employed, the concrete is also placed above the ties, so that they are entirely enclosed in a pocket of concrete. Where granite paving is to be employed the concrete is brought to a level with the ties, above which is two inches of sand to receive the

FIG. 6.—OPEN CAR—CINCINNATI STREET RAILWAY.

blocks. On all paved streets the full grooved girder rail, weighing ninety-five pounds per yard, is employed which with granite paving is required to be eight inches in depth. With asphalt and brick the same pattern of rail is employed, but the depth is only six inches and the weight eighty-six pounds per yard. The rails were manufactured by the Johnson Company and are known respectively as Nos. 216 and 200. The special work employed is of the Johnson Company and Weir Frog Company's manufacture. The joints are supported on the twelve inch ties, and are united by means of heavy (twelve inch bolt) fishplates. The base of the eight inch rail is five and a half inches wide, but that of the six inch rail is six inches.

In the process of construction the concrete is mixed on platforms resting upon the rails, and so provided with guides that they can be slid along on the track as the construction proceeds. The proportions of the concrete mixture are as follows: One sack of cement, one barrel of sand to three barrels of broken stone. A portion of stone employed between the ties consists of the old concrete foundation broken up, but fresh stone is employed under the ties. With the old concrete the proportion of cement is also slightly increased. Both asphalt and brick paving are employed to a considerable extent on the Cincinnati streets. In the opinion of the City engineer asphalt is somewhat the best, although vitrified brick is giving very excellent service. Some of the streets of Cincinnati are subject to an unusually heavy and peculiar traffic. For hauling coal to the higher portions of the city very large heavy horses are employed, and these are usually driven in teams of four, and when newly shod, the toe calks are nearly an inch in depth, so that if the animal brings his shoe down near the edge of a paving brick, the excessive weight is apt to chip off a small portion. Except for this traffic the brick paving is quite satisfactory.

The cost of the new track construction, as described above, including the repaving, and renewing of the blocks that are worn out is about $38,000 per mile of single track, or $76,000 for a double track. Where it is possible to construct both tracks at the same time the cost is a little less than the latter figure. This is claimed to be the most expensive street railway track that has ever been

built for electric service in this country on so large a mileage.

ROLLING STOCK.

The Cincinnati Street Railway Company operates on an average seventy horse cars, thirty cable trains, including a trailer in busy hours, and 150 electric cars. The Mt. Adams & Eden Park line employs forty electric cars, and thirty cable trains. In the fire which destroyed the Avondale car barn last winter the Cincinnati Street Railway Company lost eighty-four cars and thirty motor equipments. One car equipment with the Genett air brake was also destroyed. These have been replaced with a new equipment including forty closed cars built by the

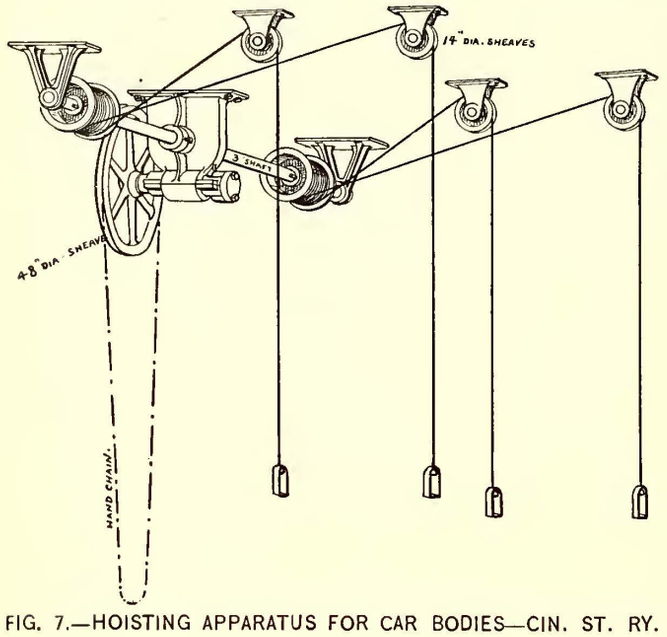


FIG. 7.—HOISTING APPARATUS FOR CAR BODIES—CIN. ST. RY.

Barney & Smith Company, of Dayton, O. These cars are eighteen feet inside measurement, and twenty-six feet over all, not including the bumpers. They are provided with a vestibule at one end, which is open on the left side. The window sashes are usually large and are stationary, there being only four lights on a side. These consist of French plate, 32 × 48 ins., and three-sixteenths of an inch in thickness. The cars are finished in cherry, natural wood, with a birds-eye maple ceiling. The ceiling, in some of the cars, however, is of prima vera, or white mahogany. The mirrors are of chipped French plate, and the decklights are also of chipped glass. The seats and backs are upholstered in dark scarlet.

The cars are provided with electric heaters of different types. Most of them, however, are of a type devised by the electrician of the company, and built in the company's shops. Electric and oil headlights are provided. The front dash of all the cars is provided with a tapering mitered board or strip, for the purpose of supporting the headlight. These are placed over the narrow portion of board, and slid down so that they are held firmly in position.

There are also ten cars which were built by the Laclede Car Company, of St. Louis, after the same specifications. The vestibules were adopted in order to comply with the requirements of a state law, which has now been pronounced unconstitutional, because it specified that electric cars only should be thus equipped. Most of the closed cars, however, were provided with vestibules last winter, at a cost averaging about $35 per car, and as noted above, not as much objection is found to the use of the vestibules as was anticipated. The motormen being required to pay for broken glass, or damage to the car from collisions, whenever it is the result of their own carelessness, have learned to be more careful, and the loss in this direction has been very light.

Among the new open cars there are sixty built by the American Car Company, and twenty by the Laclede Company, of St. Louis. These cars are twenty-nine feet six inches over all, and are provided with cross seats, having spindle backs, with bronze seat arms, and provided with rigged hand rails on the posts. The deck lights are of French chipped plate, and the cars have a seating capacity for forty-five persons. All the cars of the two systems are painted yellow, two shades only being employed, lemon yellow and cadmeum. In order to designate the different routes, four sided roller signs are employed. These are placed on the hoods, and also on the sides of the roof, and are painted red or yellow, and lettered with black or red-brown. Specifications were sent out recently, and bids asked for 110 new closed cars. Fifty-six of these will be built by the Barney & Smith Car Company, of Dayton, O., and the rest by the Laclede Car Company.

The advertising privileges are let to Carleton & Kissam, and the cars are all provided with the well known advertising racks controlled by this firm. The electric cars are built to run in one direction only.

A variety of trucks are employed. There are about eighty of the Bemis type, eighteen of the Brill manufacture, including Nos. 31 and 13; seventy-five of Peckham's manufacture, latest type; thirteen of the McGuire Columbian trucks, and one of the Barney & Smith. Double motor equipments are employed, and these embrace seventy-four of the G. E. 800, thirty-three F 40 Thomson Houston type (double reduction); fifty equipments of the W. P. 50 type; twenty-five equipments of the S. R. G. motors, and fourteen of the Westinghouse. The G. E. 800 are among the latest types purchased, and twenty-five equipments have also been recently ordered from the Card Electric Motor & Dynamo Company, of Cincinnati, and twenty of the Sperry motors have been ordered. The motor equipment of the Mt. Adams & Eden Park system embraces W. P. 50's type, the G. E. 800, and the G. E., F 30 of the Thomson-Houston style of motors. A 300 lb., thirty-three inch wheel is generally employed on electric cars, and the more recent purchases have been from the Mowry Car Wheel Works, of Cincinnati. On the cable cars, the Wharton double tread wheels are employed, which are designed to be operated with the elevated switches.

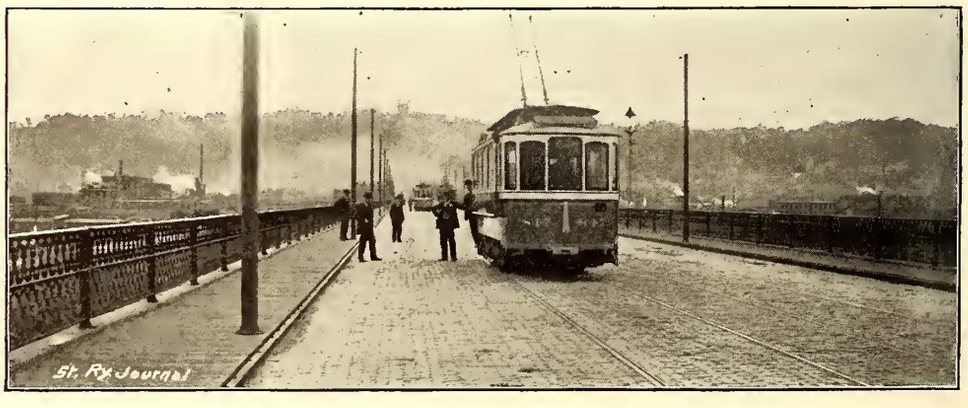


FIG. 8.—EIGHTH STREET VIADUCT—CINCINNATI STREET RAILWAY.

FARES.

The fare is five cents, with a three cent fare for children under ten years of age, or two children's fares for five cents. On all of the horse car lines six tickets are sold for twenty-four cents, or twenty-five tickets for $1. A lump sum is received from the Post Office department for the fare of mail carriers and messengers who ride on their uniform. The employes' tickets are issued to the heads of the departments who issue to such employes as require them, the tickets being punched by the issuing officer. Before the practice of issuing tickets to the heads of departments was adopted, a very large number of employes' tickets were required, but after the introduction of the above arrangement, their use fell off about half.

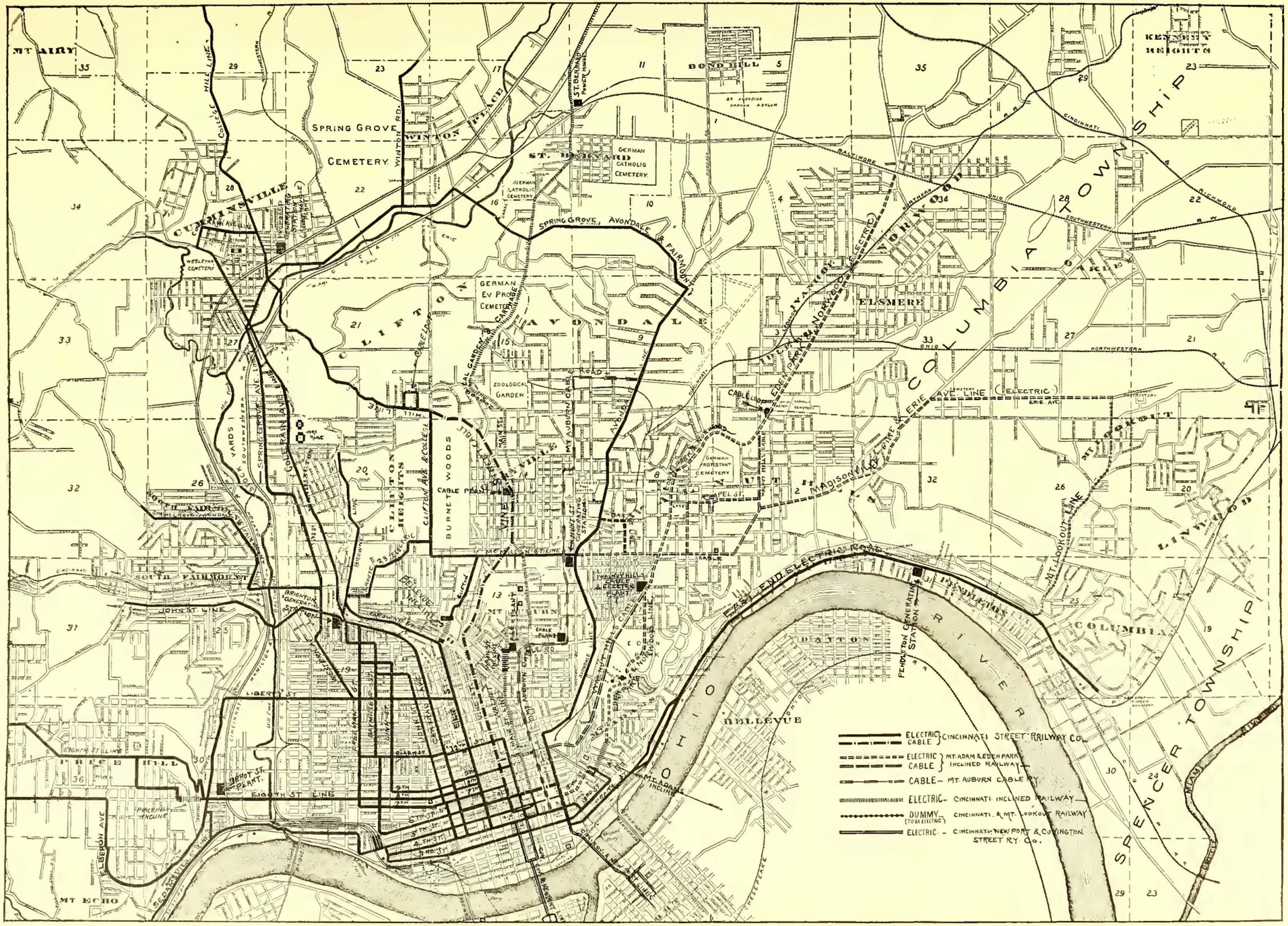


FIG. 9.—MAP OF CINCINNATI, SHOWING THE STREET RAILWAY SYSTEMS.

By the new ordinance the company is required to issue transfers as noted above, over all connecting lines and extensions, Walnut Street being the dividing line for the city. Coupon tickets are employed, which are numbered, and the day, hour and minute indicated in the ordinary manner. Transfers are issued only to passengers paying five cents cash fare, and must be called for at the time the fare is proffered. In issuing the transfers the conductors retain the coupon, which they return to the receiver, and for which they receive new tickets, being required to purchase their original supply of transfer tickets from the receivers. The present system of transfers is not wholly satisfactory to the management, and a new system will probably be adopted as soon as one is devised. Considerable loss is experienced from the abuse of the transfer privilege by passengers, and some by conductors. The conductors are provided with the bell punch and the new model registers, and punch their trip slip to indicate the fare, whether full or reduced rates.

The pay of the conductors, motormen and gripmen is $2 per day of twelve hours. Extra men are paid at the same rate. A deposit of $50 is required from conductors, and $25 from motormen.

POWER STATIONS.

The evolution of mechanical traction in Cincinnati is more strikingly indicated by a study of the power equipment than by almost any other feature, experiments having been made in the electric stations with a number of different types of boilers, engines and generators. There are now three electric power stations, with two additional in process of construction; two cable power stations, and two for operating the inclined railways, and a new one building, so that when the new ones are completed the entire engine equipment of the consolidated system as now planned will aggregate 17,300 H. P.

The first electrical station to be equipped was that at Brighton, in 1889, and the power plant was located in the basement of one of the principal car barns. The first engine installed was a Corliss, having cylinders 22 × 42 ins., of the Hooven, Owens & Rentschler Company's manufacture, from which power was transmitted to a line shaft, and two Ball high speed engines, with cylinders 16 × 16 ins. were installed, and were belted direct to four D 62 General Electric generators. These were so arranged that the generators could be run from either the line shaft or from the high speed engines. As the traffic increased two more Corliss engines were added, one having cylinders 24 × 48 ins., and the other 24 × 54 ins., with a new line shaft, and an additional equipment of generators of the same type until the number reached seventeen. There being no more room in the old station, a new brick building or extension has been added (80 × 120 ft.) with the roof supported by timber trusses and tie rods, this building being used for an engine and generator room only. The power equipment of this new station consists of two Buckeye engines of 750 H. P., each one of which is a tandem compound, run non-condensing, the cylinders being 20—32½ × 36 ins, and is run at 114 revolutions. These are coupled direct to a Siemens & Halske generator of 480 K. W. capacity. The flywheel is placed between the crank and generator, and is fourteen feet in diameter and weighs sixteen tons. The generator is ten feet six inches outside diameter, the fields being inside of the armature, and the commutator on the periphery of the machine, as previously described in these columns. The machine has eight poles, and consequently eight sets of brushes, with four brushes to each set. These are held in position by an adjusting mechanism.

The second engine is a single cylinder, 28½ × 36 ins., and is run at 110 revolutions. The flywheel is belted direct to an M. P. General Electric generator of 500 K. W. capacity. The belt is fifty inches wide, and the shaft centers are about forty-five feet apart. Both generators are connected with the same circuit, and the rated capacity of each machine is about 900 amperes, but both at times have made an output of 1,200 amperes at 550 volts, for a period of five minutes or more without apparent injury.

The switchboard of the Siemens & Halske machine is provided with Westinghouse instruments, and with a Siemens & Halske rheostat and field switch. The board for the General Electric generator is equipped with standard slate panel switchboard and the feeder with switches and instruments manufactured by the Card Electric Motor & Dynamo Company of Cincinnati. An overhead, hand power traveling crane of ten tons capacity, is provided to facilitate the handling of the heavy parts.

The power station has capacity for two additional units of power, one of which is now being installed. This consists of one McIntosh & Seymour tandem compound, non-condensing engine with cylinders 20 and 32 × 36, ins. with rated capacity of 1,100 H. P. This is belted direct to a pair of M. P. General Electric generators of 300 K. W. capacity each. The receiving pulley is placed between the two armatures, and friction couplings being provided, either one or both of the generators may be operated. The shipping weight of the new engine and attachments was 190,000 lbs., 65,000 lbs of which is in the flywheel pulley (fourteen feet in diameter and sixty-five inches face). The additional equipment being in place, the station will then have three varieties of equipment, and will furnish a very excellent opportunity for studying the relative merits of different types of engines, and methods of coupling. The first, as noted above, is a tandem compound, non-condensing, direct coupled engine; the second, a single cylinder, high pressure engine, belted direct; and third, a tandem compound, non-condensing, belted direct to two generators; the steam supply for each engine being from the same source. The second of the new equipments is to be a McIntosh & Seymour tandem with generators, the same as those described.

The boiler equipment for the Brighton station is located in another building, formerly occupied as a stable, and consists of four Babcock & Wilcox boilers, of 400 H. P. each, but often run to 500 H. P., set in two batteries. Both boilers are fired by the Roney mechanical stokers. The station has room for twelve boilers, and two additional are now being installed. The smokestack is 175 ft. in height, with a flue eleven feet six inches in diameter. The boilers are distant from the engine room about 160 ft., and the steam is delivered to a receiver, four feet in diameter and twelve feet high, in the engine room, through a riveted steel main twenty inches in diameter, properly protected and running through a tunnel under ground. The steam is led from the top of the receiver to the different engines, the water of condensation being drawn off at the bottom of the receiver.

We have not space to describe in detail the other stations, but the original equipment of the principal station consisted of Corliss engines with countershafts and D 62 type of generators. The equipments of two of the principal stations, that of Hunt Street, and the Pendleton station on Eastern Avenue, were increased about a year and a half since by the addition of a Corliss engine belted direct to an M. P., 300 K. W. generator in the first case, and to a 500 K. W. in the second, and the former station has recently been increased by a Frick-Corliss engine taken from the Brighton station, which is also belted direct to a generator of the above type. Both these stations have Babcock & Wilcox boilers, and Murphy furnaces. During the hours of heavy traffic all the engines in all the stations are in operation.

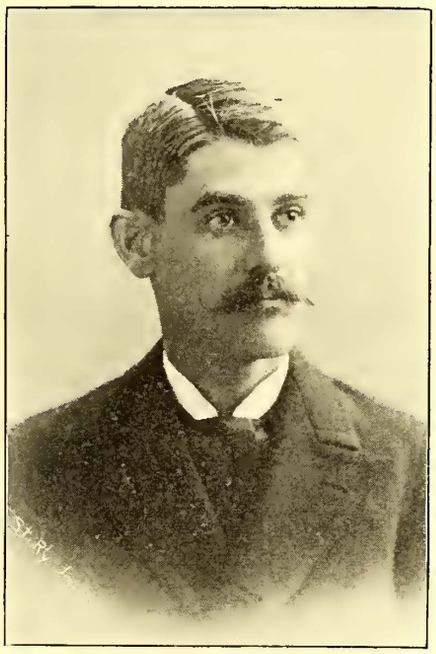
At different points in the station, dependent cords or ropes are provided, which operate over small sheaves along the ceiling or roof trusses, which connect with the cut-off valves of the engines, and by means of which, should an accident of any kind occur, the engineer or attendant can immediately shut down any one of the engines wherever he may be about the station, without the necessity of going to the throttle valve.

A new station is now being erected on Depot Street, near the Price Hill incline, adjoining one of the company's car barns. The building is to be of brick, and the dimensions of the engine room are 80 × 200 ft., and the boiler room, 54 × 200 ft. The first equipment will consist of four McIntosh & Seymour engines, of the tandem compound type, the same as described for the Brighton

station, and these will each be belted direct to a pair of M. P., 300 K. W. Thomson-Houston generators, as in the other station. The steam equipment will consist of seven boilers of the Abendroth & Root type, of 400 H. P. capacity each, and these will be fired by the Roney stokers. Economizers and mechanical draft will be employed, as the formation of the locality is quicksand, and it is not deemed expedient to erect a brick stack. It is expected this station will be in operation by September 1. The installation of the draft apparatus is being made by Westinghouse, Church, Kerr & Company.

Another plant is also to be built this season at Cumminsville, and an addition is being made to the Walmut Hills cable plant, for additional electric power, consisting of two Hamilton-Corliss engines, size 32 × 54 ins., and four belted M. P. 300 generators.

A new car barn is being constructed near the Hunt Street power station, and is designed to have a capacity for storing 100 cars. The ground plan is 200 × 180 ft., and it is covered by a double roof, each of 100 ft. span. The framework and roof trestle are of steel, and are enclosed with a brick wall laid up between the columns. The covering for the roof consists of three inch, yellow pine planking covered with tin. Each division of the barn is provided with ten tracks, and one side will be utilized for storing cars that are not in service, and the other will be employed for housing the operating cars at night. All the power stations and the new car barns have been designed and equipped under the direction of Bert L. Baldwin, mechanical engineer of the company.

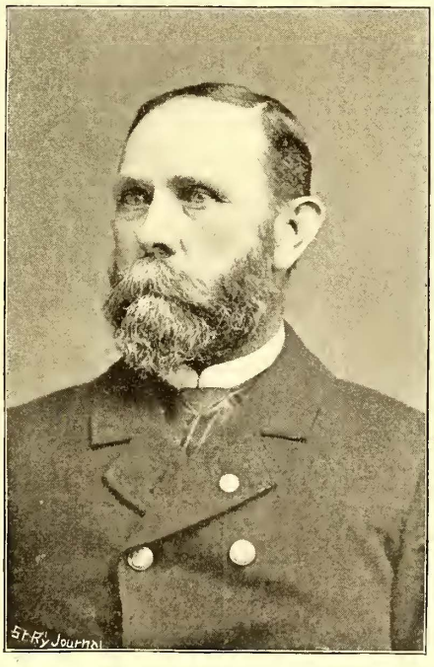


H. P. BRADFORD,

GENERAL MANAGER CINCINNATI INCLINED PLANE RAILWAY CO.

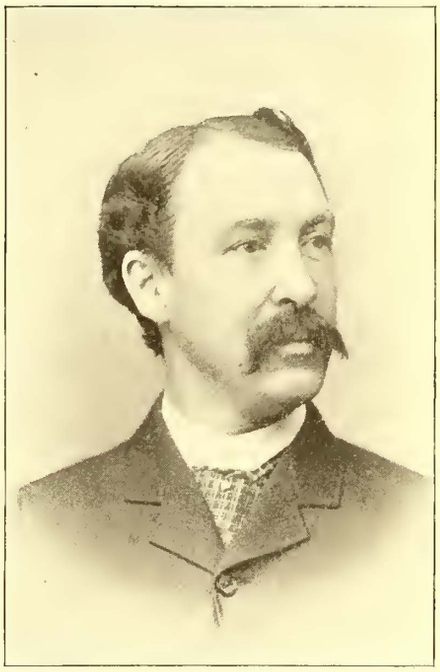
JOHN HARRIS,

GENERAL SUPERINTENDENT CINCINNATI STREET RAILWAY CO.



JOHN C. WEAVER,

SUPERINTENDENT EDEN PARK INCLINED RAILWAY CO.



JAS A COLLINS,

SECRETARY CINCINNATI STREET RAILWAY CO.

THE CITY.

Cincinnati is located on the north bank of the Ohio River, in the southern part of the state, and borders the river for a distance of about ten miles. The topography of the location is very irregular and broken. The business portion of the city occupies a plateau, three miles in width, which rises abruptly from the river to an average elevation of about eighty feet, and which is backed by an irregular line of bluffs having an average altitude of over 300 ft. above the river, over and beyond which the city has already spread. The principal hills are named, respectively, Mt. Auburn, Price Hill, Clifton, Mt. Adams, Avondale and Walnut Hills. Walnut Hills is on the northeast, and extends almost to the bank of the river. The heights are all reached by inclined planes, cable roads and, in some instances, by the electric lines, so that the rapid transit facilities of the city embrace almost every known method of traction, including horse car lines, cable and electric roads, inclined planes, and one dummy line. There are six inclined planes, on four of which the electric cars are transferred from one level to the other, and continue their course. The planes are provided with triangular shaped trucks, with platforms on a level, so that the electric cars are readily run on or off at the terminals. All the inclines are provided with the latest types of safety devices, and are operated in a very safe and satisfactory manner.

An effort was made by the Cincinnati Street Railway Company some time since, to get control of the Price Hill incline, and equip it for transferring the electric cars, the same as on the Bellevue line, but failing in this it has graded, and is building a zigzag line up the heights in the neighborhood, over which the electric cars will be operated. The grade in some sections will be as high as 11 per cent.

REPAIR SHOPS.

The present repair shops of the Cincinnati Street Railway Company are located near the Pendleton power station, on Eastern Avenue. The car barns have a capacity for eighty cars, and the wood working department occu-

pies a separate building on the opposite side of the street. The iron working tools are located in the basement of the car barn. These are operated by power from a Card motor of twenty-five horse power, which also operates an elevator between the two floors. The tool equipment is very complete, including planers, lathes, automatic gear cutters, wheel borers, etc. In the blacksmith shop are seven forges. The tin or sheet iron shop adjoins the machine shop, and there is also a very large storage room for extra wheels, axles, etc.

In the manufacture of thimbles for the motor fields, the flanges or collars are made by bending the metal into shape, which avoids the use of solder, as has been the practice heretofore, and which sometimes was melted by the heat, necessitating frequent repairs.

For the purpose of removing car bodies from trucks, a hand hoist (Fig. 7) is provided in the car barn, which is operated by a chain running over a sheave near the ceiling, and through worm gearing the power is communicated to two grooved rope drums, from which four half inch wire ropes are led over guide sheaves, in a position to bring two of the ropes on each side of the car, and near the ends. To the ends of the ropes iron stirrups are attached, of sufficient size to receive bars, by means of which, when placed across under the floor, the body is readily lifted or lowered, as the case may be. The shops are operated under the management of Patrick Leen, master mechanic.

A new incline has recently been built by the Cincinnati Company, which operates up the bluff near the Brighton station, and which is designed to transfer the electric cars over the route known as No. 23. The incline is 700 ft. in length, and on a 35 per cent. grade. The track is laid for the most part on the solid rock, which was graded out for the purpose, and there is 150 ft. of trestle work. The line is double track, and the rails are laid as in steam practice. A new brick station with brick smokestack stands at the head of the incline, and the power is to be supplied by a pair of Lane & Bodley Company's coupled link motion engines.

The Vine Street cable line, which is included in the Cincinnati Street Railway Company's system, has been in operation since 1887, and is still running in a very satisfactory manner. The tracks, except the curves and on sections where the electric cars pass, is still in good condition. The curve construction in some places has been removed, and the joints are being strengthened on those sections occupied by the electric cars. Originally the rails were laid with suspended joints, but heavier connections are being employed, and a block support is being placed under. The original grip, which is of the Lane type, is still employed.

The ropes are purchased for the most part from the Hazard Manufacturing Company, and generally last for a service of from 30,000 to 35,000 miles. Very little change has been made in the power station since it was first built, except that one set of winding drums has been renewed to provide for the wear in the grooves. The engines, which are of the Lane & Bodley manufacture, have been in steady service since installation, and are still in good condition, having had very little repair.

In the opinion of the general manager, the cable traction is cheaper and more satisfactory to operate than electric lines, where the traffic will warrant the building of a cable line. He is also of the opinion that there is not much difference in the original cost of an electric or cable line where the construction in each case is done in an equally thorough manner. Of course this is on the supposition that there are not many substructures to interfere with the excavation for the cable construction. This line was built from designs furnished by H. M. Lane, of Cincinnati, who was general engineer of construction.

The cable line of the Mt. Adams & Eden Park Incline Railway Company, which embraces eight miles of track, is also still working in a satisfactory manner.

MEDICAL DEPARTMENT.

The medical department of the system is in charge of Dr. C. S. Muscroft, who was formerly assistant to his father when he held the same position, and to which the son succeeded on the death of the latter in May, 1888.

The methods employed in this department are along the same lines as those recommended in the articles which have appeared in these columns during the last year, on "The Medical side of Street Railway Practice." The conductors on each of the lines are provided with cards, which are issued by the superintendent, and which read as follows:

"Notice to conductors:

"In case of personal injury occurring either to passenger, public or employe, in connection with your car, at once notify the company's surgeon, and state from what point the telephone message is being sent; also, if possible, the disposition of the injured person, whether going to the hospital or home.

"Dr. C. S. Muscroft, Telephone, Office and Residence 1410. John Harris, Supt.

"(Keep this card about you.)"

On the back of the card are the telephone numbers of each of the officers and of the power stations, and also the names of the officers of the company, together with the names of the heads of the departments. Arrangements are also made with the police department, so that in case of accident the police exchange notifies the surgeon, and states to what hospital the injured person has been sent, or what disposition has been made of him.

As soon as notice of injury of any kind is received, the surgeon at once responds, and in case another surgeon has been employed the company's surgeon co-operates with him and makes thorough notes of the case. In case it appears that the company is in any way responsible for the accident, the patients are treated in a private ward of the hospital, or at their homes, as the case may be, at the company's expense, which includes the drug bills as well as the surgeon's services. All employes who are injured while on duty also receive medical attention free of expense. They are not, however, treated for sickness.

The surgeon, in responding to a call, carries with him a case of instruments, sufficient to perform an amputation, if necessary. In case a call is received while the surgeon is absent from his office, he telephones for a messenger to meet him with a case of instruments. Every power station is provided with a case of medicines and appliances such as can be handled by a person of ordinary intelligence, and in each case the surgeon gives the engineers, and others in charge of these stations, instructions in the use of appliances where the injury requires prompt action, such as washing injured parts and applying bandages or tourniquets to prevent bleeding.

In case an accident occurs where the company is evidently not at fault, the surgeon does not take charge of the case, but in all cases reports to the company on blanks provided for the purpose. These reports are filed with those made by the conductor, and any reports that may come from other employes. The surgeon also co-operates with the claim department, and advises regarding the settlement of accident claims.

The surgeon examines all car employes before they are assigned to duty, but as to their eyesight only. Cross eyed men, or men with only one eye, are not engaged. In the re-examination of all the employes in the system, only two men were found who could not tell the name of the letters presented, or, in other words, who could not read. The practice of examining employes to test their eyesight grew out of an accident which occurred, where the conductor started the car before a passenger had alighted, when it was discovered he was blind in one eye, and hence did not see that the person had not left the car.

Cincinnati Inclined Plane Street Railway Company.

This company, of which H. H. Littell is president, and H. P. Bradford is general manager, has been prominent in street railway legal literature for a number of years. The contest with the telephone company, when it was first proposed to adopt electric traction, and the signal triumph of the street railway company against the opposition to electric traction, or rather the single trolley system, is the most prominent suit in which the company has

been engaged. Recently, however, it has again gained prominence from the efforts of the city solicitor to annul the company's charter, and deprive it of its corporate rights. In the preliminary suit the city was victorious, and an order was issued, restraining the company from operating its line in the principal streets after a certain period. Afterwards, however, this decision was reversed by the higher court, and it was held that inasmuch as the company was operating virtually under a steam railway franchise, the concession granted by the city and state, the company was entitled to use the streets on which its tracks were laid. Under the franchise, the company is not required to pay any car license, or any per cent. on the gross receipts into the city treasury. This suit has been appealed to a higher court, and is still pending.

Notwithstanding the difficulties under which the company has labored, and the prejudices engendered by the suits, the line is doing a better traffic to-day than ever, and a gradual increase is noted from month to month, and especially over the corresponding months of last year, so that it is one of the few lines in the country on which the traffic has steadily increased, notwithstanding the financial depression that has prevailed. This increase of traffic has been induced, doubtless, by careful management, and by attention to all the little details of service which make a line popular with its patrons.

The city terminal of the line, makes a loop about the government building, touching a corner of Fountain Square as do all the other lines in the city, with one exception. The first division is divided by an incline plane which starts at the head of Main Street, on which the cars are transferred to the upper plane, when they continue their course over a thickly settled route to the original terminal of the line at the entrance to the Zoological Gardens about four miles from the Post Office. More recently, the tracks have been extended to Carthage, O., a further distance of four miles, to which the passengers are transferred, and over which a second fare is required, so that the entire distance is about eight miles from the Post Office, embracing a single track mileage of sixteen miles.

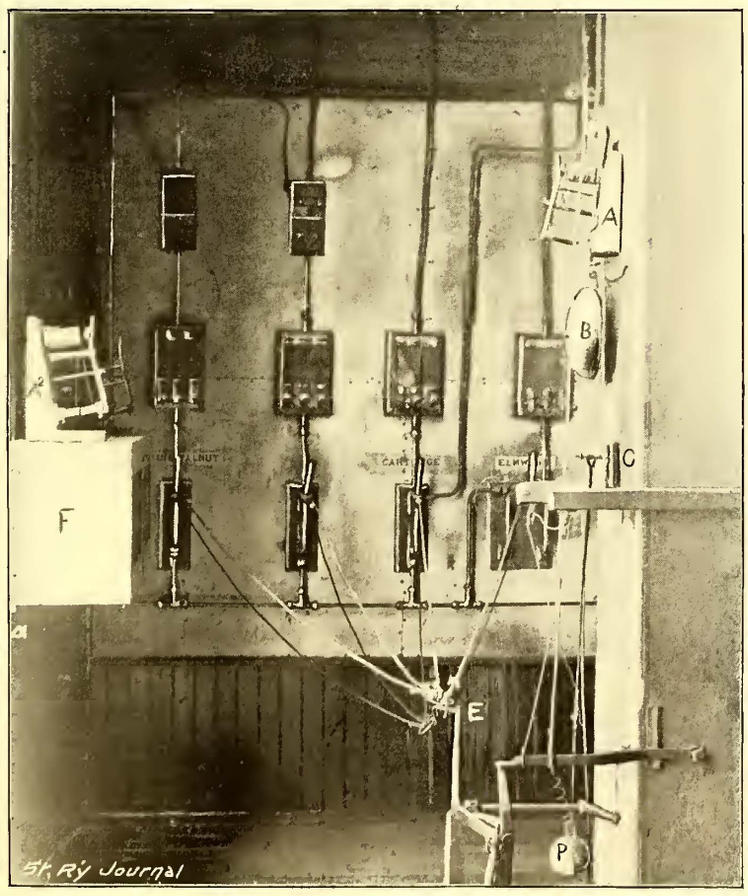


FIG. 10.—LIGHTNING ARRESTER AND CIRCUIT BREAKERS—CINCINNATI INCLINED PLANE RAILWAY.

The number of grades is very considerable, especially on the approach to the foot of the incline, where for several blocks there is a 13 per cent. grade, and the cars are run upon the incline trucks over a sharp curve on the grade. The grades and radius of curve at this point have been somewhat diminished, so that the approach is much easier than it formerly was. The incline is a double track road 960 ft. in length, and has a varying grade from 35 to 25 per cent., the total rise being 312 ft.

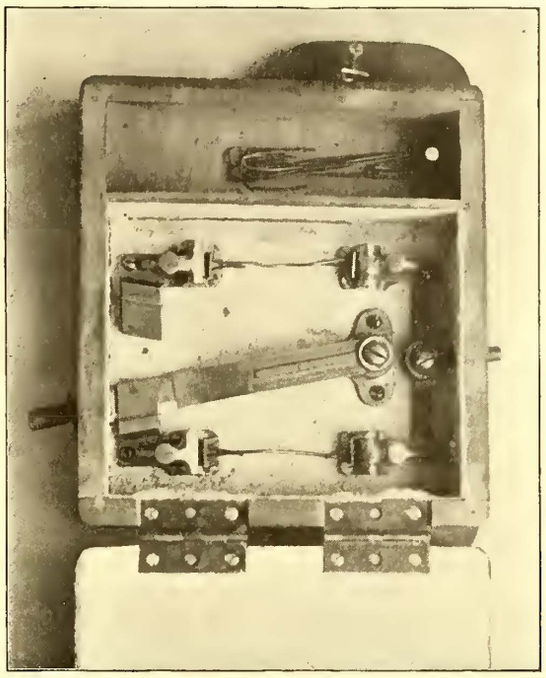


FIG 11.—DOUBLE FUSE BOX AND MAGAZINE—CINCINNATI INCLINED PLANE RAILWAY.

Before leaving the city, the line crosses the canal, makes the ascent of the inclined plane, and continues on over the brow of the hill to New Mt. Auburn, Clifton and Avondale, and descends the northern slope, where, just before reaching the power station at St. Bernard, it recrosses the canal at the same level.

The line is operated from two power stations; one is located at the head of the incline, and forms a part of the power plant which hauls the cars up the incline. The buildings and repair shops at this point are plain wooden structures, but the equipment, although not in all respects up to that employed in recently constructed power stations, is standing up well under the traffic, and has made a very excellent record.

The station equipment consists of two Lane & Bodley Corliss engines of 250 H. P. each, and one "Brown" engine of 150 H. P. These are belted to a countershaft, from which two No. 32 and four No. 20 Edison generators are operated. One Ball engine, 150 H. P., formerly employed in this station, has been transferred to the new station near the terminal.

The boiler equipment consists of four 150 H. P., tubular boilers which also supply steam for the engines of the incline. At night one engine operates the entire system, and frequently furnishes power for all the cars, the average number operated being twenty-six.

Included in the electric equipment of the station is a lighting arrester and attachments which have been devised by the electrician of the company, and since the placing of these arresters in the circuit, no burnouts have occurred from the atmospheric discharges, and the lines are never shut down during the most severe electric storms. Although there are a number of arresters of other types in the cir-

cuit, this is always the first to operate. The arrester shown at A (Fig. 20), consists of two carbon brushes attached to a lever and which at normal position are held about one-sixteenth of an inch apart. The opposite end of the lever is supported above a magnet which serves to tip the lever and break the arc as soon as it is formed.

Supplementary to the arresters is a tripping mechanism which serves to throw out all the circuit breakers whenever the arrester operates. This mechanism consists of a lever and two weights, one, D, shown in the engraving, and the other beneath the floor, and cords which connect the principal lever with the handles of the circuit breakers. The tripping weight is supported by a cord and hook which are held in position by a small copper fuse, C, placed in a horizontal position, and which forms part of the ground circuit from the arrester. In case an arc is formed through the arrester, the fuse blows, which allows the trip weight to drop. This unlatches the heavy weight which operates to open the circuit breakers, E, and sounds the gong, B. Extra fuses are kept in position beside the arrester, and as fast as one blows a new one is inserted, and the circuit breakers are immediately returned to position by the attendants. A duplicate arrester is shown at A 2, and they are also placed at intervals along the line.

The coal for this station is hauled by wagons about a mile, from the barges on the river to the foot of the incline, where it is dumped into coal cars which are attached to the incline truck, and by it hauled to the top where the coal is dumped through the trestle, and delivered at the door of the boiler room.

The second, or new power station, as before noted, is located at Ludlow Grove, on a siding of the Baltimore & Ohio Railroad, from which coal is delivered direct from the cars to the boiler room. The manager has laid in a supply of coal sufficient for operating both stations until Christmas, the object being to prevent any possible delay on account of a coal famine that might be the result of the miners' strike.

This new station is a frame building with a corrugated iron sheeting, the engine and boiler rooms being separated by a considerable space. The equipment consists of a 250 H. P., "Brown" engine manufactured by I. & E. Greenwauld of Cincinnati. This is belted to a countershaft, from which two No. 32 Edison generators are operated. There is also the Ball engine which has been transferred from the other station as above noted. Three tubular boilers of 150 H. P., each supply the steam which is led from the boilers to the engines in an underground main.

When the station was first constructed, the supply pipe led from the top of the boiler across to the engine room, and was depressed to connect with the cylinders, in which position the pipe vibrated considerably from the reaction of the exhaust, so much so that it was impossible to keep the joints tight, and the leakage of steam kept the engine and boiler room in a damp condition. Since the supply pipe was placed under the ground, no leakage has occurred. The feedwater is drawn from artesian wells and leads through a feedwater heater.

The station is kept in an exceptionally neat and tidy condition, and the engineer has given it an air of comfort and produced a pleasing effect by painting the engine and generator parts in brilliant colors. The same practice of painting the flywheels and generator fields in bright colors, is also practised in the old station, the edge of the flywheel rims being a bright yellow, and the generator fields a scarlet.

ROLLING STOCK.

The company owns forty-two cars, but the average number operated is twenty-six. The closed cars have cross seats, and the end doors are placed to one side, the end seat in each case being longer than the other, and is backed against the end of the car.

The trucks are one of the early types of Brill manufacture, and the Sprague No. 6 double reduction motors are employed, and although they have been long in service, are still working well. This is a single trolley road, and is the only single trolley operated in the city.

Formerly the car fuse box was placed under the seats, and sometimes, especially when approaching the the incline over the steep grade noted above, the fuse would blow, which tended to frighten the passengers. More recently a double fuse box has been provided, and this is attached in the usual manner under the side of the car. The fuse box being double, as noted in the engraving (Fig. 11), in case one fuse blows the motorman has only to throw the switch handle, which brings the second fuse into service. The box is also provided with a magazine or separate apartment, in which extra fuses are kept, so that the fuse box is readily re-equipped in case the fuse burns out. It is the duty of the inspector to notice that extra fuses are always provided in the magazines. The rolling stock also includes six open cars which were built by the American Car Company.

There has been no change in the return circuit since the line was constructed, except the keeping up of repairs, by renewing bond wires, etc. The track being constructed with No. 58 Johnson girder rails supported on chairs, requires considerable repairing.

The city authorities will require the company to re-equip the lines with a full grooved girder rail, just like that employed by the Cincinnati Street Railway Company.

EMPLOYES.

Motormen and conductors are paid $2 per day after the first six months' service, but begin at $1.75. Before being assigned to duty, they are required to serve as students under three different motormen, and also to work in the machine shops until they become familiar with the electric equipment. They are then examined by the electrician of the company, and go on as extras. The hiring and discharge of the car men is entirely in the hands of the manager. The fare is five cents over each division. Round trip tickets are sold to residents over the two divisions for fifteen cents. The cars carry the United States mail and deliver pouches to five different offices. The motormen who carry the mail receive a special appointment or a detail from the post office authorities.

The employes are required to wear uniforms, and to carry watches, which are to be kept with the clock at the company's headquarters. A deposit of $25 is required from the motormen and conductors as a guarantee of faithful service.

H. P. Bradford, the general manager, was formerly the superintendent of the lines in Little Rock, Ark., and at the time of H. M. Littell's transfer to New Orleans, a year and a half ago, Mr. Bradford assumed control of the system.

ZOOLOGICAL GARDENS.

As noted above, the first division of this system terminates at the entrance to the Zoological Gardens. These gardens have a world-wide reputation, and are claimed to have a finer collection of animals and birds than are to be found in any similar institution in the country, and it is the only institution of the kind that has been built and managed entirely by private enterprise without municipal aid. The grounds embrace a tract of forty-five acres, broken up in plateaus, ravines and ridges, and thoroughly improved and shaded with a selection of choice trees and shrubbery, so that the natural features are not among the least of the gardens' attractions.

The cages, houses and apartments for the accommodation of the animals are of stone and iron, and constructed in a very tasty and thorough manner, being located in different parts of the grounds, so that every turn in the driveways brings one to some new station with new attractions. The collection embraces about 1,500 specimens, gathered from all parts of the world, and all are kept in an exceptionally fine condition, and have become so thoroughly acclimated, that they seem to enjoy life in captivity equally as well as on their native heaths. Additional attractions in the way of music, athletic feats, fireworks are provided during the summer season, all of which tend to induce a large pleasure traffic over the lines of the Inclined Plane Street Railway Company. A charge of twenty-five cents is made for admission to the grounds.

The Pendleton, Mt. Lookout & East Walnut Hill Railway.

This is a suburban steam dummy line, and connects with the electric cars of the Cincinnati Street Railway Company's system at Eastern Avenue. The line is about two miles in length, and is operated by self-contained, six wheel motor cars, the engine being mounted in the cab, supported by one pair of wheels, the other end of the car resting on a four wheel truck. Trail cars are employed as occasion requires.

The line is being equipped for electric traction, and General Electric motors are being employed. It is expected the change will be effected during the present season. The line is operated under the management of C. H. Kilgour.

Mt. Auburn Cable Railway.

This line, which is four miles in length, was built in 1888–89 for the purpose of conveying passengers to the heights known as Mt. Auburn, to reach which, over the then existing lines, a fifteen cent fare was required. The moving spirit in the enterprise was Henry Martin, who owned considerable property in the neighborhood, and was himself a resident of Mt. Auburn, and who became president of the company.

The line starts on Sycamore Street, at its junction with 4th, crosses the canal and ascends the heights, terminating at the Avondale Town Hall. The ascent of the bluff is over a 9½ to 13 per cent. grade, 2,200 ft. in length, terminating near the summit on a reverse curve, which is shown in the accompanying illustration. Just before reaching the reverse curve the line makes a right angle turn into Auburn Street.

The line has had a checkered history. In the first few years of its existence it enjoyed a liberal traffic, which was afterwards decreased by having been paralleled by an electric line of the Cincinnati Street Railway Company's system, and in March, 1892, fire destroyed the power station, so that traffic was interrupted for a period of 103 days, until a new station could be built and equipped. During this interval traffic sought other lines, and has not since wholly returned to the cable.

About eight months ago the property was placed in the hands of Alfred Hill, receiver. Traffic has steadily gained during each month of the present year, and the line is now carrying about 5,000 passengers per day. Effort is being made to reorganize the company and secure sufficient capital to place the road on a solid basis. The roadbed has been considerably improved, and the whole line seems to be in a better condition than it was three years ago, when we made our first visit to the plant.

The streets along the route are being rapidly built up with a fine class of houses, and when a city terminal, as is now contemplated, is obtained near the Post Office and Fountain Square, it will doubtless become a good paying property.

FIG. 13.—COMPOUND CURVE ON 13 PER CENT GRADE—MT. AUBURN CABLE RAILWAY CO., CINCINNATI.

The new power station, illustrated in Fig. 12 was built on the site of the one destroyed by fire, at the corner of Highland and Saunders Streets, and is a one story building with basement.

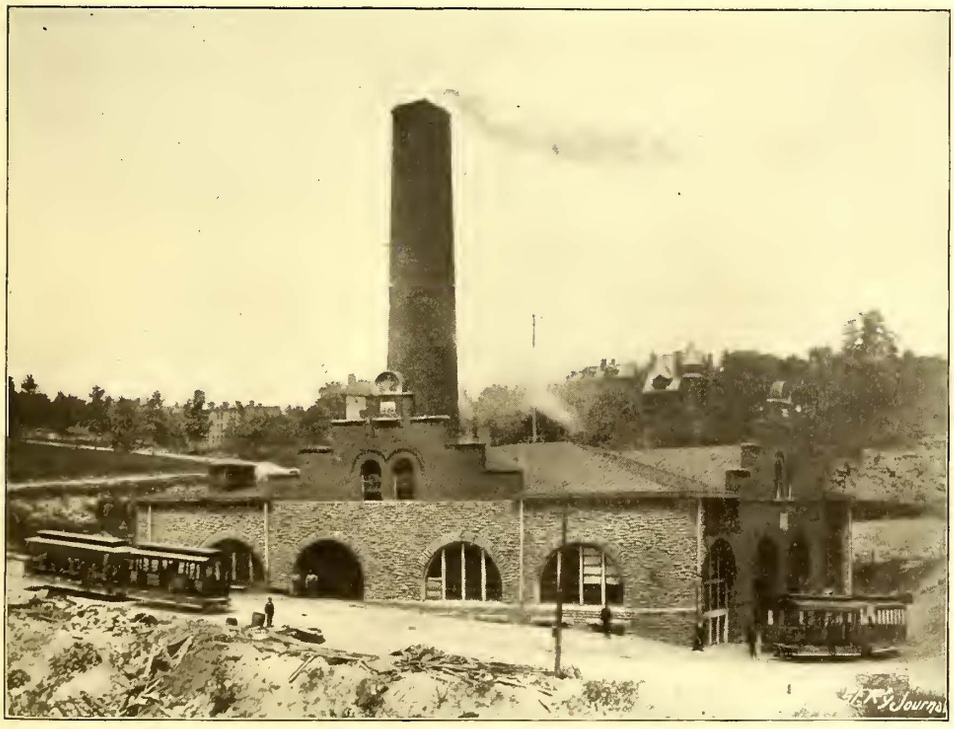


FIG. 12.—POWER STATION—MT. AUBURN CABLE RAILWAY CO., CINCINNATI.

The power equipment occupies the basement, and there are offices on the first floor, while the greater portion of the first floor is occupied by the car repair shops. The fire destroyed twenty-four cars, and a new equipment was purchased, for the most part from the St. Louis Car Company. Some new cars are being built in the company's shops.

The cars are operated in trains consisting of a grip and trailer, open cars in summer and closed cars in winter. The grip cars are of the combination type and provided with seats as well as the trailers, and the trailers are provided with an emergency slot brake, which is operated by a hand wheel from the center of the car. It is considered safer to operate over the steep grade with two cars than with one, as in case the brake mechanism of one car should fail, the other may be employed. A wheel screw grip, which has already been described in these columns, is employed. The grip jaws are now made of cast iron. Formerly phosphor bronze was employed, which sometimes failed to haul the loaded cars over the steepest points in the grade. The life of the cast iron jaw is from ten to twelve days, while that of the phosphor bronze was only about seven. The iron jaw never fails to hold the rope.

During the history of the road a runaway has never occurred, and a gripman has never lost control of a car, although, in a few instances, it has been necessary to back down the grade. It is necessary for the gripman to re-

lease the rope seven times on a trip, but the rope has not been cut, but once, in three years' service. The cars have also been recently equipped with track brakes, devised by the superentendent of the company, G. Levins. The number of trains now operated is from eleven to thirteen, depending upon the amount of traffic.

The power equipment consists of two Lane & Bodley engines, Corliss type, of 350 H. P. each, which were rebuilt after the fire. The same shafting was also employed, but new gear wheels and winding drums were substituted for the old equipment. The latter are provided with the Walker differential rings, and both are driven by intermediate gears The plant is working in a highly satisfactory manner. The ropes are operated in two sections, one being about three miles in length, the other five miles, are run at a speed of eight and ten miles per hour respectively.

The four boilers are of the tubular type, of 350 H. P. each. Pittsburgh coal is employed, which costs, delivered, $1.75 per ton, being hauled about two and a half miles in wagons, and it requires about six tons per day to operate the plant.

A new carrying pulley has been substituted for the old pulleys which were of the combination type, and weighed about fifty pounds each. The new pulleys are solid, and weigh twenty-five pounds each. These last much longer than the old ones, and with them it requires much less power to operate the ropes. The track was constructed with yokes four feet apart, and the rails, which are of the girder type, weigh fifty-six pounds per yard, and were laid with suspended joints. As noted above, the joints have been recently raised and supported on blocks, and since these repairs have been made, including the renewal of the carrying sheaves, a saving of three tons per day is made in the coal consumption. This saving strikingly illustrates the importance of a smooth track in street railway traffic. The extra amount of power required to operate over a track with low joints is not generally realized by either cable or electric railway managers.

Crossover switches are employed at the terminals, the trailer being shifted by hand. The grip car runs either end first.

The fare is five cents. A special fare of six tickets for twenty-five cents is given from the city terminal to the foot of the hill, and children's tickets are sold for three cents. After seven o'clock in the evening, and also on Sundays and holidays, during the summer season, passengers are carried the round trip for one fare, in case they do not leave the car.

Conductors and gripmen are paid $2 per day, or twenty cents a trip. A deposit of $50 is required from conductors, and $25 from gripmen.

The regular fares are recorded on a Meaker register, and special fares on a trip slip with a punch. C. B. F.

The Jersey City, Hoboken & Rutherford Electric Railway.

The line of the Jersey City, Hoboken & Rutherford Electric Railway Company is approaching completion, and operations will commence, it is thought, during July. The eastern terminus of this line will be at the Barclay Street Ferry, Hoboken, and its Western terminus at Rutherford, where it will connect with the Paterson, Passaic & Rutherford road which extends to Carlstadt. Connection will also be made at this point with the New York & Greenwood Lake branch of the Erie Railroad, and arrangements have been made for handling the excursion traffic in connection with this road.

The power house will be built on the Hackensack River, and is being constructed by Westinghouse, Church, Kerr & Company. It will employ the kodak equipments throughout. At the Hoboken end of the line a number of interesting engineering problems will be cared for, including a trestle on 2nd Street about 300 ft. long, at the point of crossing the steam railroad tracks.

The president of the company is Charles L. Johnson, who is also president of the Paterson, Passaic & Rutherford Railway Company.

Michigan Street Railway Association.

The advantages shown to be afforded by membership in a state street railway association has led to the formation of a new society of this kind, that of the street railway companies in Michigan. A meeting of the companies of this state was held at Grand Rapids, June 5, and an organization perfected to be known as the "Michigan Street Railway Association." The following officers were elected to serve until the regular meeting to be held in the same city September 19, 1894: President, W. L. Jenks, City Electric Railway Company, Port Huron, Mich; vice-president, W. Worth Bean, St. Joseph & Benton Harbor Railway & Light Company, St. Joseph, Mich.; secretary and treasurer, B S. Hanchett, Jr., Consolidated Street Railway Company, Grand Rapids, Mich.

The Executive Committee consists of the officers of the Association and David H. Jerome, City of Saginaw Street Railroad Company, Saginaw, Mich. and Strathearn Hendrie, Wyandotte & Detroit River Company, Detroit, Mich.

Electric Freight Cars in Spokane.

An important and somewhat novel application of electricity has in the last three months been made by the Spokane Street Railway Company in the City of Spokane, Wash., in the propulsion of freight cars loaded with wheat and flour over certain streets of the city between the steam railroad depots and the mills.

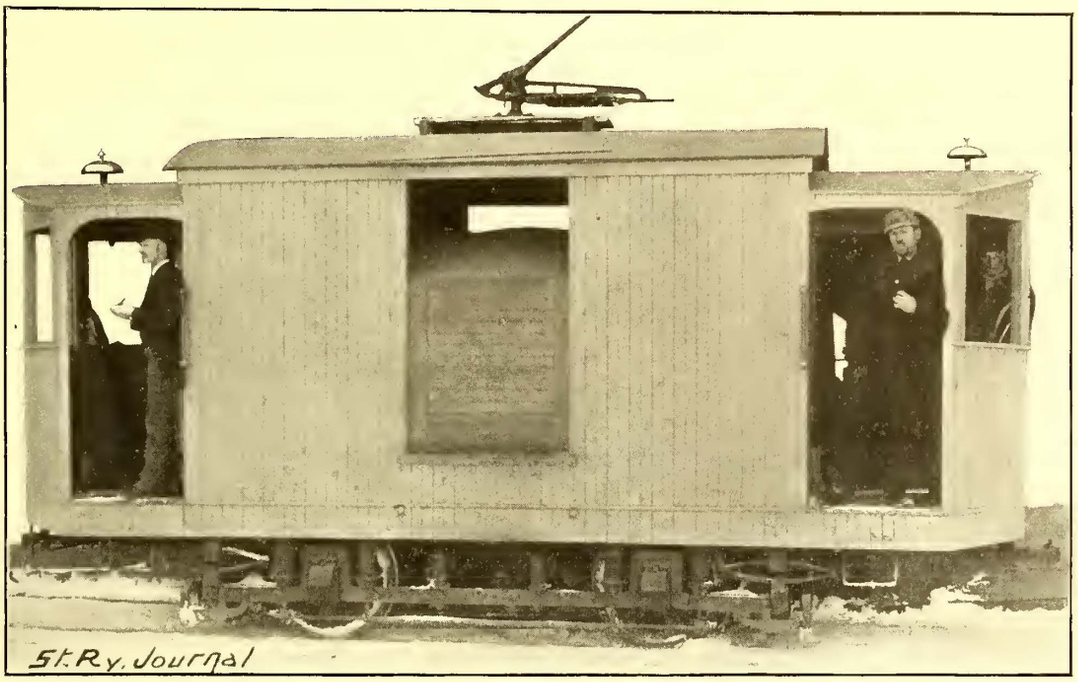
For the past three years the question of trackage facilities from the steam railroads to the water power and the mills has been one which has been under serious consideration in Spokane, and though many plans have been proposed to settle it, so far it has not received a satisfactory solution, the mills being to-day without permanent steam trackage facilities to and from the railroads centering in the city. So far the output of these flour mills has been handled by means of teams, and it was with the object of temporarily relieving the needs of the flour mills in this respect that the Spokane Street Railway Company in March last applied to the City Council for, and obtained, an ordinance giving the company "the right to haul cereals and the products of cereals on, along and over certain streets and street railway lines in the city of Spokane."

Connection now exists between the Northern Pacific Railroad transfer tracks and two of the mills, the C & C Mill and the Echo Mill; but the ordinance provides for service if necessary from any and all of the flour mills to any and all of the steam railroad depots, as well as the Northern Pacific, and it specifies that the company shall lay such track and make such connections whenever called upon to do so by the City Council or by any of the other mills. The ordinance provides that "the company shall haul all cereals and the products of cereals from any railroad affected to any mill on such roads at a charge not greater than twenty cents per ton, and if the cars are loaded both ways the charge shall not exceed fifteen cents per ton each way. This sum shall be inclusive of the cost of handling from steam cars to the electric cars, and five tons shall constitute a minimum carload." The ordinance also provides that in the case of any mill owning its own car, the company will supply current and right of way over its tracks to any depot reached at a charge for the service of a sum not to exceed $2 per car per day. With one car such as that now in use the wheat in and flour out of a 1,000 bbl. mill can be handled in fifteen round trips, or in one day's work. The capacity of the car is 12,000 lbs. or 200 bhls. of wheat. In the month of February the car handled in 230 hours, rnnning between the dry kilns and the mill, some 64,000 bhls. of wheat.

As the ordinary tracks of the electric railways are used for this freight car, and as the curvature of the company's lines had to be considered, necessity compelled the

design of electric freight cars specially arranged for this work. As a result, a very ingenious car was designed by the manager of the company and was built in the company's car shop. The car is twenty feet long over all, and twelve feet long inside; outside width six feet; five feet six inches high inside from the floor level to the roof. In external appearance it is like an ordinary box car, but beneath the inside floor of the car is a hopper, and the floor opens up in two halves from the center of the car, each half of the bottom falling over to the end of the car. When the floor is level over the hopper it is the same height from the rails as the floor of an ordinary steam freight car, which is about four feet.

The maximum speed of the car is six miles an hour; it is mounted on a Brill No. 21 truck, six feet six inch wheel base, with thirty inch wheels. The electrical equipment consists of two Edison No. 8, double reduction street car motors. The speed of these motors was reduced by special rewinding from their normal rate of 1,000 revolutions to 500 or 600 revolutions per minute. These motors are controlled by an ordinary rheostat and ordinary reverse switches, cutouts, etc., and, instead of a crank, a lever brake is used for braking purposes, which works more quickly.



ELECTRIC FREIGHT CAR—SPOKANE.

When the car is loaded it is run to the front of the mill, where it comes to a stop over the mill sink. The hopper is furnished at its lowest point with a sliding steel gate. This steel gate is then drawn and in less than a minute the contents of the car fall into the mill sink, and from thence it is conducted by elevators up into the mill for grinding. The hopper is then closed over by throwing down the hinged floors of the car, and the car is then loaded with flour for transfer to the steam railroads. A larger car of the same design is now being built by the company to handle increased business.

The car has now been on the road for three months, and has never been to the shops for repairs. There are one or two pieces of line over which the car travels having 5 per cent. and 4½ per cent. grades and a 55 deg. curve, and the car travels over them as smoothly and as rapidly as on the straight and level track. The car has been found exceedingly convenient on several occasions for the handling of macadam on the road between the rails. Macadam is loaded into the hopper portion of the car, and when its distribution is required the steel gate is drawn, the current is thrown on, and the car delivers its macadam evenly on the track proposed to be surfaced.

Up to the present all grain has been transferred from the steam cars to the electric car by hand, but the superintendent of the company, Mr. Knowles, is now perfecting an electric power shovel and elevator arrangement, whereby all grain will be moved out of the steam cars by the shovel and dumped into the boot of the elevator, which, running also by electricity, will lift the grain to a bin, from which it will flow by gravity into the electric freight car.

When the ordinance was first introduced into the Council considerable opposition was manifested on the part of some of the property owners on the streets covered by the ordinance, who supposed that this work was going to depreciate the value of their street frontage. Since then, however, they are unanimous in its favor, and as the route selected is on a street, the property on which is most suitable for wholesaling purposes, some of the property owners are already agitating the question of putting spur tracks into their property, so that freight in general can be handled in and out in less than carload lots, thus doing away with the cost of drayage between the wholesale establishments and the depots. The last two months of operation has demonstrated that even with the convenience now perfected the mill product can be handled at a less charge per steam freight car than the switching charges prevailing in the city, viz., $2.50 per car. The development of the plan started in Spokane will no doubt be watched with interest by the electrical fraternity, and the use of the street car tracks in cities for freight purposes may prove to be a considerable source of revenue to the street railway companies.

The accompanying cut shows an exterior view of the car, and is from a photograph taken last spring.

A Sprinkling Car at Toronto.

The Toronto Railway Company has recently installed upon its line a sprinkling car which has been in operation for a short time and is proving very satisfactory. The tank was built by a local firm and holds 2,800 gallons of water. It was mounted in the company's own shops on a Taylor improved truck. It takes about five minutes to fill the tank, and from one filling the car will sprinkle about ten miles of single track.

The railroad company has entered into a contract with the city to sprinkle the railway portions of the streets at sixty-five cents per mile for four sprinklings per day.

The company has something over forty miles of street, and estimates that the car will bring in gross at least $25 a day for the service above mentioned.

THE Bremen Bergbahn or hill railway near Bremen, Germany, was opened to public traffic April 16, 1894. This is the first rack railway in Germany operated by electricity, and was constructed by Siemens & Halske, of Berlin.

THE gripmen and conductors of the Third Avenue Street Railway Company, of New York, had their wages raised May 28. Hereafter the gripmen will receive $2.50, and the conductors $2.25 per day.

The Electric Railway of Genoa, Italy.

According to M. Edouard Hospitalier, the eminent French electrician, the few electric tramways now operated in Europe are a disgrace to the civilization of that respectable quarter of the world, but happily they are also an excellent sign of an awakening to benefits of which the new world has known how to take a large share. The house of Siemens & Halske whose Berlin road was one of the first ever laid down in Europe, and whose Buda-Pesth line is said to be the only successful conduit electric road in the world, has done perhaps more than any other company or individual to bring home to the European mind the many advantages of the electric street car system.

An interesting road has just been installed by this house in the famous city of Genoa, which has ever been a city of innovations, and which gave to the world the greatest of modern innovators—the discoverer of America; and the streets along which marched the captives from the Algerine coasts now ring to the sound of the electrical car gong and the hum of the trolley contact.

The line in question runs at present from the Piazza Corvetto through the Via Assarotti to the Piazza Manin where it terminates near the generating station. Another is in course of construction to run from the Piazza Corvetto along the Via San Filippo, Via Giacomo and the Via Serra to the Piazza Brignole, while another will run from the Via Circonvallazione to St. Ugo.

The system used is the overhead trolley line system, and in the careful method of insulation of the supply wires, their height above the roadway, the method of suspension, and the extreme care with which all the details of construction are carried out, the road may be considered as perfect as any yet installed in Europe. Strange to say, the project met with no great opposition on the part of ignorant editors, nor have any objections yet been raised to the appearance of the overhead conductors.

The power house and its equipment have been laid out with a view, not only of supplying the needs of the present line, but also of the extensions either under construction or in contemplation. The completed house will have three sets of boilers, three engines and three generators, besides one set of boilers, one engine and one generator as a reserve unit. At present, only one set of two boilers, one engine and one generator are in operation, the current generated by this combination being sufficient for present needs.

The power house is located about three-quarters of a mile from the present terminus at the Piazza Manin, on the road from the Porta Pila to Stagliano. The engine is of the vertical, compound, condensing type, with cylinders superposed in tandem, and was constructed in the shops of F. Tosi, of Legnano. The governor system is American, the governor weights being mounted on the shaft like a second flywheel. The bearings are all of the best anti-friction metal. The diameter of the low pressure cylinder is 18.7 ins., that of the high pressure cylinder, 12.08 ins., and the piston stroke is 14 ins. The engine operates at 260 revolutions per minute, giving 150 H. P. normal, and 200 H. P. maximum. The condenser is operated by a slow speed, horizontal engine which also operates a pump sunk in a well for keeping the water for the condenser up to level, even in the dry weather. One condenser serves for two engines. The boilers are of the Cornish type, with double grates and soft steel bodies. They are 5.1 ft. in diameter and 24½ ft. long, with a heating surface of about 67 sq. yds. The normal pressure is about 10.5 atmospheres. Water is supplied by two duplex steam pumps, one being held in reserve.

The electric generators are of the compound wound, interior pole Siemens & Halske railway type, generating 200 amperes at 525 volts when making 420 revolutions per minute. Each is fitted with four brushes, which can all be operated as a single unit, resting on a commutator with 260 sections. The resistance of the armature is .003 of an ohm, that of the fields 3.6 ohms, while the efficiency is about 94 per cent. The generators are insulated by running the base frame bolts into a mixture of sulphur, glass and pitch set in porcelain insulators filled with oil, and cemented into the foundations. The bolts themselves are insulated by wooden blocks and leather washers.

The switchboard shown in the background of the illustration of the engine and dynamo room carries three rheostats, three 200 ampere ammeters, one 550 volt voltmeter, three main switches, six 200 ampere cut-outs, four lightning arresters with magnetic blowout, a differential voltmeter for parallel working, and three magnetic circuit breakers. The line is divided up into sections so that each part may be cut out as desired for test or repairs.

The feeders and return run from the station to the Piazza Manin, a distance of 1,367 yds., in two cables containing four 7.5 M. M. wires each, on poles erected forty-four yards apart. Of the eight wires, four are return wires and are soldered to the rails, while four are carried to the trolley wires.

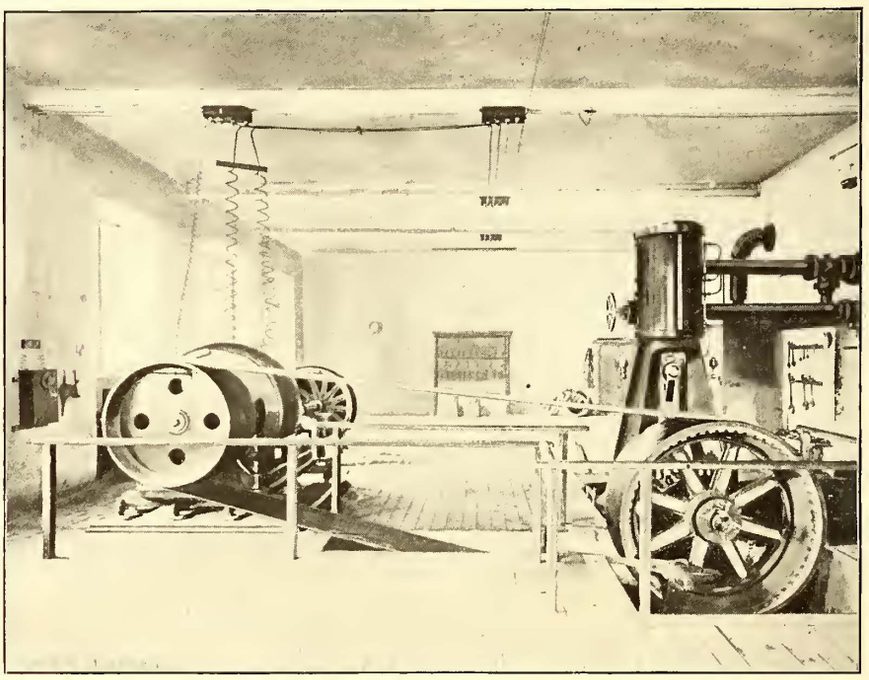


FIG. 1.—INTERIOR OF STATION—ELECTRIC RAILWAY AT GENOA, ITALY.

The rails are of the Phoenix channeled girder type set on ties in a massive granite pavement. The line in the Via Assarotti is single track throughout with the exception of one turnout. The return is provided for by a careful bonding of each rail with a copper band securely riveted. So perfect is the return that no trouble has been experienced with the telephone or telegraph service, although their earth plates are occasionally very near the street railway wires.

The span wire supports in the city are of ornamental cast iron, and are fixed to the walls of the houses by a circular iron plate and four bolts, the insulation between the support proper and the house being obtained by two creosoted cones of wood. Each support carries also a porcelain skirted insulator, to which is attached the span wire. In places where poles are used instead of these wall supports, a pole line insulator of similar form is used. The span wires of galvanized wire are one-fifth of an inch in diameter and the trolley wire of phosphor copper .28 in. in diameter. This is carried at a height of twenty-two and a half feet above the roadway. The trolley wire is not suspended in a right line directly above the center of the track, but is strung in a sinusoidal curve over the central line. This allows of a constant change of contact

point on the contact bars which replace the trolley wheel in American practice. At curves the usual number of pull-offs and wires is done away with, the conductor being doubled and held in a special suspension of the span wire.

The trolley or traveling contact is the upper side of a rectangular frame carried on a tubular support. It is of simple iron wire one third of an inch in diameter,and presses, like the trolley wheel, on the under side of the overhead conductor, a strong spiral spring keeping it in contact. Two of the frames and supports are fitted to each car, and as mentioned above, the contact point travels from side to side along the entire breadth of the contact bar.

FIG. 2.—VIEWS ON THE LINE OF THE GENOA ELECTRIC RAILWAY.

The advantages claimed for this form of contact are, a greater degree of reliability in maintaining contact, as one bar is always in contact when passing the insulators, and the elimination of the danger of the trolley jumping when the car oscillates. The pull-off wires at curves are unnecessary since the line need not follow the curve of the rails, but can form a chord across, the width of the bar being sufficient to allow of contact being preserved. The system also does away with the overhead frogs and switches at points of bifurcation, as well as the constant jumping at such points. The contact supports are so arranged on the car as to permit of their reversal automatically as soon as pressure in the reverse direction is applied.

The Siemens & Halske motors are of eighteen horse power and have a speed of 800 to 900 revolutions, two being mounted on each truck so that the fields on the one side and the armatures on the other are in parallel. The brushes are of carbon. The armature shaft is coupled by a leather friction clutch to a three-threaded worm which engages in a toothed wheel bolted to the axle. The reduction is as 10.33 to 1. Each worm and gear runs in a cast iron case filled with oil, and works absolutely noiselessly. The motors are insulated from the frame by means of rubber washers, a sheet zinc case protects the motors from dust,water and mud. One end of each motor is hung from the axle while the other is carried on the frame and supported on rubber springs to prevent shock. The resistances are placed beneath the cars and are four in number, of 4, 12, 18 and 30 ohms resistance, corresponding to the switch contacts. The maximum speed attained with a car fully loaded with 36 persons, on the steepest grade in the Via Assarotti is seven and a half miles per hour, and it was found that by a suitable arrangement of the resistances and reversing the current after removing the brakes, the car running at this speed was stopped in its own length. Each platform is furnished with a switch and set of resistances. The energy required by the motors, the car being loaded with two and a half tons of sand and running at a speed of seven and a half miles an hour on the 8 per cent grade of the Via Assarotti, is 26.4 K. W.

Each car is provided with two mechanical brakes, the first being the ordinary chain brake with shoes applied to each of the four wheels of the car, while the

second is an emergency brake by means of which the driver, by a single motion of a lever, can drop in front of the forward wheels two conical iron shoes. This brake is only used in case of grave danger, the stoppage of the car being very violent, but it provides ample security against such an occurrence as a runaway on the steep grades along which the car may be running.

An electric brake is also provided. This consists of a simple switch on the platform, which allows the driver to cut the connection between the supply wire and the motors, closing the motor circuits on a suitable resistance. The motors then operate as generators, and the wheels turn in the opposite direction. Another method is simply to reverse the current on the motors.

The cars were turned out from the Savigliano shops, and do not sin on the side of artistic effect. They are very narrow, and have a passage from end to end, the seats being arranged for two persons on one side, and one on the other. They are divided into two classes, the interior being first class, and the platform second class. So peculiar is the arrangement of the cars that there is a difference of load on the axles of about 1,600 lbs. The rolling stock of the line consists at present of four cars, three in constant service, and one in reserve. Twenty-six additional cars are now being constructed for the new lines. The company which operates this road is the Electric & Cable Tramways Company, of Kerns, Switzerland.

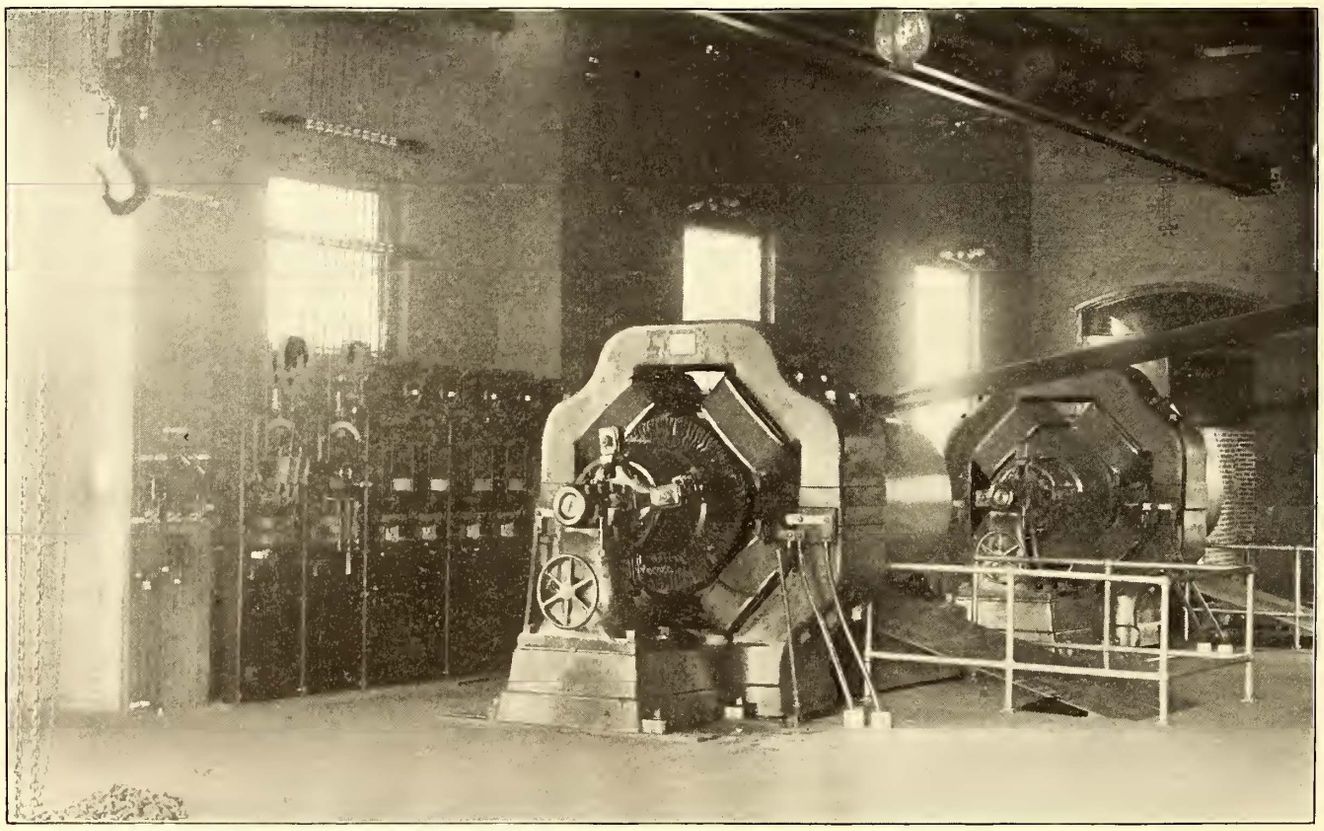


FIG. 1.—INTERIOR OF STATION—ALLENTOWN & LEHIGH VALLEY TRACTION CO.

In the Lehigh Valley.

The present line and equipment of the Allentown & Lehigh Valley Traction Company, of Allentown, Pa., merit a special mention at this time as being one of the few successful enterprises of equal magnitude projected at a time of financial panic, and carried through to completion during the most stringent four months of a trying fiscal year. Ground was only broken for the primary grants of this company on May 15, 1893, and the work of grading and track laying began at the same time. Despite the fact that the engineering obstacles presented were many, ten miles of double track were constructed and cars operated by October 1. In addition, a viaduct of nearly 1,000 ft. was built and two girder bridges were constructed. The prompt completion of these bridges was necessary to the success of the enterprise. The contract for all three was let to the Variety Iron Works Company, of Cleveland, O., and they were erected in place ready for travel within ninety days from the day of the receipt of the order.

One principal reason for the necessity of pushing the work was that the city of Allentown had demanded a forfeit deposit of $50,000, as a guarantee that the road would be built, fully equipped and in operation on or before November 1, of the year in which it was begun. This sum was furnished by A. L. Johnson, president of company, and the rapidity with which the work was done is obvious, when it is stated that cars were running nearly or quite a month before the time limit.

About March 1 last, the entire plant belonging to an earlier company, the Allentown & Bethlehem Rapid Transit Company, was purchased outright by the Traction Company, and this property is now, together with the Allentown Electric Light & Power Company, controlled and operated exclusively by the Traction Company. This gives to the latter corporation a monopoly not only of the electric railway traffic, but also of the electric lighting and power supply of the city. In conformity of the policy adopted elsewhere by the syndicate controlling this company, there has been a marked increase both in quantity and quality to the service. At the same time the fares have been reduced nearly one-half; thus the spectacle is presented here, as in other places, of a monopoly proving a public benefactor.

When the traction line has completed all its projected arms and feeders, it will have one of the most attractive and complete systems of rapid transit in the United States. At present the city is in close connection by this company's lines with the three boroughs of West Bethlehem, South Bethlehem and Bethlehem, as well as Fountain Hill, Freemansburg and Hellertown on the South, and with Fullerton, West Catasauqua, Catasauqua, Hokendauqua, Coplay, Stempton, Siegfrieds, and White Hall on the North—a total population of 120,000. All of these lines center at Rittersville, midway on the historic pike between Allentown and Bethlehem, where the railway

company has provided what is said to be the finest base-ball grounds in the State, and has engaged Mike Kelley, the well known ball player, as manager of the local team. Here also has been located a public park appropriately called Central Park, with zoological and other attractions, which has proved an added stimulant to travel.

We present on this page a group of engravings showing views along the line of route of the company. The bridges span the Little Lehigh and Jordan Rivers, the length of each span being 125 ft. They are of the Warren girder type, and are used exclusively by the cars of the Traction Company. The Aineyville Viaduct is 864 ft. in length and forty feet in height. Both bridges and viaduct were constructed under the supervision of H. F. Coleman, of the Variety Iron Works, Cleveland.

The power station measures 80×180 ft., and contains two 750 H. P. Cooper-Corliss engines, one 300 H P. engine of the same type, and one 300 H. P. Hamilton-Corliss engine. The boiler equipment consists of five 150 H. P., return tubular Cooper boilers, eight 150 H. P., return tubular Phœnix boilers and three 300 H. P. Stirling boilers. Berryman heaters and Worthington pumps are used. Fig. 1 gives a view of the General Electric generators employed.

FIG. 2.—VIEWS ON THE LINE OF THE ALLENTOWN & LEHIGH VALLEY TRACTION CO.

The rails were furnished by the Johnson Company, of Johnstown, Pa., and the Bethlehem Iron Works, of Bethlehem, Pa., all special work being supplied by the Johnson Company. In the city the rails are of the 78 lb. girder type, and in the suburbs a 70 lb. T rail is used. The rail is laid on ties 5×8 ins. × 7 ft. of white oak, placed every two feet. On the bridges and viaduct each T rail is provided with a double line of guard rails. The poles are of white cedar tastefully finished in green and white. The ballast is of stone and blast furnace cinder to a depth of twelve inches. The grades range in height up to 12½ per cent.

All of the hangers, pull-offs, insulators and other overhead appliances were supplied by the H. W. Johns Manufacturing Company, of New York, and the Steel Motor Company, of Cleveland. The trolley wire was supplied by Benedict & Burnham, of Waterbury, Conn., and the insulated feed wires by John A. Roebling's Sons Company, of Trenton, N. J.

The cars are of a special type especially adapted for suburban traffic and are sixty in number. They are of the Brill, Briggs, Lewis & Fowler, Newburyport and Stephenson makes. The car bodies are mounted on a number of trucks, including those of the Brill, McGuire, Bemis, Harris and American Car Company types. The Harris trolley is used with the Steel Motor Company's equipments and Lewis & Fowler registers, Missouri Car & Foundry Company's wheels, Star headlights and De Witt sandboxes form part of the car equipments.

The officers of the company are: President, A. L. Johnson; secretary, J. K. Page; general manager, J. J. Coleman. Both the president and general manager, though young men, are well known for the active part which they have taken in the development of street railways. Mr. Johnson, though scarcely thirty-two years of age, is interested in a number of similar enterprises in the West, on Long Island and elsewhere; but despite the demands upon his time gives the closest personal attention to his large interests in Lehigh Valley. Mr. Coleman had direct supervision of the construction of the enterprise, and has distinguished himself as an executive officer in the street railway business in more than one city of the West. The company has already expended $3,000,000 on the line and its allied features, and the contemplated extensions will necessitate an investment of a still larger amount.

The Electrical Equipment of the Brussels Tramways Company.

The power station of the Brussels Tramways Company, of Brussels, Belgium, which was put in operation a short time ago on the trolley system, contains five generators, three of which have capacity sufficient for the operation of the line. Two are kept for emergencies. These generators are driven by three engines, each of 225 H. P. Worthington pumps are used. The electrical equipment was supplied and installed by the Union Electricitäts, of Berlin.

The Street Railway Concession in Cairo.

The invitation for bids for an electric railway in Cairo, Egypt, which was published with comments in an article in our February issue, not having given any results, the Minister of Public Works of that city has published a notice that he would receive further bids up to the 1st of July, 1894. The onerous conditions have been somewhat changed, so that now bidders can suggest certain modifications under which they would be willing to take the contract. Each bid is to be accompanied, however, with the amount of 1,000 livres, which is to be retained in the treasury of the Egyptian Government until a decision shall have been taken on the propositions, when deposits will be returned with all rejected bids. The Minister of Public Works reserves the right to reject any and all bids.

The Rapid Transit Question in Newcastle-Upon-Tyne, England.

The city of Newcastle-Upon-Tyne, England, has at present an antiquated horse car system operating thirty-four cars. The city had a population in 1891 of 187,000, but the total length of the street railway system (single track) is only fourteen miles. The passengers carried last year were 3,890, receipts per car mile 12.65 pence, and expenses 11.25 pence. The average speed of the cars, exclusive of waits at termini, is five miles per hour.

The city corporation, deciding to learn what could be substituted to advantage, some time ago requested the city engineer, W. George Laws, to report on the relative advantages of the conduit electric and cable systems. The corporation advisedly excluded the overhead electric system, while the accumulator method has hitherto given such lamentable results that it was thought not worthy of consideration.

In this report, which was presented May 28, 1894, some interesting particulars are given of the Buda-Pesth conduit system, including some observations made by W. N. Colam, the eminent engineer who was recently in that city. Of this system Mr. Laws says: The chief streets of Pesth are extremely wide, sometimes 150 and 200 ft., and this allows of the tram lines being run outside of and parallel with the ordinary traffic, while leaving ample room for carriages and carts alongside the foot walks. In consequence of this peculiarity, the speed of running is much greater than could safely be allowed in our narrow and crowded streets. Labor in Pesth is one-third less than in England, while fuel is one-fifth more.

The chief facts in Buda-Pesth are:

Mileage open (single line)	14 miles
Length of route	7½ "
Miles run, per annum	1,437,000
Passengers carried	11,000,000
Receipts per car mile	11.86d.
Expenses per car mile	6.32d.
The cost per single mile of construction	£12,000
" " " " equipment	£2,750
	£14,750

The service on the electric route is at intervals of one and a fourth minutes, and the average speed is twelve miles per hour, viz.:

9.3 miles in the heart of the city.
11.16 in the residential parts.
15.5 in the suburbs.

The cars are small, to seat twenty passengers only, but with wide platforms, on which many stand. They have no seats on top.

The population of Buda-Pesth is 520,000, but as the tramways are laid only in Pesth, probably 300,000 is a fair estimate of the population served. Buda, on the other side of the Danube, is hilly, while Pesth is perfectly flat. The difficulty of working electric lines on any but very flat gradients has prevented the extension of the system into Buda, and the authorities are now inquiring into the possibility of introducing the cable system there. Commercially, the result in Pesth is that the shareholders have received dividends of 7 per cent. in 1892, and 8 per cent. in 1893; while a tax of 2 per cent. is paid to the authorities for the concession.

On a total capital of £284,000 (which includes, however, some miles of steam lines), the earnings were, in 1892, £63,893, of which, after payment of expenses, about £24,100 was available as profit, and £17,500 was divided among the shareholders.

For 1893 the figures were:

Capital expended	£284,000
Total earnings	81,330
Net earnings	32,452
Divided as profits	26,666

There are some specialities of construction which must be noted as bearing upon the applicability of such a system to English towns, and especially to Newcastle. For these particulars the committee was indebted to W. N. Colam, who visited Buda-Pesth in the course of business, with a view to see the details of the system.

Mr. Colam refers to the similarity of construction between the electric and cable conduit, but with this difference, that while in the cable system the conduit for the rope lies in the center of the way between the rails, in the electric system it is placed under one rail. Mr. Laws says, "At first sight it would appear as if this was a distinct saving in first cost by avoiding the central slot-rail; but the saving is more apparent than real, as the actual cost of the way is about £1,000 per mile more than in the cen- tral slot system. Besides this, however, there are disadvantages as compared with the central slot which are very serious, and more than counterbalance the saving of the central rail.

"The central slot is not subject to the wear and tear from the flanges of the wheels since they do not run in it, and consequently there is no tendency to wear it down or widen it, and it remains permanently at its original width of five-eighths of an inch, and the edges remain unworn. With the conduit under one rail, on the other hand, the slot takes the flanges off the wheel, and the edges are rapidly rounded off and the slot widened.

"The width required to allow the electric "collector" to pass is larger than is needed for the cable "grip." As a matter of fact, in Pesth the slot in no case is less than one and a half inches in width, and this in many cases, especially at curves, has been enlarged by the wear of the wheel flanges to two inches."

Mr. Laws then gave a description of the cable system with cost of installation and probable earnings, and in his comparison of the two systems expressed himself in favor of the cable. He recommended that the city undertake the cost of construction and that the operation be undertaken by lessees.

The Wheel and the Rail.

BY FRED. H. FITCH, C. E., CHICAGO CITY RAILWAY COMPANY.

Questions of great import present themselves in a thorough discussion of the wheel and the rail, and their relation one to the other. For in the almost endless mileage contact of the wheel and the rail, a minute difference per mile in friction, in power used in propelling cars, or in wear of rail and wheel, will materially add to or subtract from the net earnings of the road.

In this discussion we will consider thirty inch wheels and on street railways only, fixed or pressed on an axle, rotating with the axle, the wheels provided, as usual, with a five-eighths inch flange which serves to compel the tread of the wheel to run along the head or ball of the rail. The common form of this wheel is cone shaped, or, in other words, the tread of the wheel which bears upon the rail is beveled usually from one-eighth to three-sixteenths of an inch in its width of about two inches; its diameter next to the flange being one-quarter or three-eighths of an inch greater than the diameter measured on the outer edge of the tread. The common form of the rail head is flat on top, slightly crowning. It follows then that between the new wheel and the new rail there is only a very small contact, as is shown in Fig. 1.

The questions which now arise and which should be solved by every street railway manager are:

What are the salient points of the wheel and the rail to-day?

To what may these faults be assigned?

Can they be remedied?

Why is a wheel made cone shaped?

Why not flat?

Why beveled only about one-eighth of an inch?

Why is the head of the rail flat or nearly so on top?

These questions have long been the study and thought of the steam railway engineers and mechanics, but it is only recently that the importance of investigating and answering these questions has made itself apparent to the street railway manager. Heretofore, the motive power of street railways has been largely confined to animal and cable power, in neither of which the problem of traction appears. The experience of the steam railway engineers, while it will aid our investigation, cannot be taken as a criterion for all conditions affecting street railways. Their curves are gradual, their wheel treads broad, speed greater, and so many other points of difference that it will be better if we strike off alone, as in an unexplored region. Our study, thus freed from any danger of following in old ruts, will be more beneficial, and I trust more fruitful; at least, it will be original.

First, let us consider why the wheel is made cone shaped. Is it thus that it may be drawn from the chills? There is no denying the fact that a cone shape greatly facilitates this operation. Yet if we needed flat car wheels, and no other reason for their cone shape existed, flat wheels could be moulded.

Is it for the purpose of rounding curves? This may have been and probably was a consideration in fixing the shape of wheel treads primarily in steam railroad practice. For where a maximum of 10 deg. curves were in use, and where the centrifugal force of the moving car would cause the wheel on the outside rail to roll on its greatest circumference next to the flange and the inside wheel on its least circumference, it caused the outside wheel, during each revolution of the axle to travel nearly one inch farther than the inside wheel, thereby keeping the car axle radial to the curve at all times, without the slipping or sliding of either wheel. But in street railway practice, where the average curve is of fifty feet radius, it is absurd to assume that the bevel of one-eighth of an inch on a wheel, will accomplish this result; for the outside wheel in rounding an ordinary street corner must travel seven and a half feet farther than the inside wheel, and it would require the impossible amount in practice of one and a half inch bevel in a two inch tread. Without this great and impossible amount of bevel, one wheel or the other, or both, must slip or slide along the rail every time a car rounds a curve. That the wheels do this, we have evidence in the brightness of curve rails.

The bevel of the tread of car wheels does, however, subserve one of the most important requirements in railway practice. Like the crown pulley which centers the belt upon its face and corrects any side movement, or a disposition on the part of the belt to leave the pulley, the bevel of the car wheel centers the car upon the track. This on a loosely gauged track may be noted by an observer standing in the center of the track, and watching the continual movement from side to side of a receding car, the function performed by the bevel on the tread of the wheel being as follows: When one wheel is traveling over a joint, dirt or other obstruction, or when one wheel is minutely smaller in diameter than the other, and lags behind, its direction of travel is changed from a straight line to an outward direction or path until its own largest circumference next to the flange of the wheel is in contact with the ball of the rail, the other wheel meanwhile being directed in a course which brings its smallest circumference into rolling contact with the rail, which serves to accelerate the movement of the adjustment of car on track, wheels on rails, and axle of the wheels at right angles with direction of correct travel. Or the action may be described by saying, the lagging wheel "catches up." This action transmits to a car on loosely gauged track a movement from side to side, which is easily noted. When a wheel becomes flat and loses its ability to perform this important function, it is said to "run sharp." In steam road practice, wheels are declared useless or worn out upon this basis, rather than upon the depth of chill wear. This should also be the basis upon which street car wheels are condemned. As one rides in a car whose wheels are no longer mates, the grinding, grating and sideway jerks can furnish food for the imagination, concerning the great friction and excess in power required to drive such a car over the road, compared to the perfectly self-adjusting car.

Yes, the cone shape of the car wheel has a most important function, and we would at once pronounce it an indispensable adjunct. But are car wheels beveled? When they are new, yes! When the chill is far from being worn out, decidedly no!

Referring again to Fig. 1, and observing that the wear of the wheel will be only at the point of contact, it is plain why the wheels lose their bevel before the chill is worn out, and to corroborate this fact one need only to examine worn out wheels or even wheels that are a long way from being relegated to the scrap pile. But to present

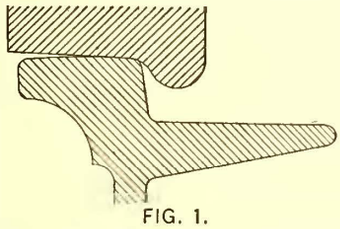


FIG. 1.

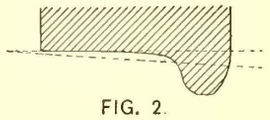


FIG. 2.

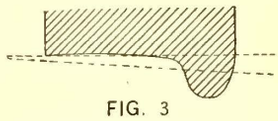


FIG. 3

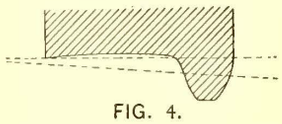


FIG. 4.

the matter in full in this paper, I have taken numerous plaster of Paris casts of old wheels, and several specimens are shown in the accompanying Figs. 2, 3 and 4.

Fig. 5 presents an engraving of two old wheels which were mates, rigidly fixed to the same axle, one having the fillet between the flange and tread almost worn to an angle, the fillet of the other being even gentler than on a new wheel. There is only one explanation which can be offered for this phenomenon, and that is that the first mentioned wheel dragged behind continually, its flange fillet constantly wearing against the corresponding fillet of the rail, which was a sharper one than that of the wheel. Needless tons of coal are thus annually consumed in the additional power required to drag flat or bevelless wheels over a roadway as against perfectly adjusting beveled wheels.

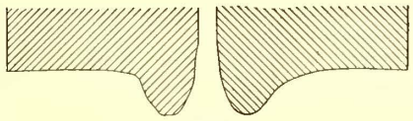


FIG. 5.

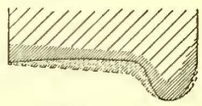


FIG 6.

But this is not the only loss from unequal wear of the wheel tread. Fig. 6 represents a section of the rim of an old car wheel, showing by dotted lines the original line of the tread surface, and also the line of efficient chill. The wheel is thrown into the scrap pile because at one point the chill is worn through, although half of the entire chill still remains. If the tread of this wheel had worn evenly, it would have run twice as many miles before the chill of the entire face would have worn away.

Summing up the foregoing remarks about the wheel, I have endeavored to show that the car wheel is made cone shaped for adjusting the speed differences between two wheels on the same axle; that for this purpose it is absolutely indispensable if the highest efficiency in traction is to be attained; that the wheels lose their cone shape long before being discarded, and that when they are discarded as worn out scarcely one half of their chill is worn away.

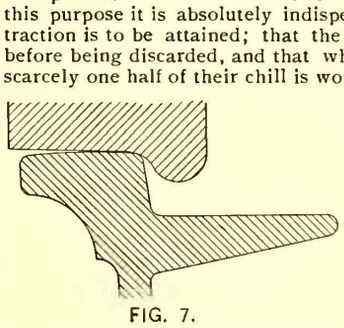


FIG. 7.

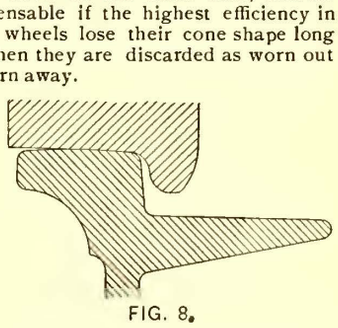


FIG. 8.

Now let us consider the rail; and referring again to Fig. 1, it is evident that as the wheel wears only across a portion of its face, the rail head will wear correspondingly on only a portion of its surface, the tendency of the wheel being to conform itself to the flat surface of the rail, and the tendency of the rail to become beveled as the wheel. Now, if the life of each was the same, the final form would be a bevel on wheel and rail about half the original bevel of the wheel. But the facts are, wheels must be renewed about once a year, while rails, at present, last six or seven years. The result is, there is always a variety of wheels running on the same track, in all stages of wear, some new and beveled, some with a slight bevel, some perfectly flat, and some even hollowed out until the outer circumference of the wheel is greater than the circumference next the flange.

Figs. 7, 8 and 9 represent a new rail and a new, one-half worn and old wheel, respectively. Figs. 10, 11 and 12 represent an old rail, and a new, one-half worn and old wheel, respectively. Here we see three distinct lines of contact for every stage of rail wear. The variety which could be derived from this basis would be endless.

Again, as the wear of the rail is mostly confined to the inner edge, it will be scarcely half worn out when the flange of the wheel will be rolling upon and digging into the flange of the rail, as is illustrated in

Fig. 12. The dire result of this cannot be better conceived than by reference to some dynamometer tests in which I found that 52 per cent. more power was required to draw a car over worn out rails, where, over long stretches, the wheel flange rolled along the rail flange, than to draw the same car over new rails, all other affecting conditions being equal. It cannot be said that flat car wheels were a factor in this case, since the same car wheels were used on both old and new rails. What would have been the result had new beveled wheels been matched against old flat wheels on old rails I cannot say, but leave to the conjecture of the interested reader.

The solution of the problem now presented is as simple as it is effective. *Make the ball of the rail beveled to conform to the bevel on the car wheel.*

This style of a rail is illustrated in Fig. 13. Besides dissolving to a most satisfactory degree every objection to the present form, it has other numerous and valuable recommendations of which I will speak later.

First of all, will a beveled wheel and a beveled rail perform the same important function of adjustment as the beveled wheel on a flat

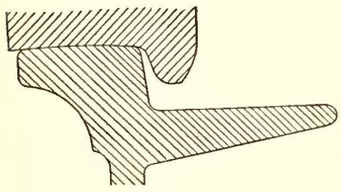


FIG. 9.

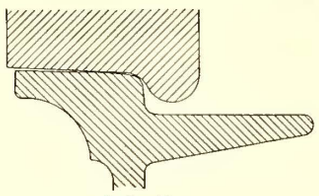


FIG. 10

rail? Referring to Fig. 14, the full line represents the position of the wheel on the rail at the time of its extreme motion to the left; the dotted lines at the time of its extreme motion to the right. It is plain that without a small difference in the gauge of track and wheels, no adjustment could take place on any rail. We will assume that this difference, or play, is one-fourth of an inch. Now the bevel of the rail in Fig. 14 should be as little as may be necessary to adjust the car on the track, because if too great the axle of the two wheels constantly rising and falling at the alternate ends as the points a and b move back and forth from and to the points a^1 and b^1, will cause the wheel to bear alternately at the points a^1 and b. If $a^1b = 2$ ins. $aa^1 = \frac{1}{4}$ in., and the bevel of $a^1b = \frac{1}{8}$ in., when the wheel is theoretically bearing only at the point a^1, the point of the wheel at b will be lifted $\frac{1}{2000}$ in. above the ball of the rail, which in practice is absurd to con-

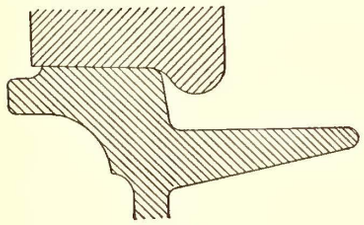


FIG. 13.

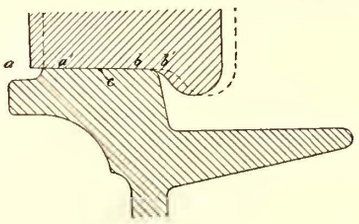


FIG. 14.

template. Therefore we may say the wheel tread has a perfect contact on the rail head at all times. Then the distance traveled by the car, or axle center, in one revolution of the wheel, equals the circumference of the wheel which is at the point, c, the center point of the rail head, which point is also the point of no friction between wheel tread and rail. As the wheel moves from a to a^1, the diameter of the wheel at the point c becomes less by $\frac{1}{32}$ in., which is twice the amount of bevel in $\frac{1}{4}$ in. The difference in circumference caused by an increase of $\frac{1}{32}$ in. in diameter is then the maximum difference in travel of the two wheels on the same axle in adjusting themselves..

The next point to consider is that of the grinding on either side of the point, c; on the right, or inside, an accelerating and on the left a retarding motion. It is admitted that additional power will be required to overcome this friction. Let us ascertain, as well as theory can, how much additional power will be required. We can afford to pay something for the numerous advantages to be derived from a beveled rail, which I will sum up hereafter.

Referring to Figs. 14 and 15, the diameter of the wheel at the point, c, will represent the diameter of travel of the wheel. That is, the forward movement of the car in one revolution of the axle, will be equal to the circumference of the wheel at the point, c. Now, if the point, b, was free to move separately from the point, c, at the end of one revolution it would come to the rail at the point, f, the distance, fg, ahead of the point, c. Likewise the point, a, would come to the rail at the point, e, the distance, de, behind the point, c. But being rigid they remain in the line, dcg, and, therefore, in each revolution of the axle there is a grinding or sliding about the point, c, which is represented by the triangles, dec and fgc. The forward motion of the car may be disregarded in this calculation, and the problem solved as if the wheel and axle were still but a force applied at the center of the axle, where the power is applied, to overcome a continual tendency to pull the center of the axle backward. The forces thus working are a series of parallel forces represented by the parallel lines in the triangles, fgc and dec. The comparative magnitudes of these forces are as the lengths of these parallel lines. The resultant of all of them will be a force at the center of gravity of the triangles, which is two-thirds of the altitude of the triangle measured from the apex, c, and equal to the sum of all of them. This sum of all the forces is the force necessary to overcome the friction between the wheel and the rail, which is the weight on the wheel multiplied by the co-efficient of friction, which we will take as .2. That is, to slide a wheel over a rail requires a force equal to .2 of the total weight upon the wheel. If the car weighs 8,000 lbs., the weight on one wheel is 2,000 lbs., .2 of which are 400 lbs., the constant direct force necessary to slide the wheel over the rail.

It is not essential to take into consideration the area of friction, for when the area of contact is greater, the weight per square inch of contact is less. Within reasonable limits friction is independent of the area and the velocity. Therefore, it matters not whether the line, fg, is three-eighths of an inch or three-quarters of an inch long, or in other words whether the bevel of the rail is one-eighth of an inch or a quarter of an inch, for it is just a question of velocity. The points along the outer and inner circumferences of the wheel have a little farther to slide in the same time, if the bevel is greater; so they slide faster, but the force required is the same whether they slide fast or slowly. We have now found that the force of friction is equal to a direct force of 400 lbs. But the force to overcome this force of friction acts at the center of the car axle and about the fulcrum at the point, c, the power arm being half the track gauge, 2 ft. 4¼ ins. + 1 ins., the distance from, c,

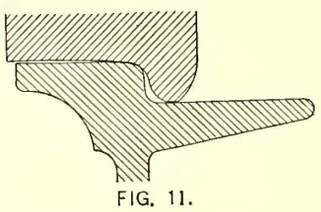


FIG. 11.

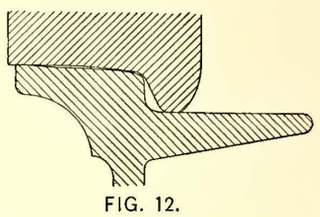


FIG. 12.

the fulcrum, to the gauge line. We have already seen that the force or weight arm was two-thirds of the altitude of the triangle which is one inch. Hence we have the proportion:

W : P :: P. arm : W. arm.
400 : x :: 29¼ : ⅔ "
x = 9.11 lbs.

This constant force multiplied by the distance through which it works in one minute, which is 880 ft., for a speed of ten miles an hour, divided by 33,000 equals the horse power caused by the grinding friction.

The result is .25 H. P. This is for each wheel. For four wheels there will be required 1 H. P. A morning car now requires about 12 H. P., so that we pay for any advantages derived from the beveled rail, 8 per cent in power.

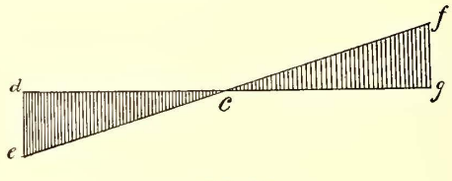


FIG. 15.

What are these advantages?

Can we afford to pay for them the price required?

First, and above all, if wheels are very carefully mated, and such unequal wear factors as sand boxes on one side only, and side pulling valve beams, are eliminated, there will never be any such thing as wheels running sharp. A wheel will have the same bevel the day it is thrown into the scrap pile as the day it was pressed upon the axle. It will be worn out solely because the efficient chill is worn through, rendering the wheel liable to break, and the tread liable to wear flat in skidding. The maximum efficiency can be gotten from the wheels. Thus, a great saving is to be had in wheels. But the greatest saving will be in the fact that the wheel will be perfectly self-adjusting until the day it is discarded. How can we compute the great saving hereby effected? But we know it must be enormous. An illustration of a wheel running sharp, which will be an aid for conception, is given by a vehicle in the track trying to turn out, one wheel behind the other, and the tire grinding against the ball of the rail. A wheel running sharp is constantly tending to turn the car from the track, and the wheel flange is ever grinding against the ball of the rail.

Another advantage is to be found in the wear of the rail. The wheel having at first only a small contact with the rail, wears it more rapidly. I will speak of the rail as wearing, although, in fact, it is mostly a process of cold rolling which it undergoes. Two days' time is sufficient to note a change in the rail section. Each succeeding day the rail wears less, as the contact becomes greater. But before the contact becomes full, and the wear at a minimum, the wheel flange touches and rolls along on the rail flange, and the dynamometer tests before mentioned have told the story of such a condition.

The city ordinances generally limit the height of the ball above the flange of the rail. In the beveled rail more metal can be put into the wearing surface of the rail, and the city ordinances still be complied with. The minimum rail wear, the result of full contact, will commence in the beginning with the beveled rail. I venture to say that the life of rails would be doubled if made with the ball of the rail beveled.

Again all wheels, whether new or old, will have the same line contact with the rail whether it be new or in its tenth year. There will be no variety, as shown in Figs. 7, 8, 9, 10, 11 and 12.

The most sensible argument, and most convincing, still remains: If a river will flow through a certain channel in spite of everything,

why expend energy in trying to divert it? Adopt the natural channel, and expend your energy in perfecting that one. A successful undertaking in the realm of the material or immaterial must not combat nature. So in mechanical details, we must, to form a perfect device, adopt in the beginning the form to which nature will eventually lead us. The final form of rails is a bevel. Why not adopt it to begin with?

Numerous incidental advantages appear of which I will speak very briefly, the chief of which, to my mind, is the rail joint. All street railways hope and look for the day when electrical welding will have reached its perfect stage and solved completely the joint problem. It has been found that no matter how firm the under bearing of the rails, that nevertheless at the joint there will be a pounding, small at first, but increasing much more rapidly as the hole formed in the rail head becomes deeper, A small cut one-eighth of an inch deep made in the center of a rail by a hack saw will make a pounding place in the rail.

What then is the remedy? Rails have been laid with mitre joints, as shown in Fig. 16, and have failed because the rail was flat. The wheel, having a bearing on only a portion of the rail next the inner edge, made it practically no better than a right angle cut. Now if the wheel had a full contact on the rail it is evident that no pounding could occur where this mitre joint was in use.

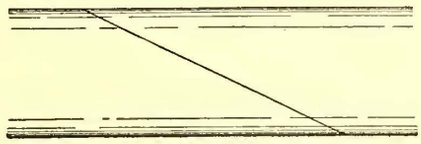


FIG. 16.

Fig. 17 shows a portion of a tongue switch. An examination of any such switch, where there is an offset in the rail for the switch tongue, will show that there is a little pocket between the points, *a* and *b*, caused by the wheel falling from a greater to a less diameter of its cone. If the rail which was cut out for the tongue had been beveled, no pocket would have formed.

Other recommending features for electric railroads are:

A path offering less resistance for the return circuit is presented in the increased contact.

Greater contact between wheels and rails will allow greater grades to be climbed, and on many roads allow of single motor equipment.

The rails will keep clean on account of their bevel.

New brake shoes will have a better bearing on old wheels.

Cars may be stopped quicker on account of more frictional area between track and wheels, and some accidents may thus be avoided.

I offer these gleanings of my study of the rail and the wheel, which I have found a most interesting study, more with a view to place the subject, as far as I have gone, before those who will take an interest in it, rather than as conclusive facts. Perhaps there are unforeseen difficulties and factors which I have entirely neglected. I believe in a beveled rail, but am not so far wrapped up in it that I am blind to

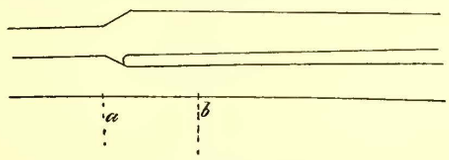


FIG. 17.

reason, and even though my ideas and hopes for a better rail were shattered by one lurking and neglected factor, I would feel that my study had not been in vain.

Annual Meeting of the American Society of Mechanical Engineers.

The annual summer convention of the American Society of Mechanical Engineers was held at Montreal, June 4-8. The professional sessions were held in the Engineering Building of the McGill University, while the headquarters of the society were at the Windsor Hotel. The meeting was in every way successful, and the excursions included a visit to the power station of the Montreal Street Railway Company, a trip to Ottawa, where the plant of the Ottawa Electric Street Railway Company was inspected, etc.

We print below abstracts of several of the papers presented:

Mechanical Draft.

By William R. Roney, Boston, Mass.

The importance of good draft, natural or artificial, for supplying sufficient oxygen for the economical combustion of fuel, has long been recognized by intelligent engineers. The gain, both in efficiency and capacity, obtained by the rapid and energetic combustion of the various kinds of coal, and the resulting high furnace temperatures, is well established. Its importance has, however, been generally conceded only within a few years. The wonderful stimulus which the development of electrical industries has given to the building of compound engines has necessitated higher boiler pressures, and this in turn has greatly increased the use of boilers of the water tube type. While high initial temperature in the furnace is essential to the best economy with all types of boilers, it is especially so with water tube boilers, with their large amount of heat absorbing surface in close contact with the products of combustion; as otherwise, the temperature of the gases will be lowered below the point of ignition and will pass to the chimney only partially consumed. To obtain this high furnace temperature requires draft sufficiently strong to deliver an abundant supply of oxygen to the furnace.

There are two well known means used for accomplishing this result, viz., natural draft, produced by a column of heated gases in a chimney of suitable proportions; and forced draft, obtained by mechanically creating a pressure under the grates with a blower or fan.

A third means, less widely known, is mechanical exhaust or induced draft, produced by a suction fan so arranged as to draw the waste gases from the furnace and discharge them into a short stack sufficiently high to clear the surrounding buildings.

The largest and most successful applications of mechanically induced draft have been made in connection with feedwater heaters designed to utilize the waste heat of the flue gases, and known as fuel economizers. This form of feedwater heaters has been manufactured in England for over fifty years, and in this country for three or four years. They have, however, been imported for many years, as their value as a fuel saving device is well established. Their successful operation is, however, so dependent upon a good draft, that no well informed engineer would think of installing an economizer without making provision for much better draft than the boilers would require without it.

On account of the reducing effect on the draft caused by lowering the temperature of the gases and retarding their flow by the mechanical interference of the pipes, it cannot be considered good engineering to attach an economizer to a chimney less than 200 ft. in height. In fact, the best working economizers in connection with chimneys are those where the chimney is considerably over 200 ft. high.

The objections to be urged against high chimneys, as compared with mechanical exhaust draft when used with economizers, are: First, excessive cost, both on account of the height required and on account of foundations, which must of necessity be very substantial, and which may involve expensive piling and filling. Second, the space required for foundations, which may be very valuable, especially in large cities, or may be required for other purposes, and which can with difficulty be spared. A chimney 250 ft. high will require foundations not less than thirty feet square, and in some cases much more. Third, a certain minimum temperature of flue gases is required to produce an effective draft and to operate the boilers economically, and this fact limits the amount of economizer heating surface which can be used, and consequently the fuel saving obtained by use of the economizer. The same fact operates unfavorably at small capacities, which are often unavoidable, when the chimney must be built large enough for future increase of the boiler plant. Fourth, a chimney once built limits the maximum capacity of the boiler plant, and also is liable to be affected by atmospheric changes which may seriously impair its efficiency.

These objections to the tall chimneys which are so essential to the use of economizers, do not hold with mechanical draft.

The first cost of a properly designed mechanical draft plant is very much less than that of a suitable chimney of equal capacity, often averaging 75 to 80 per cent. less, according to the size of chimney and character of foundations required. The fans and short stack require very little foundations, even less than that of an ordinary boiler setting. The space usually required for extensive chimney foundations can be utilized for economizers, and by elevating the economizers and fans upon beams and columns, the space underneath them can be used for pumps, condensers, etc.

Natural draft requires that the gases in the chimney be above a certain minimum temperature in order to secure a proper supply of oxygen in the furnace and a good combustion of the fuel, whereas with mechanical exhaust draft the amount of draft obtainable is entirely independent of the temperature of the flue gases, and when used in combination with a properly proportioned economizer, it is possible to lower their temperature to a point where the draft of even a very tall chimney would be practically destroyed.

Mechanical draft possesses great advantages over natural draft in its flexibility and adaptability to both large and small capacities, and in its ability to meet sudden and excessive demands for steam, either by an extra turn of the throttle valve, or by an automatic regulator controlling the steam supply to the fan engine according to the boiler pressure. It is unaffected by atmospheric changes, furnishing the desired amount of draft irrespective of conditions of wind or weather. Operating independently of the amount of heat in the stack, it is possible to obtain a higher temperature of feedwater in the economizer, and a lower temperature of escaping gases than could possibly be obtained with a chimney, and at the same time provide sufficient draft to maintain rapid and economical combustion of the fuel. There are undoubtedly many boiler plants equipped with economizers and chimneys, where the draft is so greatly reduced by the economizer, that it is an open question whether the saving in fuel by thus heating the feedwater is not more than balanced by the loss due to imperfect combustion in the furnace, and whether it would not result in a greater saving in coal to cut out the economizer and get better combustion, and a higher initial temperature due to better draft.

A mechanical draft plant properly designed, with duplicate fans and engines of suitable construction, so arranged that one is always in relay, can be made so reliable that the boilers cannot be shut down by any ordinary accident. With the fans properly designed and proportioned to the work, the power required to operate them is so small as to practically have no effect on the economy obtained. The mistaken idea that prevails somewhat, even among intelligent engineers, regarding the amount of power required for mechanical exhaust draft, is probably caused by the well known large amount of power required to drive the high speed pressure blowers and fans used for forced draft. Mechanical draft handles a large amount of heated gases with slow speed exhaust fans at a low pressure, and with a small expenditure of

power. To illustrate: The writer recently designed a mechanical draft and economizer plant for 6,000 H. P. of water tube boilers, providing duplicate, large, slow running fans of special design, each driven by an independent engine, and each having a capacity, estimated in pounds of coal burned per hour, sufficient to develop 25 per cent. in excess of rating, or 7,500 H. P. The power required to drive one fan to do this work was .6 of 1 per cent. of the boiler horse power developed. Or, estimated in coal per horse power per hour, and at $3 per ton, the fuel cost of operating the plant one year was 2 per cent. of the estimated cost of the chimney originally planned for the plant. In other words, it would not pay to build the chimney so long as money was worth more than 2 per cent. per annum.

In a typical boiler house, the economizer is elevated upon columns and beams to provide for utilizing the space under the economizer for feed pumps, condenser, etc. The exhaust fans, of which there are two placed side by side, are equipped with direct connected engines, only one engine showing in the illustration, the other being on the farther side. These fans and engines are of special design, with protected bearings, self-oiling and water jacketed, to withstand the heat when the economizer is cut out for cleaning or for repairs, and the hot gases pass directly to the fans. They are so proportioned to their work as to handle a maximum amount of gases with a minimum expenditure of power.

The arrangement of the economizer pipes and blow-off connections are worth noticing, in that they provide a means of blowing out the sediment which may accumulate in the pipes, and at the same time a complete circulation is maintained in the economizer. Many extensive plants are now in operation, or in process of construction in various parts of the country, equipped with economizers and mechanical draft similarly arranged.

Probably the largest plant of the kind yet built is that of the Philadelphia Traction Company, Philadelphia, Pa. Two large power houses are in process of erection and partly in operation for this company, one of 7,500 H. P. and one of 6,000 H. P. At the 13th and Mt. Vernon Streets Power House,* there are twenty Babcock & Wilcox boilers of 375 H. P. each, arranged in two parallel rows of ten boilers on opposite sides of the boiler room. The other station of 6,000 H. P. is arranged similarly, except as to the number of boilers. The gases from each row of boilers are conveyed by flues at the back to the center of the boiler house, drawn through the economizers and discharged into stacks by four large, slow running exhaust fans of special design. These fans are arranged in pairs, and are of such a capacity that two of them will handle the gases for the entire plant, thus leaving two in reserve. The fans are driven by duplicate engines and countershafts, so arranged that either engine will drive any one or more fans, as desired. The stacks extend but a few feet above the roof, and are lined with brick to preserve them from the corroding action of the gases. The feedwater is pumped through exhaust steam heaters to the economizers, and thence to the boilers. At the 33d and Market Streets station of the same company, the fans are driven by engines belted directly, one small engine to each fan. The economizers occupy the space originally planned for two tall chimneys, one for each side of the boiler house. These chimneys were to have been 200 ft. high, with a flue eleven feet in diameter. Two of the fans are capable of producing a draft equal to that of the two brick chimneys originally planned. The power required to drive one of these fans, as the plant is now being operated, is exceedingly small, being less than ten horse power for each 2,000 H. P. produced, or less than one-half of 1 per cent. of the power developed by the boilers.

The following data will be of interest, as showing in tabulated form the results obtained by economizers and mechanical draft in a number of plants in regular service. In every case the feedwater was partially heated by exhaust steam heaters, or in hot wells by condensed steam from various sources.

TESTS OF ECONOMIZER AND MECHANICAL DRAFT PLANTS, SHOWING INITIAL AND FINAL TEMPERATURES OF FLUE GASES AND FEED WATER IN DEGREES FAHRENHEIT.

Plants tested.	Gases entering economizer.	Gases leaving economizer.	Water entering economizer.	Water leaving economizer.	Gain in temp. of water.	Fuel saving, per cent.
1	610	340	110	287	177	16.7
2	505	212	84	276	192	17.1
3	550	205	185	305	120	11.7
4	522	320	155	300	145	13.8
5	505	320	190	300	110	10.7
6	465	250	180	295	115	11.2
7	490	290	165	280	115	11.0
8	495	190	155	320	165	15.5
9	595	299	130	311	181	16.8

Tests of Small Electric Railway Plant.—

By Jesse M. Smith, Detroit, Mich.

This paper gives the results of a test made in October, 1893, on the power plant of the Wyandotte & Detroit River Railroad, which is a suburban road running from Detroit to Trenton, Mich., 10.5 miles long.

The plant contains two tandem compound, condensing engines rated at 150 H. P. each, and guaranteed for a maximum load of 225 H. P., made by the Phoenix Iron Works Company, Meadville, Pa. Each engine is belted direct to a Westinghouse railway generator of 150 E. H. P. The vacuum is obtained by a Conover air pump and condenser belted directly to the engine shaft. The boiler feed pump is driven from the air pump shaft. Steam is supplied by two Manning vertical boilers. One engine and dynamo only were used during the test. It will be noted at the outset that each engine and dynamo is designed to deliver on average of 150 H. P., but that during the test the average load on the engine was only 70 I. H. P., and the maximum 141 I. H. P. The best conditions of economy were therefore not realized. The test was made under commercial conditions for the owners of the plant. All the machinery had been run about three months and no adjustments by the makers had been made since it was first put in. No special care had been taken to get very close regulation either of the engine or generator. One boiler was fired with coal, and used exclusively to supply steam for the fuel atomizer of the other boiler, "straight crude oil" was used exclusively as fuel for the boiler, which supplied steam to the engine, and no steam was used from that boiler for other purposes. Indicator cards were taken at intervals of five minutes during the seventeen and one-third hours of the test. A Tabor indicator was applied directly to each end of each cylinder, and all operated by the same mechanism. Indicator cards were taken simultaneously from the four indicators by two persons on a signal given at the proper time, without regard to the load on the engine. The speed of the engine was determined by a continuous revolution counter which was directly connected to the shaft of the engine. The variation of speed was shown by a tachometer belted directly to the engine shaft, and constantly in service. It was carefully compared with the revolution counter when on constant speed, and was made to agree with the counter. The speed of the dynamo was taken at four different times by a revolution counter held in the end of the shaft for five consecutive minutes each time. Three readings gave 604 revolutions, and one reading gave 603 revolutions per minute. The speed of the air pump was taken in the same way.

The steam gauges on the boilers were connected to the boiler near the bottom, so that they show the pressure due to a head of water of about ten feet in addition to the steam pressure. The boiler gauges therefore show about five pounds more pressure than the pressure of the steam in the boiler. The standard gauge, when placed on the steam pipe of the engine just above the throttle valve, showed about five pounds less pressure than the boiler gauge, so that there was practically no loss of steam pressure between the boiler and engine.

The amperes were measured by a Weston standard ammeter connected in series with the station ammeter. The volts were measured by a Weston standard voltmeter connected to the bus bars of the switchboard. Volt and ampere readings were taken every ten seconds by a different person at each instrument, the time being given by a third person.

The water used by the boilers was taken from the overflow of the air pump, and weighed in two barrels on two scales, and was pumped from the barrels by the regular feed pump worked from the shaft of the air pump. The feedwater passed through a closed heater with brass tubes, the heater being connected with the exhaust pipe between the engine and condenser. The fuel oil was stored and fed by the Snell water pressure system. The amount of fuel oil fed to the atomizer was measured by measuring the number of gallons of water which flowed into the storage tank.

The dimensions of the plant and data, and the results are given in the following tables:

DESCRIPTION OF PLANT.

Boilers.—Kind, Manning vertical tubular; number, 2; size, known as 61 in.; rated capacity, 150 H. P.; inside diameter of firebox, 6 ft.; height above grate, 3 ft. 6 ins.; number of tubes, 184; outside diameter of tubes, 2½ ins.; total length of tubes, 14 ft. 10 ins.; length of tubes below water line, 10 ft. 7 ins.; heating surface in firebox, 89.2 sq. ft.; heating surface in tubes below water line, 1,272.7 sq. ft.; heating surface in tubes above water line, 511.1 sq. ft.

Engine.—Kind, Phœnix Iron Works Company tandem compound, condensing; diameter of high pressure cylinder, 11 1/16 ins.; diameter of low pressure cylinder, 20 3/32 ins.; stroke of piston, 15 ins.; piston valves on both cylinders, both controlled by shaft governors; number of flywheels, 2; diameter of flywheels, 78 3/8 ins.; face of flywheels, 16 5/8 ins.; weight of rim of each flywheel, 2,445 lbs.

Air Pump.—Kind, Conover, belted to engine; size, No. 7; diameter of piston, 15 ins.; stroke of piston, 7 ins.; revolutions per minute, 67.

Boiler Feed Pump.—Kind, single acting plunger driven from shaft of air pump; diameter of plunger, 3 ins.; stroke, 6 ins.

Dynamo.—Kind, Westinghouse four pole railway generator; rated capacity, 150 E. H. P.; standard speed, 625 revolutions per minute; speed when tested, 604 revolutions per minute.

Cars.—Maker, Jones, length, 16 ft.; weight, 14,500 lbs.; number of seats, 22; kind of motors, Westinghouse; number of motors, 2; rated power of each motor, 30 E. H. P.; number of cars in use, 3.

Road.—Length, 10.5 miles; kind of rail, T; weight of rail per yard, 52 and 56 lbs.; supported on cross ties; ties covered with sand, and resting on sand, except from Wyandotte to Trenton, which is stone ballasted.

SPEED OF ENGINE AS CONTROLLED BY GOVERNOR.

Revolutions per minute by *revolution counter*, average for eight minutes with dynamo belt off.....	238 revolutions.
Average revolutions per minute on regular work during 362 minutes.....	234.3 "
Percentage of variation of revolutions.....	1.58
Minimum revolutions per minute, dynamo producing 180 amperes, engine developing 165 I. H. P.....	227 revolutions.

*Fully described and illustrated in the Street Railway Journal for January, 1894.

DISTRIBUTION OF POWER USED.

Power consumed by friction of engine, air pump, and boiler feed pump, with main belt off	9.22 I. H. P.
Friction of engine, air and feed pumps, and dynamo, with brushes off	11.34 I. H. P.
Friction of dynamo and belt	2.12 I. H. P.
Power consumed by engine, air and feed pumps and dynamo, with brushes on and main circuit open	14.34 I. H. P.
Power required to charge fields of dynamo	3.00 I. H. P.
Percentage of engine capacity required by friction of engine, air, and feed pumps	6.15
Maximum power developed by engine as shown by indicator cards, during economy test	141.4 I. H.P.
Minimum power developed by engine, as shown by indicator cards, during economy test	21.27 I. H. P.
Average power developed by engine, as shown by 208 sets of indicator cards, during economy test	70.1 I. H. P.
Average electrical horse power delivered by dynamo	45 E. H. P.
Average indicated horse power delivered to pulley of dynamo, estimating friction of armature shaft, to be the same as friction of belt	59.81. H. P.
Average number of cars in use during test	2.89 cars
Number of passengers on cars during 17½ hours	1,014
Average number of passengers on cars per single trip	15.2
Average number of passengers on cars at any one time (estimated)	8
Weight of ten persons at 140 lbs. each	1,400 lbs.
Weight of cars	14,500 lbs.
Total weight of cars and persons	15,900 lbs.
Average weight in motion	44,950 lbs.
Average electrical horse power per 1,000 lbs. of weight moved	0.98 E. H.P.
Average horse power developed by engine per 1,000 lbs. of weight moved	1.52 I. H. P.
Average electrical horse power per car	15.54 E. H. P.
Average horse power developed in engine per car	24.25 I. H. P.
Average watts delivered by dynamo per horse power developed in engine	478.8 watts.
Average watts delivered by dynamo per horse power delivered to belt of dynamo	557.3 watts.
Average speed of cars per hour, including all stops, twenty-one miles in 1.5 hours	14 miles per hour.
Average speed of cars between stops	15.38 miles per hour.
Total car hours	50.25
Time of test	17.33 hours.

ECONOMY TEST.

Duration of test	17⅓ hours.
Average horse power developed in engine as shown by 208 sets of indicator cards taken at five minute intervals	70.1 I. H. P.
Average horse power delivered by dynamo as shown by 6,209 sets of readings taken at ten second intervals	45. E. H. P.
Net average steam pressure in boiler by half hour readings	111.8 lbs.
Average vacuum by half hour readings	25.2 ins.
Steam used by engine per hour	1,721.1 lbs.
Steam used by engine per horse power per hour	24.55 "
Steam used by fuel oil jet per hour	291.5 "
Steam used by engine and fuel oil jet per hour	2,008.8 "
Percentage of steam used by fuel oil jet	14.5
Fuel oil used per hour for engine .....20.25 gals..	133 "
Fuel oil used per horse power per hour for engine, .29 gal.	1.9 "
Additional fuel oil which would be required to maintain oil jet for one hour .....3.43 gals..	22.58 "
Average temperature of water flowing from air pump	91.8° Fah.
Average temperature of feedwater entering boiler	126.6° "
Rise of temperature of feedwater due to heater	34.8° "
Percentage of fuel saved by heater	3.06%
Fuel oil required to evaporate 1,000 lbs. of water from 126.6° Fah., into steam at 112 lbs. pressure	11.79 gals.
Water evaporated from 126.6° Fah. into steam at 112 lbs. pressure per gallon of fuel oil	84.81 gals.
Ditto per pound of oil	12.9 lbs.
Area of steam outlet of atomizer	.07 sq. in.

Which is same as a round hole .3 in. diameter.

It will be noted that 14.5 per cent. of the total steam generated was used by the fuel oil atomizer. The atomizer was not properly proportioned for the work, and did not receive enough air. The flame was red and evidently not economical. The atomizer and furnace have since been arranged with much better results.

In this engine the piston valves which distribute the steam to both high and low pressure cylinders are controlled by the governor.

It will be noted that while this is a condensing engine the high pressure cylinder does a good share of the work even on the lightest loads, and the receiver pressure does not vary greatly either during a single revolution, or during a change of load of from 21 to 101.8 H. P. While the load changes 488 per cent., the average receiver pressure only changes 167 per cent., and even when the engine ran with the belt off and developed 9.2 H. P., there was no negative work in either end of either cylinder. These results, which I believe to be highly important, both for economy and close regulation, are due to the valves of both cylinders being controlled by the governor.

The results of a study of the indicator diagrams are given in the following table:

	Set No. 1.	Set No. 2.	Set No. 3.
I. H. P. in H. P. cylinder.			
Crank end	2.4	13.8	25.3
Head end	2.5	14.8	26.1
I. H. P. in L. P. cylinder.			
Crank end	8.3	16.6	25.2
Head end	7.8	17.6	25.2
Total I. H. P.	21.0	62.8	101.8
Maximum pressure in receiver	5.9	9.0	11.0
Minimum " " "	4.0	6.4	7.5
Average " " "	4.9	7.2	8.2

The variations in load in a plant of this kind are not only extreme, but rapid, and were from 5 to 134 amperes. In one interval of ten seconds the load increased 115 amperes, which equals 120 I. H. P.

During the regular operation of the plant and with these extreme variations in load, the needle of the tachometer never left the space enclosed by the 230 and 240 revolution marks.

Power Losses in the Transmission Machinery of Central Stations.

By Wm. S. Aldrich.

This paper presents some memoranda on the subject of power losses in the transmission machinery of central stations, which had come within the author's experience, and some of which were incompletely referred to in the discussion of the paper on the "Performance of Street Railway Power Plants," presented at Chicago meeting (July, 1893), by Messrs. Wm. A. Pike and T. W. Hugo.*

DISCUSSION OF PAPER.

Test No. 2 in paper of Messrs. Pike and Hugo showing the combined horse powers from cards taken every ten minutes, cannot possibly show the real variations of power in an electric railway plant. The frictional losses in the transmission machinery are best determined by special tests, before or after the regular run, having this one object in view.

In a joint test of an electric railroad, made in 1891, by Mr. Hermann S Hering and the author, they found that it was impossible to arrive at any satisfactory conclusion as to what became of the motive power generated to drive the dynamos, when throwing the load on and off again as quickly as it is done in an electric railroad. At times there would be as much as 40 H. P. unaccounted for; that is, for a few seconds the dynamo output would fall more than 80 H. P. below the then delivered turbine horse power; while, at other times, the horse power delivered by the turbines and the dynamos would be equal. Under light load conditions, which remained steady for about two minutes at one portion of the run, the actual difference between the turbine horse power and dynamo horse power, delivered, was 43 8. All at once, while the turbines were decreasing their output, there would be 50 or 60 H. P. thrown off or on the dynamos, and the turbine gates would keep on closing. At other times the same thing would happen while the turbines were increasing their output, and the turbine gates would keep on opening, causing the difference of power between that delivered by the turbines and that delivered by the dynamos to the line to run enormously high; the maximum difference so observed was 140 H. P., or almost 100 H. P. in excess of that lost in the transmission machinery and dynamo.

Between these extremes one can readily see that the transmission machinery acts in the way of a flywheel, storing up the excess of energy on the one hand, and giving out part of its stored energy during a deficiency on the other hand. These great differences of power exist only for a few seconds.

In our report on this test, we stated that steam engines would not be at all likely to show the same results of great excesses and deficiencies of output, while the dynamo load continued to vary in its characteristic fashion for street railway purposes. We are greatly surprised therefore, to find that the tests of Messrs. Pike and Hugo, on the Corliss engines of the Minneapolis & St. Paul electric railway plants, do show up much the same as in our turbine tests referred to. They even note that, when lightly loaded, the difference between the engine and dynamo output is *minus*, showing that the dynamos are delivering more power than the engine, similar to the case we have cited for the turbine plant. While they believe this peculiarity to be due to imperfect (better, *tardy* regulation) we think it is due almost entirely to the flywheel action of the transmission machinery.

The high speed, automatic engine, directly connected (or better, directly coupled), is, in my opinion, best adapted to meet the sudden and very great variations in electric power plants, while the well known type of Corliss engine seems best adapted to steady loads.

The following table, No. 1, contains a brief presentation of the principal figures in this connection, from the paper under discussion.

*Published in the August, 1893, issue of the STREET RAILWAY JOURNAL.

TABLE I.

No. of Test.	Kind of Engine.	How connected to Dynamo.	Ind. H. P. delivered by engine.	Elec. H. P. delivered by dynamos.	Eng. Friction H. P. by Friction Run.	Per cent. Eng. Friction.	Total Friction H. P.= I. H. P.—Elec. H. P.	Per cent. Total Friction H. P.
1	Tri-cylinder Cond. Corliss.	By Countershaft	1,237.90	1,088.0			149.90	12.10
2	Tri-cylinder Cond. Corliss.	By Countershaft carrying Friction Clutches.	756.20	624.7			131.50	17.40
2d	Same.	Same.	859.73				164.43	19.12
3b	Westinghouse Compounds.	Belted direct to Dynamo.	522.50	434.2	14.27	3.7	88.30	16.90

THE POWER LOSSES IN A TURBINE PLANT FOR AN ELECTRIC RAILWAY.

The following particulars of the performance of the turbine power plant of the Neversink Mt. Electric Railway, Reading, Pa., have been taken from the author's reprint of the published report of the test, as it appeared in the *Electrical World*, May 28 to July 30, 1892.

Each vertical shaft of the Hercules, of which there are two, transmits its power through a mortise crown and jack gear to the horizontal shaft carrying the main driving pulley. The power is thence transmitted to a countershaft, from which each dynamo is belted by means of a friction clutch pulley.

In the test of the turbine plant under a light load, observations were made to determine the distribution of power, and the several losses from the hydraulic head of the water to the available power at the car axle, during the run of a single car over the road. Table II. contains a summary of the power distribution.

The performance of the turbine plant under a heavy load, is shown in table III., which gives a summary of the power distribution.

TABLE II.

With car, on the two principal grades, 3.61% and 3.91%, no other car being on the road at that time.

Grade on which reading was taken	3.61%.		3.94%.	
Time and time interval on grade	11-37-30	11-31-45 to 11-39-20	12-8-0	12-6-0 to 12-16-0
Conditions.	Steady.	Mean.	Steady.	Mean.
Power Delivered.				
Hydraulic H. P. delivered to turbines	190.0	187.0	188.2	184.2
Turbine H.P. deliv. to transmission machinery	93.2	88.7	91.4	86.0
H. P. delivered to dynamo	56.1	53.15	55.1	51.9
E. H. P. delivered to line	48.5	45.9	47.6	44.7
E. H. P. delivered to car motors	46.0	43.1	44.8	42.3
H. P. delivered at car axles	34.50	31.92	33.7	31.78
Power Lost.				
Turbine friction H. P.	96.8	98.3	96.8	98.2
Transmission machinery H. P.	**37.1**	**35.55**	**36.3**	**34.1**
Dynamo losses	7.6	7.25	7.5	7.2
Line losses	2.5	2.8	2.8	2.4
Car motor, gearing and axle losses	11.5	11.18	11.1	10.52
Total losses, Hyd. H. P. to car axle H. P.	155.5	155.08	154.5	152.42
H. P. available at car axle	34.5	31.92	33.7	31.78
Total Hyd. H. P. delivered	190.0	187.4	188.2	184.2

TABLE III.

Section in which reading is taken	I.	II.	Total.
Time base of section, hours and minutes	10.30—11.01	11.01—11.14	10.30—11.14
Time interval of section, in minutes	31	13	44
Power Delivered.			
Hydraulic H. P. delivered to turbines	182.7	234.0	197.8
Turbine H. P. deliv. to transmission machin'y	85.1	134.9	101.0
H. P. delivered to dynamos	50.5	97.8	63.7
E. H. P. delivered to line	38.5	82.0	51.3
E. H. P. " " car motors	36.2	77.1	48.2
H. P. " " car axles	25.4	54.0	33.7
Power Lost.			
Turbine friction H. P.	97.6	95.1	96.8
Transmission machinery friction H. P.	**34.6**	**43.1**	**37.3**
Dynamo losses	12.0	13.8	12.4
Line losses	2.3	4.9	3.1
Car motor and gearing losses	10.8	23.1	14.5
Total losses Hyd. H. P. to car axle H. P.	157.3	180.0	164.1
H. P. available at car axle	25.4	54.0	33.7
Total hydraulic H. P. delivered	182.7	234.0	197.8

POWER LOSSES IN A CABLE PLANT.

This test was made on the Druid Hill Avenue cable plant, Baltimore, Md., jointly by Hermann S. Hering and the author, March 29, 1892, while associated in the department of electrical engineering at the Johns Hopkins University.

A new plan is employed to drive the cable drums by not having them geared together, but using in connection with each driving drum, a compensator. This consists of a simple box train, epicycle gear. The idler drum is double, one-half of which is mounted loose on the shaft, while the other half is keyed to the same. The cable drums are placed, one on each side of the rope drive drum, on the main shaft, and driven through positive clutch couplings. These, as well as similar clutches on the engine shaft, are operated by hand, through compound gear. In the eleven miles of single track, there are fifty-eight single track curves, making 2,900 ft. of curve construction in all. The power house at the other end of the line is a duplicate of the Druid Hill Avenue one. The above particulars are taken from the STREET RAILWAY JOURNAL, March, 1891, which contains a full and illustrated description of the "Baltimore Cable Road" and the Druid Hill Avenue power house.

The test was made under the ordinary working conditions of the road, the usual daily traffic and operations not being interfered with in the least during the normal running time of twenty-four hours. The plant consisted of two Wetherill-Corliss type engines, rated at 414 H. P., at sixty revolutions, eighty pounds boiler pressure and one-fifth cut-off. Rope driving is used to transmit the power from the engine shaft to the cable driving shaft. Only one engine was run during the test.

The frictional losses of the engine, drum, and cables were determined by running the engine with only that part of the machinery attached, of which it was desired to obtain the friction horse power. It will be noticed that the sum of the individual friction horse powers of the large and small cables is not equal to that required to drive the two together. This shows an increase in the friction of the transmission machinery and through the rope drive, a result which is to be expected when the transmitted load is increased and the two cable driving shafts are operated as one.

The power necessary to drive the cable, under no load, and at various speeds, was obtained by a special test; from the plotted results of this run it appears that the cable friction horse power varies almost directly with the speed at which the cable is running.

It is the extent of curved track and the steep grades on the road, which no doubt make the efficiency of the cables so low; for, as will be seen by referring to the summary of efficiencies, only 45.9 per cent. of the power delivered to both cables is available for use in propelling the cars.

The data and particulars involving the power losses in the transmission machinery are tabulated below:

TABLE III.

SUMMARY OF POWER DISTRIBUTION AND EFFICIENCY OF CABLE PLANT.

Power developed and delivered.	
Horse power developed, cars on, maximum 6.30 P. M.	342.2 H. P.
" " " minimum 5.04 A. M.	156.0 "
" " " mean (of run)	241.7 "
Horse power developed without cars on, but with both cables, drum and engine friction, mean	152.35 "
Horse power developed without cars on, but with downtown cable, drum and engine friction, mean	124.2 "
Same, but with uptown cable, drum and engine, mean	69.0 "
Same, but with drum and engine only, mean	47.45 "
Same, but with engine only (engine uncoupled), mean	29.15 "
Horse power delivered by engine shaft	212.55 "
Horse power delivered by main driving shaft from clutch couplings	194.25 "
Horse power delivered by both cables to cable car grips	89.35 "
Friction horse power of both cables and additional shafting required by same, mean	104.9 "
Friction horse power of both cables alone, mean	98.3 "
Power Lost.	
Engine friction horse power	29.15 H. P.
Drum friction	18.30 "
Uptown cable friction	21.55 "
Downtown cable friction	76.75 "
Shafting, due to mean load on both cables	6.60 "
Total friction horse power	152.35 H. P.
Mean available horse power delivered to cars	89.35 "
Mean total indicated horse power developed by engine	241.70 H. P.
Summary of Percentage Distribution of Power.	
Percentage lost in engine friction	12.10
" " drum friction	7.60
" " uptown cable friction	8.90
" " downtown cable friction	31.80
" " shafting (due to use of both cables)	2.70
Percentage available power at cars	36.90
Total power developed by engine	100.00

POWER LOSSES IN TRANSMITTING THROUGH A COUNTERSHAFT.

These tests were made to determine the losses in the usual method of driving dynamos; namely, through two belted connections and a countershaft. They were made jointly by Clement R. Jones and the author, in the mechanical engineering department of the West Virginia University, in March, 1894.

Engine, Wheelock, rated horse power 40, at 75 revolutions, 80 lbs. gauge $\frac{1}{4}$ cut-off. Dimensions of cylinder, 11×30.

Indicator cards, and speeds of engine and dynamometer shafts were taken every two minutes. The engine friction horse power, tabulated

or (*c*) and (*d*) were taken from a curve plotted from the previously recorded results, on the usual assumption that it varies directly as the speed, regardless of the load.

TABLE IV.

DATA AND PERFORMANCE OF THE TRANSMISSION MACHINERY.

Dimensions and Data.

Band wheel of engine—diameter on crown.... 96⅝ ins.; face, 17 ins.
Countershaft pulleys, driven—diameter on crown..... 48 " " 14½ ins.
Countershaft pulleys, driver—diameter on crown..... 48 " " 12½ ins.
Dynamometer pulleys (*c*) bare cast iron: diameter on crown..... 15¼ ins.; face, 14½ ins.
Dynamometer pulley (*d*) covered with Shultz patent leather covering: diameter on crown..... 15½ ins.; face 14½ ins.
Main driving belt, light double, oak tanned..... 11⅞ × ½ in.
Dynamometer belt, single, oak tanned..... 8 × 7/32 in.

Transmission Machinery Performance.

Plain cast iron pulley on dynamometer—column (*c*).
Shultz patent leather covering on dynamometer pulley—column (*d*).

	(*c*)	(*d*)
Time interval of run, minutes.....	60.	30.
Corrected mean boiler pressure.....	59.29	64.5
Mean revolutions per minute, engine.....	67.0	68.25
" " " " dynamometer.....	402.60	417.06
Calculated speed of dynamometer, ratio.....	6.34	6.235
" " " " speed.....	424.0	425.5
Loss in speed, from engine to dynamometer shaft....	22.2	8.44
Slip of belt, per cent. of calculated speed.....	5.23	1.98
Tension at which belts were laced and run, average of initial, and final tension on belts, pounds per square inch:		
Main driving belts.....	40.	80.
Dynamometer belt.....	75.	135.
Mean indicated horse power.....	19.122	13.210
Engine friction, horse power (from plotted curve).....	2.50	2.54
Horse power delivered to transmission machinery....	16.622	10.670
Dynamometric horse power absorbed.....	15.275	9.960
Horse power lost in transmission machinery...	**1.347**	**0.710**
Frictional loss, per cent., engine.....	13.06	19.23
Frictional loss, per cent., transmission machinery.....	**8.10**	**6.65**
Efficiency, per cent., engine.....	86.94	80.77
Efficiency, per cent., transmission machinery..	**91.90**	**93.35**

Cost of Indicated Horse Power.

Decourcy May, Niagara Falls, N. Y.

In the table presented by Mr. May and given below, the cost is given of one indicated horse power for 365 days of twenty-four hours each, and 308 days of ten and a fourth hours each, the ten and a fourth hours representing the running time in the ordinary mill or factory:

The interest on the plant is placed at..... 5 per cent.
The depreciation on the plant is placed at..... 5 " "
The insurance on three-fourths of the plant is placed at..... 1 " "
The taxes on three-fourths of the plants are placed at..... 1½ " "

No rental or interest on the land occupied by the plant or cost of water is charged.

The value of the land occupied varies so largely, especially with electric lighting and trolley plants in large cities, as to make the insertion of these figures misleading.

	Cost of one I.H.P. 365 days of 24 hours.				Cost of one I H.P. 308 days of 10¼ hours.			
	Coal per 2,240 lbs.				Coal per 2,240 lbs.			
	$2	$3	$4	$5	$2	$3	$4	$5
Triple expansion pumping, Allis, 20 revs....	48	55	61	67	31	33	35	37
Triple expansion without pumps, Allis, 50 revs	27	33	39	45	16	18	20	22
Compound mill, best engine.....	29	36	44	51	17	19	21	24
" " average.....	39	46	52	58	22	25	28	30
" electric light, average.....	122	139	157	174	78	84	90	96
" trolley.....	48	58	68	79	29	32	36	39
Triple expansion trolley.....	45	54	64	74	26	29	33	36
Condensing mill.....	44	52	61	69	25	29	33	38
Non-condensing, 50 to 200 H.P.....	70	76	81	88	49	53	57	62

The figures for engines below fifty horse power vary so widely that they have been omitted. The above table, Mr. May states, has been calculated as far as possible from actual engines running under ordinary conditions.

Electric Railway at Lyons.

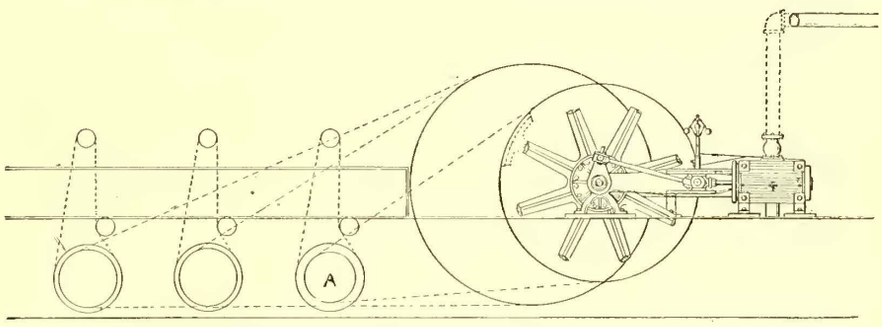
One of the recent electric railways to be put in operation and the fifth constructed in France on the overhead trolley system is that extending from the city of Lyons to Oullins. This is the second trolley road in Lyons, the other being the Lyon-Saint Just à Sainte-Foy. The Lyons-Oullins line has a length of about four miles with a maximum grade of 3½ per cent. The track is double for the entire distance, and is laid with the Marsillon type of rail. There are no curves of short radius, but one grade of considerable length upon which, when horses were used, but slow speed was attained. The cars now mount this grade at a speed of about seven and a half miles an hour.

The trolley wire is of copper .326 in. in diameter, and suspended from span wires which are supported on the ordinary type of tubular poles.

The central station is located at Oullins and contains tubular boilers manufactured in Lyons, and two 150 H. P. engines of the Piguet type operating at 100 revolutions per minute. The electrical generating machinery consists of two .00 K. W. General Electric machines over-compounded for a loss on the line of 10 per cent., and operating at 650 revolutions per minute.

Flywheel Accident at Pittsburgh, Pa.

A bursting flywheel at the Ben Venue power house, of the Pittsburgh Traction Company, interrupted traffic, and seriously wrecked the station on the afternoon of April 19. The engine was a Wetherill-Corliss, consisting of a pair of 22 × 42 in. cylinders connected to cranks at right angles upon the main shaft. It ran at seventy-five revolutions per minute, and was rated at 450 H. P. Both cylinders were under the control of one governor, a shaft, one and a half inches in diameter, and ten feet long, extending across the engine for the purpose in the ordinary way, and passing within six inches of the face of the flywheel. At the time of the accident the engine was driving, as nearly as could be learned, about 700 H. P. The flywheel which burst was twenty feet in diameter, thirty-two inches face, and weighed about sixteen tons. It showed no defects, and would have doubtless stood for years any ordinary treatment. The accident appears to have been due to a short circuit which increased the load until the belt slipped, and the five foot driven pulley belted to the engine wheel, and marked *A* in the diagram, failed. This broken pulley parted the belt which was drawn toward the engine with such force as to tear up the flooring and break the governor cross shaft mentioned above, completely stripping all the governor connections from both cylinders. The engine, being thus uncontrolled, soon attained a speed beyond that which the flywheel could stand. The wheel was made in eight sections, and broke, in each instance in the arm, as shown by the sketch.



ARRANGEMENT OF MACHINERY—BEN VENUE STATION, PITTSBURGH.

The piece which caused the most damage weighed about 400 lbs. It flew back and up at an angle of 25 degs. from a line perpendicular to the floor line, and struck the steam main directly over a central point between the two cylinders, bursting the main, which deflected it towards the boilers, where it fell on the dome of one boiler, crushing it in, and allowing all the steam to escape. This was the most serious damage incurred. A second piece about the same weight, flew off forward at a similar angle. It struck a roof I beam at a central point, and bent it to an angle of 100 degs. It then dropped on the floor and through it. A third piece, about 300 lbs. weight, struck an arc light dynamo which was on the floor directly in line with the flywheel, smashing the framework, and penetrating the dynamo for several inches. A fourth piece, about 200 lbs. weight, struck the wall below the floor line. It did no damage. A fifth piece went through the roof at an angle of about 30 degs. and dropped on a high bank 100 ft. from the power house. Several pieces went backwards, under the floor line, but did no damage, being stopped by the wall and floor. Fortunately, no one was injured, though there were several witnesses, and the accident did not seriously cripple the road, as they had a surplus of power.—*Power.*

A CHARTER was granted last month to the Roxborough, Chestnut Hill & Norristown Traction Company, of Philadelphia, capital $5,000. The incorporators are Wm. H. Huelings, Jr., John T. Dunlap, Wm. J. Ferdinand, Henry C. Esling, of Philadelphia, and George W. Vanhorn, of Chester.

Established 1884.

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We heartily invite correspondence upon all subjects of interest to street railway men. Information regarding changes of officers, new equipment, extensions, etc., will be greatly appreciated for our official directory and news columns. We especially invite the co-operation of all interested to furnish us particulars that the directory may be correct and of the greatest possible value.

Address all communications to

Street Railway Publishing Co.,
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The Meeting of the American Institute of Mechanical Engineers, held last month at Montreal, was one of the most successful in the history of that association. Questions of mechanical engineering enter so closely into street railway operation that the proceedings of this body possess an especial interest to our readers. We publish elsewhere abstracts of the principal papers bearing upon engine operation.

Double vs. Single Trolley Roads—using a legal phrase—present a case that has not as yet attracted very much attention, but in our opinion, should have a careful investigation. Under the thorough trial which the double trolley has had in Cincinnati, as detailed in another column, it has demonstrated its practicability, and eliminated many of the disadvantages which were supposed to attend the employment of a second overhead wire for the return circuit. The officials of the Street Railway Company using the system in that city speak well of it, and the advantages urged in its favor are worthy of consideration.

The Maintenance of Parks and similar attractions by street railway companies, with the object of stimulating traffic, is growing to be an important feature of this business. Reports from those railway companies which have undertaken enterprises of this character, seem to show that the results attained have been of the kind sought, and that the increase in gross earnings has been sufficient to pay for the investment made. As the land usually selected for the site of a street railway company's park is at the terminus of one of the lines, and is hence a considerable distance from the center of the city or town, it can generally be secured for a low price. The management of the entertainments provided usually devolves upon the superintendent, though it will often be found a better plan to have a special person appointed to look after this department exclusively. His duties should include that of attending to the engagement of the ball teams or other entertainment companies, advertising, care of grounds, supervision of restaurant privileges, etc. While most of the entertainments must necessarily be of an out-of-door character, a wide variety is presented to select from. One street railway company, whose park is described in this issue, has engaged a local baseball team under the captaincy of Mike Kelley, the ex-Boston player, while another, farther South, has secured the services of a prominent colored revivalist. Occasional exhibitions of fireworks will also often prove an attractive feature for such parks. The problem of encouraging traffic on street railway lines is one which is attracting more and more thought, and efforts in this direction will often be followed by a gratifying increase in gross earnings.

"The Conductor and Motorman (or Driver) were Arrested," is a statement which frequently appears in daily papers in connection with descriptions of street railway accidents, and usually without any proof that the arrested parties were in any way responsible for the accident. Generally the arrest of street railway employes and the publication of the fact is an imposition upon innocent persons, for which they seem to have as yet no redress. The practice of police officers arresting car men while on duty is quite too common, and something should be done by street railway companies to protect their men from such indignities. It is indeed an indignity to take men from their car, march them through the streets under arrest and lock them up in cells as common criminals and enemies of society, and hold them in confinement until bail can be procured. The practice and publication of the fact tends to create in the public mind a prejudice against car men as a class, causing many to hold them in about the same estimate as they do thugs and pickpockets. The practice of taking men from their car without notice often interrupts the service of a line, and is liable to subject a large number of passengers to delay and annoyance until other men can be found to supply the place of the arrested parties. A partial remedy is found in the practice which has been adopted in the city of Memphis, and which is detailed at length in another column. By an arrangement made between the operating company and police authorities, when it is the duty of an officer to apprehend a car employe, if the charge is not a serious one, the officer telephones the manager to have the man report at police headquarters at a certain time, and this the company agrees to do in all cases. If the charge is a serious one, then the officer telephones the manager to send an extra crew to relieve the men under arrest; then he boards the car and accompanies the men over their route until the relief appears. This practice prevents interruption of traffic, and when convenient to the police station the men are taken in without observation and without subjecting them to the humiliation of a march through the streets, followed by the rabble that might be drawn to the scene of the accident, whatever it might be.

The Editorial Correspondence relating to the street railway systems of Southern cities closes for the present with this issue. The Southern tour, to which reference is made above, began on the 12th of January,

when the editor of the STREET RAILWAY JOURNAL left New York by steamer of the Clyde Line for Charleston, S. C., and virtually ended on his arrival in Chicago on the 20th of last month. The cities visited on this trip in their order were Charleston, Savannah, Augusta, Atlanta, Chattanooga, Montgomery, Mobile, New Orleans, Algiers, Galveston, Houston, Ft. Worth, Dallas, Hot Springs, Ark., Memphis, Covington, Newport, Cincinnati, Dayton, Indianapolis, Chicago. On returning to New York, the total distance traveled on steam lines during this trip will be six thousand miles, and about one-third of the distance additional on street car lines. It is to be regretted that time did not permit of a visit to a number of other equally as large and interesting Southern cities from a street railway point of view, but these we will endeavor to reach in a subsequent trip. All the states of the Union, with the exception of three, have now been visited by our editor in the interests of the STREET RAILWAY JOURNAL. We have to express our gratitude to the street railway managers and others in the cities recently visited for the uniform kindness and attention with which he has been received. Only pleasant memories remain of every city visited, and of every street railway official.

* * * * *

We are sometimes asked why we go to the expense of keeping one of our editors constantly on the road, and why we do not edit the STREET RAILWAY JOURNAL from a single office, following the example of the majority of trade journals. Our answer is that, in our opinion, a description by the same observer, of the details of actual everyday practice as found in the different cities, is the most valuable class of matter that we can present to our readers. It places at the disposal of all, the mechanical and electrical devices that are being employed in different cities, as well as the methods of practice in discipline and operation. It gives us an opportunity to study the street railway business under every possible condition, so that we are better able to judge of the relative merits of the different appliances, plans of construction and methods of discipline, while by associating constantly with street railway men and the manufacturers of street railway supplies, we learn what matter will be of most value to them, and are able to provide it accordingly. We have evidence that our efforts to provide the class of matter to which reference is made above, is appreciated by our readers and patrons, and have the satisfaction of knowing that the STREET RAILWAY JOURNAL is most carefully read and studied.

The Car Service given by horse railways five years ago was frequently insufficient to meet the traffic requirements of growing municipalities. Ten and fifteen minute schedules on all except the two or three main streets of the principal cities were usual, and in smaller cities, where frequency of service is an absolute desideratum if traffic is to be secured, the schedules were often longer and the car speed less than in the larger. The introduction of electricity and the cable system has brought about a radical change in methods of management, particularly in this matter of car service. Street railway managers have found that the public is quick to appreciate increased speed and frequent cars. The great increase in gross receipts obtained by most of the street railway companies who were first to adopt electricity brought these facts forcibly to the attention of others, and the public has come to be far better served than ever before; car mileage has been doubled, trebled and even quadrupled in some places, owing to the increased speeds, the greater number of cars in service and the extensions of mileage. This increase of car service has been in some cases carried too far. In the larger cities it has been frequently a necessity and has been generally beneficial to the operating companies, although differences in comparative financial results between cities of the same general character can often be traced to differences in the car service given. In the smaller cities, however, the street railway companies are frequently obtaining large business at too heavy an operating expense, and their net income would often be improved by a reduction in car service, even should the gross receipts suffer slightly in consequence. To be sure, it is a matter of no small difficulty to reduce a service once established, and the unpopularity of such a policy is disagreeable, though usually only temporary. Nevertheless, the street railway manager has always to keep in mind the fact that in the interest of his stockholders, "net income" is always more important than "gross," and the problem of how to obtain the greatest profit with the least expenditure and without injustice to the public is one which must be carefully studied for each particular case. The question of profits in cities and towns of less than 25,000 inhabitants is perplexing. As a rule the distances are comparatively short, so that, in order to induce traffic, a car must be on hand at the moment wanted, and must travel at such a speed as to really save time to the passenger. It is in the accomplishment of these desiderata, without at the same time too greatly increasing the operating expenses, that the test of good management occurs, and if the ability to determine where economy ends and extravagance begins had been more common, many receiverships perhaps would have been avoided.

Conductors or Non-Conductors is a question which often presents itself in regard to the operation of street railway lines where the traffic is not great. The question is an important one with small railway companies, for there are many places where the employment of two men per car would make street railway operation practically prohibitive. While we are far from believing that where the traffic is sufficient to warrant the use of conductors their service can be dispensed with without loss to the railway company, there are many cities where the operation of conductorless electric cars is being carried on satisfactorily to the railway company and the general public. The practice followed in different cities has been mentioned in the descriptions of the different lines appearing in "Editorial Correspondence," and from these articles it appears that all the lines in the following cities are operated without conductors: Sioux City, Ia.; Great Falls, Mont.; Montgomery, Ala.; Dallas and Ft. Worth Tex. All the lines in San Antonio, Tex.; Dayton, O., and Anderson, Ind., two in Chattanooga, Tenn., and one or two in Atlanta, Ga., are also operated without conductors. The operating companies in the cities named do not report any increase of accidents, and no more liability to accidents, than when conductors are employed. We have observed that it is not always to the advantage of the street railway companies to thus operate cars at times of excessive traffic, as some of the passengers neglect to deposit their fares. It is the practice, however, in the cities named to employ inspectors on

special occasions, when there are crowds to handle, who board the cars at certain points, and assist in collecting the fares. In this connection, it may be said that where conductors are not employed the trolley wheel very seldom leaves the wire at crossings and switches, though when there is a man on the rear platform, the opposite of this often occurs. As a matter of fact, this point depends almost entirely upon the care with which the motormen pass the crossings and switches. When alone they generally exercise more care than with an assistant to watch out for the trolley. There is usually but little objection on the part of the traveling public to the running of cars without conductors. Of course, there are times when a conductor can give attention to passengers that is acceptable, but the latter soon learn to depend upon the motorman or upon their own resources, and when they understand that they are riding in a conductorless car they generally acquiesce in the practice of the company. In a city with wide streets there is very rarely any increased danger from the practice. It is often stated by companies who employ conductors that in their opinion a conductor can earn his wages under all circumstances and that there is no economy in operating cars without conductors, but we do not believe that this statement is generally true.

Legal.

Collision With Vehicle—Personal Injuries—Evidence.—1. In an action to recover for an injury resulting from a collision between an electric car and a vehicle, where the declaration alleged that plaintiff's ability to work and earn his usual wages were destroyed, *held*, there was no error in allowing him to testify that he was a granite and stone contractor, requiring him to be on his feet much of the time, and that he earned $5 per day.

2. In an action for collision with vehicle, plaintiff having testified that there was nothing to prevent the motorman from seeing him, may state that he thought the motorman would stop the car; this testimony illustrating and explaining the conduct of the plaintiff in managing his horse upon the occasion.

3. Before mortality tables are admitted in evidence to show expectancy so as to arrive at amount of damages he should recover, the age of plaintiff should be proven as a foundation.

4. Where a verdict for a large sum was awarded on the theory that plaintiff was in all respects a sound and healthy man, but newly discovered evidence discloses that he had previously been afflicted with rheumatism, and had received a gunshot wound, which permanently disabled his right arm, and that the injuries claimed to have been inflicted were not so serious as plaintiff alleged, justice will require a new trial. Judgment reversed. (*Atlantic, etc., St. Ry. Co.* v *Beauchamp*, Ga. S. C., Jan. 30, 1894.)

Municipal Grant—When One Street Railway Company May Appropriate Track of Another.—In an action to condemn the right to use the tracks and right of way of another company; and in an action to restrain such proceedings, and a subsequent *quo warranto* proceeding brought by the attorney general, all heard together, and from an adverse judgment the Consolidated Company appealed, wherein it is *held:*

That a street railway company, to which the council of a municipal corporation has granted the right to occupy a part of the track of another company in accordance with section 3,438 of the Revised Statutes, is authorized by section 3,440, without the aid of the amendatory provisions of April 11, 1890, to appropriate the track according to the grant, when the companies are unable to agree upon the compensation to be paid therefor; and the appropriation proceedings may be prosecuted under chapter 8 of title 2 of part 3 of the Revised Statutes. (*Toledo Consolidated St. Ry. Co.* v. *Toledo Electric St. Ry. Co.*, Ohio S. C., Jan. 5, 1894.)

Note: By Ohio statute, power of the municipal authority, within certain limitations, to grant a street railway company the right to occupy the tracks or other structure of a street railway existing in the municipality at the time of the grant, cannot be doubted. But such grant does not, of itself, confer upon the grantee the right to enter upon the occupancy of the tracks or structures. The owning company has a private property in them and their use, though devoted to a public purpose, of which it cannot be deprived without its consent, except by an authorized appropriation, in which it is entitled to have compensation therefor assessed. So that, to make effective the grant of the municipal authorities to one company to occupy the tracks or structures of another, it becomes necessary to obtain the consent of, or waiver of damages by, the owner; or, if that cannot be done, then to appropriate the tracks or structures to such use by judicial proceedings in which compensation may be assessed. (See *St. Ry. Co.* v. *St. Ry. Co.*, 36 Ohio St. 239.) And this notwithstanding the use by the owner company may be less convenient than before, and require greater care in operation. For this injury compensation must be made; and the inconvenience must be borne for the public good. But ample power is vested in a common council to prescribe by ordinance such reasonable regulations for the use by the companies of the tracks appropriated in such cases as may be necessary for the protection of both companies and the public.

Street Railroads—Injury to Passenger—Voluntary Act.—A person who voluntarily undertakes to go from the rear to the front of an open car, on the side step thereof, and is struck by an elevated railroad pillar, has no cause of action against the street car company. (*Vroman* v. *Street & Ferry Co.*, N. Y. S. C., Feby. 8, 1894.)

Note: This is an important question to modern street railways. The weight of authority upholds the statement that it is the duty of a street railway company to run its road along a way which is not dangerous. The fact that iron posts against which plaintiff struck and was injured was erected by the elevated company subsequent to the time when defendant built its road, would not justify defendant in continuing to use its road, so far as its passengers are concerned, if by so doing it became a dangerous thing to do. It should have prevented the elevated company from placing its pillars in a place where they would injure persons riding on defendant's cars who prudently and carefully did so, or else should have removed its rails further away from such pillars, or so constructed the platforms on its cars as to permit its passengers to use them without harm from such dangerous obstructions. This duty a street railway company owes its passengers. A failure to do so constitutes negligence on a company's part. In this case plaintiff may have been negligent; yet it is plain that he had a right to a seat in defendant's car; in fact it was his duty to take a seat as soon as possible. When he boarded it all the seats were occupied. He was compelled to stand. When a seat was vacated he exercised his right to have a seat by proceeding along the only passageway to the seat. Notwithstanding it was night time, and that he was not familiar with that part of the road, had he not the right to assume that it was free and clear from all danger? Such a question, at least, is one of fact for a jury to determine, and not a question of law for the court to decide.

Street Railway—Injury to Passenger—Collision. In an action by a passenger against a street car company for personal injuries, a verdict for plaintiff is sustained by the evidence where it appears that the driver of a car drove against a wagon standing across the track, and the collision threw plaintiff to the street, and injured him. (*Fox* v. *Brooklyn City R. Co.*, Brooklyn City Ct. Feby. 26, 1894.)

EDITORIAL CORRESPONDENCE.

HOT SPRINGS, ARK.; MEMPHIS, TENN.

Hot Springs, Ark.

This city, which has its origin because of the springs which are found here and from which it derives its name, is located on a spur of the Ozark Mountains, in the western part of Arkansas, fifty-five miles southwest from Little Rock, the capital of the state, and twenty-five miles northwest from Malvern, on the St. Louis, Iron Mountain & Southern Railway, with which it is connected by the Hot Springs Railroad, at present the only rail outlet.

Among the principal buildings are the hotels, boarding houses, bath houses and the military hospitals. The principal hotels are among the finest hostelries to be found at any of the health or pleasure resorts of the country. Hot water issues forth from the western slope of the Hot Springs Mountain from seventy-two springs, which are near together, most of them being from thirty to seventy-five feet above the level of the valley, while a few are near the margin of the creek. The Hot Springs Mountain, including the area in which the springs are found, is a government reservation embracing 300 acres. The waters and reservation are under the charge of the officers of the government. The springs are all housed in with low brick walls with arched roofs, cemented on the outside, from which the water is led in pipes to large airtight tanks, which have been built by the government, and from which pipes lead to the numerous bath houses and hotels. The government has a supervision over the construction of the bath houses and rates which are charged for baths, a revenue being charged for the water used. The temperature of the different springs varies from 105 to 158 degs. Fah., and contains eight and a half grains of mineral matter to the gallon. The waters are also thoroughly impregnated with free carbonic acid. These springs have the reputation of being received among the wonders of the world, and it is conceded that the efficacy of the waters excels many of the waters of the Old World.

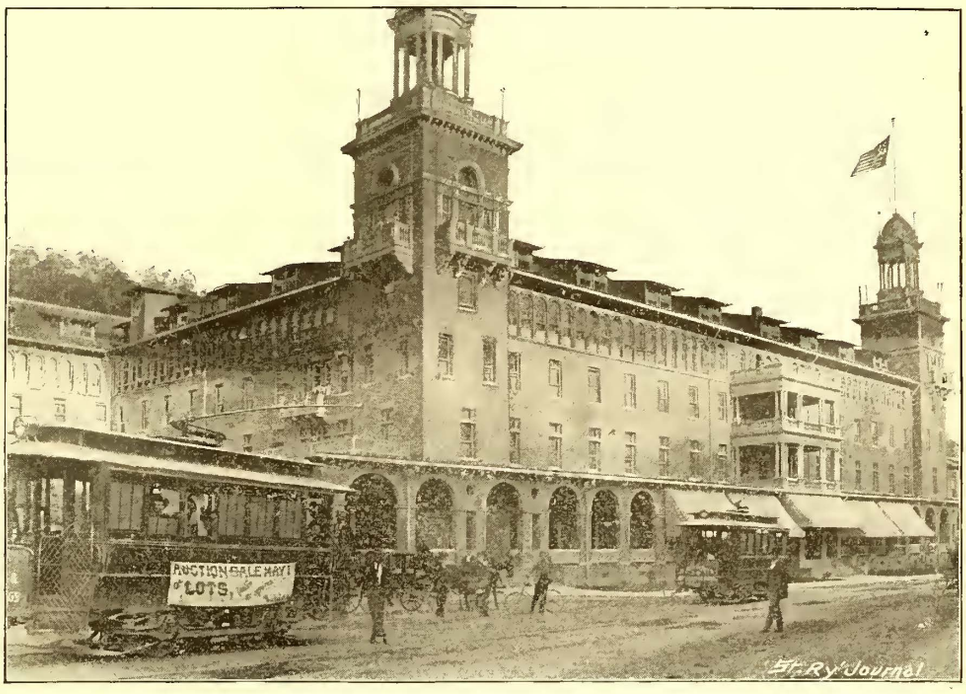


FIG. 1.—ARLINGTON HOTEL—HOT SPRINGS, ARK.

Not all the visitors, however, to this locality are in search of health, a majority are pleasure seekers and lovers of sight seeing, and the location for the latter class is a very attractive one indeed. Horseback riding is one of the principal amusements here. There are many delightful drives through the neighboring valleys and up the mountains, along which are found a great variety of trees, pines and foliage plants predominating, while not far away are the celebrated quartz crystal deposits, where are found beautiful specimens of crystals.

The Hot Springs Street Railway Company.

All the street railway lines of the city, with one exception, are controlled by this company, the exception being a short mile line over which one car is run at long intervals into one of the many valleys, known as Happy Hollow, along which the town is built. The cars of the Hot Springs Street Railway Company are all operated by electric power, the transformation from animal power having been made in June, 1893, previous to which time fifteen mule cars were run, but, since the introduction of the electric power, the traffic has increased 60 per cent., although the average number of cars now run is only ten.

The equipment of the system is first class in every particular, and a very acceptable service is maintained, as is evidenced by the patronage which averages about 105,000 passengers per month. The line embraces about sixteen miles, nearly all double track. The road on Central Avenue is the trunk line of the system, and the branches strike off at an angle at both ends of this avenue, and penetrate the radiating valleys, the length of each division being about two and a half miles. The resident population of the city is estimated to be 15,000, and for this number the mileage would seem to be excessive, but when it is remembered that the average number of transient visitors is 6,000 per month, taking the year together, the patronage which the system enjoys is readily explained. The headway of the different divisions is from six to nine minutes, but as all the cars travel through Central Avenue the headway on this section is from three to five minutes, providing a very acceptable service through the business portion of the city.

A large number of the street railway patrons are invalids, and it is gratifying to note with what care and patience the employes treat the passengers of this class, assisting them to board or alight from the car, and on the crowded streets being careful not to run them down. The management of the local affairs of the company is entirely in the hands of C. G. Convers, who spares no pains to provide a proficient service, and the success attending his efforts, considering the limited resources at his command, is certainly very flattering.

PHYSICAL FEATURES.

The track construction consists chiefly of forty-five pound T rails spiked directly to the ties. The streets are paved with what may be termed macadam, the surface of which consists of a cement gravel mined from the foot hills immediately beside the streets in different portions of the city. This gravel makes a very firm and durable surface. The overhead construction is supported on side poles except on Whittington Avenue, where center wooden poles are employed. These poles are topped with a cast iron thimble or ferule six inches in diameter and about a foot in length, the top of the pole being turned down to receive it. The arms for the support of the trolley are composed of gas pipes which are attached to

each side of the thimble, a hole in the thimble being drilled and threaded ready to receive them. They are then braced by a truss rod over the top of the post. A No. 0 trolley wire is employed.

The rolling stock consists of fourteen motor cars and fifteen trail cars. Four open cars of latest design have recently been added to the equipment, with a seating capacity for forty persons. These were mostly manufactured by the American Car Company, of St. Louis. Some were also built by the St. Louis Car Company, and by the Brownell Car Company. These are all mounted on McGuire trucks, fourteen of which are of the Columbian type, and others of the improved 19 A type. A thirty-three inch wheel is employed and a three and three-fourths inch axle. A single equipment of motors is employed, and these are all of the Thomson-Houston type, some of them being W. P. 50, and others of the F 30 type. The latter are employed on some of the cars that have been built over by the company from horse cars. Metal shields are provided on most of the cars. These are attached to the trucks and are hung near the inside face of the wheels, and are designed to prevent mud being thrown upon the apparatus and upon the car. The power is rented at a very reasonable rate from the Hot Springs Electric Light & Power Company.

The office and principal car barn of the company is located on Park Avenue, near the terminal of the line on this avenue. The structure is of wood and has a capacity of twenty cars. There is also an auxiliary shed in which the cars are stored. There are three repair pits and a repair shop equipment with a fair complement of iron working tools, the power being furnished by railway motor. Along and beside the storage tracks in the barn is provided a foot board extending just over the top of the cars, from which the trolley poles and wheels are readily reached for inspection and repairs. There is also an inverted wooden trough above the trolley wires in the barn. There are two additional barns connected with the other divisions for the storage of cars.

FIG. 2.—ONE OF THE BATH HOUSES—HOT SPRINGS, ARK.

As a means for increasing traffic the company has recently purchased and fitted up as a base ball park a large tract near the terminal of Whittington Avenue. This has been graded and inclosed by a high board fence, and a large and commodious grand stand erected. Opposite the baseball ground is a very pretty lake, which is stocked with game fish, and which has been formed by erecting a small dam across the outlet of a number of springs which border the basin. Among other attractions at this terminal is a large "merry-go-round," sheltered by a large tent and operated by steam power. One of the lines terminates at the race track, at which trials of speed are made at frequent intervals throughout the year. Trains of one or two open trail cars are run on special occasions to accommodate the traffic to the parks and race track.

FIG. 3.—COLORED BAPTISM AT WHITTINGTON PARK—TERMINUS OF LINE OF THE HOT SPRINGS STREET RAILWAY CO.

We have often recommended park and auxiliary attractions for the promotion of street railway traffic, but it has been left for the superintendent of this system to devise one of the most novel and legitimate attractions for inducing traffic. This consists in the encouragement of negro revival meetings, which are held in a large tent, and for the management of which a noted revivalist has been imported from St. Louis. Among the auxiliary attractions are occasional baptisms in the lake, and barbecues, which are introduced at stated intervals. The tent is moved as occasion requires from the terminal of one division to another to accommodate the people in different parts of the city.

OPERATING FEATURES.

Motormen are paid $40 per month and conductors $30, and they work from ten to eleven hours a day. A comparatively young class of men are employed, though none are under twenty-one years of age. Married men are generally employed for motormen, as they are considered to be more steady. Vacancies in the motorman class are filled by promoting the conductors. Usually the opportunity of promotion is held as an encouragement to faithful service on the part of the conductors. The extra men are paid by the regular men whose places they supply. Crews of extra cars are paid by the company. The average cost for operating a car per month, including power, is $70. The fare is five cents, with school tickets twenty for fifty cents. No free passes are issued to any parties. Policemen ride on their uniforms or badges.

Transfers are issued by an agent at one point only. This is at the junction of Park and Whittington Avenues with Central Avenue, and here is provided in the open space a discarded horse car which serves as a waiting room. The franchise of the company is for sixty-six years from 1892.

Hot Springs Electric Light & Power Company.

The power station of this company, which supplies power to operate the cars, and also for stationary motors, as well as for lighting the city, is situated on Malvern Avenue, just outside the business center of the city. The building is a one story brick structure, and is in the neighborhood of the gas plant. The same parties control the Garland Gas Light Company and the Hot Springs Water Company which furnishes the water supply for the city. The equipment of the electric power station consists of one 250 H. P. boiler, of the Stirling type, and three tubular boilers of the same capacity. The fuel consists of Arkansas coal, costing $3.60 per ton, and sometimes as high as $5. The power is principally supplied by a Hamilton-Corliss cross compound, condensing engine, of 400 H. P., which is belted direct to a General Electric M. P., 200 K. W. generator which furnishes the power for operating the cars. There are also two Westinghouse straight valve, rotary engines, of seventy-five horse power each. One of these is directly connected with an auxiliary shaft from which the lighting generators are driven, but in case the Corliss engine is idle the power generator is driven from the same shaft. The second Westinghouse engine is located in the basement of the station, from which power is transmitted by belting to the countershaft. The lighting generators consist of two Westinghouse machines, with a capacity of 250 incandescent lights each, and a fifty light arc machine manufactured by the Western Electric Company, of Chicago. The installation of an additional engine for power work is contemplated.

The water works station is erected some two miles from the city, and is equipped with Knowles pumps having a capacity of 2,000,000 gals. a day. The supply is obtained from springs, and is lifted into a reservoir having an elevation of 268 ft. above the city, thus giving a strong pressure upon the mains.

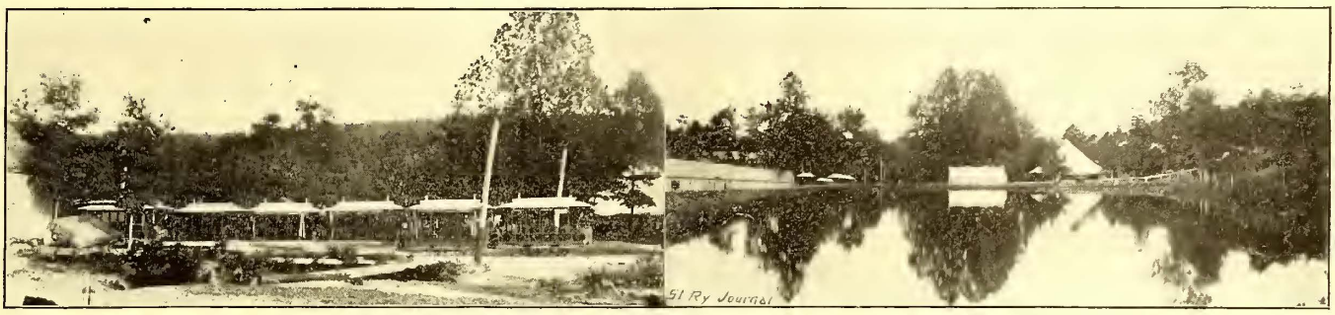
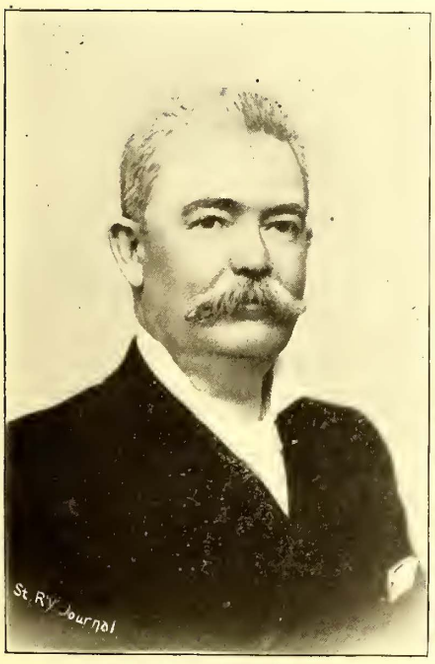


FIG. 4.—VIEWS IN WHITTINGTON PARK—HOT SPRINGS, ARK.



C. G. CONVERS,

TREASURER AND MANAGER HOT SPRINGS STREET RAILWAY CO.

PHILIP T. BIGLEY,

ELECTRICIAN HOT SPRING SSTREET RAILWAY CO.

Memphis, Tenn.

History tells us that Fernando de Soto, the discoverer of the Mississippi, first saw its yellow waters in 1541, from a bluff near where Jackson Mound Park, a part of Memphis, now stands. Here, a town was laid out as early as 1819 and named Memphis, probably after the old city of that name, the mistress of the Nile Valley. The new town was incorporated in 1827, but not until 1840 was there any evidence of the future great city, which by the census of 1860 showed a population of 22,643. This number has now increased to an estimated population of 100,000. This is not included, however, in the city limits, for these are quite limited, but it has spread beyond its original limits and now covers a closely filled up territory of at least six square miles.

The city is located on what is known as the fourth Chickasaw Bluff, on the east side of the Mississippi River, and has an altitude from thirty-five to fifty feet above high water and about 200 ft. above sea level. The location is said to be the only suitable place for the building of a city for several miles up or down the river. Memphis stands at the head of all-the-year-round navigation on the river, and is distant from St. Louis by river 450 miles and from New Orleans 818 miles, but in a direct line only 350 miles north of the Gulf of Mexico. Its position gives it great commercial advantage, and it disputes the claims of Houston as being the greatest inland cotton market in the world, and until recently, at least, the city has ranked second only to New Orleans as a cotton market. As a wholesale grocery center it ranks fifth in the country. The amount invested in this branch alone, by the clearing house figures of 1890, was $6,000,000 with sales for the year amounting to $16,000,000. As a hard wood lumber market it is the largest in the world. It is also the largest manufacturer of oil from cotton seed, while its bank facilities exceed those of any other Southern city, save New Orleans. Among its nine banks not one suspended during the recent troublous times, and during last year there was not an important commercial failure reported. For the year 1893, the volume of trade was $160,000,000. The capital invested in its 430 manufacturing enterprises is about $14,000,000.

The city also has unlimited advantages for the collection and distribution of the resources and commercial products of a large and productive region, in that there

are eleven lines of railway, seven on the east and four on the west side of the river and besides the free navigation of the mighty river, which with its branches has 18,000 miles of navigable water. In connection with its transportation facilities should be mentioned the great steel bridge which was completed a few years since, at a cost of over $3,500,000. The bridge is the property of the Kansas City, Memphis & Birmingham road and with its approaches is 7,400 ft. long and spans the river just below the city. Its business streets are wide, well paved and bordered by magnificent business structures of brick and stone. The government building, including the custom house and post office, is stone, of an attractive design, and stands alone at the foot of Madison Street immediately on the bank of the river and near the steamboat landing.

Near the business center of the city is a public park, which occupies an entire square. This is provided with a fountain and is shaded by large old oak trees. The principal attraction of the park, however, is a colony of gray squirrels to the number of 200 or more, which are provided with boxes or little houses among the trees in which they nest. These animals are all very tame and are great pets with the children. They can be easily approached and will take nuts and candy from the hands when proffered them. Everybody seems to have a special care for them and dogs are not allowed to approach the park. There are also tame ravens, pigeons, peacocks and other pets about the grounds, making it one of the most attractive of city parks in the country.

general thing, are advantageously laid out for the accommodation of residents in all parts of the city. Some few changes are, however, being made in the location of some of the interior tracks, in order to avoid curves, and to properly divide traffic between different lines.

It is worthy of remark at the beginning of these notes, that we have seldom found a city in which the relations between the street railway companies and the city officials were more pleasant than in Memphis. The people and their representatives have come to realize that the best interests of the city and those of the street railway company are virtually the same, and the officials in both cases are working together with a companionship that is commendable, and argues a good future for the development of transit facilities. The credit for this state of affairs is largely due to the general manager who spares no effort to make the service attractive and acceptable to the patrons. In the effort he is heartily seconded by his assistants in each of the departments, and by the employes who are, to a marked degree, polite and attentive in the performance of their duties.

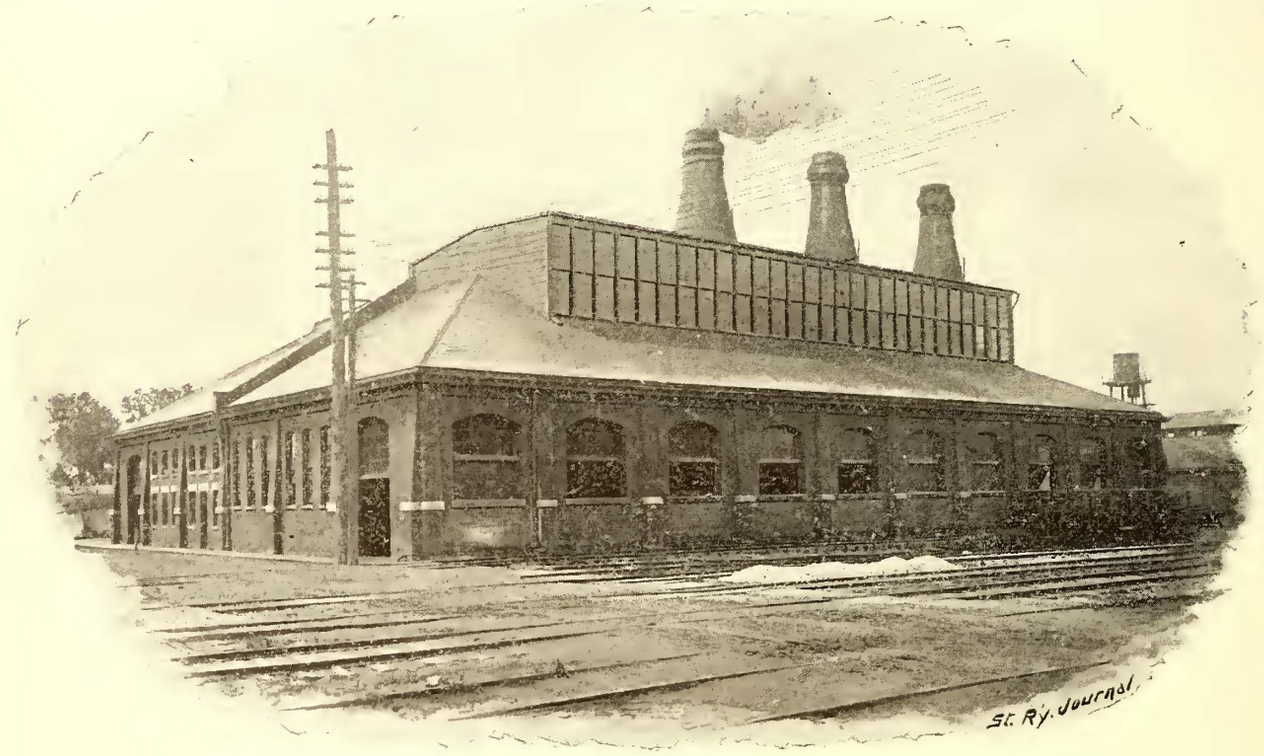


FIG. 5—EXTERIOR OF POWER STATION—CITIZENS' STREET RAILWAY CO., MEMPHIS, TENN.

STREET RAILWAYS.

There are sixty-six miles of street railway, all of which, with the exception of a suburban line to Raleigh Springs, is controlled by

The Citizens' Street Railroad Company,

the owners of which have within the past year purchased both the City & Suburban and East End Railways. The local manager of this system is F. G. Jones who is one of the principal owners. The lines of the East End Railway were, until recently, operated by steam dummies, but, since their purchase by the above company, the line, which embraces five and a half miles of double and single track, has been electrified, the transformation having been accomplished in five weeks after the purchase, but the roadbed was rebuilt, and the overhead equipment installed, within the period of thirty days. The lines, as a

PHYSICAL FEATURES.

The rolling stock embraces eighty motor cars and eighty trail cars, but the average number daily run is sixty. They were manufactured by the Lamokin and by the Pullman Companies. Fifteen open cars, recently purchased, were manufactured by the Pullman Company. Bemis, Brill and McGuire trucks are employed. Closed cars are provided with wire screens outside the windows, to protect passengers from accidents from the center poles by which the overhead construction is supported on Main Street. The new open cars have a double equipment of G. E. 800 motors, but the original motor equipment consisted chiefly of the Edison and S. R. G. types. Sixty equipments, of the Edison type, have recently been changed by the electrician of the company, and greatly improved, so that they are now doing very excellent service, and burnouts are rare. In the reconstruction, the commutated fields are changed to straight fields, and a rheostat employed, but which is cut out on the fourth point of the controlling switch. Strong fields, with 175 turns, are employed, and are connected in series. By this arrangement, three wires less are employed on the motor board, and one rheostat operates both motors. On some of the other motors the close coil armatures have been changed to open coil, and the cross connection of the

commutator avoided, so as to do away with two of the brushes, and with this arrangement no trouble is found with short circuits. It is also the practice of the electrician to equalize the two motors on each car after they are put in service. This is accomplished after testing the motors with amperemeters by the adjustment of the fields. Two meters are attached to a short board and placed upon the car in a convenient position (over the back of one of the seats in open cars), and are connected with the armatures in series. By watching the meters while the car is in service, a difference in the work they are doing is noted, and if one is found to be doing more than the other, the fields of this one are weakened by the spreading of the pole pieces, and the adjustment continued until a new one substituted with very little trouble and delay. This device was designed and is manufactured by the Livermore Foundry Company, of Memphis, and is said to be giving excellent satisfaction. This company is also the manufacturer of pinions, trolley wheels and other brass supplies for electric railways. The brake shoes on all cars are attached by means of adjustable slippers, and are cast to embrace the flange of the wheel. By this arrangement the shoes are readily removed and replaced. The cars are provided with a switch throw for the use of the motormen, which consists of a wooden handle an inch and a half in diameter and three feet long, which terminates in a thimble made from a two inch iron pipe, which is flattened at the lower end and slightly

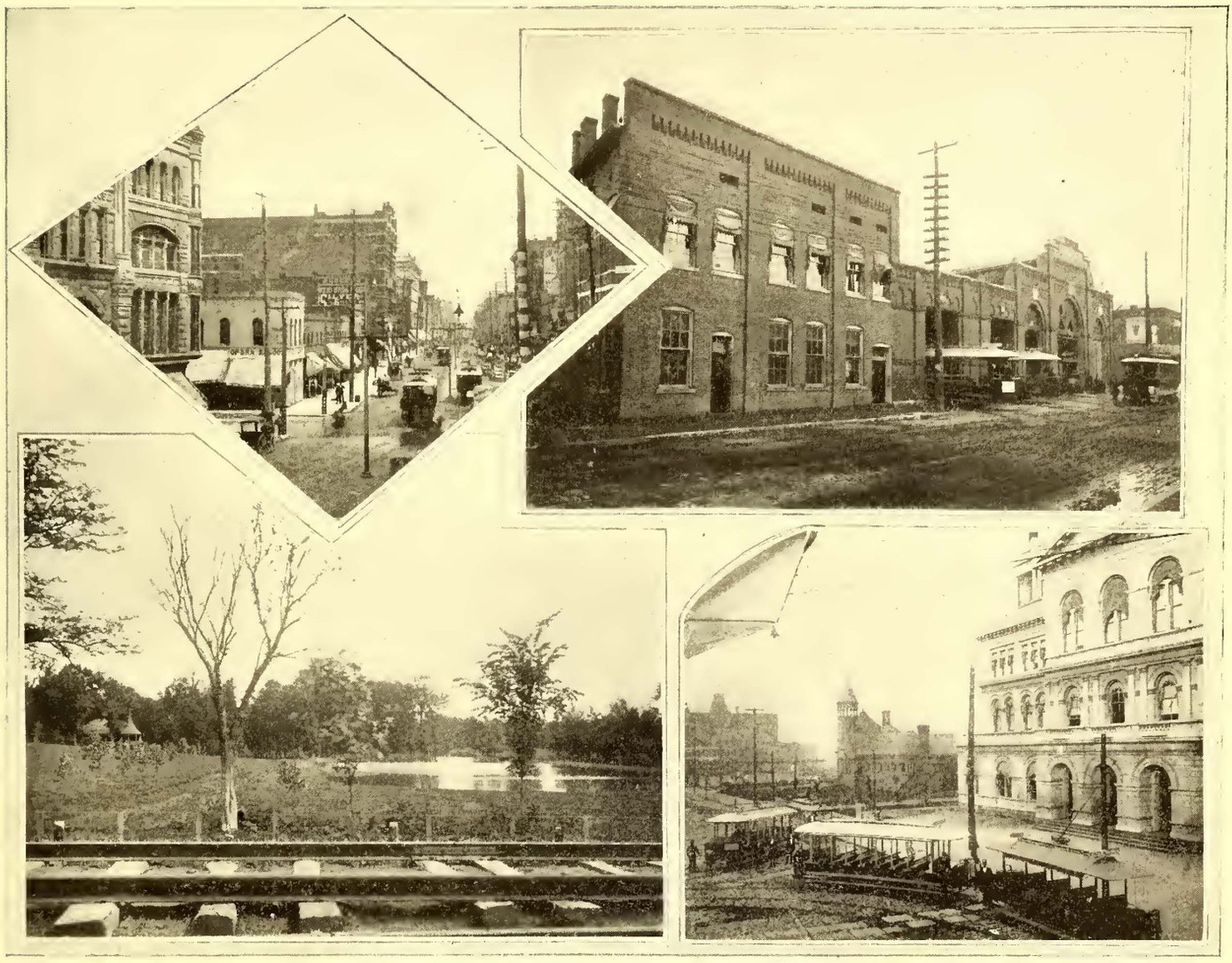


FIG 6.—VIEW ON LINES OF THE CITIZENS' STREET RAILROAD CO.—MEMPHIS, TENN.

MAIN STREET CORNER OF BEALE.
EAST END PARK.
EXTERIOR CAR SHEDS AND OFFICE.
CUSTOM HOUSE ON FRONT STREET.

the work of the motors is equalized. The S. R. G. motors are equalized or adjusted by changing the position of the brushes. It is also found of advantage to use the same armature with the same fields. This, however, is more of a mechanical than an electrical advantage, as it insures a proper adjustment of pinions and brasses. Both solid and wave pinions are being employed, and the former are giving excellent satisfaction. A change is being made from six inch to four and a half inch gears and pinions. The narrow pinions have proven sufficiently strong, last equally well and make less noise. The pinions are all incased, and run in oil.

A composite gear is also being employed. This is constructed with a spider or split core which is attached to the axle by specially designed bolts and nuts. The removable rim is cast in two parts and held in position by bolts. When worn or broken the rim is removed and curved. This answers for turning the switch tongue, and also, in case of broken contact with the rail, the metal portion can be used to make contact between wheel and rail without danger of shocks to the person holding it.

The principal car barn, repair shop and office of the company is located at the corner of Gayoso and Hernanda Streets, near the business center of the city. The main building is a reconstructed horse barn, which has been enlarged by a brick addition containing the offices and repair shops. The repair shop is constructed with a brick floor and iron doors which make it practically fireproof. The power for operating the machinery in the repair shop is supplied by a ten horse power Eddy motor, and the machines embrace the usual equipment of iron working tools, together with a hydraulic wheel press.

The power station is located at the corner of Davies Avenue and Broadway, and is a brick building of pleasing

design. The engine room is 150 × 58 ft. and forty-five feet in height, with a truss roof support. The boiler room is about the same dimensions. The boiler equipment consists of three Hazelton tripod boilers of 500 H. P. each, with auxiliary equipment of Worthington pumps and Berryman heaters. The boiler sare provided with the Reliance water gauge whistle, of Cleveland, which sounds with a variation in the height of water of ten inches either way. Alabama slack coal is at present employed for fuel,

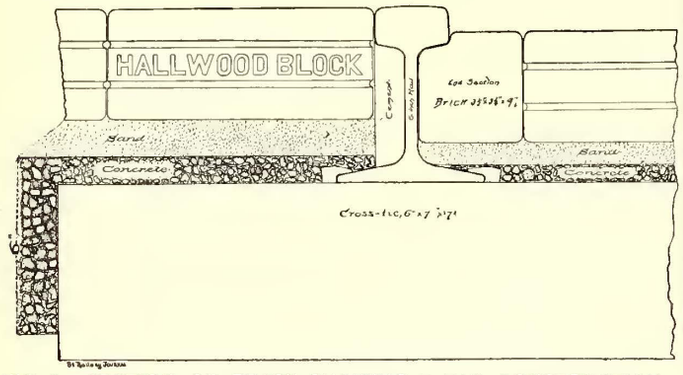


FIG. 7.—SECTION OF TRACK SHOWING T RAIL CONSTRUCTION—MEMPHIS, TENN.

which costs, delivered, $1.60 per ton, and it requires an average of twenty-five tons per day to operate the sixty cars. The feedwater is derived from two artesian wells, 500 ft. in depth, is comparatively pure, and forms no scale, but pits the iron with which it comes in contact to a considerable extent.

The power equipment consists of five Ideal engines of 250 H. P. each, making 230 revolutions. These are placed in a line to one side of the room, and are each belted direct to a 200 K. W. Edison generator, the shaft centers being from thirty to thirty-five feet apart. A slate switchboard is provided, on which Westinghouse instruments are employed. In connection with the circuit breakers, the electrician and engineer of the station have devised an alarm signal, which consists of a pair of V shaped copper springs placed just beneath the handle of the circuit breaker, so that when this falls the handle makes contact between the springs and rings a signal bell. The power is distributed over ten divisions by twenty-one feed wires. The minimum is 1,000 amperes to the maximum load, 1,600 amperes. The lights on the switchboard do not go out when the circuit breakers drop.

The auxiliary equipment consists of twelve Wason lightning arresters arranged in a case by themselves beside the switchboard. There are twelve General Electric lightning arresters and five Westinghouse on the outside lines. The station has suffered no harm from lightning discharge since September last, and only slightly then.

An overhead crane is mounted above the generators. This was built by W. C. Ellis & Son, Memphis. The metal oil tanks for the station supply are placed in a row near the entrance to the boiler room, and are joined by a half inch steam pipe, through which live steam from the boiler passes to keep the oils at a sufficient temperature to run freely.

Most of the original track construction consisted of a light girder rail supported on iron chairs, but chair construction is not in favor with the management, as it needs constant repairs. In the more recent construction on the paved streets a seventy-two pound, six inch T rail has been employed, which is spiked directly to the ties. Where the brick pavement is to be employed the tie is placed on a gravel foundation with concrete between and over the tie, so that the tie is enclosed in a pocket of concrete. Above this is a one inch layer of sand on which the bricks are placed. The bricks are of the Hallwood type. The T rail construction for paved streets, of which two additional miles are now being built, is both satisfactory to the city authorities and the street railway company. The experimental section which was first constructed on this plan is standing up excellently well. It is claimed that a T rail does not vibrate or disturb the pavement as much as rails of other types. The lines of the East End, outside the city limits, were constructed with a seventy-two pound T rail with gravel foundation.

The original bonding consisted of No. 4 iron wire, which had a short life only. In the present practice the rails are bonded with No. 0 copper wire. There are several overhead return wires, and an additional return has been made through the bayous. At points where the track crosses the bayous a nest of eight or ten old thirty-eight pound rails has been driven thirty feet into the soil by pile drivers, and to these the tracks are connected. In addition, old rails of the same weight are bonded with double 0 wires and connected with the driven rails, and are strung along the bayou to the power station. After the return conductors thus described were provided, it was noted that although fifteen additional cars were operated, less current was required than formerly.

OPERATING FEATURES.

The fare is five cents, with twenty-two tickets for a $1, excepting over the East End line where, beyond a designated point, the fare is ten cents, with tickets to residents twenty for $1. The line runs to the race track, and during the sporting season enjoys an enormous traffic. Ordinarily the headway is of fifteen minutes, but on race days it is reduced to four or five minutes. This line also passes East End Park, which is owned by the company. The park is provided with a handsome pavilion, where the usual park attractions are given. A very pretty lake with pleasure boats is a pleasing feature.

Conductors and motormen are paid fourteen cents

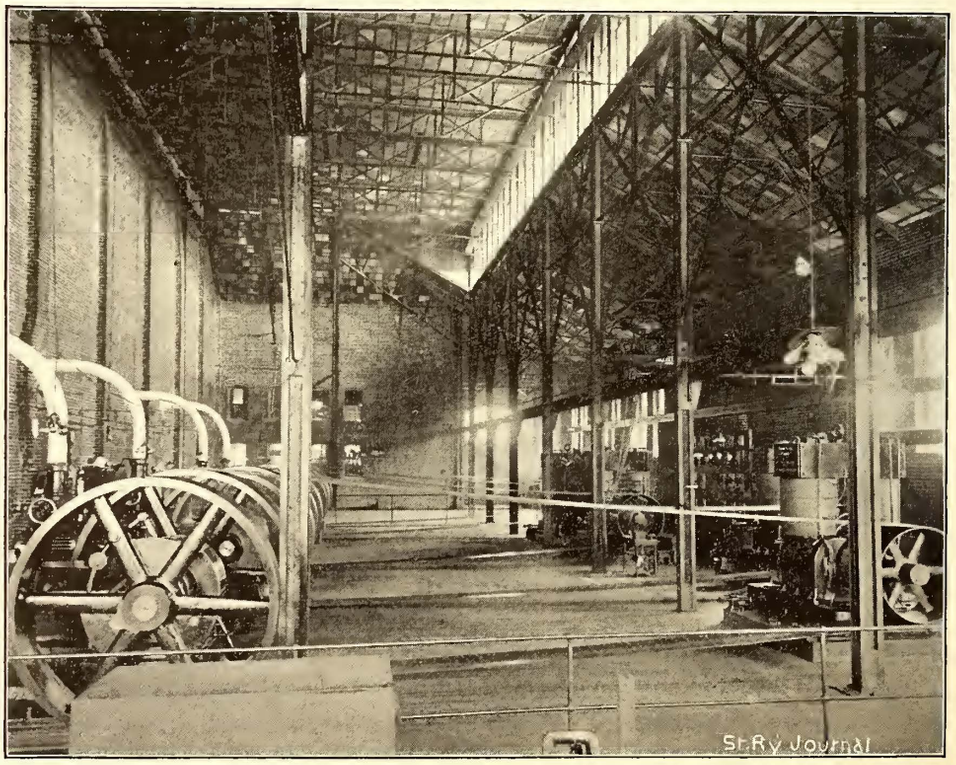
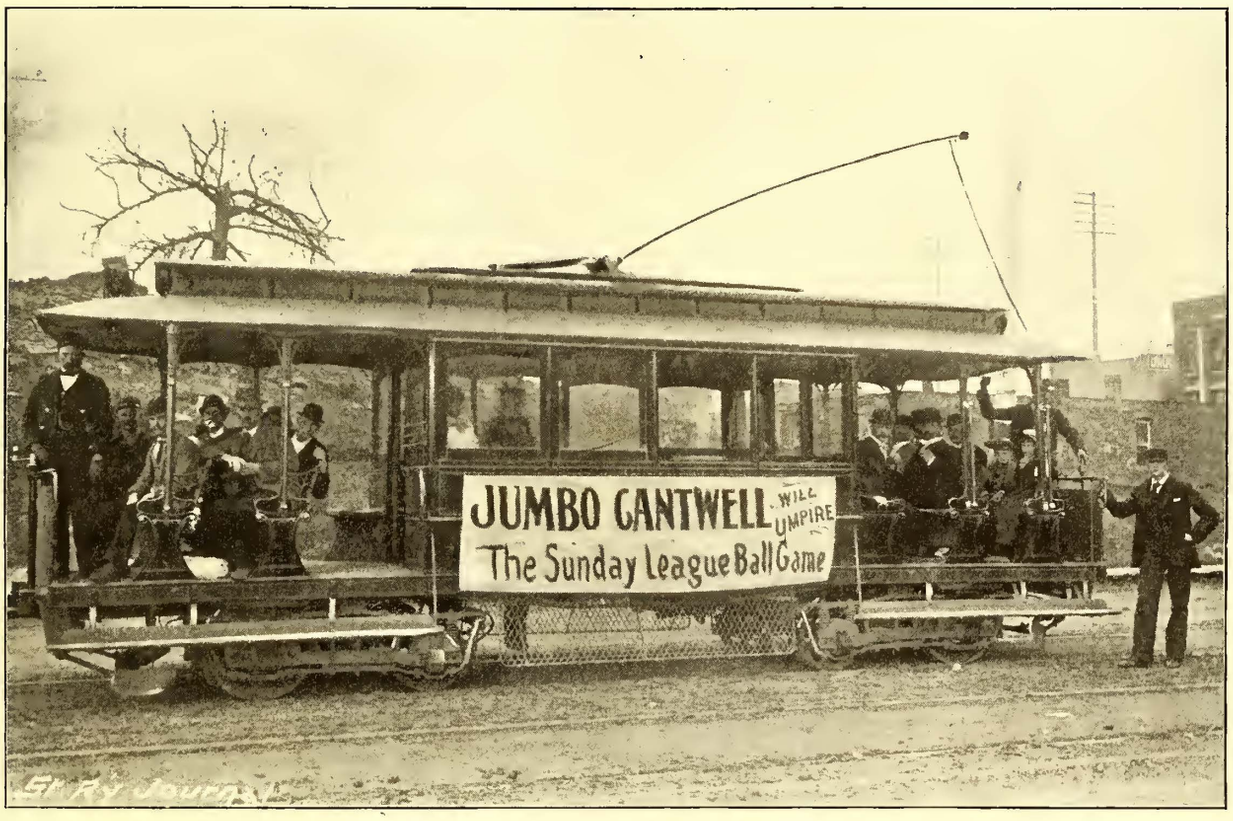


FIG. 8.—INTERIOR OF POWER STATION—CITIZENS' STREET RAILROAD. MEMPHIS, TENN.

an hour. 150 car men are employed and forty extras, and consist of a very superior class of men. It is not the custom of the company to employ men who have been engaged in street railway service in other cities. The assistant manager, Frank Smith, who has charge of the car men prefers to break their own men and accustom them to work according to the rules of the company; this also, in a measure, prevents the introduction of "tricks of the trade" that may be practised in other cities. The car men are required to wear a regulation uniform and when employed to make a deposit of $20 with the company, which is held as a guarantee against dishonesty or damage to property through carelessness.

An arrangement has been made with police authorities so that in case of accident men who are arrested are not taken from their cars. If the accident is not serious, the policeman telephones the street railway company, who guarantees to send the man to police headquarters as soon as relieved from duty. In case of serious trouble the policeman telephones the company to send relief and he accompanies the arrested person on this car until the relief appears, so that traffic is not interrupted. It is also a rule of the company that one car shall not pass another while discharging passengers without first coming to a full stop, nor are cars allowed to pass each other at street crossings.



ADVERTISING A BASE BALL ATTRACTION—SPOKANE.

Raleigh Springs Street Railway Company.

This is the line referred to above as running into the suburbs. It is a single track line about nine miles in length, constructed of T rails, and connects with Raleigh Springs, a resort northeast of the city. At the springs is a large hotel, the property of the street railway company. The line passes the United States Military Cemetery, about five miles distant from the city. Cars are run every thirty minutes to the cemetery, and every hour through to the springs. They are not run late at night. The line also passes through Binghamton, a new suburban manufacturing town, where is located the Memphis Car & Foundry Company, which was formerly located at Litchfield, Ill., and known as the Litchfield Car Works. The company manufactures steam cars and gives employment to a large number of people. It is expected the place will develop into a large village in the near future.

The rolling stock of the company consists of eight eight wheel cars mounted on the Brill maximum traction trucks. Only three cars are being run at present, however.

The power station is about midway of the line. The equipment consists of two Armington & Sims 100 H. P. engines, and two eighty horse power Thomson-Houston generators. There is a new 400 H. P. Reynolds & Corliss engine, and a 400 H. P., M. P. Thomson-Houston generator on the grounds, but not yet set up. The steam is generated in tubular boilers.

Single fares are fifteen cents, with round trip tickets for twenty-five cents. For about five months the line has been in the hands of Tate & Grosvenor, receivers.

C. B. F.

The Commonweal Movement in Spokane.

The managers of the Spokane Street Railway Company are enterprising men, and ready to improve any opportunity for increasing the traffic of their railway. A chance offered itself during the recent passage of one branch of the Coxey army through that city. One of the leaders of the movement, and member of the Pacific brigade of the Commonweal Army was Jumbo Cantwell, and his name became well known to everyone in Spokane during his stay in that city. His services were secured one Sunday as an umpire for a baseball game, and as the grounds of the club were on the line of the street railway company, banners announcing his engagement were placed on the cars for several days before the game. He proved to be a drawing card, and both the gate receipts of the ball clubs and the passenger receipts of the street railway company were materially increased. Our engraving gives a view of one of the cars with announcement.

THERE are a number of indications that business is improving, one of which is the statement of the Lewis & Fowler Manufacturing Company, of Brooklyn, N. Y., that for the thirty days previous to June 19 that company received orders for 1,077 of its improved alarm passenger registers.

The Bayard Street Station of the Third Avenue Railway Company, of New York.

Full particulars of the main cable power station of the Third Avenue Railway Company, New York, and of the track construction and rolling stock of the company have been published in the Street Railway Journal. The downtown station of the company is located at the corner of the Bowery and Bayard Street, and operates that portion of the line from 6th Street to the Post Office. This station has just completed its trial run of ninety days after installation by the Pennsylvania Iron Works Company under the supervision of the company's engineers, B. W. Grist and E. A. Moore. The run has been accomplished without a single hitch in the operating of the plant, a record which is especially remarkable, and we believe deserves comment at this time.

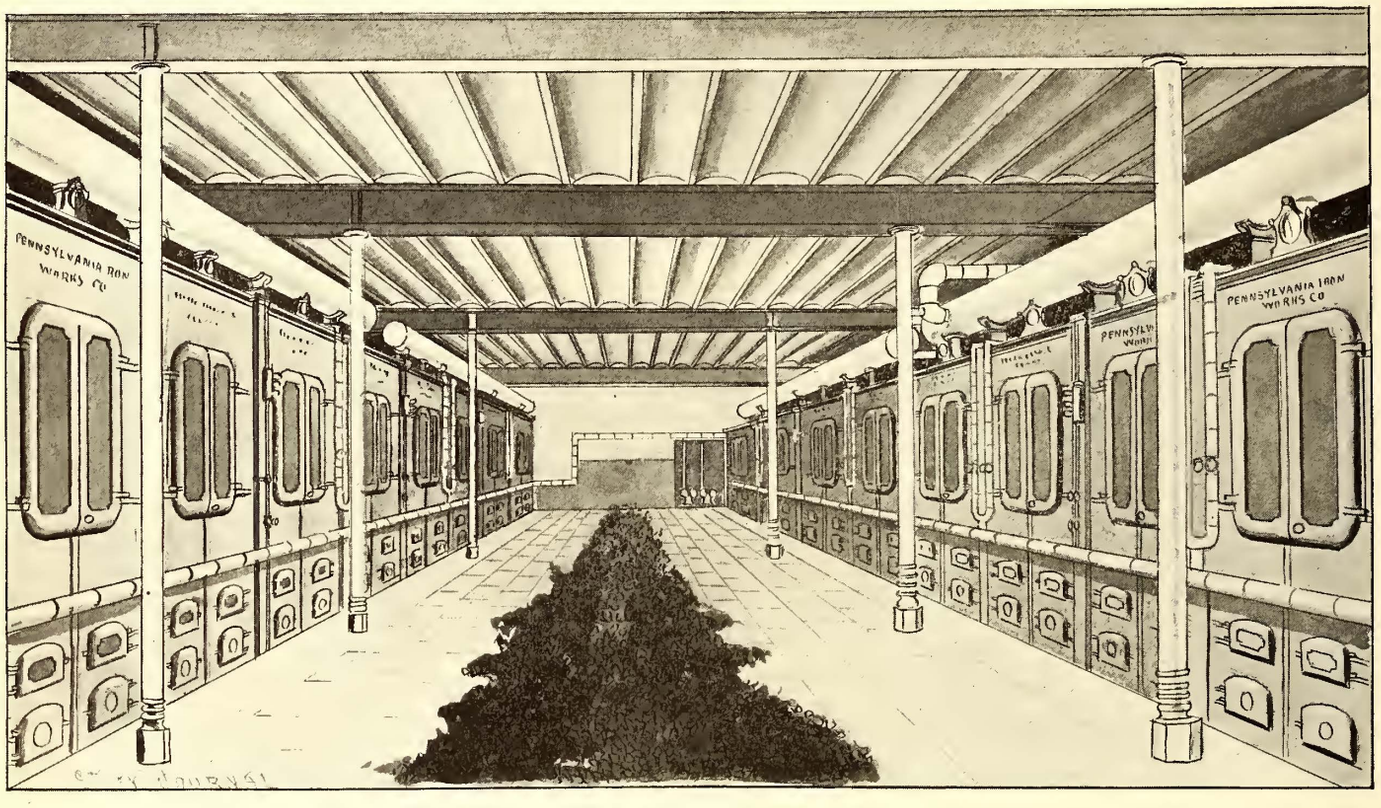
The plant operates three ropes and contains two engines of the George H. Corliss type, with cylinders forty inches in diameter by seventy-two stroke. They are connected to the main line shaft direct by means of plate couplings with crosskeys made of cast steel. The main line shaft is made up of three sections, each provided with a coupling similar to the ones connecting the engines. The shafts are eighteen inches diameter in the journals and twenty inches diameter in the swells, and are mounted in extra large pedestals supported on heavy cast iron adjusting stands, in every respect similar to those that have been described and illustrated heretofore in connection with the 65th Street power station.

The system of driving at this station is by means of the Lambeth cotton rope, and there are three sets of driving gear. The small driving drums are three in number; two of these are nine feet in diameter, and one seven feet six inches in diameter, each containing grooves for twenty-two two and a quarter inch diameter cotton ropes. They are mounted loosely on the sections of main shafting, and are fitted to engage with the Weston Walker friction clutches. The large rope driving drums are thirty-two feet in diameter, and contain the same number of grooves. These are mounted on shafts twenty-four inches diameter in the swells and twenty inches in the journals. A steel spur gear sixteen feet in diameter, sixteen inch face and four and a half inch pitch is mounted on each of the large rope drum shafts, and is geared into an overhanging pinion which in turn transmits the power to a spur gear of equal dimensions with the larger ones, for the purpose of driving the secondary cable drum.

The shaft of the secondary cable drum is eighteen inches diameter in the swell and fifteen inches in the journal, is substantially mounted in pedestals similar in design and construction to those described for the other part of the plant. The cable drums are fifteen feet in diameter for the fast rope and thirteen feet in diameter for the slow rope. The fifteen foot diameter drums are for operating the fast ropes, and the smaller diameter for the slow or loop rope. The fast ropes out of this station run to the terminal vault at the Post Office, back to the 6th Street vault at 6th Street and Third Avenue, thence to the station. The slow rope merely operates from the station to and around the balloon loop at the Post Office, and carries the cars back to the pick-up point opposite the *Times* Building, as described in our issue for January, 1894.

A pair of auxiliary engines has been provided, together with the necessary line shafting, sliding gear, pinions, etc., for overhauling either of the cables at will for purposes of examination, thereby dispensing with the necessity for using the large engine.

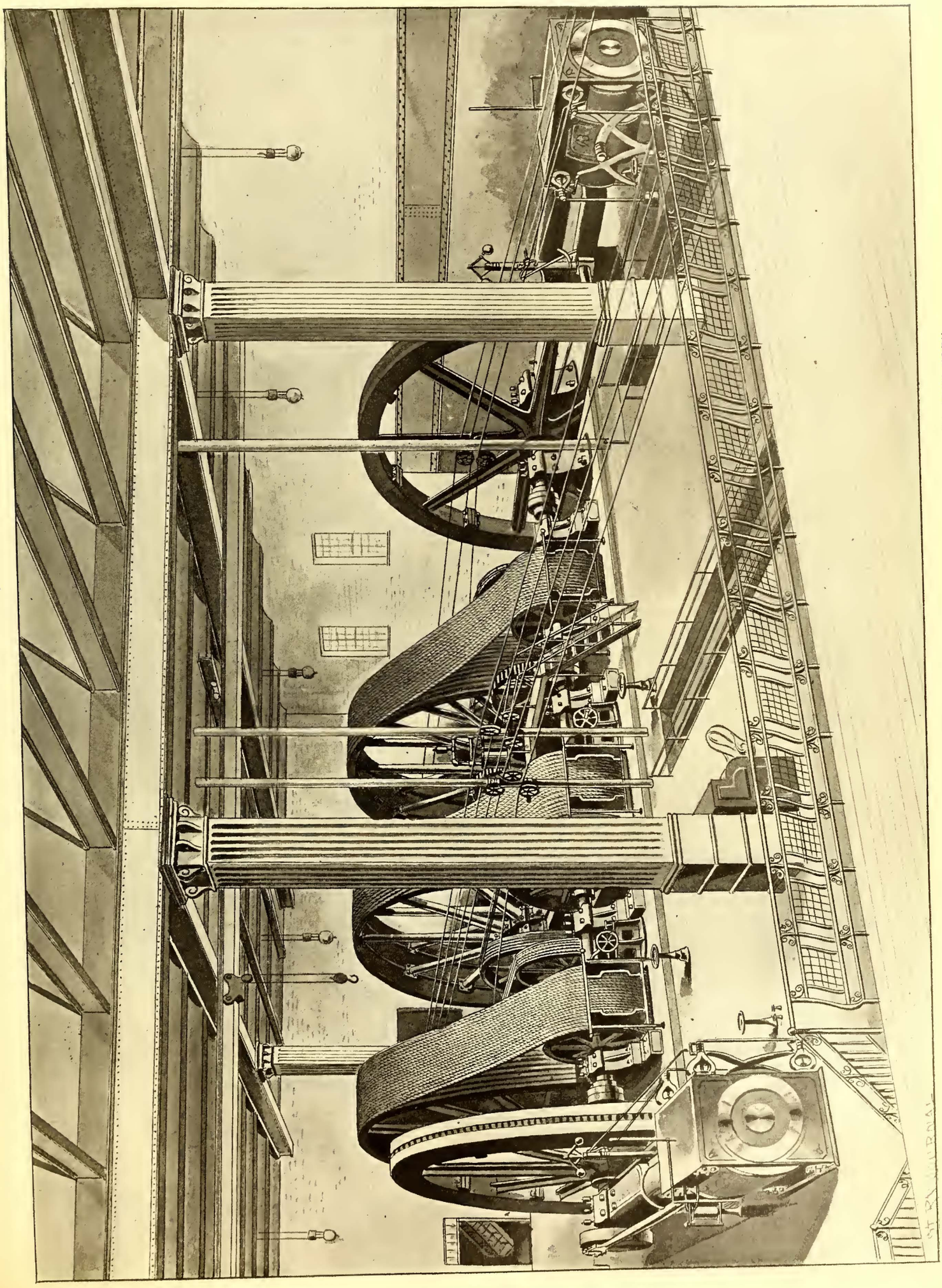
The steam service at this plant is composed of six-



BOILER ROOM—BAYARD STREET STATION OF THIRD AVENUE RAILWAY, NEW YORK.

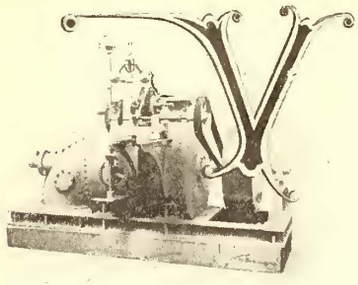
teen horizontal tubular boilers six feet in diameter by eighteen feet long. They are placed in two batteries of eight boilers each, and these in turn are divided into two nests of four each. The boiler room is placed on a grade level with the sidewalk, while the machinery floor level is forty-five feet below this point. The heaters, two in number, of 1,000 H. P. capacity each, of the Goubert type, are placed in the boiler room, as are also the two 10 × 6 × 10 in. Snow duplex pumps and two Monitor injectors, all in close proximity to each other, and are especially well arranged for their accessibility and manipulation.

Owing to the short distance which this plant afforded for tension runs and apparatus, it has been imperative to devise some special means for securing the maximum amount of travel on a short run to obviate the necessity for shortening the ropes. A special type of tightening agent has been provided in the "direct tension" weights, whereby a sufficient travel has been obtained equal almost to the length of the run, and the take-up gear instead of being a part of the tension carriage, as in most instances, is permanently fixed at the extreme end of the run. The lead of the ropes, to which the weights are suspended, is secured by means of an overhead structure, to which the carriage sheaves and brackets are attached, thus maintaining the much desired space in the reel room, which is on the same level with the machinery floor.



INTERIOR OF BAYARD STREET POWER STATION.—THIRD AVENUE RAILWAY, NEW YORK.

The Electric Long Distance Transmission Plant at Portland, Ore.



VERY many street railway managers are now directing their attention to the subject of the long distance transmission of power, and believe that in many sections of the country where cheap sources of energy are available it will often prove more economical to carry this power for some distance to the point of use than to employ more expensive methods of power generation on the spot. An interesting example of a long distance transmission of power plant is that at Portland, Ore., a number of illustrations of which we present herewith.

The Portland General Electric Company, of Portland, Ore., of which P. F. Morey is president, H. W. Goode is manager, and W. C. Cheney electrician, was organized two years since with a capital stock of $4,250,000, has purchased the entire water power embraced in the falls of the Willamette River at Oregon City, twelve miles above the city of Portland. The minimum capacity of the river at this point is estimated to be 50,000 available H. P., under a head of forty feet. The steppe of the falls is composed of basaltic rock, and has a very irregular outline, being worn into fantastic shapes by the action of the water. A dam was thrown across the river some years since following the irregular lines, and there are numerous factories and mills in operation, to which over 4,000 H. P. of direct water power is now leased (Fig. 1).

One of the principal plants that are here operated by water is an electric station, situated on a rocky island near the middle of the river, at which an electric current is generated and transmitted to Portland, where it is employed for lighting the streets and dwellings of the city,

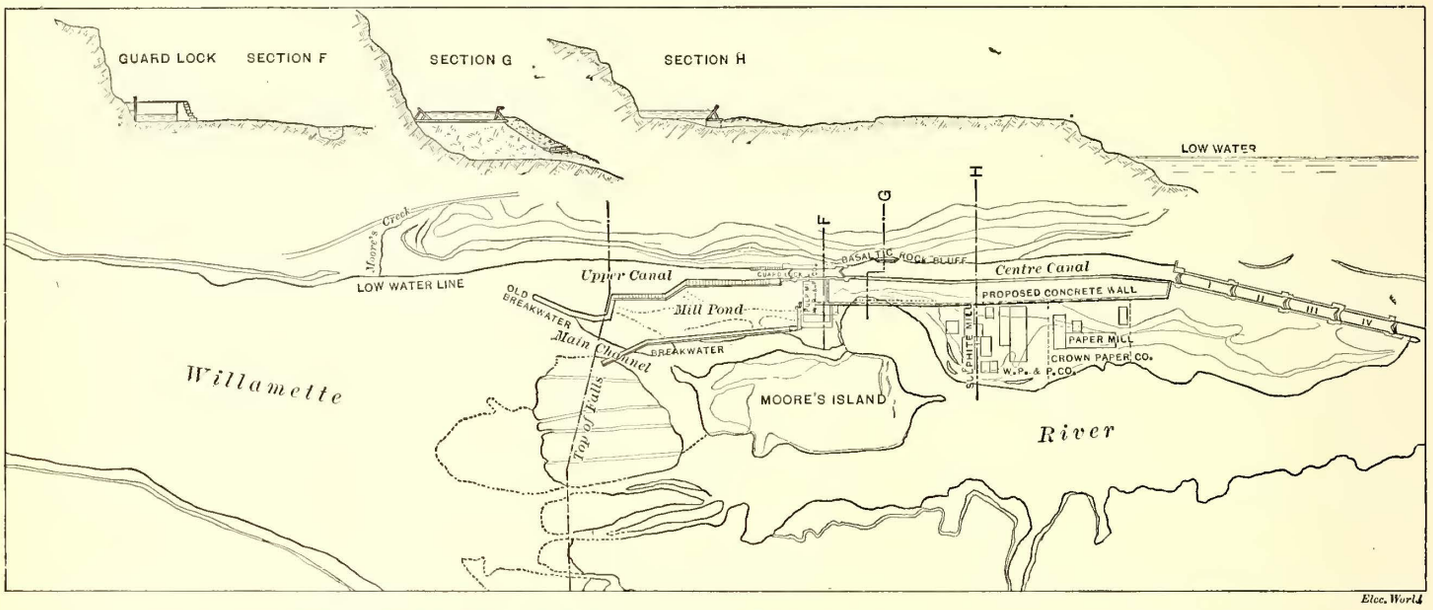


FIG. 1.—MAP SHOWING LOCATION OF ELECTRIC LONG DISTANCE TRANSMISSION PLANT—PORTLAND, ORE.

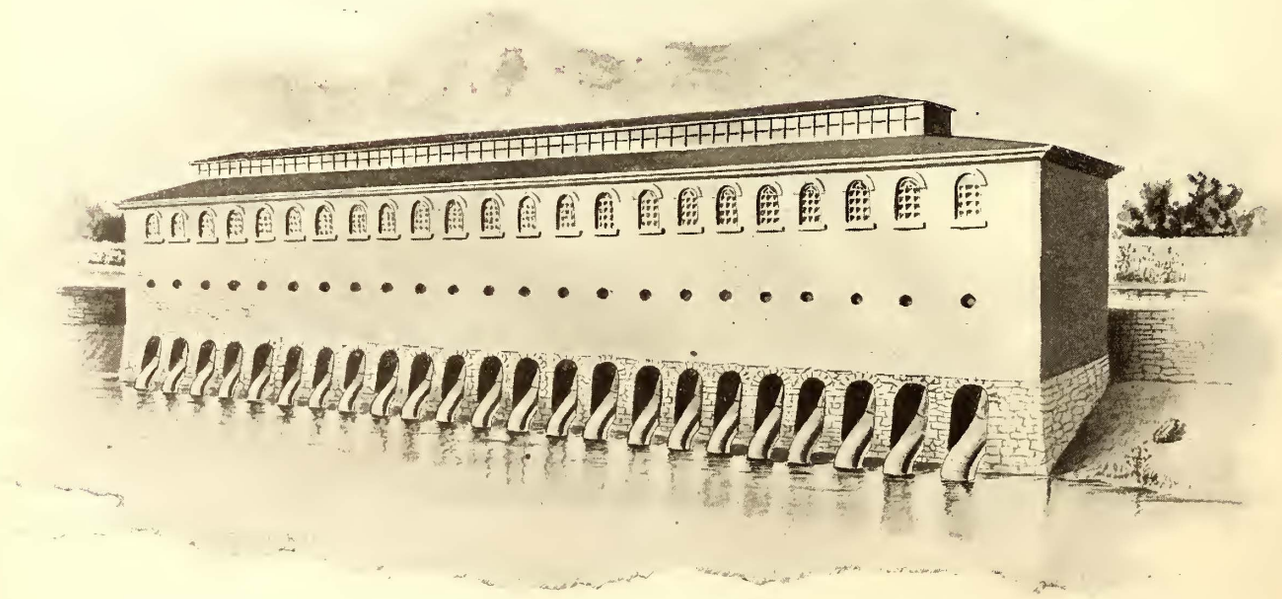


FIG. 2.—EXTERIOR OF POWER STATION—ELECTRIC LONG DISTANCE TRANSMISSION PLANT, PORTLAND, ORE.

and also for the operation of that section of the East Side Street Railway lying between Oregon City and Milwaukee, a distance of seven miles. For the running of the lighting generators, seven vertical Victor turbine wheels are employed and one 500 H. P., horizontal wheel of the same type, while one 200 H. P., horizontal wheel drives the railway generators. The loss, it is claimed, in the transmission of the lighting current to Portland, a distance of twelve miles is only 10 per cent.

The purchase embraces 1,600 acres of valuable land in the neighborhood, having a river frontage of about three and a half miles, which takes in all the valuable sites of manufacturing institutions. It also embraces a ship canal and locks on the west side of the river, which were constructed some years since under a subsidy from the state of Oregon of $200,000, the entire cost being about $650,000. By means of the canal and locks the large steamboats which ply on the river between Portland and up-river points, are carried past the falls, the river being navigable for about seventy-five miles above.

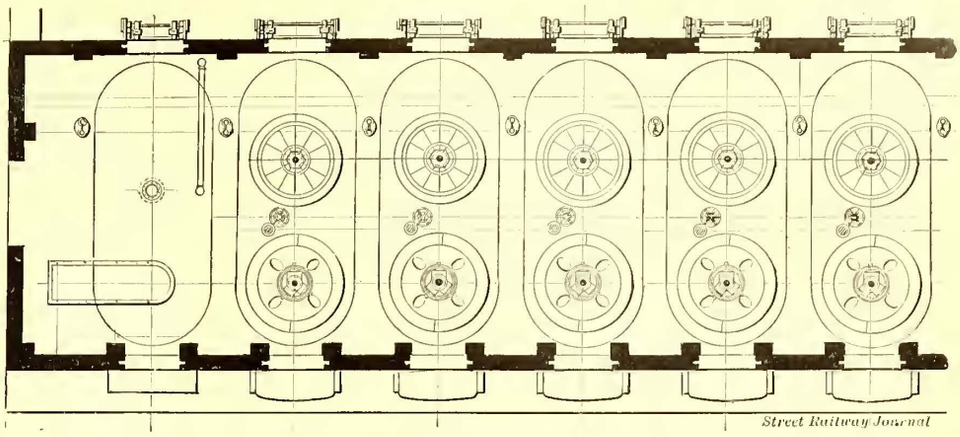


FIG. 3.—PLAN OF DYNAMO ROOM—ELECTRIC LONG DISTANCE TRANSMISSION PLANT—PORTLAND, ORE.

The new power station (Fig. 2) which is now being constructed and which was briefly described in the May, 1893, issue of the STREET RAILWAY JOURNAL after a personal visit, is located on the west side of the river, opposite Oregon City, and borders the canal, the front wall being a portion of the new concrete wall which has been built for the purpose of widening the canal, and through which the water is to be led to the wheels, and new and substantial bulkhead gates have been installed. The ultimate capacity of the new station is to be 12,000 H. P.; only 6,000 H. P., however, is to be at present installed.

The structure is to be of concrete, stone, iron and brick, is to have an ultimate length, parallel with the river, of 364 ft., and the eaves are seventy-seven feet above mean low water mark, the width of the building being thirty-eight feet. The water is to be taken from the canal, and after passing through the wheels is discharged into the river below. The accompanying illustration (Fig. 2) presents the river side of the structure, from which it will be noted that the upper floor is lighted from transoms in the monitor roof, and by a row of ordinary windows, while the middle floor is lighted through circular openings in the wall, four feet in diameter, but which terminate on the inside with a bull's-eye sash and glass, three feet in diameter, and made

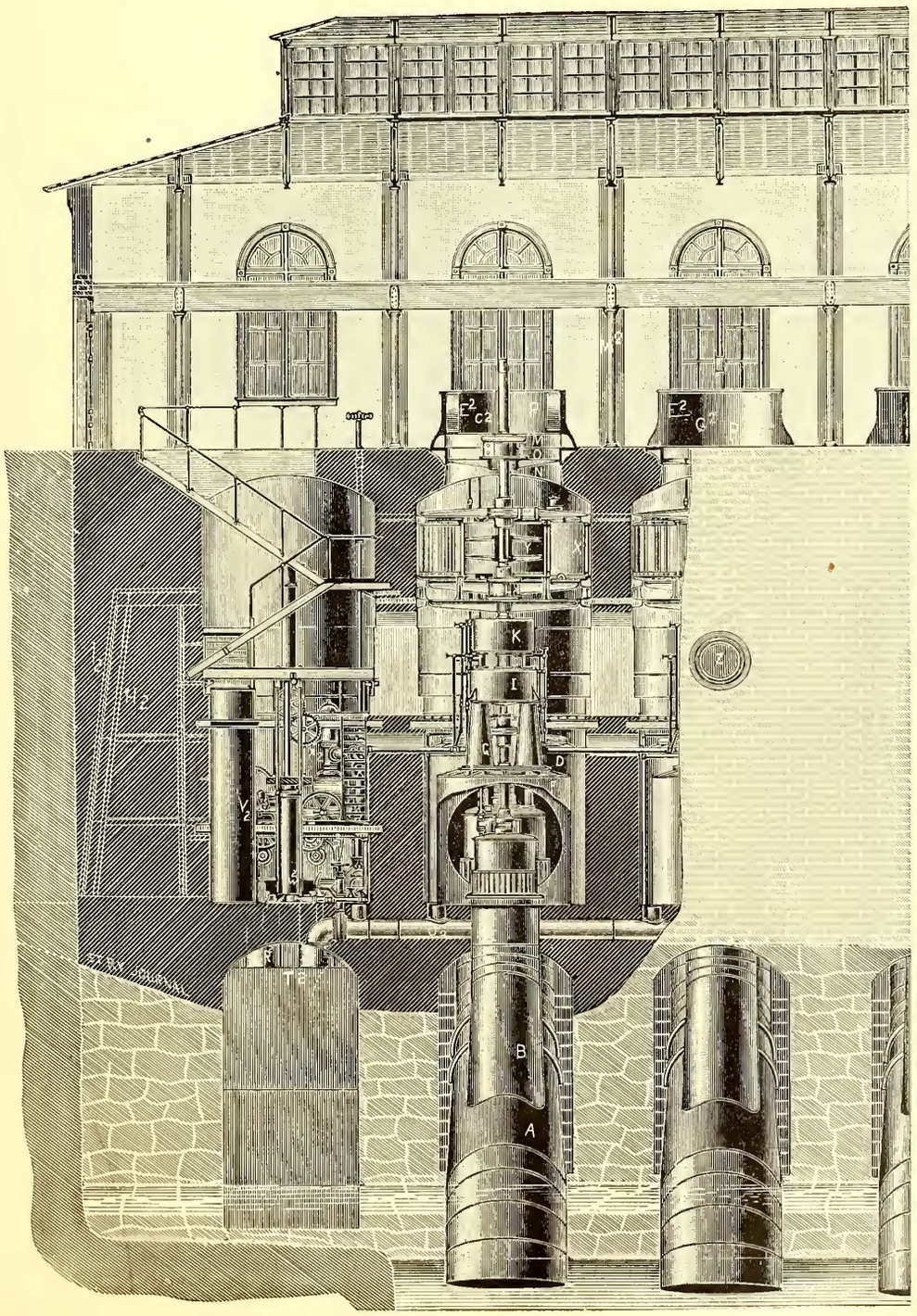


FIG. 5.—LONGITUDINAL ELEVATION OF THE UP-STREAM END OF POWER STATION, SHOWING PART IN SECTION—PORTLAND, ORE.

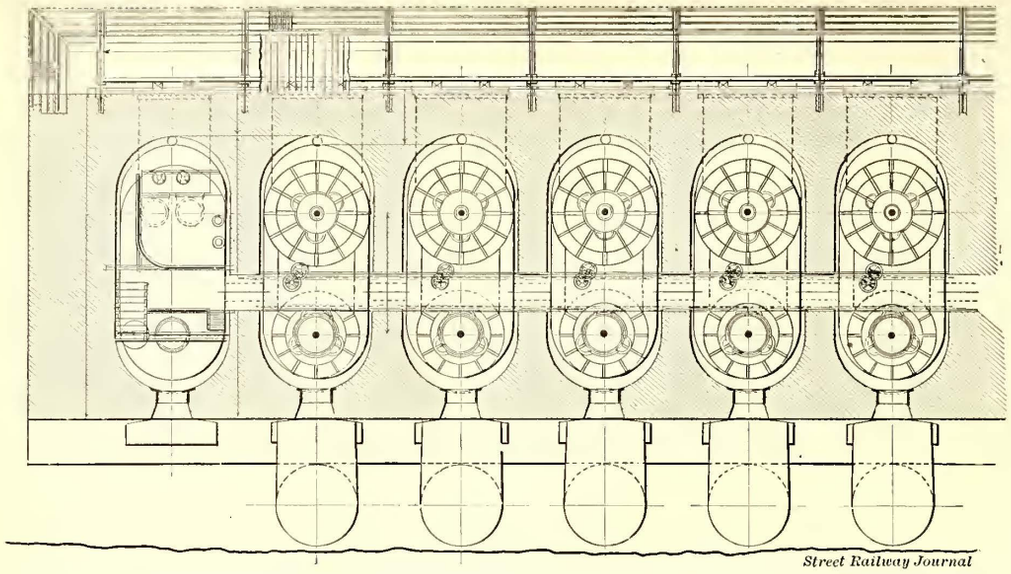


FIG 4.—PLAN OF STATION ABOVE WHEELS AND FLUMES—ELECTRIC LONG DISTANCE TRANSMISSION PLANT, PORTLAND, ORE.

to close watertight, like the bull's-eyes in the sides of ocean steamers. These are designed to protect the interior during periods of excessive high water. Figs. 3 and 4 are the floor plans.

The units of power, of which there are to be ten in the present equipment, each entirely independent of all the others, are located as shown in the engravings, and consist of a pair of vertical, cylinder gate, improved Victor turbine wheels, of forty-two and sixty inches diameter, respectively (Figs. 5 and 6). The large wheel is auxiliary to the other, and is provided for use only at periods of excessive high water which, according to the records, occurs, usually, every five years. The wheels, it will be noted, are located on the same level, one in the rear of the other, and only about one-half the distance below the level of the water, the theory being that the weight of the water in the discharge or draft pipe is as thoroughly utilized as if it were all above the wheel. The lower end of the pipe being always below the surface of the water in the tail race, it is hermetically sealed, so that the weight tends to form a vacuum next the wheel.

The generator of each unit is of 600 H. P. capacity, and is located on the upper floor of the building, with the armature in a horizontal position attached to the vertical shaft of the forty-two inch wheel, and is thirty feet above the wheel which is designed to run at a speed of 200 revolutions per minute. The shaft of the sixty inch wheel, which is to be employed only at periods of high water, is provided with a horizontal belt pulley, twelve feet in diameter, with a forty-eight inch face, from which the power is transmitted by a leather belt to a six foot receiving pulley on the generator shaft, both being placed twelve feet above the wheel. By this reduction the large wheel, which makes but 100 revolutions per minute, will drive the generator at a uniform speed of 200 revolutions, the same as the forty-two inch wheel. When it becomes necessary to employ the large wheel, the generator shaft is uncoupled from its wheel at a point just above the flume, and the belt is brought into contact with its pulleys by means of the tightener pulley shown in Fig. 7

In order to support the belt in place when not in use, the pulleys are all surrounded by a shelf and rack, with perpendicular pipe guards, which is also attached to the tightener pulley, and which, by the movement of the latter away from the belt, carries the belt with it, and causes it to spring away from the surface of the small pulley, so that it receives no frictional wear while idle.

The most interesting features of the equipment are the bearings (Fig. 8) which are employed to support the weight of the vertical shafts, which in the case of the armature and shaft aggregates 33,500 lbs. The wheel shafts are supported on double step bearings, as is customary in vertical turbine wheels, but these not being sufficient to carry the weight of the shaft and armature, extra bearings

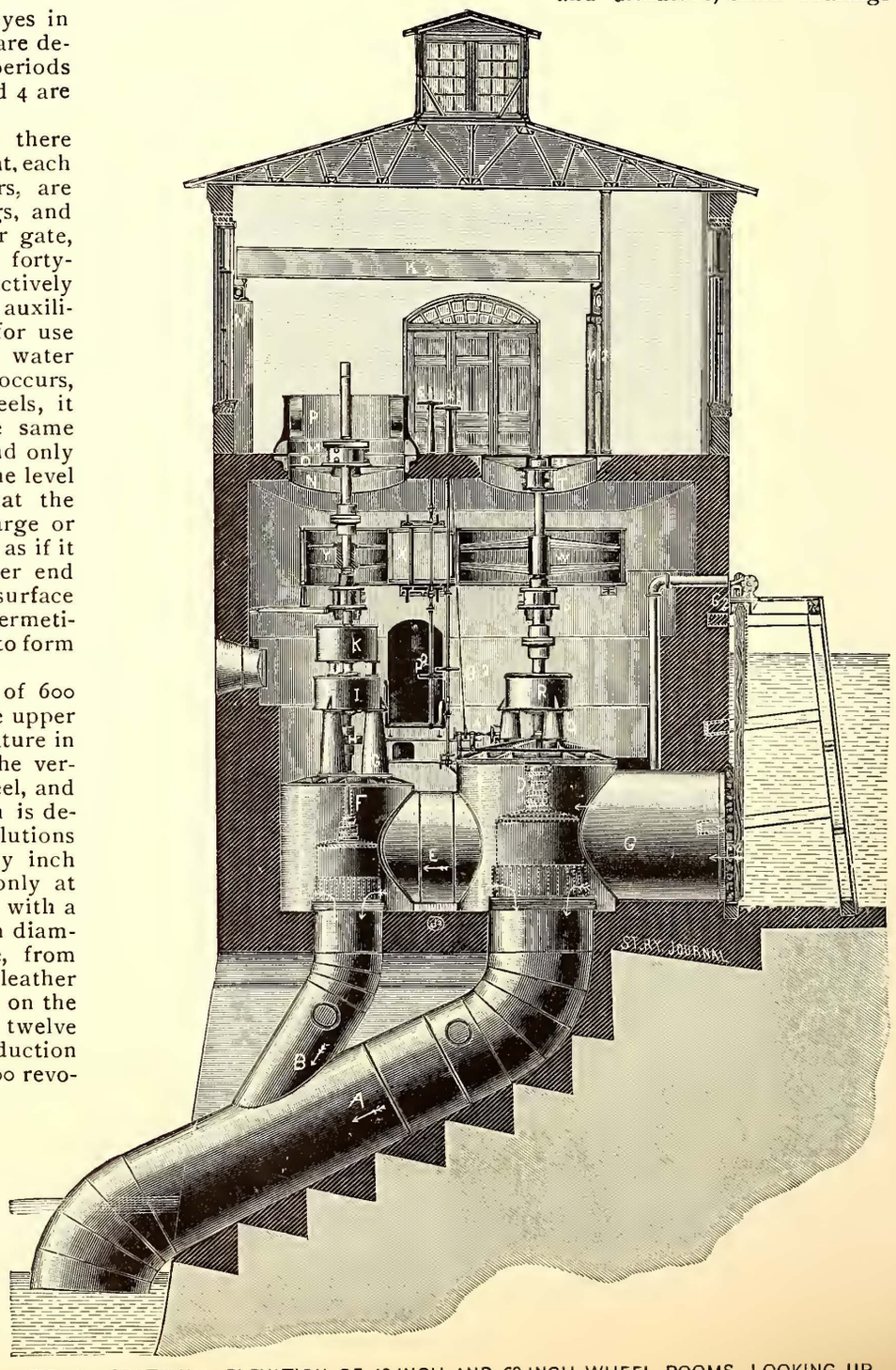


FIG. 6.—SECTIONAL ELEVATION OF 42-INCH AND 60-INCH WHEEL ROOMS, LOOKING UP STREAM—PORTLAND, ORE.

are provided, and these are of two types; a ring thrust bearing, similar to those commonly employed on the propeller shafts of steamboats, and an hydraulic oil bearing which supplements the ring bearing on the generator shaft. Both types are enclosed in cases to which the oil is delivered by hydraulic pressure, and all the cases are waterjacketed, for the purpose of absorbing the heat generated by the excessive friction. The ring bearings are adjustable, and so constructed that the oil cannot fly off or run down the shaft. The generator shaft which is twenty-nine feet in length and eight and three-eighths inches in diameter, while it is an extension of the shaft of the forty-two inch wheel, does not rest upon the latter, but the faces of the disk couplings, through which the power is transmitted, are ordinarily about one-half inch apart. The couplings are connected by twelve two inch vertical bolts, which are tapered at the lower ends, and held firmly into the lower plate by means of

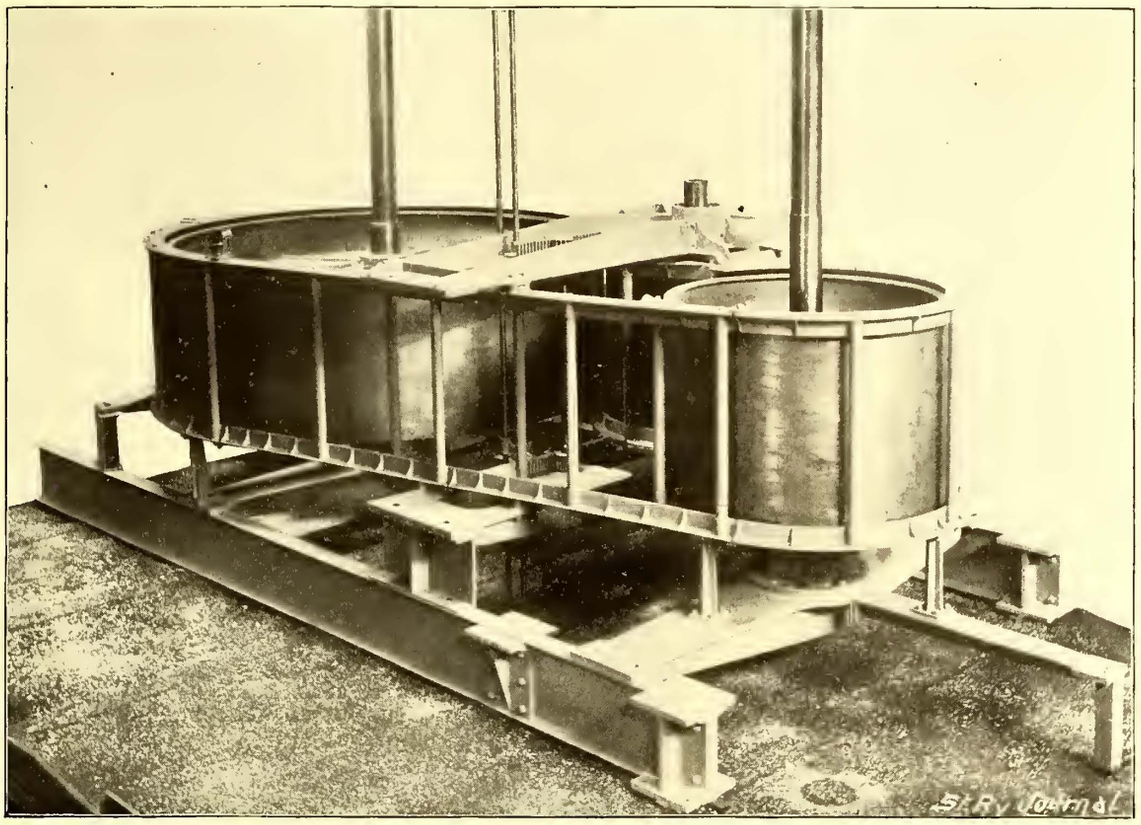


FIG. 7.—COUPLING PULLEYS, BELT TIGHTENER AND SHELF FOR SUPPORTING BELT WHEN IDLE—PORTLAND, ORE.

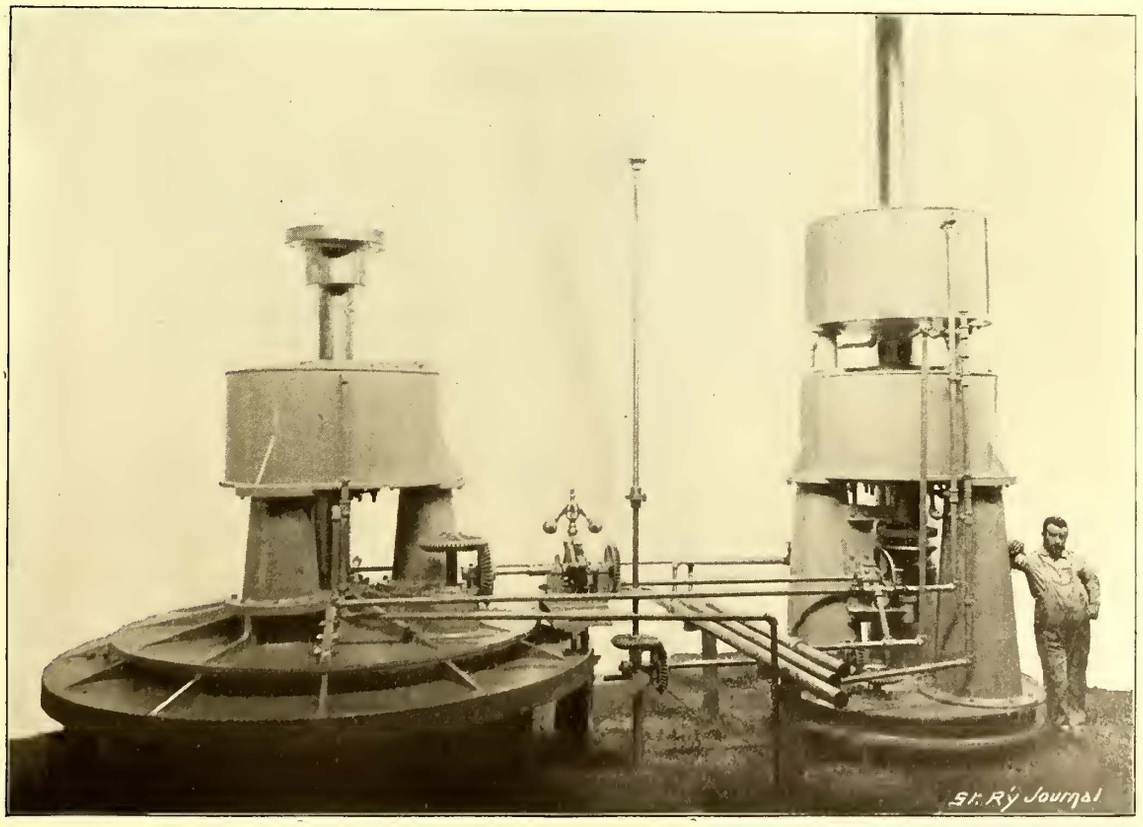


FIG. 8.—HYDRAULIC AND THRUST BEARING CYLINDERS TO CARRY GENERATOR SHAFT—PORTLAND, ORE.

heavy nuts, but simply pass through close fitting holes in the upper plate so that the generator shaft has a slight free movement up or down, and may be readily uncoupled from the wheel shaft by removing the nuts and lifting out the bolts. The extension of the sixty inch wheel shaft is twenty-three feet long and nine and three-eighths inches diameter and is supported by a ring thrust bearing only. It is designed that the hydraulic oil bearing shall carry the load of the generator shaft under ordinary conditions, but it may all be transferred to the ring bearings when necessary. In the construction of the hydraulic bearing the shaft is encircled by a four inch ring, which has its lower face inserted in a sealed case which is filled with oil and kept at a constant pressure of 275 lbs. per square inch. The thrust bearing cases, it will be noted, are supported in each instance on cast iron pedestals which rest on the top of the wheel flumes.

Both water wheels are controlled by the same vertical shaft which is provided with a hand wheel on each floor, marked C, and B (Figs. 5 and 6), and both are regulated by the same governor (shown in Fig. 8). By the shifting of the beveled gears on the governor mechanism, the gates of either wheel are operated by the one hand wheel and governor as desired. The belt tightener is also controlled from either floor by means of a hand wheel (Figs. 6 and 7).

The water is admitted to the penstock from the race by means of head gates operated from a platform alongside of the building, each of which is provided with a small gate which is first opened and which allows the penstock to fill, and so balance the pressure against the main gate when it is readily raised. The penstocks are each ten feet in diameter, and are constructed of riveted steel plates. The flumes which enclose the wheels have cast iron heads and steel sides, and are so arranged that the water passes first through the large flume and on through a short penstock to the flume of the forty-two inch wheel, and from the wheels it is discharged directly into the draft tubes, which are re-united before reaching the tail race. The draft tubes are thoroughly anchored to the steps of the foundation as shown.

The wheel guide, or case, is shown in Fig. 9. The paddle-like openings, are the intake chutes, which are closed by means of a hollow cylinder gate which fits the openings closely all around. The turbine is mounted within the gate, which, on being raised, allows the water to pass through the chutes on all sides, when it comes in contact with the curved buckets of the wheel, and passing through is discharged at the under side of the wheel, so that the force of the water is practically applied to the wheel at two points, first by impact against the buckets, and second by the reaction of the discharge. The cylinder gate is raised or lowered by means of the beveled gears shown in the figure, and is balanced by means of a wire rope and weight operating over the grooved pulley shown on the opposite side of the wheel case from the gears. Ordinarily the Snow governor is employed for the regulation of the Victor turbine wheels, but more recently a combined electrical and mechanical governor has been devised for use in electrical power plants, which has proved sufficiently sensitive to readily conform to the widely fluctuating loads that are characteristic of electric power plants.

The auxiliary power equipment of the station consists of a set of pumps, including an hydraulic pump for supplying oil to the thrust bearing cylinders, and a duplex water pump for keeping up the circulation in the water jackets about these cylinders. The pump room occupies the first, or left hand section of the building shown in Fig. 12, and the pumps are operated by means of two fifteen inch horizontal Victor turbines, enclosed in the same flume, one of which operates the duplex power pump for supplying the cylinder jackets, and the other the hydraulic

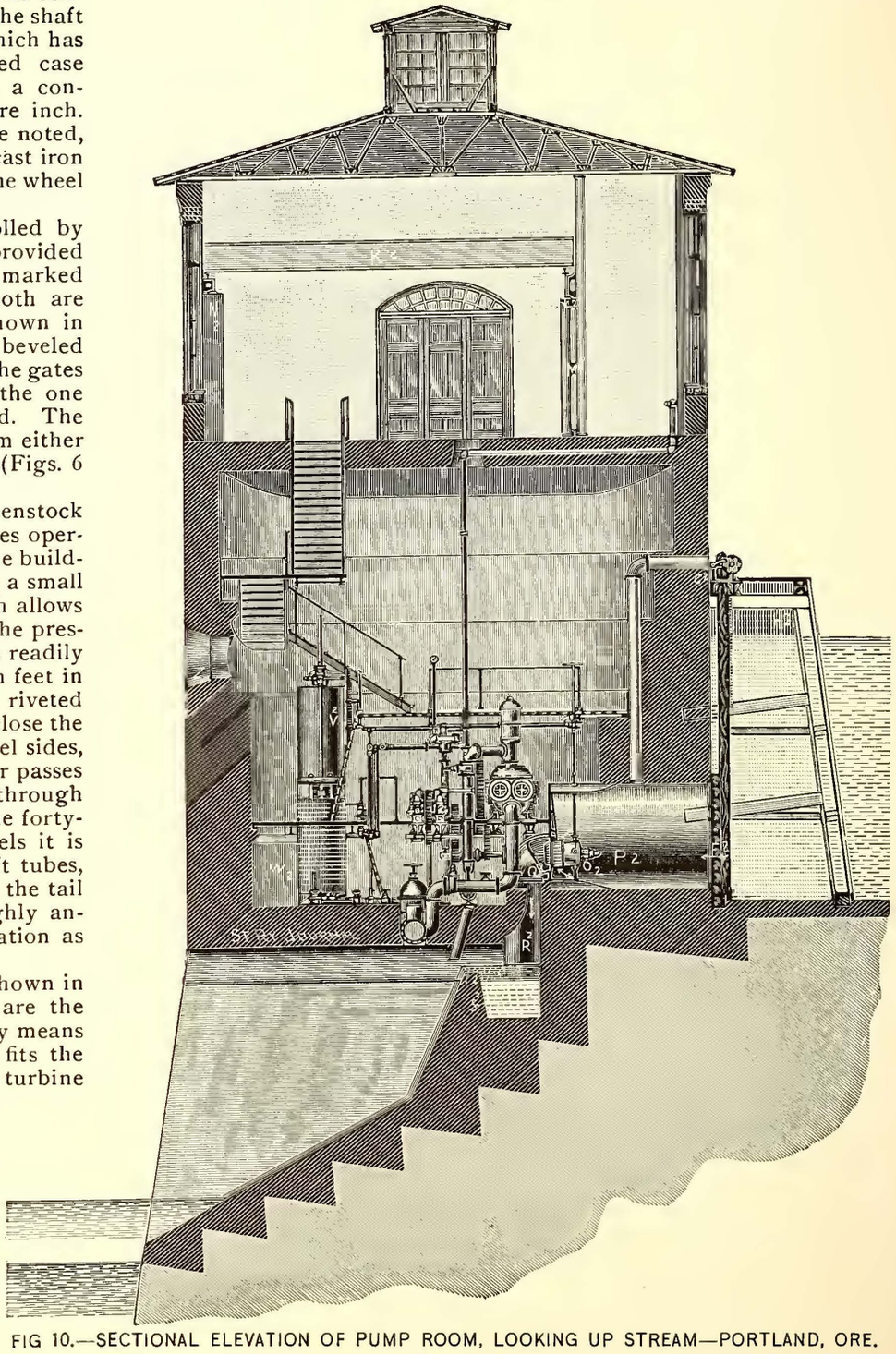


FIG 10.—SECTIONAL ELEVATION OF PUMP ROOM, LOOKING UP STREAM—PORTLAND, ORE.

oil pump. The oil is first delivered to the accumulator shown in Fig. 11, the plunger of which is weighted so that the pressure is kept uniformly at 275 lbs. to the square inch. The arm of the accumulator is connected with a governing mechanism, and automatically regulates the supply of oil in the cylinder. The pipes connecting the pump with the accumulator are provided with check valves, so that in case there should be a break in the pipes at any point, the pressure would not be reduced in the supply pipes or cylinders.

Another chamber which occupies the center portion

of the building, or the first one to the right of the first ten units, is known as the exciter room (Fig. 12), and is provided with a pair of vertical turbine wheels and generators. The wheels are each forty-eight inches in diameter, and operate a pair of exciters of 400 H. P. capacity at 125 revolutions per minute, each of the armatures of the exciters being attached to the vertical shafts of the turbines in the same manner described for the generator armatures, both shafts being provided with ring and hydraulic thrust bearings. In this case the shafts are not belted together as in the generator room. The turbines are controlled by hand wheels from both floors, as shown at A_4 and B_4 (Fig. 12). Ordinarily it is expected that one exciter will be sufficient to energize the fields of all the generators, but two are provided in case one is idle from any cause. Adding the capacity of the exciting generators to that of the power generators, the ultimate electrical capacity of the station will be 12,800 H. P., divided into twenty-two separate units.

An electric overhead traveling crane of twelve tons capacity is provided in the generator room for the purpose of handling armatures and other heavy parts. This crane has a longitudinal movement of about 360 ft., and a cross movement of twenty-four feet six inches. The switchboard is to be located near the center of the station, and supported against the columns which carry the crane.

RECAPITULATION.

Fig. 1 is a map of the falls, and not only shows the location of the new plant, but also the industrial plants now in operation. Fig. 2 is an exterior view of the power station of the Portland General Electric Company, looking from the river side. Figs. 3 and 4 are ground plans of the upper and lower floors, showing the position of the wheels and generators together with the draft tubes. Fig. 5 is an elevation of the building with the side broken out, showing to the left the interior of the pump room, one of the power units, and a portion of the second unit, looking shoreward from a position in the river. Fig. 6 is a cross section showing a pair of wheels and the generator, from a position looking up stream. In these figures, A and B are the draft tubes, C and E the penstocks, D and F the flumes enclosing the wheels, which are shown by the dotted lines, G and Q the pedestals supporting the bearing cylinders, H the shaft coupling, I and R the ring thrust bearing cylinders, K the hydraulic cylinder, which are also shown enlarged in Fig. 8, W the twelve foot transmission pulley, Y the six foot receiving pulley on the generator shaft, X the belt tightener. Views of these parts are also given enlarged in Fig. 7. P is the generator, C_2 and B_2 the hand wheels for controlling the gates; E_2 and D_2 the hand wheels for controlling the belt tightener pulley, and A_2 the governing mechanism, which is also shown in Fig. 8.

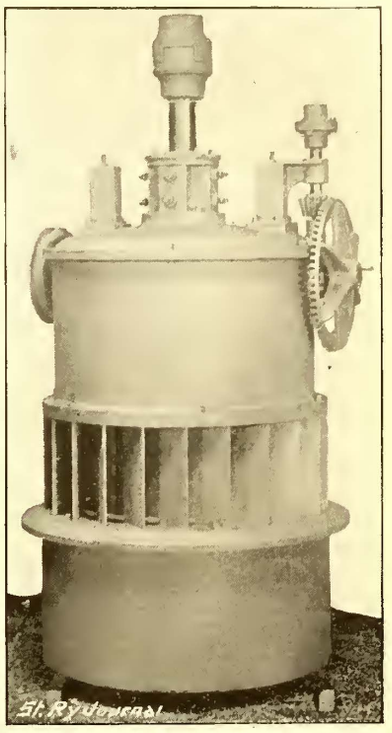


FIG. 9.—NEW UPRIGHT VICTOR WHEEL COMPLETE, SHOWING INTAKE SHOOTS—PORTLAND, ORE.

Figs. 10 and 11 show the arrangement of the pump room, in which P_2 is the penstock and O_2 the two fifteen inch wheels which operate the pumps from which the water is discharged through the draft pipes, R_2, to the well, S_2, from which it overflows and passes to the river below. X_2 is the duplex water pump and U_2 the hydraulic oil pump, from which the oil is delivered to the accumulator, V_2.

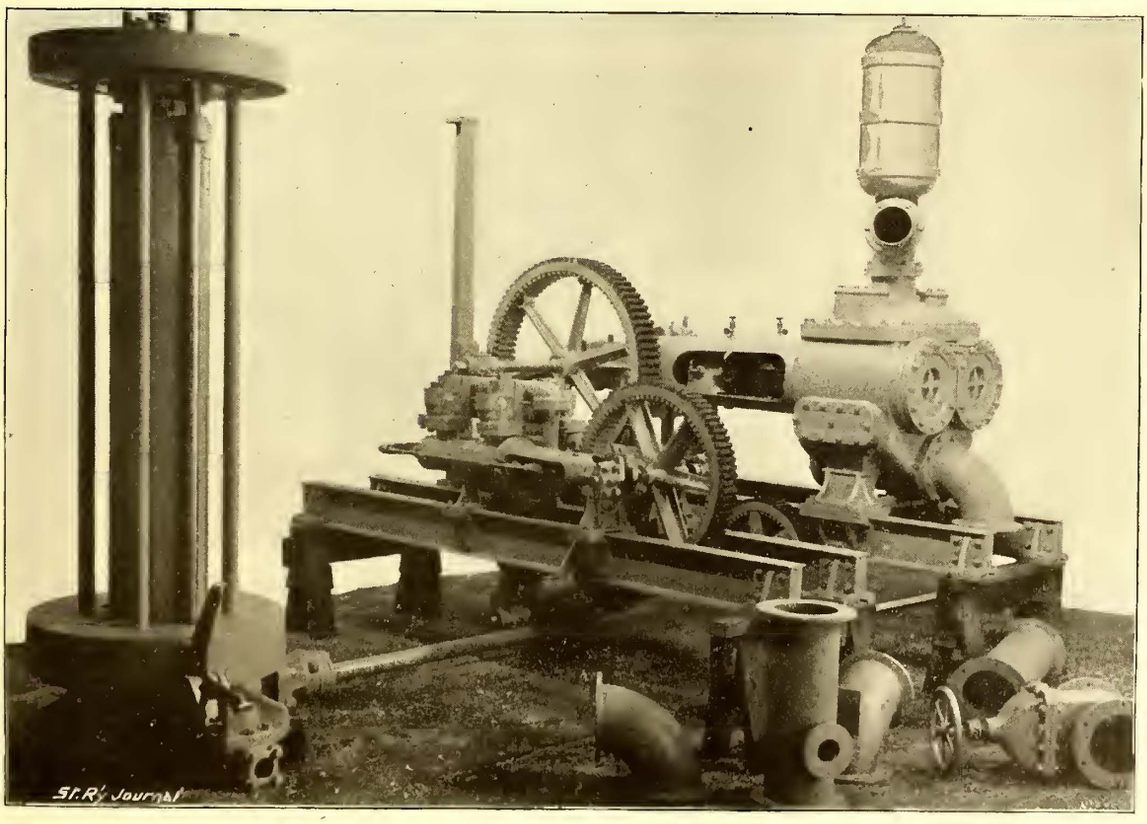


FIG. 11.—PUMPS AND ACCUMULATOR FOR SUPPLYING OIL TO HYDRAULIC GEARINGS AND WATER TO JACKETS OF ALL CYLINDER BEARINGS—PORTLAND, ORE.

Fig. 12 is a cross section showing the pair of forty-eight inch wheels and the two exciters, from a position looking up stream. Corresponding parts are lettered the same as in the other figures, but it will be noted that each shaft is supported by both a ring and a hydraulic bearing.

L_2 and N_2 (Fig. 12) are the tracks which support the traveling crane, Z is the bull's eye through which light is admitted to the lower room, and G_2 indicates one of the race gates.

There is a drain pipe extending the whole length of the building for the purpose of removing the seepage water, should any penetrate the walls during periods of high water. C_1 is the drain pipe, by means of which the water in the race may be discharged.

The entire power equipment of the station was manufactured by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O., of which R. N. King is president, after designs made by the general superintendent and engineer of the company, A. C. Rice, who also made the building plans, and plans for the enlargement of the canal and of the head gates.

The entire electrical equipment is furnished by the General Electric Company, of New York, Boston and Chicago, and the generators are among the largest yet to be constructed where the armature revolves in a horizontal position. The electrical equipment of the plant, although not described in detail, is of as equally high order as that of the power equipment, and it is expected that the transmission can be made to Portland, a distance of twelve miles, with less loss even than that of the old plant, which, as before noticed, is only 10 per cent. When fully in operation it is expected sufficient power will be delivered to operate all the street cars of the city, light and warm the houses, and supply power to most of the manufacturing establishments, as well as for the operation of store and hotel elevators. The operation of the plant will be watched with a great deal of interest, at it is among the first attempts in this country to transmit so large a horse power to so great a distance by electricity.

THE STILWELL-BIERCE & SMITH-VAILE COMPANY, OF DAYTON, O.

The company controls and operates two large shops in the above city, one of which (Fig. 13) formerly known as the Stilwell & Bierce shops, is located about a square below the Main Street bridge on the Dayton View Hydraulic, or race, leading from the Miami River, and from which the water is drawn for power purposes. The other, formerly known as the Smith-Vaile shops, is at North Dayton, on the Mad River, above the point at which it joins the Miami (Fig. 14).

The former plant consists of a number of brick buildings which cover a large area, and is devoted exclusively to the manufacture of turbine wheels, penstocks, flumes, shafting and gearings for a complete water power equipment. The second plant is devoted to the manufacture of hydraulic machinery, steam pumps, including oil mill machinery, and feedwater heaters and purifiers. The company employs about 750 hands in the two plants. The machine equipment for the manufacture of turbines is very complete, including a number of machines designed and manufactured in the company's plant. Among these are large pit lathes, on which the turbines, or large pulleys, can be bored and faced at the same operation. There are hoists and transfer cars for the convenient handling of heavy parts.

Great care is exercised in the construction of all the machinery, even the foundation frames for the turbines being surfaced on the planer, and all junction parts are carefully faced by machinery, so that close fitting joints are obtained. The company has gained a wide reputation in the manufacture of the Victor turbine wheels, and has had the contracts for the equipment of many of the largest water power plants in this country, including many in New England for the operation of cotton, woolen and pulp mill machinery, and also in many foreign countries.

This company was the first to employ to any extent the turbine wheels in a horizontal position, and it has a number of these wheels operating street railway electric power plants, several of which have been illustrated and described in our columns during the last year; notably, the plant of Great Falls, Mont.; Spokane, Wash.; Oregon City, Ore.; Augusta, Ga., and other points.

Interior views of the erecting room are shown in Figs. 15 and 16, and illustrating an equipment of twin turbines, twenty-seven inches in diameter, with penstocks ten feet in diameter in process of construction. Fig. 17 shows a single twelve inch Victor turbine manufactured

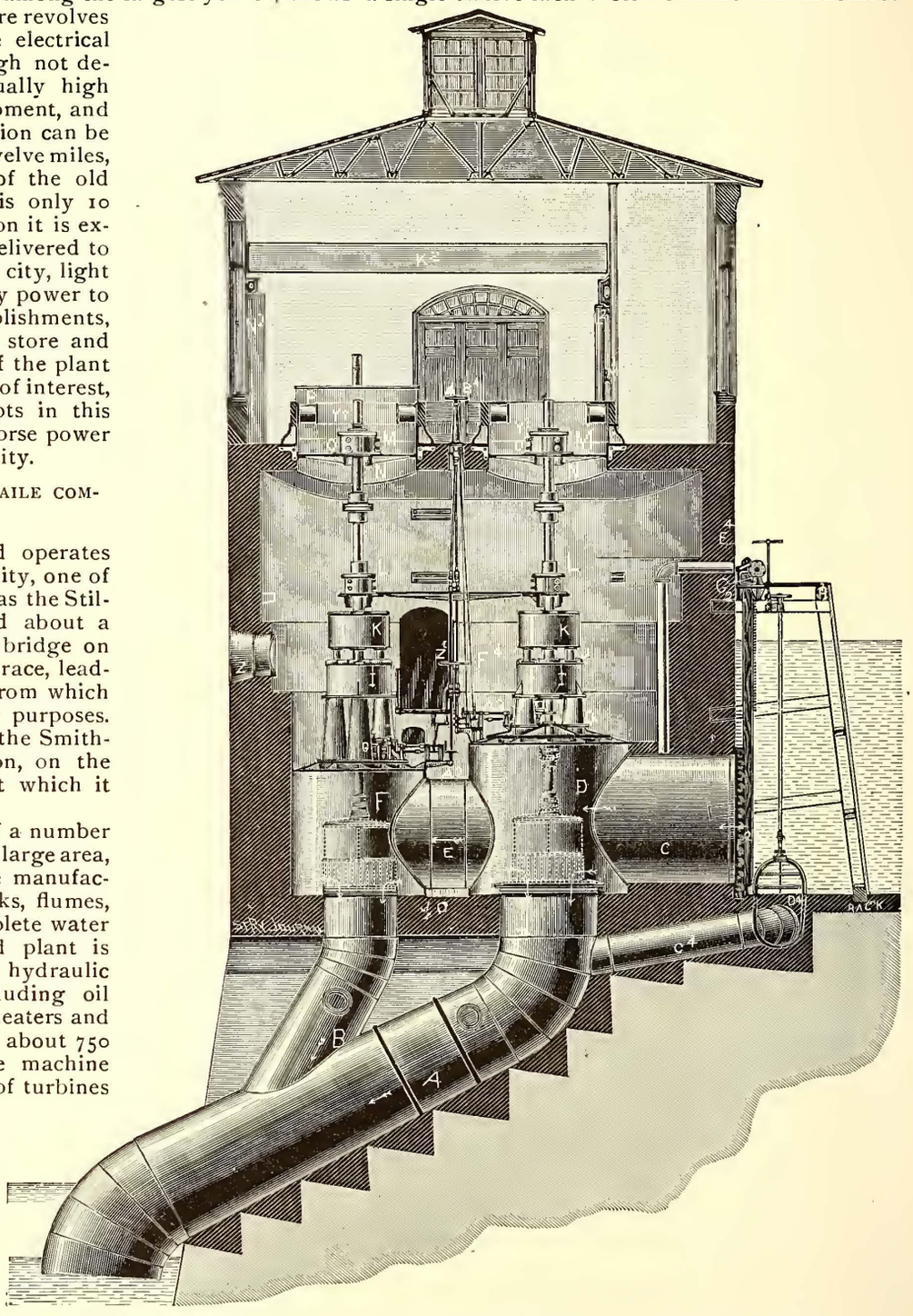


FIG. 12.—SECTIONAL ELEVATION OF 48-INCH WHEEL ROOM, LOOKING UP STREAM—PORTLAND, ORE.

for Fred. Nell, London, Eng., and in Fig. 18 is a single ten inch turbine of the same type, provided with friction couplings designed to operate two generators.

Fig. 19 shows the latest design for a flume for a pair of wheels. The company manufactures two types of Victor turbines, those with a register, and with a cylinder gate. The register gate is provided with openings which, when it is revolved on its axis, register with the intake chutes, and allow the water to come in contact with the wheel. The cylinder gate is a closed cylinder which is raised vertically, or drawn sideways, horizontally, so that

the water passes underneath the gate, and the volume depends upon the distance to which the gate is opened. The company builds either a register or cylinder gate type, but recommends the latter in most cases.

It is needless to say that in design and mechanical structure the turbines manufactured by this company are of a very superior order.

One of the most interesting plants recently designed is that of a wood pulp mill, at Plattsburgh, N. Y., in which eleven horizontal turbines are employed, which are operated from a single penstock, thirteen feet in diameter, and about 500 ft. long, to the shafts of which the grindstones, which reduce the logs to pulp, are directly connected.

As said above, the east shop, of which a birdseye view is presented in Fig. 14, is devoted to the manufacture of hydraulic machinery, steam and power pumps, cotton and linseed oil machinery, filter presses, etc., and was formerly known as

THE SMITH-VAILE SHOPS.

The buildings are very extensive, and are equipped with a larger and better assortment of iron working tools than is usually found in similar establishments. The large tools are all served by pneumatic lifts and trolleys, the air cylinders being supported by trolleys, and all are very quick acting. Lifts of this character are essential in a plant of this kind, for some of the castings are very heavy,

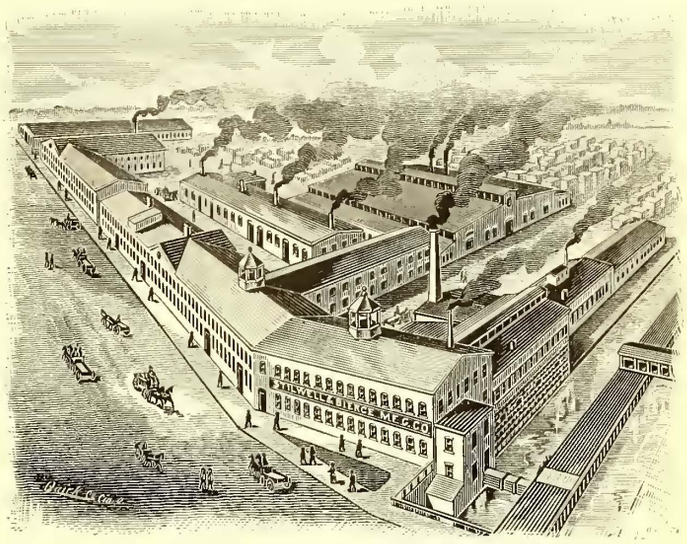


FIG. 13.—BIRD'S EYE VIEW OF THE STILWELL-BIERCE WORKS—DAYTON, O.

ilar to those employed in hotel offices, and whenever a workman is in need of a tool of any kind he touches a button, a boy responds to the number, and then brings whatever tool is required, a check for the number of the workman being deposited for every tool drawn from the tool room. By this arrangement an accurate record is kept of the tools, and if one of the tools should be broken or lost it can be at once traced to the man who drew it. There is also a time record clock provided, and the employes are checked in and out of the shop.

The foundry is provided with an overhead traveling crane, which spans the whole floor. It is operated by hydraulic lifts through the medium of wire ropes. There are three hydraulic cylinders located on one side of the shop, and two on the other, so that the crane has a movement in four directions. The lifts are controlled by levers on a platform on one side of the foundry.

For making the smaller standard parts two or three moulding machines are provided.

There is also a hydraulic elevator or lift, by means of which the metal and coke are elevated for the purpose of charging the cupolas.

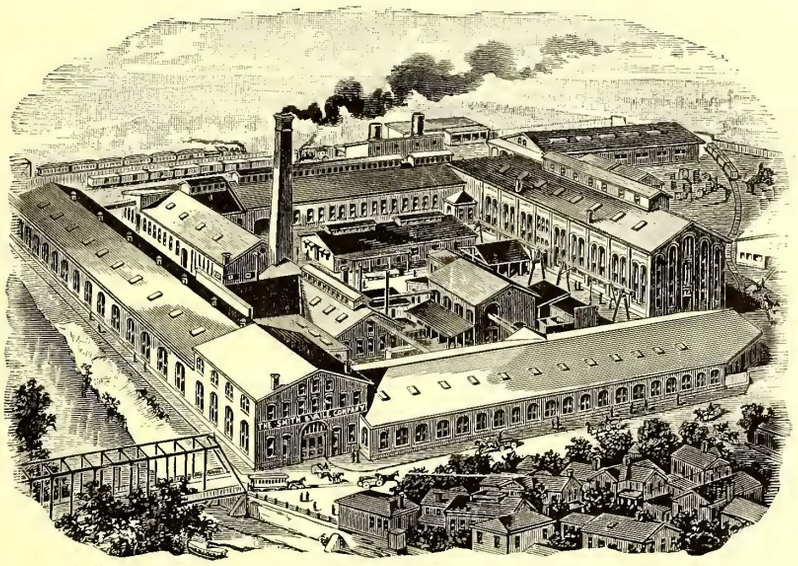


FIG 14.—BIRD'S EYE VIEW OF SMITH-VAILE WORKS—DAYTON, O.

especially those for the cylinders of the hydraulic oil presses that have a shell eight inches in thickness, and the castings have to be made from metal of a very fine texture, in order to stand the pressure, 5,000 lbs. per square inch, to which they are subjected. In ordinary castings, water under this pressure would be forced through the pores of the metal.

The tool room is fenced off from the shop, and none of the workmen are allowed to apply personally for tools. The shops are equipped with electric calls, sim-

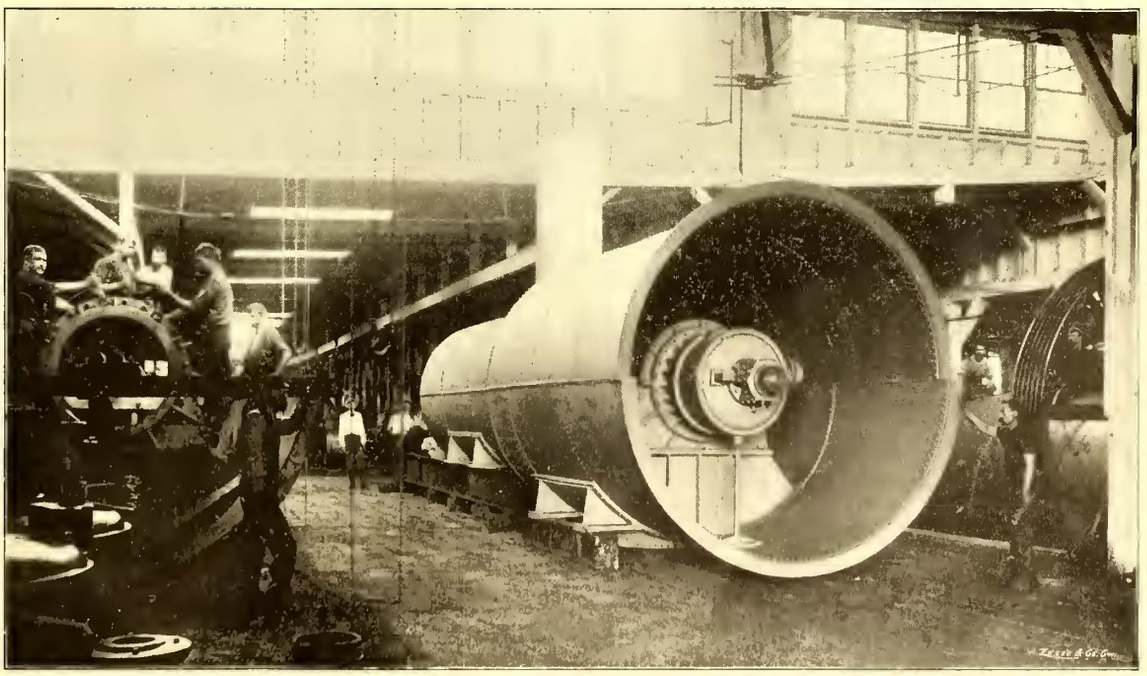


FIG. 15.—INTERIOR VIEW OF THE ERECTING ROOM—STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, O.

There are also pneumatic lifts for the ladles, and for handling the smaller parts. A steam riveter is provided for riveting together the side parts and plates for oil presses. There is also one steam hammer. A very large pump and receiver are provided for supplying the water to the hydraulic cranes and elevators. The pump is self-acting, depending upon the pressure in the receiver.

A testing room is provided near the boilers, which is also supplied with a hydraulic lift, where all the pumps and presses manufactured are first tested before being shipped away. A side track from one of the steam lines enters the yard. All shipments are made directly from the shop, hoists and cranes being provided so that all parts are delivered directly on board cars. None but skilled workmen are employed, while the engineering talent, like that employed in the turbine department, is of a high order. The erecting engineers having had long training, are able to put the machines in position in a skillful and workmanlike manner.

The Smith-Vaile pumps are too well known to require a lengthy description in this connection. They are manufactured in a great variety of styles and sizes, and designed for every class of service.

Stilwell's live steam purifier is also well known to the street railway fraternity, and is employed for removing impurities from feedwater to prevent the formation of scale in boilers, while the improved open heater and filter combined removes the impurities, separates the cylinder oil from the exhaust steam and clarifies roily water, while in it the feedwater is heated to the boiling point.

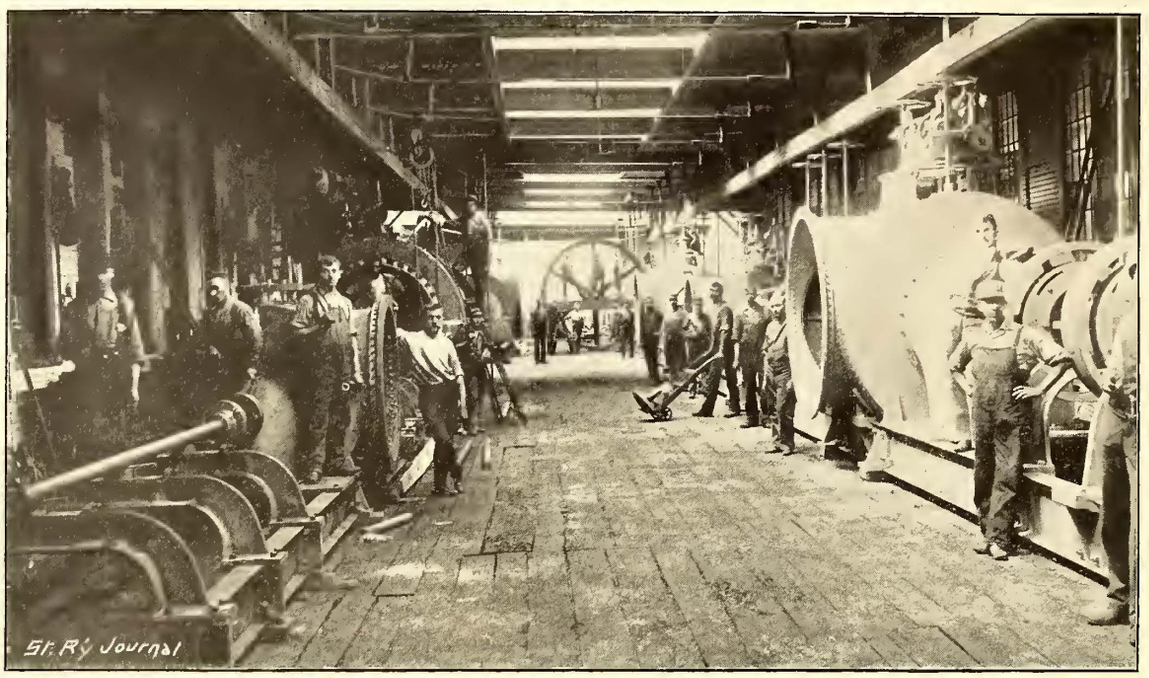


FIG. 16.—INTERIOR VIEW OF THE ERECTING ROOM—STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, O.

An international electrical exhibition will be held at Paris from July 1 to October 31, 1895. It will consist of two sections connected by an electric railroad. The generating plant will be in the Palais-des-Machines, at the Champs de Mars, while the different electrical plant accessories will be shown in operation in the Palais de l' Industrie at the Champs-Elysées.

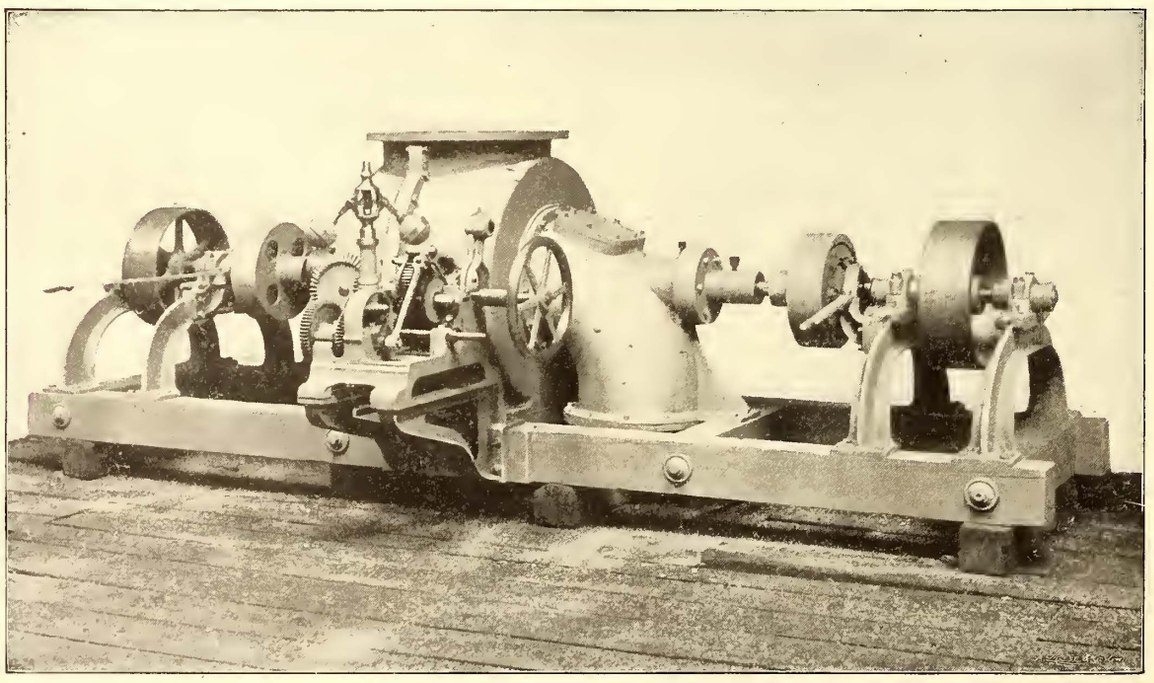


FIG. 17.—SINGLE 12-INCH VICTOR TURBINE.

Electric Conduit Road in New York.

President Vreeland, of the Metropolitan Street Railway Company, in an interview last month stated that a contract had been given to the General Electric Company to construct three miles of conduit road over a route not yet selected. The voltage used will be 300. The roadbed and conduit will be built precisely in the same manner as if a cable were to be used, and the road can be changed to a cable road later, if it should prove desirable. The Siemens & Halske Company will not build a section of conduit track in New York, as was at first proposed.

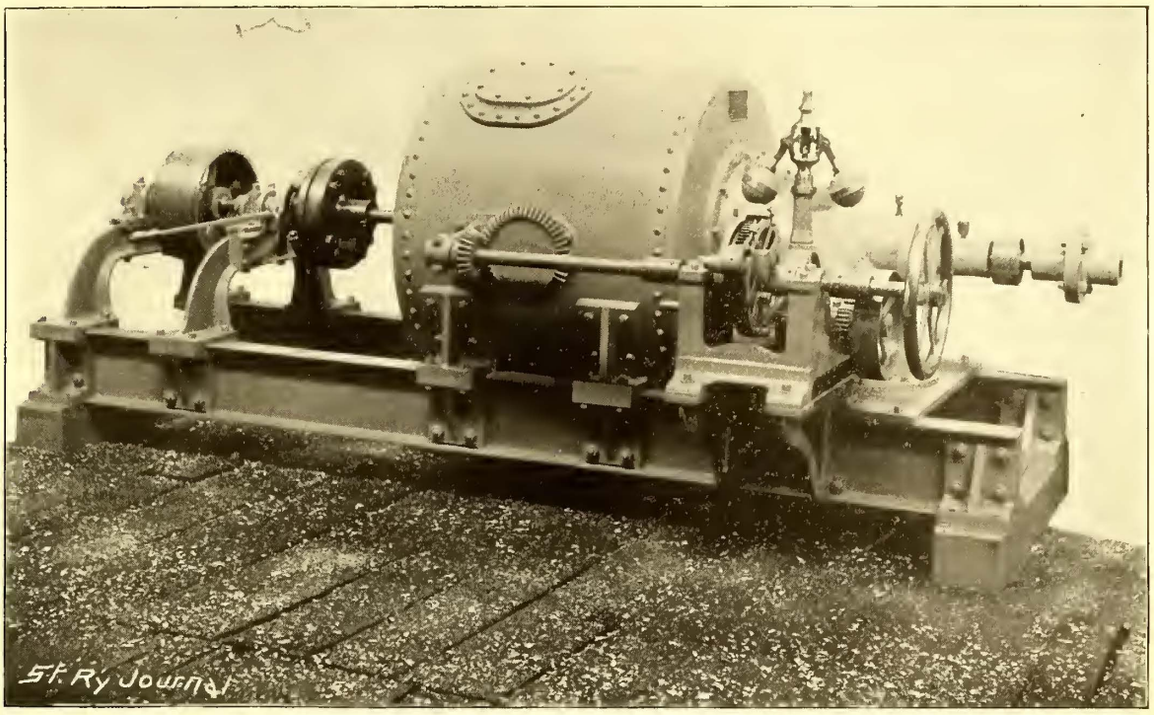


FIG. 18.—SINGLE 10-INCH VICTOR TURBINE ON HORIZONTAL SHAFT.

The installation will probably be made on Lexington Avenue, and owing to the fact that the system will be adopted in case it should prove a success, the construction of the cable railway on that avenue will be suspended for the present. It is stated that both the Siemens & Halske Company and the General Electric Company own fundamental patents covering the feasible construction of a conduit railway, and, as a result, patent litigation on the subject is extremely possible in case the experiment is successful.

Large Electrical Contract Awarded in Chicago.

On June 22, the Metropolitan West Side Elevated Railway Company let its contract for generators, switchboard, motors, line and construction work to the General Electric Company. The amount of the contract is said to be about $200,000. There will be two generators of 1,500 K. W. each and two 800 K. W. machines. At present the road will be operated by fifty-five three-car trains, each motor car being supplied with two 100 H. P. motors. The third rail, and in general many other details used on the Intramural road at the World's Fair last summer, will be adopted. The line is about five miles long and runs due West between Van Buren and Congress Streets with a northern branch at Paulina Street.

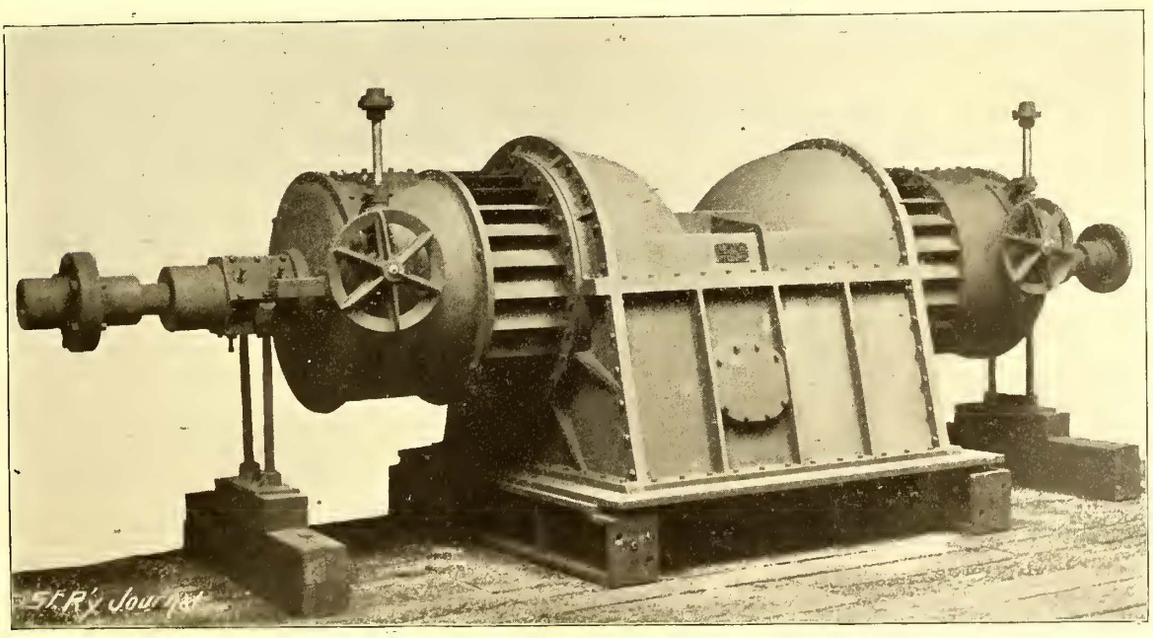


FIG. 19.—PAIR OF 33-INCH CYLINDER GATE VICTOR TURBINES DISCHARGING INTO ONE DRAUGHT TUBE.

Electric Welding in Brooklyn.

Work on the track construction of the Nassau Electric Railway of Brooklyn is going on rapidly on 39th Street, South Brooklyn. From the plans of this company, which have already been published in the Street Railway Journal, it will be remembered that from fifty to sixty miles of track will be laid this summer, and that the company contemplates the ultimate installation of an exceedingly important system in Brooklyn. A. L. Johnson, of Cleveland, O., is largely interested in the road, and is president of the Nassau Electric Railway Company,

FIG. 1.—RAIL WELDING EQUIPMENT—NASSAU ELECTRIC RAILWAY, BROOKLYN.

while the work of installation is carried on under the direction of Mr. Heffton, of Johnstown, Pa.

Electrically welded rails will be used throughout. Fig. 1 gives a view of the electric welder now at work on 39th Street, near Fifth Avenue. This machine differs in a number of particulars from that in use in St. Louis and elsewhere, the equipment being in two cars instead of one. The car farthest from the observer in Fig. 1 contains the transformer or motor-dynamo. This is operated by current taken from the overhead wire, which at present is receiving its current from the power station of the Atlantic Avenue Railroad Company. Leads from this motor-dynamo carry the alternating current, which is at 300 volts, to the forward car. This contains the welder, consisting of an enormous clamp made of gun metal, so as to be non-magnetic, supported on a frame operated by an hydraulic jack. The 300 volt current is transformed at the point of use to an alternating current of about four volts and 50,000 amperes, the amount of current being varied by a reactive coil carried on the forward car.

When the rails are laid the ends of two joints out of three are butted, and at the third joint a space of one-sixteenth of an inch is left. The process of welding then is as follows: The sides of the webs for a distance of three to three and a half inches from the end at each joint are ground with an emery wheel carried on a tender car. This is to make good contact at all points and to insure a perfect weld. At the butted joints two pieces of soft steel, conforming in shape to the rail, are then placed on each side of the joint, there being four pieces in all, two for the head of the rail and two for the lower flange. The jaws of the clamp are then brought to bear on the joint by a handwheel holding the pieces of steel tightly to the joint. The current is then thrown on, when the steel pieces rapidly fuse together and to the rail. Against the head of the rail is pressed a non-conductor of heat, so that the temper of the rail at the joint is not reduced. A circuit of water is kept up through the welder so as to keep it cool during the process. Where the joints are not butted a thin section of rail is slipped in between the ends so that there may be no break in the rail. After the process of welding, which takes about thirty-seconds, is completed the clamp is removed and the joint is ready for use. The rails are also connected together for the return circuit by welding a flat steel bar, ½ × 2½ ins. from rail to rail every 600 ft. In a double track the interior rails of each track are also connected by similar bars, also located every 600 ft.

FIG. 2.—INTERIOR OF TRANSFORMER CAR—BROOKLYN.

FIG. 3.—METHOD OF WELDING RAILS.

Summer Meeting of the Northwestern Electrical Association.

The summer meeting of the Northwestern Electrical Association will be held in St. Paul, July 18, 19 and 20. At the last meeting, held in Milwaukee, 150 were present, and a larger number of attendants is expected at this meeting. Representatives from Illinois, Iowa, Michigan, Wisconsin and North and South Dakota have written that they will be present. An excellent programme has been prepared.

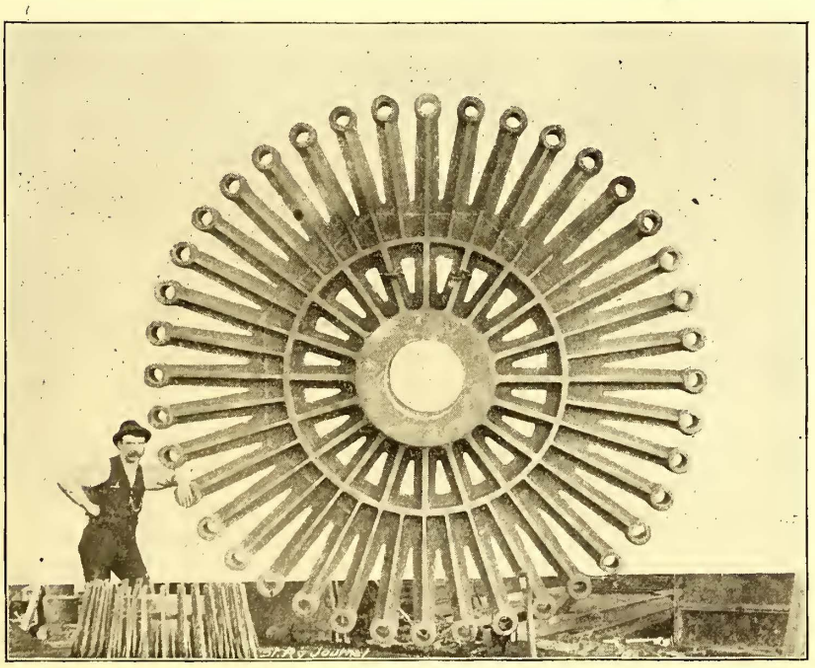
An exhibit of electrical appliances will be made in connection with the meetings of the Association by manufacturers, who will be accorded every courtesy by the Association.

A Large Armature Star.

What is claimed to be the largest armature star or carrier casting in the world has recently been constructed for the Siemens & Halske Electric Company of America by the Wells & French Company, and is shown in the accompanying engraving. A pair of these has been made, and they will be used at Toronto, Ont., for street railway service. The machines, when completed, will weigh about sixty tons each, and will have a nominal capacity of about 1,200 K. W. or 1,600 E. H. P., and will be overcompounded for 12 per cent. drop in the lines. They are to be direct connected to a pair of horizontal, cross compound, condensing engines, making eighty turns per minute.

The armature stars are thirteen feet in diameter, and weigh something over ten tons each. The brush carriers will be about fourteen feet six inches in diameter, being made by the same concern. These castings came from the mould absolutely perfect, without warp, crack, flaw or blow hole, and are now being finished for the armature.

Considering the form and size and the difficulty of making castings, the Wells & French Company is to be highly commended for the skill and workmanship in successfully turning out such perfect work on its first order of this kind.

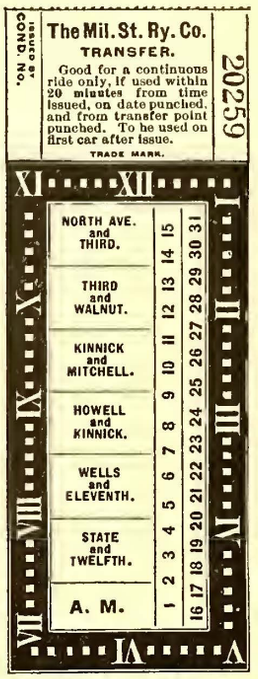


LARGE ARMATURE STAR.

AN inspection of the Calumet Electric Street Railway was made June 16, by the officers of that road and guests upon invitation of John Farson. A special train was provided by Superintendent Oliphant, gaily decorated with flags, and both officers and visitors expressed themselves as greatly pleased with the result of the inspection.

New Type of Transfer Ticket.

We present herewith an engraving of a novel transfer ticket, recently adopted by the Milwaukee Street Railway Company, and devised by the officials of that company. The principal point of interest in this ticket is its simplicity. As will be seen, the ticket bears, distinctly marked, the time of day in clock figures. The passenger receiving the ticket, therefore, naturally has his attention called to the question of time, which might, perhaps, not occur where arabic numerals are used without explanation. The limit as to time is explained in a note at the head of the ticket, so that a passenger looking at the dial on the ticket and then at the note sees readily that the intention of the ticket is to limit him to the next car, or to twenty minutes. As will be seen, the month of issue is not put on the ticket, as the serial numbers are thought sufficient indication of the month. This reduces the number of figures and printing, and makes the ticket very simple, while securing the objects of a ticket of this kind.



NEW TYPE OF TRANSFER TICKET.

While transfer tickets have not been used before in Milwaukee, and as, in consequence, they were a novelty in that city, it is interesting to note that they were put in use with hardly any friction, and transfers are now being made smoothly and easily.

The Ottawa Electric Railway Company.

This is the title of a new company which will include all of the electric railways in Ottawa, Can. The bill before the Dominion Parliament amalgamating the Ottawa City Passenger Railway Company, and the Electric Street Railway Company passed its final reading June 15. The authorized capital of the new company is $1,000,000, and the rolling stock consists of twenty-two open and thirty-one closed motor cars, four trail cars, three postal cars and five sweepers.

A Deserved Testimonial.

During the recent May musical festival at Cincinnati, the facilities of the cars of the Cincinnati Street Railway Company were taxed to their uttermost. In spite of the enormous crowds of passengers, the service was very efficient, and all the patrons of the company were carried without a single accident. The officials of the company recognizing the fact that this record was owing to the efficiency of the superintendent, Mr. Harris, and was deserving of special recognition, passed resolutions at its meeting held May 29, and voted that thanks and commendation be tendered to the superintendent "for his very efficient services and very satisfactory manner in which the cars and passengers were handled during the above named occasion."

THE Wabash Electric Street Railway Company is the title of a new corporation to build an electric railway in Wabash, Ind. James P. Ross is largely interested.

Notes on European Street Railway Practice.

By G. Braet, Engineer to the Minister of the Railway, Postal and Telegraph Departments Brussels, Belgium.

Sick Benefit Funds of Street Railway Companies in Holland.

In the December issue of the Street Railway Journal the writer described the organization of sick and accident funds among the street railway companies of Germany. Below are presented some particulars, which it is thought will prove of interest, of similar benevolent institutions adopted in Holland by the principal street railway companies, operated by animal and steam power, such as those of Rotterdam and of Guelders, in favor of their employes, these affording the latter important aid, not only in case of sickness or accident occurring through circumstances over which they had no control, but also during their old age, when arduous labor has become practically impossible.

The Steam Street Railway Company of Guelders.—The object of the establishment of a benefit fund for the employes is three-fold. First, in case of sickness, to provide for the employes prompt and good medical care and supplies. Second, to afford a certain weekly pension during sickness when the employe's regular salary is stopped. Third, so far as the conditions of the benefit fund permit, to allow a certain weekly pension to employes when they have reached the age of fifty-five years, and when they are no longer capable of performing their work in an efficient manner. Participation in the liabilities and benefits of this fund has been obligatory upon all the regular employes of the company since January 1, 1890. Clerks and others employed in the office of the company, receiving a salary of less than 500 florins ($210) are also obliged to become members.

Administration of the Fund.—The regular and permanent income of the fund consists, first, in an assessment on each member of 1 per cent. of his weekly salary; second, a fixed and annual contribution of 500 florins paid by the street railway company. The dues of the members are payable quarterly, January 1, April 1, July 1 and October 1, to the manager of the fund or his regular authorized agent. A statement of all receipts is printed, and a copy mailed to each member. The street railway pays its assessment on July 1 of each year.

The extra receipts of the fund consist of the following: First, a portion of the annual profits of the company; second, gifts, bequests, etc., given the fund.

The board of managers of the fund is composed of the general manager of the street railway company, who acts as manager of the fund, and of five commissioners elected by and from the members. A board meeting of the fund must be held at least twice a year. The fiscal year of the fund commences January 1 and ends December 31, on which day the books are closed, and there is rendered as soon as possible to each member, a report giving the exact condition of the fund. Each member has the right to criticise this statement, on condition of doing so in writing.

Each year the term of one of the board of managers expires, but he is re-eligible. Votes are taken by written ballot.

The doctor and druggist are appointed by the manager. Employes who desire medical aid have to address the general manager or the local manager of the fund in order to obtain the necessary certificate. If the employe does not live more than twenty minutes distant from the office of the doctor, he is visited at his home by the latter. If he lives farther, he is obliged to go to the doctor's office. For the delivery at homes of medicines, the same rules are applied as for the visit of the doctor. Each recipe given by the doctor bears the letters G. S. T. M. (the initials of the company's name). In taking this to the druggist to be filled the employe must provide a bottle or other receptacle for the medicine. If this is not done, the druggist can make a charge for anything provided in addition to the medicine.

When a member, through causes for which he is not responsible, has for fourteen days been incapacitated for service and this incapacity has been attested by a medical certificate, he receives his entire daily or weekly wages. If his sickness lasts a long time he is given, by the sick fund, a certain pension, equal at least to half his daily or weekly wages.

When the total receipts of the fund are not sufficient for the minimum quantity of medicines and medical aid specified, the deficiency is made good by the street railway company.

Pensions.—The board of managers of the fund decides just when it is capable of affording a pension to those employes who have reached the age of fifty-five years, and who are no longer capable of performing efficient service. The amount which can be disposed of in this way is calculated each year on the number of pensionaries. The decisions of the board of managers are determined by a majority vote. The votes concerning persons are taken in writing; those relating to general business *viva voce.*

The Rotterdam Street Railway Company.

All the employes who are paid by the week are obliged to become members. Only the employes paid by the month or by the year are exempted from participation. The administration of the fund is entrusted to a commission composed of a president, a secretary, who is also treasurer, and three other members. The president and the secretary-treasurer are appointed by the general manager of the street railway company. The three members participating in the management of the fund are elected by the members contributing. Vote is taken by sealed ballots. If on counting the ballots no one has secured a majority, a new ballot is taken between the two candidates having the highest number of votes. If one of the members of the commission is prevented from acting for a long time he is replaced by another member. The president and the secretary-treasurer are obliged to perform the duties of their office from the date of their appointment until they have been discharged from office. Each year, at the end of December, the board submits a statement of the fund to the general manager of the tramway company.

The funds necessary for the creation and maintenance of the fund are obtained by the retention of 1 per cent. on the weekly salary of all the employes or members of the fund; by rewards paid for property found in the cars, etc.; by fines inflicted; by different gifts, legacies, etc., in favor of the fund, and by interest on the moneys of the fund obtained in the manner above and placed on loan.

The benefits of the fund are extended to each member provided he has been at least three months in service, and in cases of sickness not occurring in service or on acount of service, and in case of accident without his fault, in service or on account of service. If the financial condition of the fund is very favorable, special payments will be made in addition, with the approval of the general manager of the railway company and at the suggestion of the board of managers in extraordinary cases.

In case of sickness not occurring in service or on account of service, the employe receives one-half his daily wages for six weeks of sickness. This payment commences on the third day after the street railway company has ceased the payment of salary. In case of accident incurred in the service or on account of service, for which he is not to blame, the employe receives from the street railway company half of his daily salary during those weeks, or a longer time, as is determined by the general manager of the company. If the distribution of the benefit funds exceeds the capacity of the fund, the street railway company may temporarily supply the deficiency, but is not obligated to do so.

All participation in the fund ceases when the employe leaves the service of the tramway company, or when he voluntarily ceases to pay his assessments. In these two cases such a member has no right to demand any sums which he may have paid.

The money of the fund is placed at interest as advantageously as possible, with the advice of the manager of

the street railway company. The board of managers has the right, with the approval of the manager of the company, to make such changes in the rules as experience may demonstrate to be useful and necessary.

The general manager has a right to suspend the operation of the fund for just reasons, and in such case the amount of money on hand is to be divided among those persons then members of the fund.

Pensions.—In the interest of its employes, the Rotterdam Street Railway Company has made a contract with the Holland Life Insurance Company, of Amsterdam, having for its object, first, the payment of a pension to the employes of the company after reaching the age of sixty years, and, second, in case of death to pay a certain sum to the heirs of the deceased.

All employes in regular service, whose salary is less than seven florins per week, except those less than twenty years of age, are obliged to become insured. In order to pay for this insurance, 2 per cent of the salaries of each member is retained, and in addition the street railway company contributes a sum equal to that provided by the assessment mentioned on the salary of the employes. Every member at sixty years of age, who has left the service of the company before or at that age, has a right to a pension. Those who wish to, can remain in the service after sixty years of age, and are not then obliged to pay any assessment.

At the end of each year the contributions of the company and the assessments are devoted to paying up these annuity policies, and the sums thus paid are themselves reinsured so that in case of death a certain sum can be paid to the heirs of the deceased. If a member receives honorable dismissal before, at or after sixty years of age, these annuity policies, if for more than fifty florins, are given to the payee, and they mature at the sixtieth year in the first case and immediately in the two other cases. In the case of a discharge, pure and simple, the employe receives only a policy of the value of the assessments paid by himself, the value of the premiums paid by the street railway company being retained. In the case of the death of a member, his heirs are paid the assessments paid him.

Members who, on their honorable discharge, manifest the desire of not remaining members of the society, can withdraw the sums turned by them during the duration of their service, as well as the assessments paid for their benefit by the company, after a deduction has been made from the latter, of the amount paid for the "reinsurance" mentioned above. Those employes, who are simply discharged, are entitled only to the sums which they have paid in.

The $50,000 Prize of the Metropolitan Traction Company.

The Railroad Commissioners of the State of New York who, it will be remembered, were asked to act as judges in the prize competition of the Metropolitan Traction Company for a motive power system for street railways, which should be superior to the trolley system, have issued a statement giving the recent correspondence between them and the Metropolitan Traction Company relative to the withdrawal of this prize. The general interest which has been felt in the competition and the large number of plans presented in answer thereto make this correspondence so interesting that we print it in full. The Commissioners state that they regret exceedingly the unsatisfactory termination of the affair.

CORRESPONDENCE.

BOARD OF RAILROAD COMMISSIONERS.

ALBANY, MAY 3, 1894.

Secretary Metropolitan Traction Co., Cable Building, New York City.

DEAR SIR:—We herewith enclose a copy of Senate Bill P. No. 186 which was to-day signed by the Governor.

This Board is now in position to accept your proposition of November 29, 1893, offering a prize of $50,000, to be awarded by the Board of Railroad Commissioners for the best "actual working system of motive power for street railway cars, demonstrated to be superior or equal to the overhead trolley," but without its objectionable features, and does hereby formally accept the same. The Board believes that the offering and awarding of such prize will stimulate invention and result in rapid and vast improvements in methods of street car propulsion.

At conferences in December and January last between representatives of your company and the members of this Board, the determination of the Board to act only under legislative authority was made known and the impossibility of having the tests properly conducted within the time fixed in your letter of November 29th, viz., by March 1st, 1894, was pointed out, and your representatives then stated that the time limit was waived and that this question would be left to the discretion of this Board.

The results of these conferences were made public, and prompted by the prospect of an opportunity to compete for the prize offered by your company, inventors from all over the world have entered their applications; hence, in spite of the delay in the passage of the bill before the Assembly, much progress has been made, at least toward locating possible competitors and ascertaining their number.

In replying to the letters received relative to the prize, the Board has notified its correspondents that the time limit has been waived by your company and that the acceptance of your proposition by this Board depended upon the action of the legislature. This authority having been given and your proposition having been formally accepted, the Board is now ready to confer with representatives of your company in regard to arranging the necessary details in connection therewith.

By the Board,
CHARLES R. DEFREEST,
Secretary.

ENCLOSURE.

AN ACT TO AMEND THE RAILROAD LAW IN RELATION TO IMPROVEMENTS IN RAILROAD APPLIANCES.

The People of the State of New York, represented in Senate and Assembly do enact as follows:

SECTION 1. The Railroad Law is hereby amended by adding thereto a new section, to be known as section one hundred and seventy-two, and to read as follows:

SECTION 172. The Railroad Commissioners may, in their discretion, act as judges to award prizes which may be offered by any responsible person for improvements in machinery or appliances for operating railroads.

SECTION 2. This act will take effect immediately.

METROPOLITAN TRACTION COMPANY OF NEW YORK.

NEW YORK, May 15, 1894.

Secretary Board of Railroad Commissioners, Albany, N. Y.

DEAR SIR:—I am directed by the Board of Directors of the Metropolitan Traction Company to acknowledge receipt of your letter of May 3d, 1894, notifying this Company of the passage of the act conferring upon your Board power to act as "judges to award prizes which may be offered by any responsible person for improvements in machinery or appliances for operating railroads."

Your letter further states in substance that in December and January last, at a conference then held, it was stated by representatives of this company, that the time limit fixed in our letter of November 29th would not be insisted upon, and you notify this company that you are now ready to proceed to arrange the details in connection with the proposed award.

In reply to your communication I am directed to say that at this conference in December last it was stated by your Board, and agreed by us, that the proposed amendment to the railroad law, being unobjectionable in character, would doubtless be passed by the first or second legislative week of the then coming session, so that only a short time would be lost and the matter could be proceeded with at that time with expedition. It was solely upon that supposition that this company proposed to extend the time. We have had no subsequent conferences with the Board, but, as it soon appeared that long delay was likely to occur in the passage of the act, which has since occurred, this company proceeded to employ experts, and conduct the investigations which it was originally proposed to have the Railroad Commissioners conduct, and has spent a large sum of money, exceeding the $50,000 which the company proposed to award, in determining the same question which was to be the subject of investigation and award.

This company is about to enter upon a large expenditure, based upon the results of its enquiries, and should prefer to await the results of some practical experiments which it is now entering upon as the result of contracts with one or two electric companies, before deciding to go on with the matter of the award.

In other words, the company has itself conducted the investigation, and has passed beyond the stage of inquiry, and has determined for itself upon an improved motive power, and is about to put it in. It will, of course, be seen that such a state of affairs presents an entirely different situation.

Yours very truly,
CHARLES E. WARREN,
Secretary.

BOARD OF RAILROAD COMMISSIONERS.

ALBANY, May 22, 1894.

Secretary Metropolitan Traction Company.

DEAR SIR:—I am directed by the Board to acknowledge the receipt of your favor of the 15th inst. in relation to the proposition of the Metropolitan Traction Company offering a prize of $50,000 for an improved system of motive power, etc., and to express regret that the Board was not notified at an earlier date of the decision of the company to withdraw the prize, which seems to have been arrived at as early as last January. Such notification would have permitted the Board to inform the public and legislature of the abandonment of your offer, and it would seem in justice, particularly to the persons who have been induced by the publication of the offer to make application for permission to compete for the prize, that such notice should have been given. As agreed to in our circular letter to competitors, the

Board will immediately take steps to inform them that your offer has been withdrawn, and so far as it is concerned we consider the matter closed.

Very truly yours,
CHARLES R. DEFREEST,
Secretary.

The Commissioners state that any letters, plans, drawings or models sent to them for competition in connection with the above prize will be returned to the senders if requested.

Electric Car Heating.

W. S. HADAWAY, JR.

There are many theoretical and practical considerations upon which electric car heating by electricity may be urged. Questions of economy are not the only considerations in the car heating problem. In a car subject to draughts it is practically impossible to distribute the heat from a stove uniformly to all parts of the car, and unequal temperatures result, a source of discomfort and danger to health. These facts are in themselves sufficient to warrant the use of other means of heating than by stoves, even at an increased cost.

The price of electricity varies greatly in different localities, according to the size of the road, cost of coal, labor, etc., so that the figures obtained from the cost of operating one road cannot be used in figuring the cost of heating by electricity in general. The only fair basis of comparison is from average figures, and not extreme figures. It has been found in actual practice, this practice including several hundred cars, that 100 watts are sufficient to warm thirty cubic feet of space in an average well built twenty foot car, having from 100 to 125 sq. ft. glass area and a monitor roof with windows of moderate tightness. This value does not apply to extreme northern latitudes, and is a representative value for the Southern New England and Central States. The value for the northern latitudes can be computed from the foregoing figures by comparing the weather extremes in the two cases.

Carrying out the value given in the preceding paragraph, we find that in a twenty foot car in latitudes stated, 3,000 watt hours, or 4 H. P. H., sufficient to allow for weather extremes; and the average running value will be determined by the severity of the season, exposure to winds, average running speeds, and what may be generally termed local conditions. The practical application of heating in cars is substantially the same problem as offered in conservatory heating, with the disadvantages of the car in motion and many loose fitting windows and doors, and the advantage of a considerably decreased proportionate glass area. In practice no competent heat engineer would attempt to heat a conservatory by distributing the heat by direct radiation or convection from one point only. As the space to be heated is comparatively large, a small boiler can be successfully employed distributing the heat through pipes by either steam or hot water, but preferably the latter. The relatively small size of the car, however, permits the use of stoves or heat storage systems, and these consequently have been largely resorted to. The claim can be successfully substantiated that the factor of uniform heat distribution from electric heaters giving to all portions of the car proper increments of heat warrants the use of the electric heaters at figures even in excess of what is claimed to be the actual cost of heat from stoves.

There are two forms of electric heaters by which an equable distribution of heat can be effected. First: By radiation from a heated surface in which convection currents enter to some degree. Second: By direct air heaters or registers in which little or no radiation surface is offered, the hot air rising from the heater and setting up air currents which circulate about and thus distribute the heat.

Of course, in an enclosure in which there are no draughts, and given time enough, one form of heater will ultimately heat the car through as many degrees as another. But we find in actual tests of cars in practice, that on windy days, and especially according to whether the car is going with the wind or against the wind, the front end of the car is frequently 7 or 8 degs. colder than the rear end, and if we depend too largely on air circulation to effect the warming, the same currents that cause the warm air in the car to rush towards the rear end, deflect the hot air currents rising from the heater, and leave the front end of the car without source of supply of heat. There appear to be few reliable records of the differences in temperature under varying weather conditions, between the front and rear ends of a car when heated by stoves. It is certain, however, that these differences are very much greater than when the car is heated by properly designed electric heaters.

The forms of electric car heaters so far proposed are heaters by simple resistance, so that the form of heater to be chosen is dependent upon its durability, first cost and manner of distributing heat throughout the car. During the past winter the opportunity was again taken advantage of to make an exhaustive study of electric heaters in actual use on cars equipped by the Central Electric Heating Company, of New York, and the New England Electric Heating Company, of Boston, and valuable data were obtained. These tests were made with a thermometer on the front end of the car and one on the rear end of the car, each about five feet six inches from the platform floor. The inside temperatures were obtained by placing one thermometer on the inside of the front end and one on the inside of the rear end, and two thermometers on opposite sides, but equidistant between the two ends. These two intermediate thermometers were varied in position, being attached part of the time to the window frames and part of the time to the straps, and at a height to which persons of average size would feel the temperature most keenly, viz., at the back of the neck. These tests were carried on with heaters of four distributing points, of six distributing points, and of radiating surface distributed uniformly throughout the car. It was found that the electric heaters successfully warmed all portions of the car, and that the distribution of warm air was far superior to the distribution attained in cars heated by stoves, which were run on neighboring lines. There is no doubt that the popular verdict is very strongly in favor of the electric heater.

As regards the bare cost of operation, every railway manager can figure for himself on the data given. A case in point of a road figuring its power at $2. per horse power, per month, shows the operating cost of the heater to be twenty-seven cents per day when run at maximum heat, but that on an average the cost is less than twenty cents per day by reason of the full heat not being needed all the time. There are instances where it is claimed that electric heaters are operated more cheaply than stoves could be, and it is apparent from the excellent results obtained in practice that the cost of operation of electric heaters is not as serious a problem as it has appeared to be, especially as it has been found in actual practice that the fares obtained from the space appropriated by the coal stove fully compensate for the cost of running an electric heater.

To those who have followed the progress of heating and ventilation in vehicles for public carriage the use of the electric heater makes one further step in the progress of public interest. The writer remembers when Prof. W. R. Nichols published his first determinations of air analysis from smoking cars running into Boston on various lines. The filthy conditions of the air there shown have been powerful factors in securing proper heating and ventilation of such cars. The least value which experts place upon the air capacity per person per minute for proper ventilation is thirty cubic feet. The average twenty foot car contains about 900 cu. ft. of air, and these cars frequently carry on the inside from twenty-five to thirty people so that for proper ventilation the air should be changed about once per minute. No such provisions are made in car heating by any system, but from the fact that the doors are so frequently opened partial supply is obtained in this way, setting up, however, cold draughts of air which require appreciable intervals of time to become diffused throughout the car. If, as in electric heating, a source of heat is placed near the doors to cause warm air heated either by radiation or convection to rise with the cold air, the air is tempered to a considerable extent, and in practice this is found to be an essential feature of the electric heater.

As in the present construction the passenger sits with shoulders and back of head exposed to the window, he is so situated as to be peculiarly sensitive to cold, and a slight amount of warmth circulating around each occupant is found in practice to counteract the chilliness resulting from the rapid heat radiation from the glass surface.

There appears to be as yet no feasible plan suggested for properly ventilating a street car. It is an important step in advance, however, to heat large quantities of air to moderate temperatures through the entire length of the car, causing uniform displacement of vitiated air and more rapid heat diffusion without introducing into the car any products of combustion or noxious gases. There is a cleanliness in air supplied for breathing as in food, and while it is a repugnant comparison, there is as much reason for filth in the preparation of foods as in the breathing of air over and over again by occupants in varying stages of health and cleanliness. In fact, heating by stoves is a sort of free lunch in which each occupant only secures his quota by reaching over the heads of his neighbor, and in the passage from hand to hand what is obtained is contaminated by passage. The air arising from the electrical heaters is, on the other hand, akin to a well ordered table, in which each participant receives his quota by proper means of distribution.

The items of space occupied, cleanliness, freedom from damage to car, and from carrying in coal and taking out of ashes, and generally decreased depreciation, are strong factors in favor of the electric heater. We thus see that in practice there is no reason why electric heaters cannot be successfully operated.

The fact that makes it more profitable to operate street cars by electricity than by other methods of propulsion, also makes it possible to heat the cars by electricity. Long continued heavy loads with load lines of moderate maxima and minima, render the cost of the power to the street railroads a comparatively small one, and while the transformations through which the heat energy passes before its expenditure in useful work are many, the prerequisites, outside of cost, which the electric heater is called upon to fulfill warrants its use.

Railway Supplies: Western Electric Company.

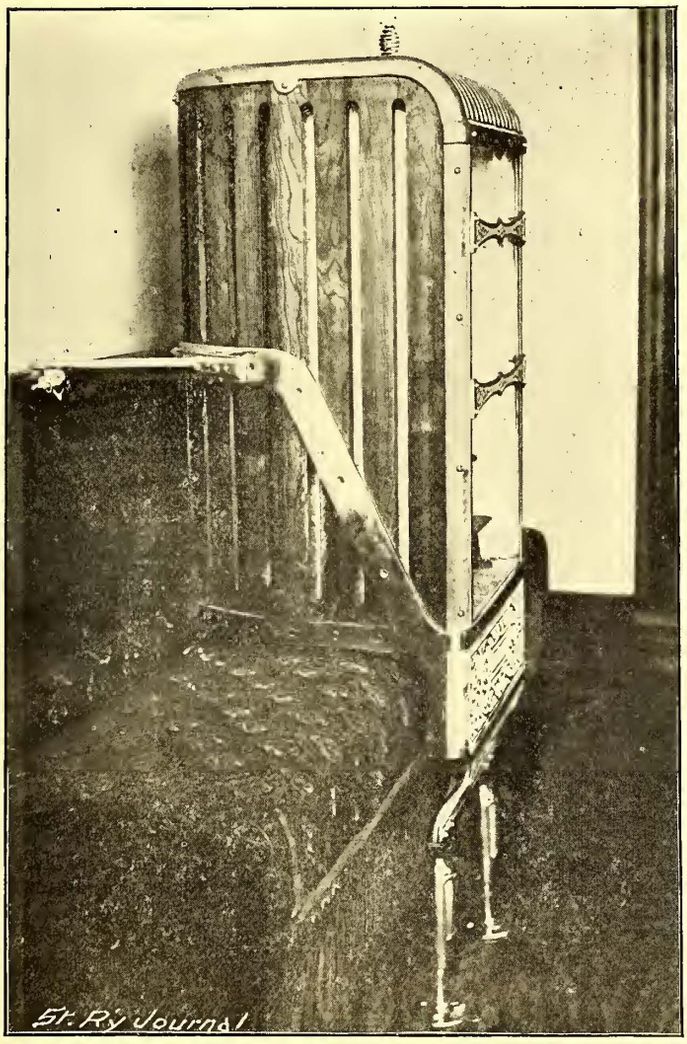
The Western Electric Company, of New York, which has a very wide reputation as a manufacturer of electric lighting, telephone and telegraph apparatus and supplies, and which is probably the largest manufacturer in the country in the "supply" business, is about to go into the railway supply business on an extensive scale and make a specialty of it. This company has a large factory at Greenwich and Thames Streets, this city, as well as a separate building located one block distant from its factory, from which the entire supply business is handled. The company, we understand, intends to handle the railway supply business on a large scale as it is now handling the lighting supply business.

If the record which the Western Electric Company has made in lighting supplies can be taken as a criterion, its success in railway supplies is certainly assured.

THE Market Street, Richmond & Frankford Street Railway Company, of Philadelphia, Pa., was incorporated May 28, with a capital stock of $180,000. Walter N. Boyer, 1215 Filbert Street, Philadelphia, is president of the company. Others interested are Radcliffe B. Mills and Milton M. Dorland, of Philadelphia, and Edwin D. Graves, of East Berlin, Conn.

"Columbia" Magazine, Cast Iron Street Car Heater.

The accompanying cut shows the "Columbia" street car heater, as manufactured and sold by the McGuire Manufacturing Company of Chicago. It will be noticed that very important additions have been made since last year. In the first place the frame intended to hold the stove in position is made of a solid casting, and embraces the front apron, the strap that passes around the back, and the arms that fasten it to the top of the seat rail are all in one piece. It will be noticed that the legs are made adjustable, so that the frame can accommodate itself to any form of car seat, and when in position look like the arms of an easy chair and are as firm as any part of the car. This frame is first set in over the car seat, the legs adjusted and fastened, and then the stove is simply lifted into position. This operation can be done inside of ten minutes by any ordinary mechanic, and when the stove is in position it cannot be disturbed except by the use of tools. It is adjusted so as to rest above the cushion, apparently resting upon it.



"COLUMBIA" HEATER.

The stove can be placed in any car without cutting or fitting either the stove casing or the car seat. It does not rest upon, and, consequently, does not wear out either the seat, cushion, or coverings, either front, top or back. It can also be set upon the floor of the car, and for this purpose a handsome stand is used, placing the stove at any height desired by the railway manager. In either position it is not an eyesore, as is the case with many car heaters, but actually an ornament to any car.

The stove is a self feeder, holding twelve hours' fuel, and, it is claimed, requires no attention whatever from conductors. The fire is usually started before the car leaves the barn, so that the car goes out warm in the morning. It burns one pound of hard coal per hour, heating a twenty-one foot car, equal to a cost of about five cents per day. The exterior is always cool, so that the passengers can sit in actual contact with it and cannot burn themselves. As the sample is seen in the office of the McGuire Manufacturing Company, it is attractive in appearance, and if it accomplishes all that is claimed for it, it should prove a great success. Patents have been allowed, and the McGuire Company has purchased the sole right of sale and manufacture.

THE Brooklyn Heights Railroad Company has applied for consent that it may extend its lines through a number of streets and avenues in the town of New Utrecht, N. Y.

A New Arc Lamp.

We present herewith engravings of a new arc lamp, applications for a patent covering the main features of which were made by William Jandus in 1887. The lamp, which is manufactured by the Manhattan General Construction Company, of New York, has a number of novel features, one of which is that it is so designed that it will burn at six amperes and about seventy-five volts or one in series on incandescent circuits. An engraving of the lamp complete is shown in Fig. 1, and a view of the skeleton in Fig. 2, the airtight shell at the center being removed to show the feed mechanism.

In Fig. 2, A is the magnet, B the armature carrying the clutch pan, C, and engaging through suitable slots in the armature of the clutch rings, D. In the upward travel of the armature, B, the flaring pan, C, engages the clutch rings, D, against the inserted upper carbon, raising it to form the arc. B is the negative terminal casting, into the lower part of which is threaded the negative carbon frame. G is the negative carbon clamp suitably insulated from the dust pan, H. M is

FIG. 1.—LAMP COMPLETE.

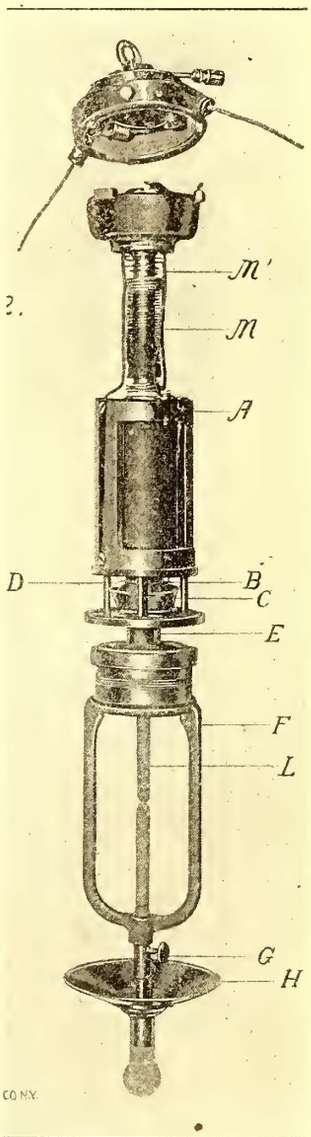


FIG. 2.—LAMP SKELETON.

a resistance path to the cut-out ring. M^1 (part of same resistance coil) is a shunt on the main coil of the magnet to regulate the length of the arc.

The circuit through the lamp is as follows: The current passes from the positive terminal through the main coil of the magnet into the magnet, A, and through to the brushes and clutch rings to the upper carbon, to the lower carbon and out through the negative terminal. It is provided with two paths, one through the main coil and carbons, and the other through the resistance, M, spring and cut-out ring, to the seat of the casting, E, and out through the negative terminal. An insulating washer separates the armature, B, from the cut-out ring.

On the formation of an arc the enclosed air is heated and rarified, the surplus air escaping through the lower vent. The contained oxygen is soon reduced by combustion with the carbon points to carbon monoxide, and this with the remaining nitrogen surrounds the arc and protects the points from further combustion. These highly rarified gases being much lighter than the surrounding comparatively cold air, have a tendency to rise, and finding no outlet at the top,

remain in the globe to the exclusion of the surrounding air which, is much colder and heavier, and which can enter only by slow diffusion.

The distance between the brush rings conveying current to the top carbon and the socket holding the lower is only about eight inches. The small distance being constant and the resistance between the two carbons remaining constant, there is introduced no variation of voltage in the arc; and copper covered carbons, with their objectionable features, are unnecessary. Owing also to the greatly reduced length of the lamp, it is particularly susceptible to decoration.

This lamp does not require a special grade of carbon, and it is found that ordinary carbons burned in this enclosed chamber will last about five times as long, and a better quality of carbons about six times as long, as the same carbons burning in the open air. The lamp illustrated in Fig. 1 is designed to burn one week on half night service without retrimming or renewal of carbons. A similar lamp is made to burn about four nights on all night service, or will require trimming but twice a week.

It has been found that in this enclosed chamber it is possible to successfully burn a longer arc than in the open air, and when desirable in series arc work a 2,000 candle power lamp can be run at about seventy-five volts and six amperes.

New Method of Motor Support.

The development of the electric street railway in America during the past ten years, furnishes a unique and remarkable example unparalleled in the history of engineering. One difficulty after another has been successfully overcome, until, to-day, with respect to economical operation, freedom from breakdowns, and durability of apparatus, there is little left to be desired. One of the last problems to be taken up, since it lay outside of actual motor design, was that of the deterioration of the track. This question has been constantly increasing in importance, proportionate to the increase in traffic, and consequent demand for heavier cars and higher speeds. It is a problem, the solution of which will be warmly welcomed by every street railway manager and stockholder, since, at present, the heaviest item in the cost of maintenance is that for roadbed. The obvious and essential condition necessary to the solution of this most important difficulty is that all rigid contact between motor and axle shall be avoided, thus lessening, to the greatest possible extent, the impact of the wheels at the rail joints.

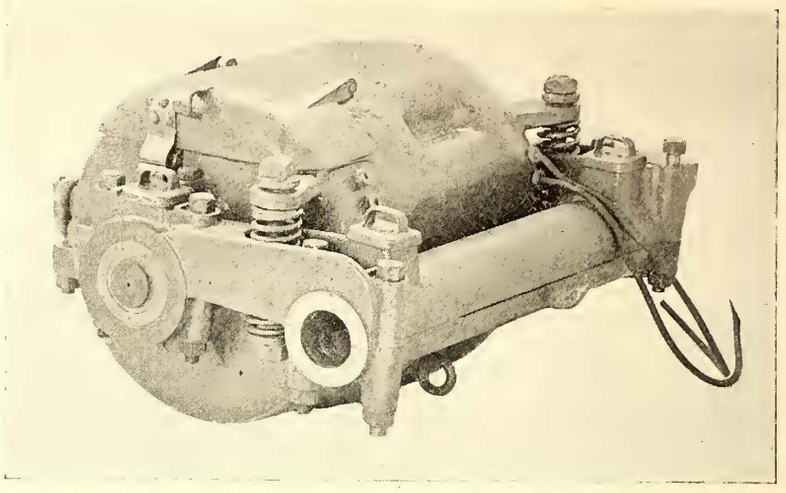


FIG. 2.—WALKER MOTOR—SHOWING METHOD OF SUSPENSION.

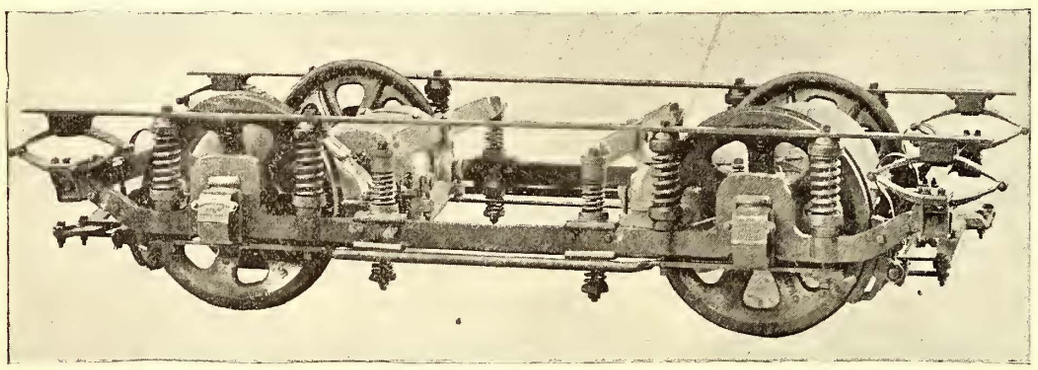


FIG. 1.—TRUCK WITH WALKER MOTOR, SHOWING METHOD OF SUSPENSION.

In the earliest application of electricity to street car propulsion, the motor was supported at one end by springs, while the other was journaled directly to the axle. But this was done more for the purpose of relieving the gear teeth from shock than out of consideration of the impact effect upon the rails, and it is only recently that this latter consideration has been seriously taken up by manufacturers.

In placing upon the market a new system of electric railway equipment, the Walker Manufacturing Company, of Cleveland, O., has aimed to produce a system that should combine all the long tried and approved principles of construction with the solution of the problem of suspension. In addition, the matter of cleanliness, and the exclusion from the commutator, armature and field coils of all oil and grease has been studied, and a design has been produced which is thoroughly effective. The method of suspension embodied in the Walker Manufacturing Company's system is a very simple one, and accomplishes very efficiently and practically its purpose. The Walker Company believes that the only way to avoid the impact at the rail joints is to disconnect the motor from rigid contact with the axle in such a way as to prevent, not only the hammer blow, due to the weight of the motor, but the inertia blow, due to its yielding mass It considers that suspending the motor at its center of gravity may remove the direct dead weight from the axle when in a state of rest, but that any upward thrust, due to imperfect rail joints or other irregularities in the track, is still opposed by the mass of the motor, whose inertia is very considerable, and the consequent inertia blow on the rails is not avoided.

The engravings herewith presented show the ingenious and novel, yet simple method by which the elimination of both these effects is accomplished in the system under consideration. The motor is trunnioned by its bearing cases, and swings freely between the arms of a U shaped yoke. The part corresponding to the rounded end of the U is journaled on the car axle in the ordinary way. The motor is then supported at the rear by springs between the arms of the yoke, and heavy lugs projecting from the casing. At the front end it is supported by a swinging arm from the regular spring cross bar.

In this arrangement it is obvious that the only rigid connection between motor and axle is in the horizontal plane, in which lie the gear centers, and the only direct dead weight upon the axle is that of the U shaped yoke, which is insignificant. Thus, not only is the torque of the pinion against the gear doubly eased, but all thrust due to irregularities in the track is immediately met and cushioned by the springs. It is found in practice that this method of suspension, combined with the fact that this new motor has been reduced to a very light weight for its output has made possible a very great saving in the cost of maintenance of way, not to mention the increased life of the motor itself, by reason of the reduction of destructive vibration and shocks.

Another feature of this system well worth mentioning is the disposition of the bearings. These are made extra long and large, and their inside ends are removed about three inches from the openings in the housing which is only just large enough to allow a small clearance for the shaft in passing through. In this three inch space are the thrust collars, and all the grease that is forced out between the ends of the bearings and these collars is thrown by the centrifugal action against the walls of the recess, from whence it finds its way, through a large opening in the bottom, to the ground. Thus, no oil or grease can possibly get to the commutator or windings.

The shaft is so constructed that in case of wear of the journals it can be withdrawn from the armature body on the removal of a single locked nut, and a new one can be inserted without the least disturbance of the windings. The motor, as will be seen by the engraving, is entirely encased, and proof against snow, dirt, moisture and physical injury. The gears are in a detachable, dustproof housing, and run in oil.

Grooved Raw Hide Belting.

It will be remembered that one of the features of the Shultz sable rawhide belting is that it is tanned on the surfaces only, instead of all the way through. This preserves an interior of rawhide, retaining, it is claimed, the original strength and greater durability. A driving surface is also provided which to the touch much resembles kid and is capable of excellent contact with the pulley.

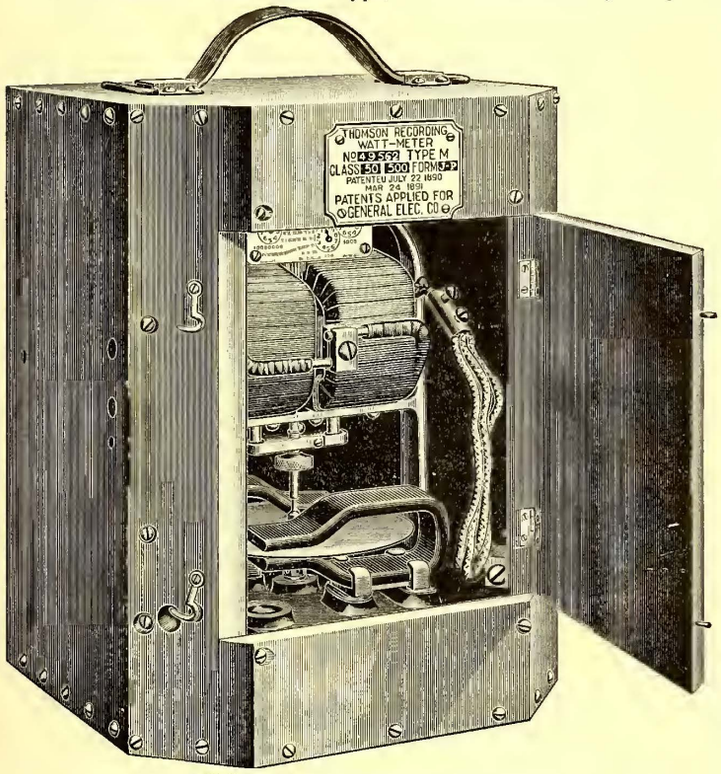
GROOVED RAW HIDE BELTING.

The section of belting shown herewith is manufactured by the Shultz Belting Company, of St. Louis, and is called by this company patent grooved sable rawhide belting. It is made of precisely the

same material as the Shultz sable rawhide belting, but also has grooves running lengthwise. These serve the purpose of channels to permit the escape of air from between belt and pulleys, and to such a degree that the air cushion is said to be overcome, making it possible for the belt to run very nearly as slack as link belting: The grooves are kept constantly clean by the current of air passing through them. It is also possible to run the belt satisfactorily with either slack top or bottom, and it is practically noiseless. This belt has been employed in the station of the St. Louis Electric Light & Power Company for about two years, where it has given excellent satisfaction.

Portable Recording Wattmeter.

The latest development in the electrical meter line is the new Thomson portable recording wattmeter, which, identical in general character with the standard meter of that type, is constructed with special provision for transportation from place to place, and for use in places where it is exposed to jarring and rough shaking. While it may, of course, be used for any and all classes of testing work in which a portable recording meter is requisite, its special use is for the testing of street car work and in this field it will be found most valuable.



PORTABLE RECORDING WATTMETER.

The meter is mounted on a skeleton frame suspended between strong elastic rubber nettings within the case. Detrimental shocks and vibrations become absorbed in these nettings, and no interference with the movement of the meter occurs. Its accuracy is unaffected even when placed on the floor of a rapidly moving car. The meter is mounted in a handsome polished wood case. The twenty-five ampere size will be found the most suitable for general car testing; it will stand and accurately record extreme overloads for short intervals.

This meter is the result of long and careful experiment on the part of the General Electric Company, and has manifest advantages over the rigidly mounted and bulky portable meters, formerly used for car testing in default of a superior device. This meter is claimed to be the only portable recording wattmeter on the market and is the outcome of an important demand from the street car companies for a meter which would enable them to check the efficiency of every car equipment and the average number of horse power hours needed to take any car over any route of their systems. They are manufactured in the following sizes: Three amperes one and a half horse power; fifteen amperes seven and a half horse power; twenty-five amperes, fifteen horse power; fifty amperes, thirty horse power; all for 500 volt circuits. They can also be made for any other voltage according to order.

The New Robinson "Ajax" Four Wheel Truck.

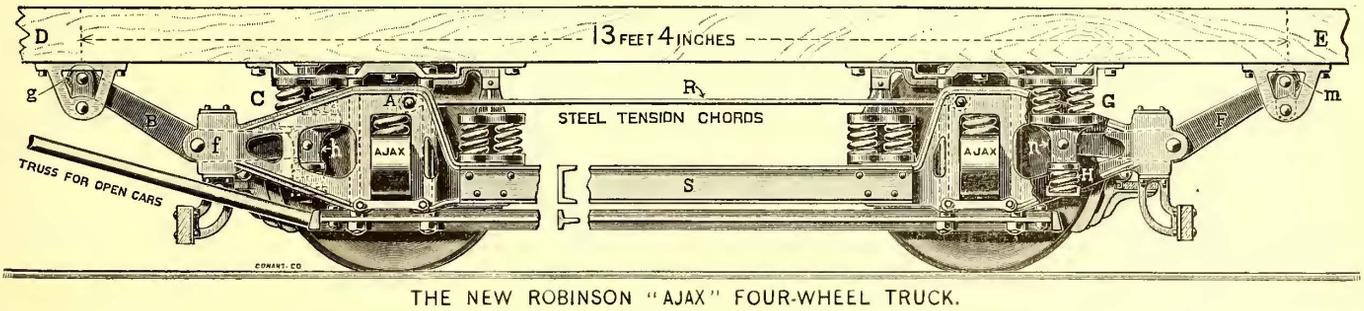
Most of the trucks heretofore introduced for use under four wheeled electric cars have been constructed on the same general principle, the difference consisting merely in details of construction. The principle involved in these trucks is to lessen the end teetering motion of the car by introducing springs between the car body and extensions of the truck frame projecting outwardly some distance beyond the axle boxes, the descending end of the car body compressing the springs from the top only. Some of these trucks have materially diminished the teetering of the car, while others have been less successful in this regard. The question is not an easy one to solve. The modern four wheeled car is virtually a natural teetering rack, approximately thirty feet long, mounted on two fulcrums six feet or six feet six inches apart. The problem of rendering this monstrosity non-teetering, without moving the axles out near to the end of the car where, from a mechanical standpoint, they should be, is difficult.

The new Robinson Ajax four wheel truck therefore, shown on this page, will prove of especial interest to our readers from its claim of presenting a solution for this important problem. It is the invention of William Robinson, inventor of the well known Robinson radial truck and general manager of the Robinson Electric Truck & Supply Company, of Boston, Mass.

The novel features of the Ajax truck will be best understood by referring to the illustration, below, in which the saddle casting, A, which embraces the journal box, forms, at f, a fulcrum for the bent lever, B, one end of which is flexibly connected to the car sill, as shown at g, while the other end of said lever, B, supports the springs, C, upon which the car body rests. The lever, F, at the opposite end of the truck is arranged in the same manner as the lever, B, just described, and it will be observed that both levers are located wholly beyond the journal boxes outwardly. The operation will be understood as follows: Assume that the end, D, of the car body descends, as in teetering; this depresses the outer end, g, of the lever, B, raises the inner end, h, of the same and compresses the springs, C, from the bottom, thus resisting the downward tendency of the end, D, of the car.

Now if the end, D, of the car descends, in teetering, the opposite end, E, of course must ascend, raising the outer end, m, of the lever, F, lowering the inner end, n, of the same, thus removing support from the springs, G, and compressing the cushion spring, H, all of which resists the rising tendency of the end, E, of the car. In this connection it will be observed also that the action of the spring, H, is peculiar. This spring is supported by a spring seat in the saddle casting, and exerts an upward pressure on the inner end of the levers. Now when the outer end of the lever, F, for instance, is raised by the rising end, E, of the car body, the inner end of said lever, F compresses the spring, H, which thus directly and positively resists the rising tendency of the end, E, of the car body. At the same time this pressure on the spring, H, exerts a positive pressure to push the truck frame downwardly. In other trucks the cushion spring, when one is used at all, exerts a positive pressure to raise the truck from the boxes, or the boxes from the axles, as the case may be, when the end of the car rises in teetering. Additional springs, supported on the truck frame between the boxes, as shown, are used, and a portion of the weight of the car body is carried on these. The number of springs and their arrangement make the riding extremely easy.

It will be seen, furthermore, that there are springs located between the axle boxes and the truck frame. The advantages of these springs in taking up shocks, preventing strain on the truck frame and tending to ease of riding, are too well known to need comment here. The Ajax truck is provided with lever brake hangers, adjustable brake release springs of a novel character, and anti-rattlers, all of which are found to work in the most satisfactory manner.



THE NEW ROBINSON "AJAX" FOUR-WHEEL TRUCK.

Six men stood on the extreme end of a twenty-eight foot body mounted on one of these trucks with a six foot six inch wheel base. These men got up a swaying up and down motion together, doing their best to teeter the car. The springs showed great sensitiveness and ease of movement, but they failed to teeter the car.

The lower side members of the frame are composed of steel channels hot riveted to the lower part of the saddles. The upper side members of the frame are composed of steel tension chords, a construction giving the greatest possible strength with lightness and simplicity. The ends of the truck are composed of specially heavy and strong channels securely hot riveted to castings similarly riveted to the sides of the frame. The whole design and construction is expert work, the result of many years of expert experience.

The Hunt Air Brake.

The increasing demand for surface rapid transit brings with it the demand for some means more powerful than hand power by which a car can be quickly brought under control, under all conditions, by the operator. It is with this in mind that the air brake shown herewith has been put on the market by H. E. Hunt, of Pittsburgh. It is a combination of an air pump supported by trunnions and worked by an eccentric and piston rod attached to the car axle; a reservoir for compressed air located under seats of the car; an air brake cylinder of ordinary type and brake connections; the connection of the brake cylinder to the air reservoir being controlled by a specially made three-way valve located in the cab. An automatic pressure regulator is so constructed that when air pressure in the reservoir is up to the desired amount, all pressure on the pump is relieved and discharged into the atmosphere directly; thus relieving the work of the pump and power required to operate it.

With these facts in view, it has been the inventor's aim to provide a very simple, durable and reliable air brake for a low figure; and he now feels that, after three years of continuous practice and developments, he is justified in making the above statement.

The following cuts and description of the system will be readily understood.

Fig. 1 shows the arrangement as applied to the rear truck of a double truck cable car. The pump is double acting, four inches diameter, eight inches stroke, and oscillates to take the up and down motion of eccentric. All parts are so constructed as to stand the greatest amount of wear and in case of breakage to be easily repaired

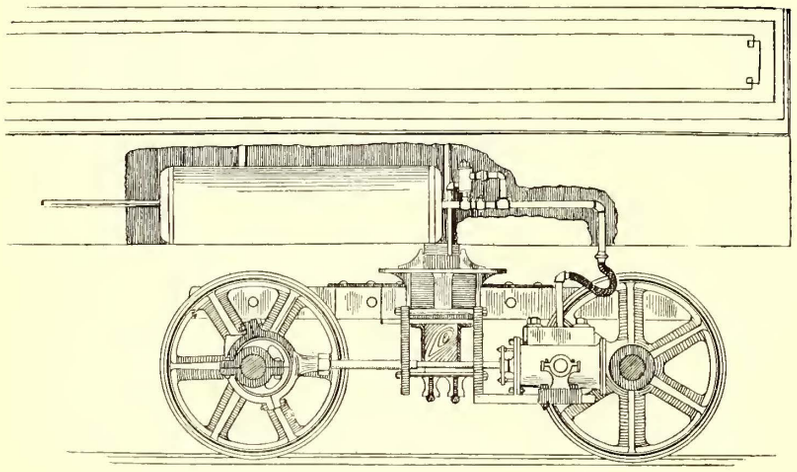


FIG 1.—GENERAL ARRANGEMENT HUNT AIR BRAKE.

or replaced. To show the durability of the apparatus, it need only be mentioned that one set at this writing is on its twenty-first month of steady running and has never required repairing.

The reservoirs are made of steel, and lap welded and tested to 200 lbs. cold water pressure. It is also supplied with a valve for the blowing-off of condensation. The automatic pressure regulator is placed next to reservoir, and is made of brass, to prevent corrosion or rust, and contains no complicated mechanism to get out of order. Its operation is different from any other valve of its kind, and immeditely takes all load from pump, when reservoir pressure is attained, as it acts directly on pump simultaneously, the pump working through it direct and not through reservoir or reservoir pressure, as do other valves designed to accomplish the same object. It is very sensitive and has a movement of only one-sixteenth of an inch. The valve is also capable of being adjusted to carry any pressure—from thirty pounds per square inch up—desired. Its release is such that no disagreeable noise is heard.

The three-way valve is shown in Fig. 2 and is made entirely of brass. The valve seat and valve disk contain nine ports and by-ports, so arranged and registered with each other that the brake can be applied with any degree of pressure desired, held or released at will. In ordinary stopping or slowing up, the valve handle has a movement of only one-half inch. When an emergency stop is required, the handle has a movement of one inch, which brings the brake cylinder in connection with the reservoir through four ports, and releases through five. There is no noise in releasing.

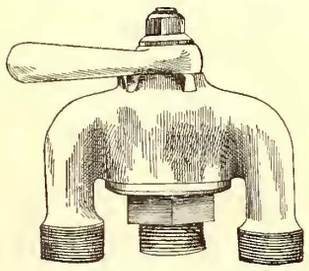


FIG. 2.—HUNT 3-WAY VALVE.

The claims made for this system over any other are: Its simplicity, compactness, durability, least possible number of wearing parts, easy access to all parts that wear, small power required to run pump, and that all parts are made interchangeable; also:

That a car fitted with the brake will run on any track after power has been released, as far as any cars without it.

That a car fitted with the system can be stopped in one-half the distance of a car under some conditions with any hand brake, and will wear a set of shoes longer than a car without it.

That a cable car has run with the brake for 577 days, covering 46,160 miles; and the cost of all repairs to brake system, including labor, has been less than $5.

The Spillman Trolley Ear.

The accompanying cuts show different views of the Spillman trolley ear which the Ohio Brass Company, of Mansfield, O., has recently made exclusive arrangements to manufacture and is now offering to the trade. The ear has several features peculiar to itself which commend it to the users of similar devices. The great objection raised to the use of soldered ears, namely, that of burning the trolley wire, the time and material consumed in soldering, the difficulty of adjusting

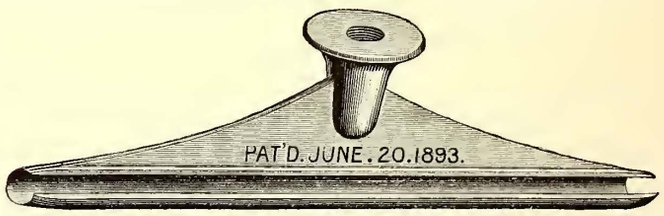


FIG 1.—TROLLEY EAR.

the hanger after once in place, as well as the objection to many clamps, that of sparking when the trolley wheel passes over it, have all been overcome in the design and construction of this ear. It has been given a practical test both on straight line and curve work for over a year past on one of the largest roads in the West, and its utility thoroughly demonstrated.

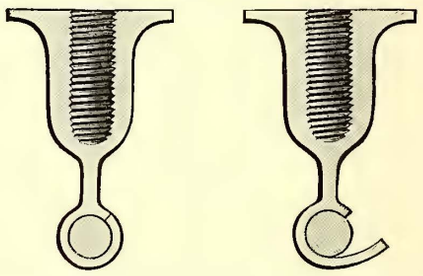
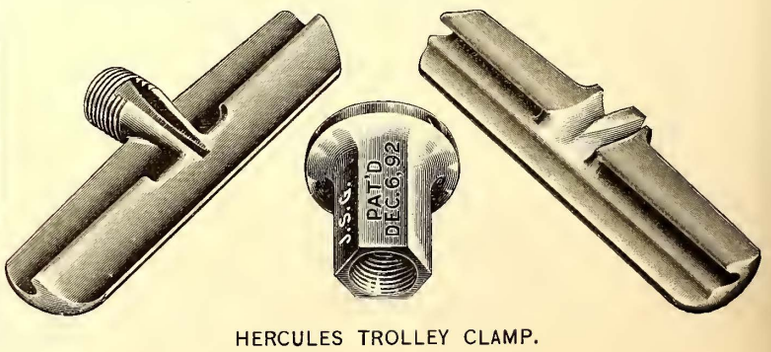


FIG. 2.—SECTIONS OF EAR SHOWING METHOD OF FASTENING LINE WIRE.

The ear is screwed onto the hanger body and the trolley wire placed in the concave lip. The trolley wire is then pulled to the necessary tautness and the lip of the ear is compressed over it. A metal block is held on the back side of the ear and a copper hammer used to do the forming with, beginning at the center and working toward the ends. On curves the ear should be hung so that the side strain of the trolley wire is against the web. If it is necessary to adjust the hanger the lips can be opened sufficiently to slip the ear along the trolley wire.

Hercules Trolley Clamp.

The difference in cost between two trolley lines, one of which is put up with soldered ears, and the other with trolley clamps, or automatic ears, as they are sometimes called, is said to be at least five to one in favor of the line put up with trolley clamps. The Hercules



HERCULES TROLLEY CLAMP.

trolley clamp, manufactured by J. S. Gustin & Company, of 84 Market Street, Chicago, is claimed to have the particular merits of the soldered ear, viz., the strong hold on the wire, and the smooth passage that it affords the trolley wheel, and yet it does not, at any point of its entire length, enclose but little more than half of the trolley wire, so that it

affords a perfectly smooth path for the trolley wheel. The Hercules trolley clamp consists of but three parts, the smallest number it is possible to make any clamping device of. Two of these parts grip the wire, and the third, the nut, holds the others in engagement, and also fastens the complete device to the insulators. The threaded shank being all on one part of the clamp, it is readily seen that when the nut is brought to bear on the loose part, the pressure on the nut is all on one side; consequently the nut is locked, and the clamp cannot be jarred loose. Whenever it is desired to adjust this clamp on the wire, which, by the way, has to be done frequently on new lines, it is not necessary to take the nut off completely, but simply unscrew it for three or four turns, when the clamp will be loose enough to be moved to the required position, and can then be refastened.

The Hercules trolley clamp is made of malleable iron, subjected to a very heavy pressure, so as to make the metal perfectly homogeneous. After the several parts have had the machine work done on them, and have been carefully inspected for any flaws there might be, they are each given a heavy electroplating of copper, and finally assembled. To show on just what grounds the manufacturers base their guarantee, we were shown a report of a test made recently by the Robert W. Hunt & Company Testing Bureau, of a Hercules trolley clamp and a fifteen inch soldered ear. This report stated that the Hercules trolley clamp was subjected to a strain of 1,000 lbs., and yet was not injured in any way, while the soldered ear, with a strain of only 500 lbs., was so distorted that it could never be used again.

The Hercules trolley clamp is made for three sizes of wire, namely, Nos. 0 and 1, B. & S. gauge, and No. 2, Birmingham gauge, and it can be furnished for any size stud from seven-sixteenths of an inch to five-eighths of an inch, inclusive.

New Style of Convertible Car.

One of the most important questions in street railway economy is how to run a road without being obliged to have a double equipment of cars, trucks, motors, etc. This is a very important item, for if a full equipment of both open and closed cars is kept, one set remains idle in the car house continuously. This represents a large amount of unproductive capital, the interest on which is a direct loss to the railway company. Many car builders in this country have tried to solve this problem, but the Convertible Car Manufacturing Company, whose office is in the Old Colony Building, Chicago, Ill., claims to have removed all the difficulties heretofore existing in cars of this type. The car manufactured by this company is run on the 63d Street line of the Chicago City Street Railway Company, where it is giving excellent results. A good idea of the satisfaction which the car is giving to the general public was shown by the statements of the conductor, who has been running the car for about a month, to a representative of the STREET RAILWAY JOURNAL. The conductor said that during the cold weather early in June, the car did more business than any other car on the line, for the reason that during the early part of the day and in the evening the car was kept closed, and run as a closed car, but during the middle of the day, when the weather was warm, the car was operated as a summer car, open on both sides. He said the car can be operated with one side closed and one side open, so that in cases of a sudden rain or extreme weather, one-half of the car can be closed and the other open. The car can be changed from an open to a closed car by the conductor in three minutes, and with the assistance of the motorman it can be changed in one-half the time. In fact, no emergency can arise, in the way of inclement weather, that cannot immediately be overcome by those in charge of the car.

When the car is open as a summer car, it can be used as an end car or a side car, or both. This car is equipped with a full length side step which is only used when the car is used as an open car, and folded up in a compact way against the side of the truck when used as a closed car. The car is equipped with leather upholstered, reversible seats, eight on a side, thus giving a seating capacity of thirty-two. The seats are very comfortable and easy to ride.

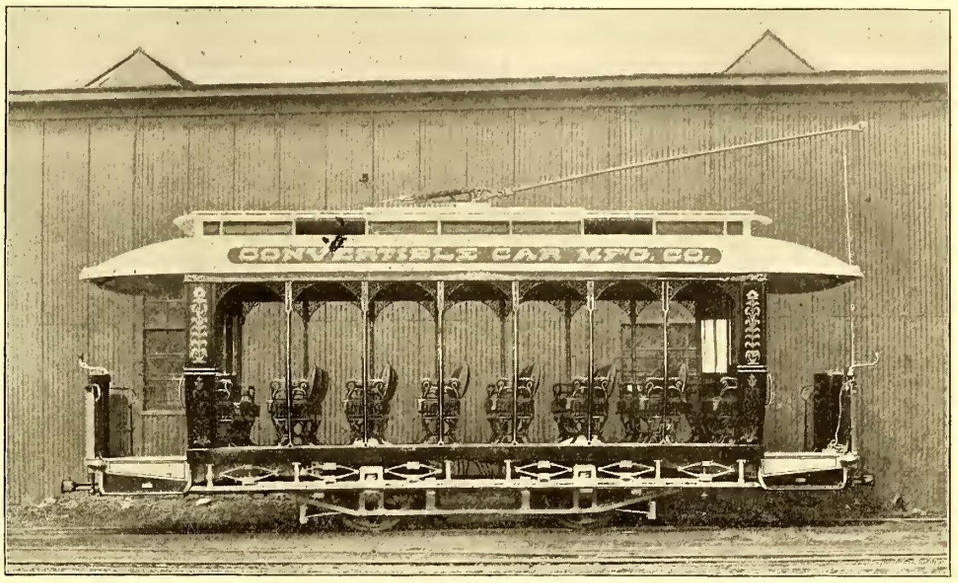


FIG. 1.—CONVERTIBLE CAR.

This car is mounted on one of the Chicago Electric Truck Company's trucks, having a fifteen foot spring base and seven foot wheel base. One of the most extraordinary things about this truck is the fact that it was one of the first trucks built by the company, and went direct from the designer's hands into actual use, where it has been run every day since first started. The motor used is the G. E. 800 type.

The originator of this car, T. H. Lovejoy, has had considerable experience in street car business in the city of Portland, Ore., where he occupied the position of superintendent of the car works in Portland, and he built a number of cars of this type, which are now being used in Portland, San Francisco and Tacoma.

Mr. Lovejoy has come East for the purpose of giving his time and attention to the building of these cars, and to putting them on the market. A company has been formed, under the name of the Convertible Car Manufacturing Company, with officers as follows: Horace Tucker, president; J. M. Thompson, vice-president; Horace M. Johnson, secretary; E. C. Talmadge, treasurer; J. W. Alderman, manager, and J. H. Lovejoy, superintendent.

With plenty of capital to back it up, there is no reason why this company should not do an excellent business.

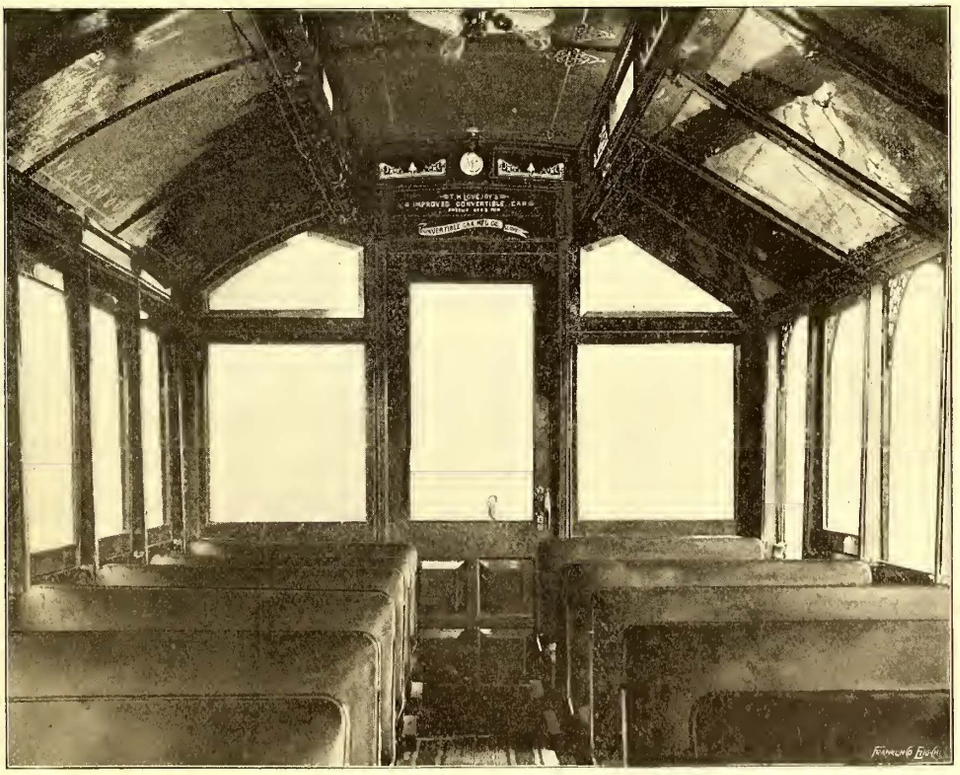
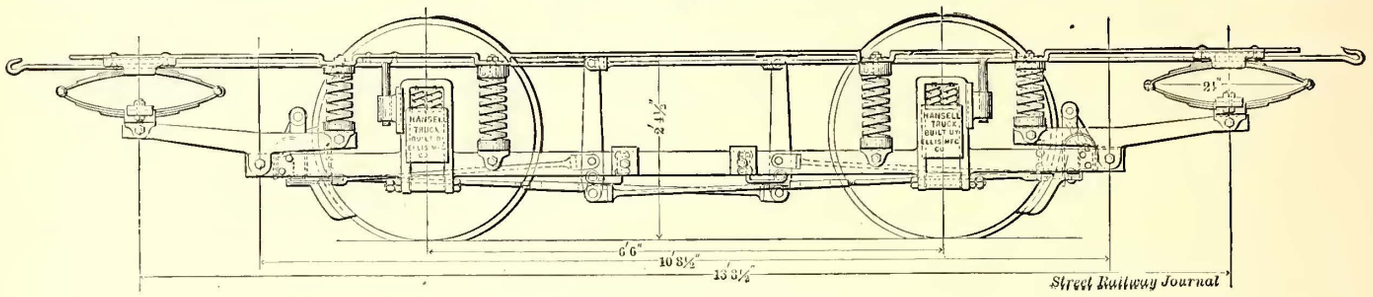


FIG. 2.—INTERIOR OF CONVERTIBLE CAR.

The Hansell Equalizing Trucks.

The Ellis Manufacturing Company of Philadelphia, a company recently organized with Harvey Ellis as president, and J. C. Hancock as secretary and treasurer, has put upon the market a truck, a side view of which is shown in the accompanying engraving. One chief claim made for this truck is that oscillation is eliminated by means of the equalizing beams outside of the journals. These beams are pivoted, as shown, to an extension of the side bar of the truck and carry at their outside extremities twenty-four inch elliptical springs. By extending



THE HANSELL EQUALIZING TRUCK.

these springs and stiffening the spiral springs accordingly, the spring base is almost illimitable.

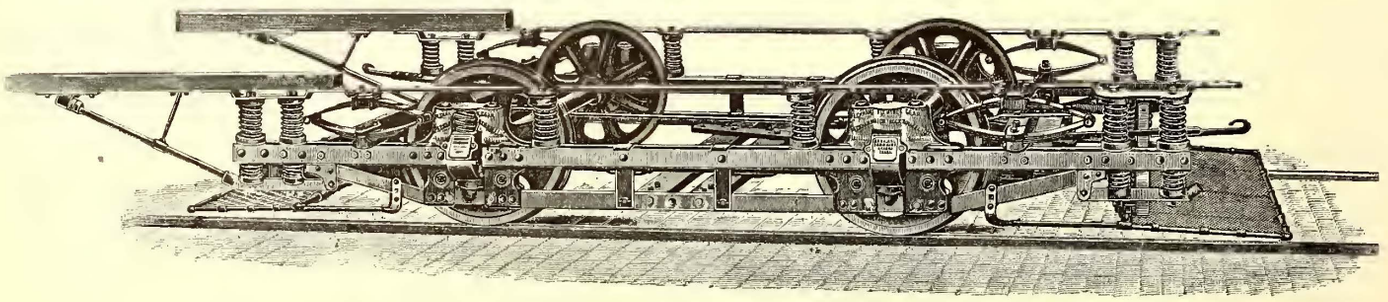
Another important feature of the truck is the cushioned journals by which any inequalities of the truck are not communicated to the truck frame. The yoke having a broad guide face gives more positive action of the journal boxes, avoiding a wabbling motion. The journal boxes are built on the M. C. B, standard. The braking apparatus is positive in action, the shoes being operated simultaneously with great leverage. The wheels and axles can be removed quickly and with very little trouble by loosening one bolt under the journals. Any springs can also be replaced without taking off the car body.

Peckham's Improved Extra Long Truck.

This truck is an improvement on the extra long 6 D truck manufactured by the Peckham Motor Truck & Wheel Company, and consists of an increased spring base and a new truss extension for supporting open cars. It is designed expressly for twenty-two foot closed, or thirty-two foot open cars. The spring base of this truck is fourteen feet with a wheel base of six feet six inches. The extreme length of the forged steel top frames is sixteen feet. It is equipped with the Peckham spiral spring cushioned gear, and has the same general arrangement of springs as his standard truck, except that it is provided with an extra spiral spring at each end which increases the spring base and prevents oscillation of cars.

The spring cushioned gear consists of a steel yoke provided with a cylindrical aperture on the upper part into which is inserted the graduated spiral springs. These springs are of different lengths and diameters, insuring flexibility under both light and heavy loads. The side frames are constructed of wrought steel bars secured to steel yokes entirely by rivets driven hot by skilled boiler makers. The general construction of side frames, brakes, etc., is the same as that of their standard truck, which has been described in former numbers of the Street Railway Journal.

The truck is equipped with the Peckham automatic life and wheel guard which was illustrated and described in the June issue of the Street Railway Journal.



PECKHAM'S IMPROVED EXTRA LONG TRUCK.

The Composite Brake Shoe Company.

This is the title of a new company which has succeeded to the business and to all the rights, titles, etc., of the Safety Brake Shoe Company, of Boston. The officers of the Composite Brake Shoe Company are Wm. W. Whitcomb, president and general manager; George C. Ewing, superintendent; Charles H. Burrage, secretary and treasurer. The headquarters are at 620 Atlantic Avenue, Boston.

The composite brake shoe is well known and has achieved an excellent reputation for its braking and wearing qualities, and descriptions of the shoe have already been published in these columns. The new company will have larger facilities for business than were enjoyed by the Safety Brake Shoe Company,

Aluminum Bronze for Overhead Railway Material.

The Fiberite Company, of Mechanicville, N. Y., has taken a new departure in the matter of overhead material. Recognizing the importance of having the strongest and most durable metal, this Company has recently adopted aluminum bronze in place of the ordinary red bronze. As is well known, aluminum bronze, like iron, may be forged and welded, and is very strong and firm. The relative tensile strength of ordinary bronze, as compared with aluminum bronze, is as follows: Ordinary bronze tests 36,000 lbs. to the square inch, aluminum bronze 90,000 lbs. to the square inch. One of the important features of aluminum bronze is that it is not in any way subject to oxidation.

This company is constantly adding to its line of specialties, making among other things, frogs, crossovers, section insulators, trolley harps, trolleys, and many other specialties which are useful to street railroads. It is the first company in the country to apply the use of aluminum to street railway apparatus.

The Hazelton or Porcupine Boiler.

The use of the vertical boiler manufactured by the Hazelton Boiler Company, of New York, is so extensive that a few particulars in regard to its main features and advantages will not be without interest.

The boiler consists essentially of a vertical standpipe or cylinder, varying in diameter, height and thickness, according to the power required. From this vertical pipe the water tubes radiate, giving to the boiler before it is enclosed, somewhat the appearance of an enormous porcupine standing erect; hence its name. The standpipe rests upon a circular, cast iron foundation plate, placed upon a supplementary foundation of brick, raised one course above the level of the foundation. That portion of the standpipe below the grate bars forms the mud drum, into which a manhole with a plate is placed, affording ready facility for entering the boiler and examining every portion of its interior surface. Owing to the very rapid and perfect circulation in this boiler, the extraneous matter contained in the water is deposited in the lower end of the standpipe and either blown off or removed through the manhole.

The diameter, length and number of the radial tubes depend upon the size of the boiler. One end of each tube is open, the other is closed upon itself, forming a hemispherical or round end, and in the process of closing, the end is thickened, thereby adding strength and producing a homogeneous tube. The open end of each tube is expanded into the standpipe, the tube extending outward horizontally, its closed end being about one inch distant from the inner surface of the brickwork enclosure of the boiler. Thus the radial tubes, being secured at one end only, and clear of the brickwork at the other end, can expand and contract without strain.

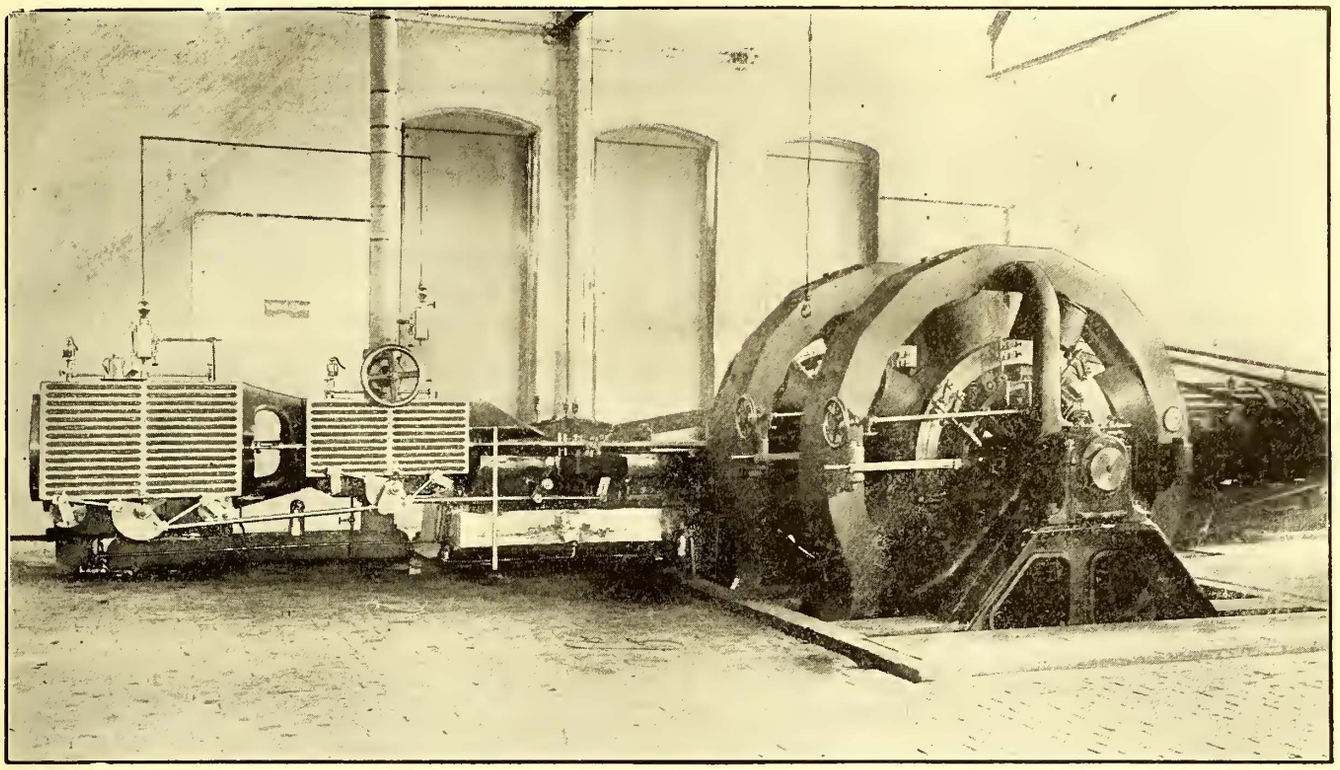
The grate surface is circular in form, and extends entirely around the standpipe. The grate bars, at their inner ends, rest upon a wrought iron ring, supported by wrought iron brackets riveted to the standpipe, and the outer ends are supported by cast iron plates resting upon a projection of brickwork.

The Jefferson Avenue Railroad, of New Orleans, (La.) is the title of a new corporation, with a capital of $500,000, organized in New Orleans, which will build a street railway to operate in connection with a pleasure resort on what was formerly the Perkins sugar plantation, and which will comprise twenty-five acres. The officers of the company are W. N. Louque, president; Octave Besancon, secretary and treasurer, and Wm. Cummings, superintendent. The company proposes to illuminate the grounds by means of electric light, run a hotel and restaurant, a base ball park and athletic grounds, etc.

Direct Coupled Russell Engine and G. E. Dynamos.

The direct coupled dynamos and engine shown herewith were recently installed in the station of the Edison Electric Light Company, at Grand Rapids, Mich. They present some features of interest, and deserve special notice. The outfit consists of one four valve, compound, condensing engine, 15×24×24, rated at from 300 to 400 H. P., built by Russell & Company. of Massillon, O., and two 100 K. W. generators, made by the General Electric Company, of Schenectady, N. Y.

The bed of the engine, and the fields of the dynamos rest upon a common iron base. The main shaft of the engine, carrying, in addition to the flywheel, the two armatures, is supported in two pillow blocks



DIRECT COUPLED RUSSELL ENGINE AND GENERAL ELECTRIC DYNAMOS.

mounted on detachable iron stands, so that the armatures may be removed without lifting the shaft out of place.

A test conducted by Frank A. Simonds, mechanical engineer, to determine the engine's economy in verification of guarantees, yielded the following results:

RUNNING NON-CONDENSING.

Duration trial, 6 hrs.	
Average steam pressure	139.05
" revolutions per minute	162.00
" I. H. P. developed	307.74
Water per I. H. P.	18.45

RUNNING CONDENSING.

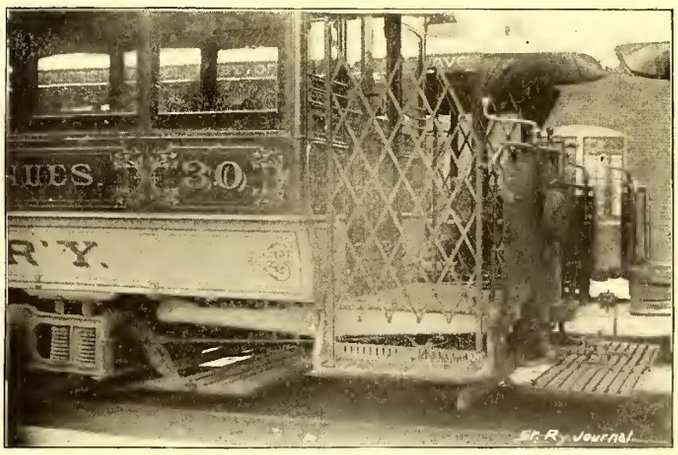
Duration trial 6 hrs.	
Average steam pressure	130.00
" vacuum	25.75
" revolutions	162.00
" I. H. P.	327.75
Water per I. H. P.	15.59

The Hennegin Life Guard.

The accompanying illustration shows a life guard embodying a number of entirely new ideas. It is the invention of H. H. Hennegin, 306 Temple Building, St. Louis. The aim of the guard is not only to save a person from being run over by a car, but also to stop the car in a shorter space than is possible with the ordinary brakes. One of the most important features of the device is that it is not dependent upon the motorman for its efficient working, but is self acting.

Its construction is as follows: Directly under the platform, about a foot from the front of the same, is a triangular steel casting, the apex of one of whose angles hinges to a piece which is attached to the under side of the floor. To the vertical side of the casting is attached the board seen under the front part of the platform, as shown. To another side are connected the rods seen below the platform supports under the car body. When an obstruction strikes the above mentioned board, which is but four inches from the rails, its displacement being brought about by any weight above twenty-five pounds, it causes it to turn on its axis, being attached to the triangular casting. Thus motion is communicated to the rods, and they, in turn, actuate the mechanism of the guard. The engraving shows the apparatus in its normal position ready for operation. The large casting which, together with its mate on the opposite side of the car, supports the framework of the guard, is strongly connected with the car truck. Great strength is here required, for when the steel bar blocks the car wheel there is a severe dragging motion.

The action of the fender has been frequently tested with dummies and other obstructions. An obstacle striking the board beneath the platform causes it, by means of the mechanism explained above, to throw the guard board to the rails, and at the same time block the wheels. Thus the obstacle is caught by the board and carried along, and at the same time the car is being stopped. The revolution of the wheels then ceases, and the wheels are caused to slide, thus bringing the car to a standstill in the minimum time. The guard was tested while the car was running at a rate of twenty miles an hour and fifty feet a minute, and in all cases it worked most satisfactorily. In the tests on car No. 30 of the Cass Avenue line, of the Cass Avenue & Fair Grounds Railway, of St. Louis, several unexpected obstructions were encountered, such as large stones in the street, and in these cases, the



NEW LIFE GUARD—ST. LOUIS.

comparatively easy working of the device at all times was proven. The guard is reset from the platform.

The grate bar guard shown at the front of the car is also the invention of Mr. Hennegin. It is intended for use between motor and trail cars. It is detachable, and can be changed from one end of the car to the other in a moment's time, where such operation is necessary. The method of hanging the guard on the platform can easily be understood on reference to the cut, the vertical portions of its arms fitting in brass sockets at their upper ends, and resting against the platform at their lower ends. The arms are held in the sockets by heavy screws, and are thus supported.

The Works of the Card Electric Motor & Dynamo Company.

This business was established in Cincinnati in 1882 in a modest way, for the purpose of manufacturing generators and stationary motors from designs made by Mr. Card, after whom the company derived its name. Mr. Card, however, has not been connected with the company for about eight years, and the original design and method of construction of the machines have been greatly modified, and have little resemblance to the original dynamos first manufactured, though the name is retained.

From small beginnings the business has grown to large proportions, and the works now occupy the company's own building, a large four story brick structure on the corner of Broadway and Hunt Street, with from fifty to seventy-five employes. Notwithstanding the financial depression, the business of the firm has steadily increased, especially since January 1, so that it has been necessary to run overtime. The ground dimensions of the building are 175×80 ft., with the principal side entrance on Hunt Street. Capacious offices are on the second floor, with entrance on Broadway.

The machine shop is located on the ground floor, and is equipped with a large and fine assortment of lathes, planers and radial drills, of latest designs, for the economical manufacture of dynamos and motors, and each one of which is driven by an independent motor, no shafting being employed. The current for operating the motors has a potential of about 110 volts, which is derived from an eighty horse power generator driven by an engine of 200 H. P. capacity, through the medium of a countershaft, and from which other generators are driven for producing the current employed in the testing new motors.

The motor which operates a lathe is usually placed on the floor under the machine, that for the drills to one side, while the planers are operated by a belt from the motor suspended to the ceiling. The rheostat and switches are attached to the field of the motors, or to the frame of the machines, and the lathes are controlled by a wooden bar which is attached to the side of the frame, and has a motion endways, back and forth, for stopping, starting or reversing, and by which the speed can be controlled, it being of sufficient length to be reached by an attendant from any part of the machine. The switches of the motors for driving the radial drills are operated by hand wheels, through the medium of a shaft which extends across the machine, the wheels being accessible from either side. The operation of the tools by this method has proved very satisfactory, and the workmen take kindly to it. The change of speed, and the starting and stopping take less time than where countershaft and belts are employed, and the danger of adjusting belts to coned pulleys is avoided. The first shop equipment by this method is said to be but little, if any, more than the expense of shafting, and much less power is required to operate the tools.

More recently a motor has been devised for operating lathes in which the armature is wound on a thimble embracing a shaft in line with the spindle of the machine, and the fields form part of the frame-work, making virtually an ironclad motor and a self contained machine, the spindle being driven by differential gears, the same as employed with coned pulleys. The lathe, equipped as illustrated in our May issue, was manufactured by the Lodge & Davis Machine Tool Company, of Cincinnati, which manufactures most of the machines which are equipped in this manner with the Card motors. For extra large lathes a multipolar motor is employed. The plan of thus driving iron working tools,

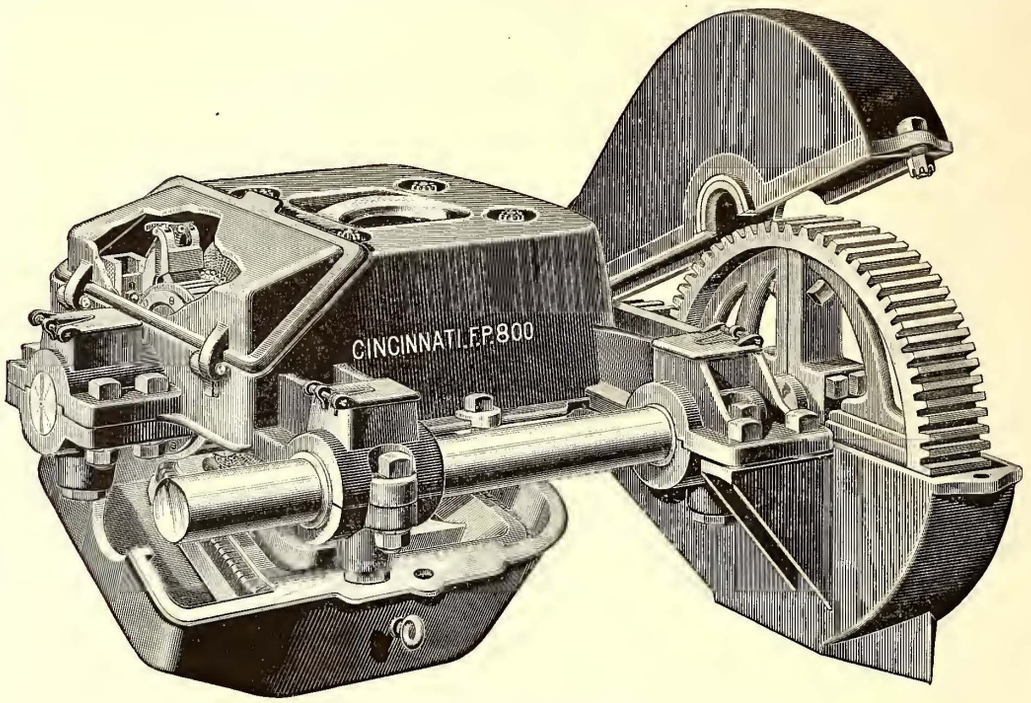


FIG 2.—MOTOR—CARD ELECTRIC MOTOR & DYNAMO CO.

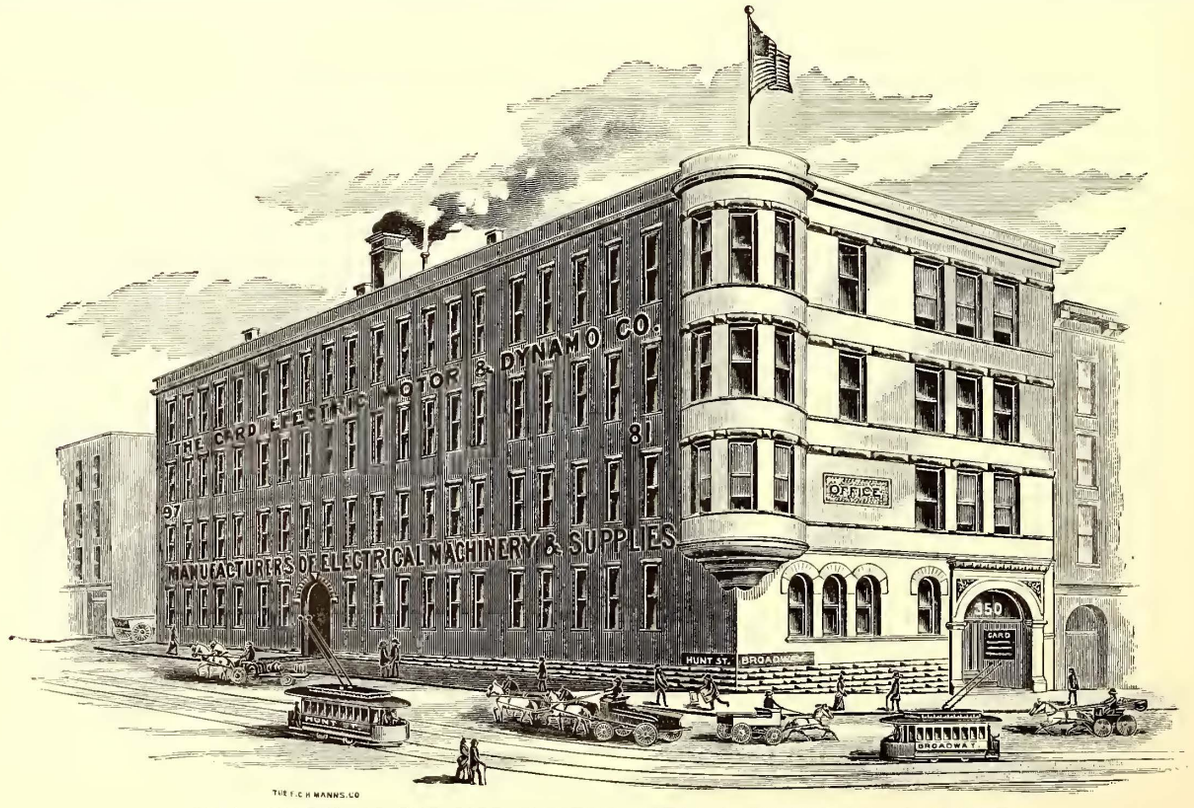


FIG. 1.—WORKS OF THE CARD ELECTRIC MOTOR & DYNAMO CO., CINCINNATI.

it is claimed, was originated by this company. Machines thus driven are particularly adapted to street railway work, for they can be set up at the car barn, power station, in the machine shop, or wherever it is necessary to make repairs, and can be readily moved from one station to another in case it is necessary.

The works turn out generators and stationary and car motors. The stationary motors are manufactured up to eighty horse power, and are adapted for service in all cases where power is required. The shafts of the large motors are supported on long, self adjusting, self oiling journal bearings, and are built and finished in a most thorough manner, evidencing a superior class of workmanship.

Recently the company has brought out a railway motor which is modeled after the design of the General Electric Company's 800 motor, but differs from it in that the lower half of the frame is hinged, and can be swung down when it is necessary to remove the armature. The armature shaft is held in place by a collar which, when unbolted, allows the armature to be let down. This motor is also provided with self oiling bearings which are longer than those employed in the G. E. 800 machine, and the motors are also equipped with a steel shaft, while the cover is of a somewhat different pattern from the original type. Twenty-five equipments of these motors have been recently put in service on the lines of the Cincinnati Street Railway Company, as noted on another page of this issue.

The Card Motor Company has also recently rebuilt or repaired a number of motors, of the waterproof type, which went through the fire in the burning of the car barns of the Cincinnati Street Railway Company last winter.

The winding room of the works is located on the second floor, and the four floors are served by an elevator which is operated by an electric motor. The second floor is occupied by a large drafting and designing room in the front of the building, and a stock room in the rear half of the floor. The fourth floor is used for a pattern shop and storage of patterns and light castings.

The Lodge & Davis Machine Tool Co.'s Works.

The works of this company occupy an entire block, bounded by Sixth, Eggleston Avenue, Culvert and Eighth Streets, Cincinnati. They consist of a collection of well constructed two and three story buildings, having a floor space of over 60,000 sq. ft., and splendidly adapted to the business for which they were designed. The location is near some of the steam lines, from which sidings lead directly into the buildings, facilitating the delivery of supplies and the shipping of material. Among the manufacturing industries of the city, none command a more conspicuous position, either in location or reputation, than the large works of the above company. The works when running full give employment to about 650 men.

The business consists in the manufacture of tools for working iron, steel and brass, and includes lathes, planers, shapers, milling machines radial drills, screw machines, bolt cutters. As these tools enter largely into the manufacture of all classes of traction machinery, including street cars, dynamos and electric motors, and are also employed in the repair of this machinery, their manufacture is of special interest to the street railway fraternity.

The different departments of the works are well lighted, well ventilated and thoroughly furnished in every department with almost every description of iron working tools for the processes required in the different shops and finishing rooms; and also with trolleys and hoists for handling heavy casting and serving the tools with the greatest possible despatch and economy.

The products of the works go all over the world. This company was among the largest exhibitors of iron working tools at the Columbian Exposition, making an exhibit which cost over $25,000, and which has brought in since the close of the exposition a very large increase in foreign orders. Among the tools in process of construction at the recent visit of a representative of the STREET RAILWAY JOURNAL were noted radial drills, planers and shaping machines which are being built for the Government railways of Hungary, and which are to be shipped directly to Buda-Pesth. We also noted a number of orders from South American countries, and an order for a 24 × 12 lathe for a mining camp located in the mountains of Mexico, in the construction of which the specifications required that the shears and all parts should be so joined and broken up that the whole machine could be packed in boxes which should not exceed in weight 250 or 300 lbs., so that they could be carried over the mountain trails on the backs of burros.

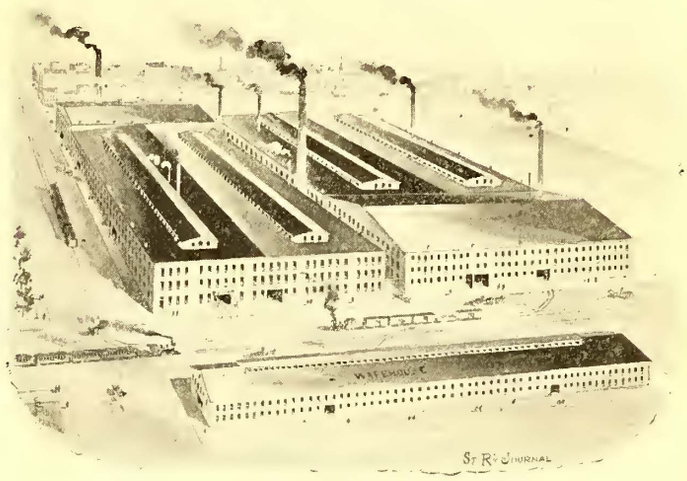
A special feature which commends this company's work, is that all parts of the machines are built on the interchangeable plan. This not only insures accuracy, but enables duplicate parts to be finished at once.

One of the most interesting features of the works is the tool room, in which there are a number of carefully constructed machine tools designed for the manufacture of drills, taps, etc., employed in the shops. The tool room is provided with shelves and cupboards for the storing of the small tools, which are arranged in sections and properly numbered. There is also an electric call board similar to those employed in hotel offices. This is in charge of an attendant who delivers the tools to the various workmen on signal, which each can give by touching a push button near his machine. The tool is delivered and the workman's check taken in receipt, so that a careful check is kept on all the small tools. The oil and other supplies are also issued on check in the same manner, and none of the workmen are allowed to enter the tool room without special permission. The store room for castings is also managed in the same way, only one man being allowed to remove a casting of any kind from its department, when it is delivered and charged up to the individual workman.

The Lodge & Davis Company was among the first, if not the first, to manufacture lathes and other iron working tools with a cabinet in the legs or pedestals of the machine. This company was also the first to place the lead screw of the large lathes inside the bed, giving to the carriages uniform motion, and avoiding the tendency to bind, as is the case where the lead screw is placed on the outside. It was also the first to employ an automatic stop for lathes and drills. By means of this attachment any number of pieces may be bored or turned up on a lathe without resetting or remarking. The drill press spindle will stop automatically when a certain depth is reached after the stop has been properly set. This is a very essential device where a large amount of duplicate work is to be done.

Among some of the improvements recently introduced by the company in the manufacture of large planers is the mounting of the bull wheel under a table having a shaft with its ends supported in bronze bushings in the sides of the frame, so that the bearings can be oiled from the outside. Formerly these wheels were mounted loose on a stationary shaft, and the matter of oiling the bearings was attended with considerable difficulty. A shield of brass is also provided for the friction mechanism, and the reversing mechanism is of the latest improved type.

Among the latest improvements in tool machinery introduced by this company, is the manufacture of lathes and planers and other tools, equipped with an individual electric motor for driving, so that the tools are independent of countershafts and other connections. In these machines a motor of the Card type is chiefly employed. The employment of an individual motor for machines has been practised for some time, but in most cases the motor was placed in position under, above, or near the machines, and the power transmitted by belts. Now, however, for lathes of different sizes the armature is mounted directly on the shaft, and a portion of the framework of the machines becomes the motor field, so that the working tool may be driven at any speed to suit the convenience of the operator. The current is controlled by a switch and rheostat operated by a wooden slide lever attached to the side of the machine in a convenient position to be operated. The works are having a large run on these machines, as they are becoming popular with manufacturing companies.



WORKS OF THE LODGE & DAVIS MACHINE TOOL CO.

The details of the shop practices are also interesting, and account chiefly for the superior workmanship for which the tools of this firm have a wide reputation, and also for the improvements and new devices that are constantly being introduced. The president of the company holds a conference with the heads of all the departments at a certain hour every Saturday morning, in which the details of the business are discussed, the requirements of the supplies in each department presented; and no supplies are ordered except such as are approved of by a unanimous vote of the heads of all the departments. The advantages of improved and new devices of every kind are carefully discussed at these meetings, and are adopted only on the recommendation of the foremen. This practice, it is claimed, sets the foremen to thinking, and makes them take more interest in the affairs of the company than is generally the case. With this practice the heads of the departments, draftsmen, and workmen throughout the shop are encouraged to make suggestions and give the company the benefit of any devices that may be invented that will tend to facilitate the operation of the works. Blue prints for different parts accompany each shop order, and each workman keeps a record of the time he spends in the manufacture of any piece, or appliance, so that the cost of any special part of a tool is readily estimated.

Among the specialties of this shop are iron working tools for the equipment of machine shops in technical schools throughout the country. These machines usually receive an extra finish, and are built with special care and with great accuracy.

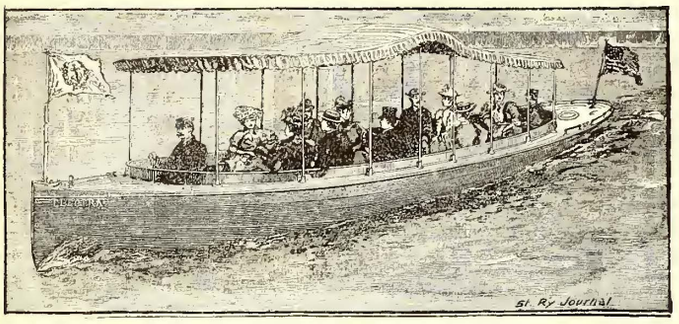
The company employs agents who travel in every civilized country, one of its foreign representatives being able to speak nine different languages. The reciprocal trade relations with the Spanish speaking countries of South America have brought large orders for tools from these countries, and the export trade, as noted above, is constantly on the increase. The company has branch stores in New York, Boston, Chicago, Pittsburgh and St. Louis.

About $500,000 capital is employed in the business, and the officers of the company are as follows: Charles Davis, president; William H. Burtner, vice president and treasurer.

Electric Launches for Street Railway Companies.

Reference was made in our last issue to the use of electric launches by street railway companies, as attractions in pleasure resorts reached by the lines of the company. The General Electric Launch Company, of 44 Broad Street, New York, which operated the electric launches on the lagoons at the World's Fair, Chicago, has been disposing of the launches in use there for $2,000 apiece. A number has been operated profitably for hire since, and among other users, in addition to those mentioned in our last issue, are the Milwaukee Electric Launch Company, of Milwaukee, Wis.; Altoona & Logan Valley Railway Company, of Altoona, Pa.; Hartman General Electric Company, of Duluth, Minn.; Pueblo City Railway Company, of Pueblo, Colo., and Prof. S. H. Short, of Cleveland, O.

It will be found, upon inquiring of those using the launches for hire, that they will go far towards earning their cost in one season.



ELECTRIC LAUNCH "ELECTRA."

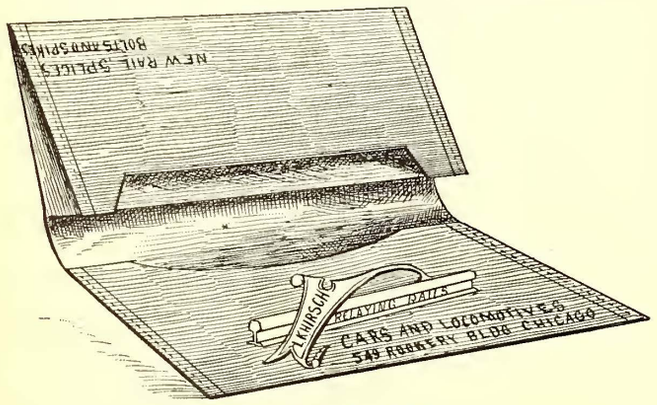
At the World's Fair they earned, at times, as much as $150, each, a day. Assuming that, on the most conservative basis, a launch earns but $20 a day for a season of two months, this will net $960, after deducting $2 a day for captain, $1 a day for current (three cents per horse power hour), and $1 a day for maintenance. Each of the launches seats thirty passengers; at twenty-five cents each per trip (the charge at the World's Fair was fifty cents) it would make $7.50 per trip of, say, one hour's duration.

The $2,000 includes the time, traveling expenses and services of a competent man to start the launch and teach the purchaser all about caring for it and running it. The boats, new, cost nearly double this sum, and at the price and seating capacity are cheaper than steam or naphtha. The boats are over thirty-five feet long, with six feet beam, draft of thirty inches when loaded, and will seat, comfortably, thirty people. They are lighted and propelled by their own electricity. They can be charged from any direct current, trolley, incandescent or arc, and will run from twelve to fourteen hours at their normal rate of speed—six miles an hour—on one charge. They may be charged over night, or at any convenient hour of the day. When fully discharged, it takes about six hours to charge.

A Neat Card Case.

We are in receipt of a neat leather card case from L. K. Hirsch, of Chicago.

The card case is stamped in silver with Mr. Hirsch's trade mark—a



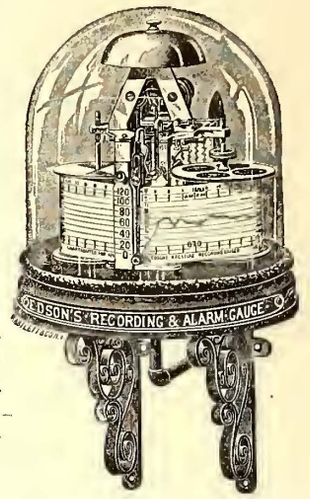
A NEAT CARD CASE.

scroll bearing his name and resting against a section of rail. The card case also gives the information that Mr, Hirsch has in stock rails, splices, bolts and spikes, cars and locomotives, and relaying rails.

The Philadelphia & Trenton Street Railway Company was incorporated June 13, with a capital of $150,000, to construct and operate an electric street railway in the counties of Philadelphia and Bucks, State of Pennsylvania. L. Calvin Maus, of Philadelphia, is the president of the company; others interested are Theodore F. Hansen, Philadelphia, and J. Uhle Bethell, Lansdowne, Pa.

A Well Known Pressure Recording Gauge.

The pressure recording gauge manufactured by Jarvis B. Edson of New York, was awarded a short time ago the John Scott Legacy Medal by the Committee on Science and the Arts of the Franklin Institute, Philadelphia. The report, which is signed by Joseph M. Wilson, president and Wm, H. Wahl, secretary, and which is countersigned by H. R. Heyl, chairman, reads in part as follows:



EDSON PRESSURE RECORDING GAUGE.

"The Edson instrument affords a written tracing or log of every degree of pressure sustained within a steam boiler, tank, pipe or any reservoir, of water, oil, air, steam or other liquid to which it is attached, and of the time when such pressure existed. It gives, if continuously applied, a complete biography of a boiler and a correct exhibit of all the work done. The recorder is a good check on night guards, and if regularly kept will show indisputably whether a boiler has been overstrained. The record can be read at a glance, as the co-ordinates of time and pressure are rectangular and not circular as in most of the other recording gauges.

"The Edson pressure recording gauge has been in service for many years, and a few of the testimonials submitted to the investigating committee clearly show the durability and practical value of the instruments. The gauge is mechanically one of the finest pieces of workmanship of its class now in the market, and the fact that it can be used continuously makes it particularly desirable where it would be inconvenient to change records every twenty-four hours."

New Roads.

Bradford, Pa.—The Bradford Electric Street Railway Company was incorporated June 7, with a capital stock of $100,000. Lewis Emery, Jr., of Bradford, is the president of the company, and others interested are C. P. Collins, W. R. Weaver and L. E. Hamsher, all of Bradford.

Bridgeport, Ct.—The Bridgeport Traction Co. last month began the excavation for power station. Poles are being located and deliveries of the trolley line insulators furnished by the H. W. Johns Manufacturing Co. will soon begin.

Brooklyn, N. Y.—It is reported that a franchise has been obtained by a company called the Long Island Electric Railway Company. The road is to run parallel with the Long Island Railroad through Suffolk County to Patchogue and all the towns along the line, including Baldwin's, Milburn, Freeport, Merrick, New Bridge and Seaford to Babylon, and also north and south from the mainland and from Rockville Centre to Hempstead village, Garden City and Mineola. The following are the officers of the company: President, A. R. Hart; vice-president, Charles H. Mullin, of Mount Holly Springs, Pa.; treasurer, Clarence Wolf; secretary, J. C. Von Arx.

Cincinnati, O.—The County Commissioners have granted a fifty year franchise to the Hamilton, Le Sourdsville & Middletown Electric Railroad Company for a road between this city and Hamilton. This is to be a branch of the Cincinnati & Dayton Electric Railway.

Cortland, N. Y.—The Cortland & Homer Traction Company has filed a certificate of incorporation, with a capital stock of $300,000. Some of the directors are: P. S. Page, C. D. Simpson, H. E. Hand and I. L. Post. The company will construct an electric railroad, twelve miles in length, from Cortland to Homer, and extend to McGrawville.

Delaware, O.—The County Commissioners have granted a franchise in this county for the Delaware & Centerburg Electric Railway.

Detroit, Mich.—The County Commissioners have granted a twenty-five year franchise for the construction of the Detroit Electric Railroad through Lucas County. The franchise specifies that the motive power shall be electricity. The road is to be completed within eighteen months. The parties who secured the franchise are J. H. Ainsworth, J. Ellery Eaton, W. G. Gardiner, J. N. Bick and Jas. A. Dawson.

Galt, Ont.—It is reported that the contract of the Galt & Preston Street Railway Company, for dynamos, motor cars, overhead work, etc., has been awarded to Ahearn & Soper, of Ottawa, and the contract for engines and boilers to the Goldie & McCulloch Company, of Galt.

Goshen, Ind.—The Indiana Electric Railway Company of Goshen, is the name of a new company which has secured control of the old Goshen Electric Street Railway Company's lines. At the head of the new company are J. J. Burns, J. H. McIlhenney and K. G. Ripley, all of Chicago, who will extend the line to Elkhart, and also to New Paris, there to connect with the Wabash Railway.

Harrisburg, Pa.—The Cumberland Valley Traction Company, of Carlisle, has purchased the franchise of the Harrisburg & Mechan-

icsburg Electric Railway Company, and will build the line this summer. The Cumberland Valley Traction Company has also leased the Cumberland Valley Electric Railway, which is now being constructed between Carlisle and Boiling Springs. The line will be extended to Mt. Holly, the Carlisle Indian training school, and also to Mechanicsburg, where it will connect with the road of the Harrisburg & Mechanicsburg Company.

Hartford, Conn.—Work on the electrical construction of forty-three miles of road is being pushed by the Hartford Street Railway Company. The overhead line is well under way, the Johns-Pratt insulating materials being used.

Lewiston, Ont.—At a recent meeting of the directors of the Lewiston & Youngstown Electric Railroad, a committee was appointed to obtain the right of way for the road building along what is known as the Crick Road, on account of great opposition of property owners on the River Road.

Omaha, Neb.—The Council Bluffs & Lake Manawa Electric Motor Company has received a ten year franchise.

Oneonta, N. Y.—It is said that capitalists in Oneonta and Richfield Springs are actively interested in an effort to build an electric railroad between the two towns.

Pittsburgh, Pa.—A new electric road is to be built from Castle Shannon to this city, to be known as the Knoxville, Fair Haven & Mt. Lebanon Railway. The company is capitalized at $100,000. The Knoxville Land Improvement Company and the Fair Haven Land Company are at the head of the scheme. The president of the new company is J. F. Grimes, of Knoxville, and the treasurer W. W. Murray.

Poughkeepsie, N. Y.—The Poughkeepsie & Wappinger Falls Railway Company, in addition to the orders mentioned in our last issue, has awarded the contract for trolley line insulators to the H. W. Johns Manufacturing Company, and the registers to the Lewis & Fowler Manufacturing Company.

Watertown, Mass.—The Watertown Selectmen have been asked by the Newtonville & Watertown Street Railway Company for an extension of time on its franchise to build an electric road on North Beacon Street as far as the Boston line.

Personal.

Mr. A. H. Lewis, has formed a business connection with the Abendroth & Root Manufacturing Company, of New York. Mr. Lewis will make his headquarters in Cincinnati.

Mr. Arthur S. Beves, formerly treasurer and assistant secretary of the General Electric Company, recently opened an office in the Edison Building, 44 Broad Street, New York, where he deals in investment securities, making a specialty of street railway securities.

Mr. Henry G. Issertel, E. E., has formed a connection with the H. W. Johns Manufacturing Company, of New York. Mr. Issertel was formerly manager of the railway department of Alexander, Barney & Chapin, and has recently been engaged as a consulting electrical engineer.

Mr. A. H. Englund, secretary and manager of the International Register Company, of Chicago, made a trip East last month combining both business and pleasure. Mr. Englund reports a good business in portable registers, and that the International register is maintaining its old popularity.

Mr. Everett K. Day, whose name is familiar to our readers through interesting experiments conducted by him in electric freight transportation at Sanford, Me., called at our office last month. Mr. Day has resigned his position as superintendent of the Mousam River Electric Railway Company at Sanford.

Mr. Philip Dawson, of London, who was engaged with the late Mr. Anthony Reckenzaun in engineering work, and who is now associated with Mr. R. W. Blackwell of that city, in electrical engineering, was in New York the first part of last month. Mr. Dawson is spending some time in this country inspecting the electric railway systems here, and before his return will visit the Pacific slope.

Mr. Wm. W. Nugent, of Chicago, Western manager for C. & G. Cooper & Company, met with an accident May 18, which confined him to his room for several weeks. When about to board a street car he was struck by an express wagon. No bones were broken, but he was severely bruised and remained unconscious for four hours. He was taken to the Alexian Brothers Hospital, but was aftewards removed to his home.

M. Pierre Arbel, managing director of the Société Anonyme Industrielle des Etablissements Arbel, of France, has recently been appointed to the Order of the Legion of Honor. This high honor was conferred as a recompense for two interesting reports on Mines and Metallurgy, which the French Government requested him to prepare, during his stay at Chicago, as delegate to the World's Columbian Exposition. Mr. Arbel, it is interesting to state, is still a young man, being in his thirty-fifth year.

New Publications.

A Catalogue of Rail Sections. Published by the Illinois Steel Company.

The 1894 catalogue of the Illinois Steel Company contains eighty-four sections of types of rails manufactured by it. The dimensions of each section are given, together with the weight per yard, number of tons per mile of track, disposition of metal, and the names of some of the principal companies using that particular section. Also included in the catalogue are a number of tables, useful in railroad construction, giving the number of spikes used per mile of track, crossties required, etc.

The Steam Engine and Other Heat Engines: By J. A. Ewing, M. A. Professor of Mechanism and Applied Mechanics in the University of Cambridge. 400 pages. MacMillan & Company, New York. Price $3.75.

During the last few years there has been published a large number of text books to cover the theory of steam and other heat engines, some of which are important additions to the literature on this subject. One of these is the book which has just been issued by MacMillan & Company, and from the pen of Professor Ewing. The properties of steam and the general theory of the steam engine are taken up in a careful and systematic manner. Special types of engines are not described, but the general characteristics and distinguishing features of general types are given. Altogether we can unqualifiedly recommend this book to students and engineers.

Handbook of Street Railway Track and Trolley Equipment. Published by the Pettingell-Andrews Company, of 72 and 74 Federal Street, Boston, Mass.

That the Pettingell-Andrews Company is fully prepared to supply all equipment useful in electric railway work is shown by the new handbook which has just been issued. The company supplies grooved and T rails of all sizes, from 35 lbs. to 105 lbs. to the yard, spikes, ties and all necessary parts of track construction; insulators, pull-offs and all parts of the overhead equipment, including the well known "West End" and "Emerson" types, trolleys, wire cutters, wrenches, Davis tower wagons, commutators and commutator bars, wires of all kinds, etc. The catalogue contains a number of tables of useful information in the equipment of lines, giving the number of track bolts, spikes, etc., required in street railway construction; definitions of technical terms used, formulæ for estimating sizes of wire, etc. The manager of the railway department is Frank X. Cicott.

Obituary.

John H. Dalzell, one of the best known street railway men of Pittsburgh, died May 27, at his residence, Allegheny City. His death was the result of a complication of diseases superinduced by liver complaint.

Mr. Dalzell was born sixty years ago in Pittsburgh. His early education was received in the public schools of this city, after which he attended the Western University. In the early days of the oil business he was one of the most successful operators, and retired with a large fortune. He early became interested in street railways. He was president of the Pittsburgh, Allegheny & Manchester Traction Company and an official of the Allegheny Traction Company, besides holding stocks of numerous other rapid transit lines. He was also interested in the Standard Underground Cable Company and other prominent corporations of Pittsburgh. A wife and two daughters survive him.

Equipment Notes.

W. D. Hoffman has succeeded Huxley & Hoffman as agent of the Buckeye engine in Boston.

The American Electrical Works, of Providence, R. I., has decided to open a warehouse and sales room in Chicago. Francis E. Donohoe will have charge.

The Fishkill Landing Machine Company, Fishkill-on-the-Hudson N. Y., builder of the Fishkill-Corliss horizontal and vertical engines will shortly issue a new edition of its catalogue.

Charles E. Chapin, of 136 Liberty Street, New York, is doing a large business in general electric railway supplies. Mr. Chapin is a manufacturers' agent and deals in street railway material of all kinds.

Joseph Sachs, an electrical engineer who will make a specialty of assisting inventors in working out their ideas in a practical manner, has recently opened an office in the Mutual Life Building, 32 Nassau Street, this city.

F. A. Scheffler, who has been connected with the Stirling Company for the last year as its sales agent in New York, is now at the Boston office of the company, where he will be associated with J. Bradford Sargent, the New England representative of the Stirling Company.

The Lewis & Fowler Manufacturing Company, of Brooklyn, N. Y., writes us that the contract for registers for the cars of the Poughkeepsie (N. Y.) & Wappinger Falls Railroad Company has been awarded to it and not to another company, as mentioned in our last issue. The Lewis & Fowler register maintains its long established popularity, and the company is constantly adding new lines to its extensive list as users of this improved register.

The Lewis Electric Company, of New York, has put upon the market an electric lighting system for cars, which has been in operation with success for a considerable time on one of the cars of the New York & Brooklyn Bridge cable road. The company has recently been reorganized, and a large interest secured by Drexel Morgan & Company. G. W. Moslin has been elected president of the company, with Messrs. E. H. Johnson, E. West, Jr., I. N. Lewis and H. E. Fanshawe as directors.

The Mather Electric Company, of Manchester, Conn., is receiving encouraging orders for its new direct connected and belted generators both for lighting and railway work. The well known capacity of this company to turn out first class and highly efficient apparatus, gained by fourteen years' experience in the business, suffices to insure a purchaser confidence in these erratic times. J. Holt Gates, 1139-40 Monadnock Building, Chicago, general Western agent, reports a good steady business.

The Gleason & Bailey Manufacturing Company, of New York, the manufacturer of hurry up wagons for street railway service, writes us that its shops are busily employed in the construction of these wagons and modern fire apparatus for which the company has a large reputation. The towns of Plaquemine, La., Gardiner, Me., and West Groton, Mass., were among the company's customers last month. The city of Cleveland, O., has also placed another order for a Gleason & Bailey steel truck.

The Sterling Supply & Manufacturing Company, of New York, is installing its fender on the cars of the Broadway cable railway, New York. This fender is very similar to that used on the Third Avenue cable railway in New York and is carried directly on the truck running close to the ground. It has been very successful on the Third Avenue line, and as it takes up no room in the street, being entirely under the car, seems especially adapted to the requirements of the Broadway service.

The Laconia Car Company, of Laconia, N. H., had a disastrous fire at its works on June 3. It is thought that the conflagration originated from the paint shop. The greater part of the loss was covered by insurance. The company states that it will begin immediately to rebuild and re-equip the destroyed shops, and that the event will not materially affect its business or ability to accept new contracts. The management promises that the new works will be more complete and commodious than the old.

The Phosphor Bronze Smelting Company, of Philadelphia, Pa., manufactures the well known "Elephant" brand alloys. This material has proved its value in the construction of machine castings, pinions, cog wheels, valves, cylinder linings, plungers, etc., where toughness and hardness with ability to resist crystallization and corrosion are desirable. The metal has also been successfully employed for bells, steam whistles, rods and bolts. The company also manufactures the "Elephant" brand of phosphor bronze bearing metal.

The H. W. Johns Manufacturing Company, of New York, has been kept busy in filling the large number of orders received for line appliances, insulators and insulating material. This company is to supply the trolley line appliances for the Nassau Electric Railway Company, of Brooklyn, N. Y. Other roads which will use the John's-Pratt insulators, and whose orders have been received recently, are the Bridgeport Traction Company, of Bridgeport, Conn., the Hartford Street Railway Company, of Hartford, Conn., and the Poughkeepsie & Wappinger Falls Railway Company, of Poughkeepsie, N. Y.

F. W. Darlington, consulting and electrical engineer of Philadelphia, Pa., has moved his office from 4210 Chestnut Street to Room 503 Girard Building, Philadelphia. Mr. Darlington was formerly chief engineer of the Philadelphia Traction Company, and had previously for a long time been connected with the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., for whom he supervised the installation of a large number of electric railway, light and power plants. Mr. Darlington is prepared to submit estimates, plans and specifications for electric stations, and give the installation of such stations his personal superintendence.

A. B. Wetmore & Son is the title of the firm which will carry on hereafter the extensive lumber business of A. B. Wetmore of New York, Wm. H. Wetmore, son of A. B. Wetmore having been made a member of the firm June 1. The firm will carry on a wholesale business in hard woods, North Carolina and long leaf yellow pine by carload and cargo, and will make a specialty of ties and poles for street railway companies. Wm. H. Wetmore has been connected with the business in New York and the South since June, 1884. The firm enjoys an excellent reputation among street railway companies and has done a large business in this line.

The Berlin Iron Bridge Company, of East Berlin, Co., is building a new boiler house for the Coe Brass Manufacturing Company, at Torrington, Conn., and has also received the contract for the roof of the new electric light station belonging to the Flatbush Gas Company, at Flatbush, N. Y. This building will be sixty feet wide and seventy-three feet long, divided into a dynamo room and boiler house, and the roof of the building will be covered with that company's patent anti-condensation, corrugated iron roof covering. The Berlin Iron Bridge Company has appointed W. E. Sterns its purchasing agent, to fill the vacancy caused by the death of Wm. H. Riley.

The Clonbrock Steam Boiler Works, the sole manufacturer of the Morrin Climax Steam Generator, of Brooklyn, N. Y., informs us of the following contracts for Climax boilers during one week of last month: The United Electric Light & Power Company, East 29th Street, New York City, 10,000 H. P.; Thomson-Houston Electric Company, East 24th Street, New York City, 1,000 H. P.; Newark Electric Light & Power Company, Newark, N. J., 2,000 H. P.; Central Railway & Electric Company, New Britain, Conn., 1,000 H. P.; Edison Electric Illuminating Company, of Brooklyn, N. Y., 4,000 H. P., for the first district station of this company on Pearl Street.

George Cradock & Company, of Wakefield, England, write us that their last rope to be removed from the North Chicago tunnel worked eighty-eight days and was at last taken out on account of its being worn too small for the grippers to take hold of it. This cable as mentioned in our last issue, was installed February 11, and removed May 7. Although having made this excellent record, it is still good enough for use and will be employed on the South Clark Street cable line. The previous tunnel rope supplied by George Cradock & Company was taken out December 2, after running ninety-eight days, and was put to work again on the South Clark Street line on May 12.

The Central Electric Heating Company, of New York, has been carrying on a series of tests to determine the amount of current required in heating electric cars with heaters of its make. The company has sent us a number of reports of tests made on the line of the Atlantic Avenue Railway Company of Brooklyn, giving the amperage with different cars and under different conditions of weather. In most of these tests five thermometers were carried on each car, three of these usually being located at different points inside the car and two on the outside. The records show that a comparatively small amount of current is required to properly heat the cars, even under the most adverse conditions of weather.

Chas. A. Schieren & Company, of New York, write us that last fall the Bangkok Tramway Company, Limited, Bangkok, Siam, received two of their fourteen inch perforated electric leather belts. Upon the arrival of the belts at their destination they were immediately put into use on Brush generators for the electric railway, on the Short system in operation there. In a letter written to the Brush Electric Company, January 16, 1894, Mr. Aage Westenholz, among other items of interest, states regarding the belting as follows: "The belting is also running, and has so far given us extreme satisfaction; our chief engineer can in fact scarcely find terms to express his admiration for its fine appearance and smooth running."

The Pettingell Andrews Company, of Boston, Mass., is making large sales of commutator bars for the Billings & Spencer Company, as well as a large number of other electric railway specialties. The company has issued a large number of cards upon which is mounted a sample of the Billings' patent commutator bars. These bars are drop forged and are particularly guaranteed to be free from blow holes, porosity and all imperfections. The sample shown on the card gives an excellent idea of the finished product. The company is also sending out in the same way a sample of the Billings & Spencer No. 262 wrench, unfinished. The company reports having closed a large number of contracts for overhead line material.

The Mica Insulator Company, of New York, sole manufacturer of micanite plates, commutator segments, rings, washers, cloth, paint, etc., for electrical insulation, has recently published a new catalogue devoted to the subject of micanite. This company's line of micanite insulators is being increased constantly, and the catalogue embraces a number of new features, and is complete as far as it goes. The company has met with deserved success in its introduction of micanite as an insulator. This material has given universal satisfaction, and the managers of the company tell us that their sales have steadily increased, the month of May being the largest in spite of the dull times. They have also introduced micanite in Europe, and the demand has steadily increased from that section.

The Ellis Manufacturing Company, of 218 S. 4th Street, Philadelphia, Pa., is the title of a corporation which is now manufacturing the Hansell electric equalizing truck. The officers of the company are Harvey Ellis, president, and Joel C. Hancock, secretary and treasurer. Both of these gentlemen are well known in the steel and street railway trades, having been for about eighteen years connected with the Cambria Iron Company. The truck of this company is a novelty from the fact that the equalizing bar is outside of the journals, giving easy riding and preventing oscillation. It is constructed on pure mechanical principles, and has received the most flattering criticisms from the railway and mechanical engineers throughout the country who have inspected it. While the truck is in no respect a cheap one, the manufacturers believe that they will be able to meet the market.

The Foster Automatic Safety Guard Company, of New York, whose orders for fenders in Paterson and Hoboken were mentioned in our last issue, has received the following letter from M. R. McAdoo, manager of the Paterson Railway Company. "The Paterson Railway Company have decided, after making trials and tests of several safety guards on our cars, to adopt your form, and we desire you to make immediate arrangements to place them on all our cars. I am personally very much pleased with the simplicity and automatic action of the cradle, and after making thorough tests of all best known guards on the market have recommended its adoption by our company." This company has recently established a factory at Paterson, N. J., and is now able to turn out fenders rapidly. The work of equipment of the cars of the Paterson Railway Company is going on rapidly.

The Ball & Wood Company, of New York, mentions to us, among recent contracts, that of the Poughkeepsie & Wappinger Falls Electric Railway Company which has given an order for two Ball & Wood 300 H. P., cross compound engines. The Ball & Wood engines will also be furnished to the Manayunk & Roxborough Incline Plane Railway, Yonkers Railway Company, Athol Gas & Electric Company, of Athol, Mass., and for the Geneva Brush Light & Power Company, of Geneva, N. Y., all for railroad purposes. The Ball & Wood Company has received so many orders recently that the managers have found it necessary to increase their factory force by the addition of a night gang. Beginning May 28, the company's works have been run to their full capacity twenty-four hours a day, which speaks well for the reputation of the company's engines, and the excellent service which they are giving on many roads.

The Ball & Wood Company, of New York, has again been successful in securing through its secretary and treasurer, Mr. Vincent, one of the largest power contracts which has recently been placed.

The order comprises six Ball & Wood improved, cross compound, condensing engines, of 300 H. P. each, for the Hartford Street Railway Company, of Hartford, Conn. It is this type and make of engine which has proved so economical and efficient at the Grand Street station of the Consolidated Traction Company in Jersey City, where the duty has been most severe and the engines subjected to almost constant overloads of from 20 to 50 per cent., pending the increase of the power plant. The factory of the Ball & Wood Company has been running twenty-four hours per day since about June 1, and this Hartford contract will permit no diminution of its forces for some weeks. In times like these such activity is unusual, and it reflects the popularity of these engines, which are indeed remarkable for their reliability.

Stern & Silverman, of Philadelphia, report business as very active. In the railway department they have contracts for the reconstruction of the Brigantine Transit Company's road at Brigantine. N. J., seven miles in length on trestle construction; at Altoona the Bellwood extension of the Logan Valley road for the Pennsylvania Railroad, eight miles in length; also the Roxborough Incline Plane & Railway, six miles long, running from Philadelphia to Barren Hill. In the steam department they report 600 H. P. boiler plant for the Roxborough road, and two 300 H. P., Ball & Wood compound condensing engines; one 10 × 11 in., direct connected Ball & Wood engine for Dooner's Hotel, Philadelphia; one 10 × 11 in., direct connected, Ball & Wood engine for the Mann Building, Philadelphia, and one 8 × 10 in. engine for the boat "Havana." In the lighting department they have contracts under way for a central station at Overbrook, N. J.; the lighting of the Episcopal Hospital, Philadelphia: electrical equipment of the river boat "Havana;" and an arc plant for the pleasure pavilions at Brigantine Beach, N. J.

The American Tool & Machine Company, of Boston, whose factories are located at Hyde Park, Mass , and whose main office is at 84 Kingston Street, and which has been prominent in its special line for over thirty years, has just announced an important change in its officials. E. C. Huxley, who is well known in Boston's business circles, and who has earned for himself especial distinction in the line of mill construction work, becomes its president and general manager, and W. H. Hoffman, who has for a number of years been more or less associated with Mr. Huxley in his labors, and who was for a long period general superintendent of the Eastern works, at Hartford, Conn., of the Buckeye Engine Company, has been appointed the general superintendent of the company. The other officials of the company are M. H. Barker, chief engineer, W. O. Lincoln, treasurer, and M. M. Whipple, superintendent of the sales department. These gentlemen have been connected with the company for a long time, and are favorably known to the trade. It can be confidently stated that the future of this company promises to be unusually successful.

The Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa., reports through its St. Louis representative, Guido Pantaleoni, 608 American Central Building, that city, the sale of forty twenty-five horse power, single reduction motors to the Lindell Railway Company, of St. Louis. There are now 240 Westinghouse single reduction motors in use on this company's lines and those of the Compton Heights, Union Depot & Merchants' Terminal Railway and Taylor Avenue Railway Companies. The Westinghouse Company has gained the best possible reputation in St. Louis as elsewhere for the superiority of its motors, dynamos and everything else in the line of street railway equipments. It is also receiving its share of the electric lighting business. The Missouri Electric Light & Power Company, of St. Louis, has recently installed a large, direct coupled Westinghouse engine and generator in this plant. This is the largest incandescent lighting station in St. Louis, and its entire equipment of over 3,000 H. P. consists of Westinghouse apparatus only. The Southern Railway Company, of St. Louis, reports that it is highly pleased with the Westinghouse twenty horse power, single reduction motors, which were sold to it some time ago, and that its repair account has been greatly reduced as far as the Westinghouse motors are concerned.

The Gilbert & Barker Manufacturing Company, of New York, and Springfield, Mass., has issued a circular descriptive of the aerated fuel process of the company. By the system of this company oil is used as fuel, and at the burner is atomized and mixed with air. The flame, as a result, is clean, dry and smokeless, and, it is claimed, in every particular similar to that furnished by the purest of coal or natural gas. The company has found that by its system the amount of oil required to equal a ton of anthracite coal, is from 60 to 120 gals. Aside from the saving in first cost of fuel, the oil of course presents a great many advantages over coal. The number of users of this fuel is large, as will be seen at a glance over the testimonials received by the company. Among those manufacturers and corporations whose names are most familiar to street railway managers and who are using the system may be mentioned the following: Boston & Albany Railroad; Brooks Locomotive Works, Dunkirk, N. Y.; Chapman Valve Company, Indian Orchard, Mass.; Hall Steam Pump Company, Allegheny, Pa.; The Scovill Manufacturing Company, Waterbury, Conn.; Fibre Conduit Company, Orangeburgh, N. Y.; Berlin Iron Bridge Company, East Berlin Conn.; The Brownell & Company, Dayton, O.; Harlan & Hollingsworth, Wilmington, Del.; Rhode Island Locomotive Works, Providence R. I.; Libbey Glass Company, Toledo, O.; American Wire Glass Manfacturing Company, Philadelphia, Pa.; Okonite Company, Passaic, N. J.

The Consolidated Car Heating Company, of Albany, N. Y., whose electric heating system is well known, has decided to put on the American market an improved lighting system. As the result of most close and careful investigation the company has decided to adopt the Pope system, which is so widely used in Great Britain, and has acquired the ownership for, and sole right of introducing this system into the United States. In order that it may be thoroughly understood that the Pope system is in no way experimental, we may mention that it has been in operation on most of the large English railways since the year 1886, and that up to the present time over 14,000 cars have been equipped therewith by English railway companies, among them the following: London & Northwestern Railway Company, 3,693 cars; Lancashire & Yorkshire Railway Company, 2,942 cars; Great Northern Railway Company, 2,057 cars, and the North Eastern Railway Company, 835 cars. The company has already entered into contracts for equipping a considerable number of cars in the United States, and has begun or completed arrangements for the erection of gas plants at the principal railroad centers. The system is said to be interchangeable with the "Pintsch" system, and precisely the same gas may be used in both. The Consolidated Car Heating Company made an exhibit of the Pope system at the Master Car Builders' and Master Mechanics' conventions at Saratoga, and attracted considerable attention by the quality of material, excellent workmanship, and neatness of design of the apparatus exhibited there.

The Electrical & Mechanical Engineering & Trading Company, of New York, which was organized only a little more than a year ago, has already been awarded a large number of contracts. Among others may be mentioned the following: Contract for car house, cars, motors, trucks and generators for Hoosick Railway Company, Hoosick Falls, N. Y. Contract for an electric light station and complete equipment at Rumsen Neck, N. J., for Rumsen Improvement Company. Contract for electric lighting in new addition to Buckingham Hotel, New York City. Contract for underground conduit system, telephone system and electrical conductors for J. C. Hoagland and Raymond Hoagland, Rumsen Neck, N. J. Consulting engineers for Trinidad Electric Light & Power Company, Port of Spain, Trinidad. Contract for electric lighting system, underground conduits, pole line, etc., for Edward Kemp, Esq., Rumsen Neck, N. J. Supervising and consulting engineers for Poughkeepsie City & Wappinger Falls Electric Railway Company. This railway system will involve a 600 H. P. steam plant, compound, condensing engines and direct driven generators; there will be some fine long distance work, as one section of the road extends ten miles to the towns of Wappinger Falls and New Hamburg, operating cars in and between both towns. The plant will incorporate the use of Stirling boilers, compound, condensing Ball & Wood engines, direct driven General Electric generators and General Electric 800 motors. Mr. Vail gives all the business of his company his personal attention, and turns out none but the best of engineering and construction. The company has pleasant and commodious offices at 39 Cortlandt Street, and here may be found some of the most experienced engineers engaged in the business.

The United States Headlight Company, of Utica, N. Y., is the title of a new corporation organized with a capital of $1,500,000 to manufacture locomotive, electric, cable, motor car and other headlights. The company is well equipped for the manufacture of headlights, having purchased all the machinery, tools, patterns, etc., of the following well known companies: M. M. Buck & Company, The Dayton Manufacturing Company, Kelly Lamp Company, Steam Gauge & Lantern Company, I. A. Williams & Company, and The Adams & Westlake Company, together with thirty-two letters patent and a number of applications for patents, covering, it is claimed, all of the standard devices for illuminated numbers and signals in headlights and other desirable improvements therein. It is the intention of the United States Headlight Company to unite with the patents and facilities thus acquired, the result of over forty years' experience in manufacturing headlights, for the purpose of embodying in them the latest improved devices which will add to the design, convenience and durability; furnishing headlights for all purposes superior to any heretofore supplied, at the lowest possible price consistent with first class material and workmanship. Selling agents for this company will be conveniently located in the best distributing points of the country, who will carry in stock a full line of standard headlights and parts thereof, for the purpose of filling all orders promptly. This company having secured these valuable patents and assumed the litigation now in progress, railroads and others purchasing its goods will thereby protect themselves from action for infringement. The co-operation of buyers is earnestly solicited in recognizing the object in view and the patented rights it has acquired. While it is desirous to avoid controversy, it will, whenever necessary, ask the courts to sustain the validity of its patents.

WESTERN NOTES.

The Barney & Smith Car Company, of Dayton, O., has been awarded the contract for fifty-six of the 110 new cars recently ordered by the Cincinnati Street Railway Company.

James H. Harris, Chicago agent of the Heine Safety Boiler Company has removed his office from No, 28 McVicker's Theatre, where he has been located for seven years, to 1521 Monadnock Building.

The Lodge & Davis Machine Tool Company, of Cincinnati, O., has just shipped two carloads of machinery to be forwarded to its various customers in England, Germany, Austria and South America. This company's export business has increased fully 50 per cent. since the first of this year, which it attributes directly to its recent exhibit at the World's Fair.

The McGuire Manufacturing Company, of Chicago, writes us that it has purchased the Christensen air brake which has shown excellent results on a number of electric railways already. The McGuire Manufacturing Company is preparing to manufacture this air brake on a large scale and expects to offer it to street railway companies at a satisfactory price and with an absolute guarantee that the brake will do its work perfectly.

The Simplex Electrical Company, of Chicago, writes us that the relations heretofore existing, by which George Cutter has been acting as the company's Western selling agent, have been dissolved. The company's Chicago office will hereafter be located at 1137 and 1138 Monadnock Block, and H. R. Hixson, who has for some time been identified with the company's interests in Chicago, will be in charge. A stock of Simplex wire will be kept on hand, from which prompt shipments can be made.

The "Western Electrician," of Chicago, has published a circular entitled "Facts and Fancies." This contains a comparison of the advantages of an Eastern and a Western paper as an advertising medium, and is written in a bright and pithy style. Also included is an article on the publication offices of the "*Western Electrician*" accompanied by handsome engravings. We congratulate our Western contemporary on the success which it has made.

Philip G. Roeder, of Cleveland, O., has recently published an "Exporters' Handbook of Mexico" comprising a carefully revised list of bankers, merchants, professional men, etc., in the different cities of the republic of Mexico. The object of the book is to enable manufacturers to increase their trade in these cities by direct correspondence. The work includes the names of the steam railroads in the different cities, but not the street railway companies. The price of the book is $2.

The Partridge Carbon Company, of Sandusky, O., is the manufacturer of the Partridge self lubricating motor brush, which is giving good satisfaction on a number of leading railways. The company claims that dynamo users need have no more trouble with their commutators if they adopt these goods. The special points claimed for these brushes are that they will wear one-fourth longer, keep the commutator in perfect condition, and need no oil or grease of any kind. The company numbers among its customers a number of leading street railway companies.

The Ohio Brass Company, of Mansfield, O., as will be seen from the illustrated article in our reading columns has recently added a new device for a trolley wire support to its already complete line of construction material. The company is always on the lookout for new articles of merit which will interest the trade, and fill any wants. The company reports the manufacture of many special devices embodying the ideas of the operators of the local roads as the company's facilities for turning out this class of work are unsurpassed. Large orders and numerous inquiries are received with a regularity that cannot fail to be gratifying.

The Mason Electric Company, Chicago, finding its office and storeroom too small for its growing business, has secured a lease of the store, 7 Adams Street, directly opposite the Pullman Building. This location is one of the best in the city, and the store is well fitted for the purposes intended. The original company started by Mr. Mason was for several years at 11 Adams Street, where a large business was built up, which is being continued by the present company. The company confines itself to the manufacture and sale of electric railway supplies only and is a recognized authority in this particular line of business.

The Shultz Belting Company, of Broadway and Barton Street, St. Louis, controls a large portion of the leather belt trade between the United States and foreign countries. The company's agents in the principal cities of the world keep the home office constantly posted as to the wants of foreigners in the belt line, and many orders of this kind are the result. The Shultz Company recently received large orders from Russia and India. There is no reason for the company's large foreign trade, other than the unexampled superiority of its product and its correct method of doing business. The company's orders from various points in this country are very large, and its extensive works are in constant operation as a consequence of these and its foreign trade.

The Dodge Manufacturing Company, of Mishawaka, Ind., manufacturer of wood split pulleys and power transmitting machinery, has established a New York branch at 43 and 45 Dey Street, under the charge of S. W. Schuyler. The company will keep in stock here wooden pulleys of all sizes, shafting, hangers, rope transmission apparatus and, in fact, all machinery which enters into the power transmission line. The company will also have a small fitting machine shop at this place, where there will be facilities for the cutting of shafts, boring boxes, etc. Mr. Schuyler reports that the rope transmission business is growing, and that the company has taken a large number of contracts for its well known apparatus, including a number of orders for cast iron center, wood rim flywheels. The company has just opened a Boston office at 137 Purchase Street, in charge of F. W. Underwood.

The Buckeye Engine Company, of Salem, O., wishes to inform its customers and friends, through the Street Railway Journal, that in the June issue of that paper it was incorrectly stated that the Buckeye Company had just established a St. Louis office. This company has had an office in St. Louis for several years past. The office is not in the Security Building, that city, as stated in the item referred to, but at 511 Commercial Building. The company's St. Louis agent is A. M. Morse. This gentleman informs us that he has recently received an order for a 150 H. P. Buckeye engine from the Bloomington (Ill.) Electric Railway. This is the third Buckeye engine which has been purchased by that company. The vertical, cross compound Buckeye engine, which is being built in sizes from 150 to 1,000 H. P., is meeting with great favor for electric railway service, and the company reports a large number of new orders.

The Card Electric Company, of Mansfield, O., whose motor equipment was described in our last issue, is creating quite a stir among street railway men. The controlling stand has made quite a hit on account of its simplicity. On a central shaft are placed eight cams, insulated by hard rubber tubing, and held in place by hard rubber pins. Opposite each cam is a switch fastened by a bracket to the back, near the shaft. Each switch is provided with contact pieces to engage with clips on binding blocks fastened to the back. It is easy to see that the controller consists simply of a series of break switches, doing entirely away with all the inefficient sliding contacts, etc., so noticeably bothersome in other controllers. J. Holt Gates, 1139 40 Monadnock Building, Chicago, Western agent, reports many inquiries and an encouraging amount of work on hand. A recent catalogue gotten out by this company is very tasteful and carefully prepared to give full details on both motor and necessary apparatus. Card motors have been in operation for some months in Fremont and Mansfield, O., where they have given entire satisfaction.

The Independent Electric Traction Company, of the old Colony Building, Chicago, has secured the right to manufacture the Patton motors, the invention of W. H. Patton, of Chicago. The principle of this motor, which has been described in former issues, it will be remembered, consists of the combination of a gas engine, electric generator, storage battery and electric railway motor. The generator is driven by a gas motor and is used to start the battery which delivers the current to the motor as required. In this way a constant load is kept on the generator, which is of the shunt wound type. A car equipped with this system is now in operation on the Calumet Electric Railway line at 67th Street, Chicago, where it is running on an 8 per cent grade, and drawing a standard size trailer. The motor car seats comfortably thirty-six persons, although it is but sixteen feet long. The power required when pulling the trailer is not great, as the engine consumes but twenty gallons of gasoline during twelve hours' run. The expense of operation is said to be about $1 a day, and the car weighs 15,000 lbs., as against 12,000 lbs., the weight of a similar sized trolley car.

The Laclede Car Company, of 4500 North Second Street, St. Louis, informs us that its shops are full of work, that they have been so throughout the winter, and that from present prospects they will continue to be so during the summer. Most of the cars now building are for Philadelphia, Pa., and a number of other Eastern cities. The car company recently received an order from the Consolidated Traction Company, of Newark, N. J., for fifty open motor cars to be operated on the Jersey City, N. J., lines. These will be very similar to the open cars being sent by the car company to Philadelphia, Pa., being each equipped with two twenty-five horse power Westinghouse single reduction motors, extraordinarily large buffers, but with nine benches instead of eight. The Laclede Company also sent some very handsome motor cars to Washington, D. C., for the Brightwood Railway Company of that city. General Manager Robinson of the Laclede Company has recently put an electric motor car truck on the market with solid frame and embodying a number of new features. The truck was illustrated and its good points explained in the new catalogue recently issued from the company's offices. Mr. Robinson's patent sand box is now in use on the cars of some of the principal street railway companies of the United States.

The American Car Company, of St. Louis, reports business as very brisk with it at the present time. The company's paint shop, which will accommodate 160 cars at one time is now full. The other departments of the extensive works are also filled, in fact a great deal of work during the summer months is assured, and the management is very much encouraged at the prospects. Among the largest orders is a very large equipment of open cars for the lines of the Electric Traction Company of Philadelphia, Pa., also various sized orders for the Union Railway Company, of New York City; the West Chicago Street Railroad Company, of Chicago, Ill.; the Missouri Railroad Company's electric lines, St. Louis; and for a number of other points in the country, chiefly in the East. The Philadelphia cars are to be mounted on Bemis and McGuire trucks. Mr. Sutton, president of the car company and inventor of the "anti-concussion electric motor truck" reports that the latter is having a most successful trial on the Market Street electric line of the Missouri Railroad Company of St. Louis, and that the many advantages that were anticipated in this truck over others in the market have been fully realized. The patent street car door, also invented by Mr. Sutton, has already been placed on many cars turned out of the company's shops recently, among them a number to a point in Iowa, which have brought forth flattering testimonials as to the merits of the new door. The improved combined platform dash grab handle and bonnet support recently patented by the same gentleman and illustrated and described in this paper some time ago have also called forth many approvals from superintendents and managers of the street railway companies whose cars have been equipped with the same. The car company has been contemplating some large additions to its already extensive works, and if business continues as at present, it is the intention of the management to carry out the plans.

A Novel Advertisement.

A novel and striking advertising sign has recently been erected in front of the ticket office of the Big Four Route in Cincinnati. It is in the shape of a Maltese cross outlined by a large number of incandescent lights, and is fifteen feet in circumference. The lights are operated by a drum driven by a motor and carrying a large number of connections. In the daytime the sign attracts much attention from its remarkable appearance, but at night it can be seen for a long distance, and the effect is to be imagined rather than described. The current is switched through different sections, and finally the entire sign is illuminated, showing the names of the four cities, Cleveland, Cincinnati, Chicago and St. Louis, from which the road takes its name, as well as the words "Big Four Route." The sign was built from designs submitted by E. O. McCormick, passenger traffic manager of the road.

QUOTATIONS OF STREET RAILWAY STOCKS.

ALBANY STOCKS AND BONDS.—Corrected by SPENCER TRASK & Co., Bankers and Brokers, corner State and James Streets, Albany, N. Y., June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Albany R. R. Co.	100	750,000	Q Feb.	1½	1890	115	116
Watervleit Turnpike & R. R. Co.	100	240,000	.....	...	1863	3	.....

BONDS.	Date of Issue	Amount Out-standing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Albany R. R. Co., 1st Mort.	1865	40.000	J. & J.	5	1905	101½	.....
" " " 2d Mort.	1873	20,000	M. & N.	7	1893	101½	.....
" " " 3d Mort.	1875	28,500	J. & J.	7	1895	101½	.....
" " " 4th Mort.	1880	11,500	M. & S.	6	1905	100	.....
" " " 5th Mort.	1888	50,000	M. & S.	5	1913	101	.....
" " " Consol Mtg	1890	350,000	J. & J.	5	1930	102½	.....
" " " Debenture.	1891	200,000	M. & N.	6	1901	111	.....
Watervliet Turnpike & R. R., 1st Mort.	1889	350,000	M. & N.	6	1919	111	112
Watervliet Turnpike & R. R., 2d Mort.	1889	150,000	M. & N.	6	1919	110	113

BALTIMORE STOCKS AND BONDS.—Corrected by HAMBLETON & Co. Bankers, 9 South Street, Baltimore, Md., June 19. Stock quotations are prices per share,

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Balto. City Pass. Ry. Co.	25	2.500,000	Sem-an	4	.....	51	52
City & Suburban Ry. Co.	50	3,000,000	.....	1	.....	33	35
Central Pass. Ry. Co.	50	300,000	.....	...	.....	60	65
Balto. Traction Co. (Cable).	25	5,000,000	Quart.	1	.....	14¾	15

BONDS.	Date of Issue	Amount Out-standing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Central Pass. Ry.	1892	250,000	J. & J.	6	1912	110	112
" " " cons. mort.	1892	500,000	.....	5	.....	108½	109
City & Sub. Ry. Co. gen. mort	.....	2,000 000	J. & D.	5	1922	104¾	105
Balto. Traction Co. (Cable).	1899	1,500,000	M. & N.	5	1929	105½	106
Balt. Trac. Co., No. Balt. Div	1892	1,750,000	J. & D	5	1942	98	99
" " "	1891	1,250,000	M. & S.	6	1901	100	101
City Pass. R. R. Co.	1891	2,000,000	"	5	1911	112	112½

BOSTON STOCKS.—Corrected by R. L. DAY & Co., 40 Water Street, Members of Boston Stock Exchange, June 19. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
West End Pref.	50	$6,400,000	J. & J.	4	1887	76	77
West End Com'n	50	9,085,000	J. & J.	3	1890–1892	46	46¼

BROOKLYN STOCKS AND BONDS.—Corrected by C. E. STAPLES & Co., 215 Montague Street, Brooklyn, June 23. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Brooklyn City R. R. Co.	10	6,000,000	Q.—J.	2	.....	173	175
Brooklyn Traction Co., pref.	100	3,000 000	.....	...	1893	67	.....
" " common.	100	6,000,000	.....	...	1893	15	.....
Coney Island & Brooklyn R. R. Co.	100	500,000	Oct. 1.	4	.....	.....	144
Long Island Traction Co.	100	30,000,000			1893	15	15¼

BONDS.	Date of Issue	Amount Out-standing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Broadway R. R. Co.	.....	350,000	J. & J.	5	6m. notice	100	.....
Brooklyn Traction Co.	1893	3,000,000	.....	...	.....		
Coney Island & Brooklyn R. R. Co., 1st bonds	.....	300,000	J. & J.	5	Jan. 1909	102	.....
Coney Island & Brooklyn R. R. Co., certificates	.....	300,000	J. & J.	6	July, 1894	.....	.....
South Brooklyn Central R. R. Co., 1st.	.....	125,000	F. & A.	7	Aug. 1897	104	.....
South Brooklyn Central R. R. Co., 2d.	.....	150,000	F. & A.	6	July, 1941	100	.....
Brooklyn City R. R. Co., 1st.	.....	3,000,000	J. & J.	5	July, 1916	112	115

CHARLESTON STOCKS AND BONDS.—Corrected by A. C. KAUFMAN, Charleston, S. C., June 23. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Charleston City Ry. Co.	50	$100,000	J. & J.	0	.....	.....	65
Enterprise Ry. Co.	25	250,000	.....	...	.....	.....	5

BONDS.	Date of Issue	Amo'nt Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Charleston City Ry. Co.	.....	100,000	J. & J.	6	1915	.....	.....
Enterprise Ry. Co.	.....	50,000	J. & J.	5	1906	.....	.....

CHICAGO STOCKS AND BONDS.—Corrected by WILLIAM B. WRENN, 108 LaSalle Street, Chicago, Ill., June 23.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Chicago City	100	$9,000,000	Q.—J.	3	.....	305	.....
Chicago Passenger	100	1,000,000	A. & O.	2½	.....	1 0	.....
North Chicago City	100	500,000	Q.—J.	7½	.....	500	.....
North Chicago Street	100	5.500,000	J. & J.	4	.....	241	242
West Division City	100	1.250,000	Q.—J.	8¾	.....	625	.....
West Chicago Street	100	13,189,000	Q.—F.	1½	.....	137	137½

BONDS.	Date of Issue	Amount Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Chicago City	.....	4,619.500	J. & J.	4½	.....	101¾	102
Chicago Passenger	1883	400.000	F. & A.	6	1903	105	110
North Chicago City, 1st mort.	.....	500,000	M. & N.	6	1900	105	.....
" " "	.....	1,850.000	M. & N.	4½	1927	....	100
North Chicago Street 1st mort	.....	2,350.000	J. & J.	5	1906	.....	103½
West Chicago Street	.....	4.160.000	M. & N.	5	.....	103	103½
West Chicago Street, Tunnel	.....	1,500,000	F. & A.	5	.....	100	101½
" " " Deb. 6's	.....	2,000.000	J. & D.	6	.....	103¼	103½

CINCINNATI STOCKS AND BONDS.—Corrected by GEO. EUSTIS & Co., Bankers and Brokers, 26 West Third Street, Cincinnati, June 19. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Cincinnati	50	$7,500,000	Q.—J.	5	.....	105	105¼
Mt. Adams & Eden Park	50	1,600,000	Q.—J.	5	.....	106¾	107¼
Mt. Auburn Cable	100	300,000	.....	...	.....	.....	.....
Cin. Inclined Plane Ry	100	500,000	.....	...	.....	59½	60½
" " " Pref.	100	100.000	.....	6	.....	97	98½
Cin. Newport & Cov. St. Ry.	100	3,000,000	.....	.	.....	20½	22

BONDS.	Date of Issue	Amount Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Cincinnati Street	.....	50,000	J. & J.	7	July, 1894	100	.....
" "	.....	50,000	J. & J.	7	July, 1895	101½	104
" "	.....	50,000	J. & J.	7	July, 1896	104	106
" " extended	.....	100,000	J. & J.	4	.....	98	99½
	.....	150,000	J. & J.	5	.....	100½	101½
Mt. Adams & Eden Park	.....	50,000	A. & O.	6	July, 1895	101	103
" " "	.....	50,000	A. & O.	6	July, 1900	107½	110
" " "	.....	100,000	A. & O.	6	July, 1905	110½	111½
" " 10-20's	.....	200,000	J. & D	6	Je. '94-1924	102½	.....
" " Cable.	.....	250,000	M. & S.	5	Mar. 1906	104¾	105¼
Cin. Inclined Plane Ry.	.....	125,000	J. & J.	7	July, 1899	107	108
" " " "	.....	300,000	J. & J.	6	Jan. 1914	105	106
Mt. Auburn Cable	.....	200,000	J. & D.	5	June, 1907	.....	.....
" " " 5-20's 2d.	.....	100,000	A. & O.	7	Ap. '93-1908	.....	.....
S. Covington & Cincinnati	.....	250,000	M. & S.	6	Mar. 1912	114	115
S.Cov.& Cin. 2d Mort. gold 6's	.....	250,000	J. & J	...	1932	113½	114½

CLEVELAND STOCKS AND BONDS.—Corrected by W. J. HAYES & SONS, Bankers, Cleveland, O., June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
The Cleveland Electric Ry. Co	100	12,000,000	.....	....	1893	48	49
The Cleveland City Ry. Co.	100	8,000,000	.....	....	1893	57	60

BONDS.	Date of Issue	Amount Out-standing	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
The Cleveland Electric Ry. Co.	1893	2.000,000	M.—S.	5	1910	101	102½
" " City " "	1893	2.349 000	.....			95	96

DETROIT STOCKS.—Corrected by CAMERON CURRIE & Co., Bankers and Brokers, 82 Griswold Street, Detroit, June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Fort Wayne & Belle Isle Ry. Co.	100	$250,000	.....	...	.....	200	.....
Detroit Citizens Street Ry. Co.	100	2,000,000	.....	...	.....	.....	100
Wyandotte & Detroit River Ry.	100	200,000	.....	...	.....	100	110

HOLYOKE STOCKS.—Corrected by J. G. MACKINTOSH & Co., Bankers, Holyoke, Mass., June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
Springfield Street R. R. Co.....	100	1,000,000	J. & J.	4	.....	210	225
Holyoke Street R. R.....	100	250,000	J. & J.	4	.....	200	225
Northampton Street R. R.....	100	50,000	.....	...	.....	125	150

LOUISVILLE STOCKS AND BONDS.—Corrected by ALMSTEDT BROS. Stock and Bond Brokers, 510 West Main Street, Loulsville, Ky., June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Loulsville St. Ry, Co., pref...	100	$1,000,000	A. & O.	5	Jan. 1891	87	88
Louisville St. Ry. Co., com....	100	5,000,000	.....	...	Jan. 1891	37	38

BONDS.	Date of Issue	Amount Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Louisville St. Ry. Co., 1st mort	1890	6,000,000	J. & J.	5	1930	100	101
Louisville City Ry. Co. Cons .	1884	1,000,000	J. & J.	6	1909	115	116
Central Passenger Ry. Co....	1888	400,000	M. & N.	6	1908	115	116
New Albany St. Ry. 1st Mort.	1888	150,000	J. & J.	6	1913	85	90

NEW HAVEN STOCKS AND BONDS.—Corrected by H. C. WARREN & Co., Bankers and Brokers, New Haven, Conn. June 19. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
F. Haven & Westville R. R. Co.	25	$600,000	J. & J.	4	.....	45	47
State Street Horse R. R. Co....	25	23,000	J. & J.	3	.....	40	.....
New Haven & W. Haven R.R.Co	25	.....	.....	...	.....	.....	.....
New Haven & Centville H. R. Co.	.....	.....	.....	...	.....	.....	.....
Whitney Ave. Ry. Co.....	50	25,000	.....	...	.....	7	.....
Bridgeport Horse R. R. Co.....	100	140,000	.....	...	.....	.....	.....
Hartford & Wethersfield Horse R. R. Co.....	100	200,000	J. & J.	3	.....	125	.....

BONDS.	Date of Issue	Amo'nt Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
State Street Horse R. R. Co...	1874	20,000	J. & J.	7	Aug.1,1894	104	.....
New Haven & W. Haven R. R. Co	1892	500,000	M. & N.	5	Nov. 1912	100	102
Bridgeport Horse R. R. Co.....	.....	50,000	.....	6	.....	.....	.....
Hartford & Wethersfield Horse R. R. Co., Deb. Series A.....	1888	100,000	M. & S.	5	Sept., 1908	.....	.....
Hartford & Wethersfield Horse R. R. Co., Deb. Series B....	1890	100,000	M. & N.	5	May, 1910	.....	.....
Hartford & Wethersfield Horse R. R. Co., Deb. Series C.....	.....	100,000	M. & N.	5	May, 1910	.....	.....

NEW ORLEANS STOCKS AND BONDS.—Corrected by GEORGE LE SASSIER, 188 Common Street, New Orleans, La., June 22. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Carrollton R. R. Co.	100	1,200,000	Quart.	1½	1867	124¾	128
Crescent City R. Co.....	100	1,150,000	"	3	1866	80	89
Canal & Claiborne R. R. Co..	40	240,000	Semi.	2½	1888	38	40
New Orleans City & Lake Co.	100	1,500,000	Quart.	2⅛	1860	107⅛	112
Orleans R. R. Co.....	50	185,000	"	2	1868	32	.....
St. Charles Street R. R. Co ..	50	600,000	"	2½	1865	55	58

Bonds.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Canal & Claiborne Sts. R. R.	1892	150,000	M & N	6	1912	.....	.....
Crescent City R. R. 1st Mort.	1883	75,000	M & N	6	'95-'99	.....	.....
do do new	1886	40,000	M & N	6	1896	.....	.....
N. O. City R. R. Co.....	1879	416,500	J & D	6	1903	113½	116
N. O. & Carrollton R. R. Co..	1882	250,000	F & A	6	'97-'06	.....	.....
N. O. City & Lake R. R. Co., 1st Mort.....	1893	1,725,000	J & J	5	1943	.....	100
St. Charles Street R. R. Co...	1881	120,000	J & D	6	'93-'01	.....	.....

MONTREAL STOCKS AND BONDS.—Corrected by GORDON STRATHY & Co. Members Montreal Stock Exchange, 9 St. Sacrament Street, June 19. Stock quotations are per cent. values.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Montreal St. Ry. (old stock)	50	$2,000,000	M. & N.	4	May, '91.	148¾	149
" " (new stock)	50	2,000,000	.....	...	May, '94.	144	144½

BONDS.	Date of Issue	Amount Out-standing.	Inter-est Period.	%	Principal Due.	Bid.	Ask'd
Montreal St. Ry.....	1885	£60,000	.....	5	1905	.....	.....
	1893	700,000		4½			

NEW YORK STOCKS AND BONDS.—Corrected by JAMES MCGOVERN & Co., 6 Wall St., New York, June 23.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Bleecker St. & Fulton Ferry...	100	900,000	J. & J.	¾	.....	25	30
Broadway & Seventh Avenue..	100	2,100,000	Q.—J.	2½	.....	185	188
Cen'l Park, North & East River	100	1,800,000	Q.—J.	1½	.....	1 0	155
Central Crosstown.....	100	600,000	Q.—F.	1¾	.....	140	.....
Dry Dock, E. B'way & Battery.	100	1,200,000	Q.—F.	2	.....	132	135
42d & Grand St. Ferry.....	100	748,000	Q.—F.	4	.....	300	.....
42d St., Manhat. & St. Nich. Av.	100	2,500,000	.....	...	.....	50	55
Eighth Avenue.....	100	1,600,000	Q.—J.	3	.....	250	.....
Houston, W. St. & Pav. Ferry.	100	1,000,000	Q—F.	2	.....	200	.....
Second Avenue.....	100	1,862,000	Q.—J.	1	.....	132	135
Sixth Avenue.....	100	1,500,000	Q.—J.	1¾	.....	148	.....
Third Avenue.....	100	5,000,000	Q.—M.	4	.....	182	184
23d St.....	100	600,000	Q.—F.	2½	.....	290	.....
Ninth Avenue.....	100	800,000	Q.—J.	1½	.....	139	.....
Union Railway Co.....	100	2,000,000	.....	...	.....	.....	.....

Bonds.	Date of Issue	Amount.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Bleecker St. & Fulton Ferry...	.....	700,000	J. & J.	7	July, 1900	108	111
B'way & 7th Ave., 1st mort....	.....	1,500,000	J. & D.	5	June, 1904	106	.....
2d mort.....	.....	500,000	J. & J.	5	July, 1914	106	.....
Broadway Guaranteed 1sts....	.....	1,125,000	J. & J.	5	July 1924	106	.....
" 2ds interest as rental	.....	1,000,000	J. & J.	5	July, 1905	103	.....
Broadway Consolidated.....	.....	7,650,000	J. & J.	5	 1943	108	109
Cen'l Park, North & East River	.....	1,200,000	J. & D.	7	Dec., 1902	110	.....
Central Crosstown—1st mort..	.....	250,000	M. & N.	6	Nov., 1922	115	120
Dry Dock, E. B'way & Battery, 1st mort.....	.....	.....	J. & D.	5	 1932	105	.....
Scrip (can be called at par)..	.....	1,200,000	F. & A.	6	Aug. 1914	99	100
42d St. Manhat. & St. Nich. Av 1st mort.....	.....	1,200,000	M & S.	6	Sept., 1910	110	112
2d mort. income bonds.....	.....	1,200,000	J. & J.	6	.1915	55	.....
Eighth Ave., Scrip.....	.....	1,000,000	F. & A.	6	Aug., 1914	100	105
Houston, W. St. & Pav. F'ry, 1st	.....	500,000	J. & J.	7	July, 1894	100	.....
Second Avenue, 1st mort.....	.....	1,600,000	M. & N.	5	Nov., 1909	102	.....
Third Avenue.....	.....	5,000,000	J. & J.	5	Jan., 1937	118½	120
Union Railway Co.....	.....	2,000,000	F. & A.	5	Feb., 1942	.....	.....

PHILADELPHIA SECURITIES.—Corrected by HUHN & GLENNINNING, 143 South Fourth st. (Bullitt Building), Philadelphia, June 19. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Citizens'.....	50	$500,000	Q.—J.	4	1858	260	265
Continental.....	50	1,000,000	J.—J.	6	1873	124½	126
Frankford & Southwark.....	50	1,250,000	Q.—J.	5	1854	307½	310
Germantown.....	50	1,500,000	Q.—J.	2¼	1858	111	112
Green & Coates...	50	500,000	Q.—J.	3	1858	123	125
Hestonville.....	50	2,050,000	.....	...	1859	35	40
Lombard & South.....	25	500,000	A.—O.	8	1861	90	90
People's Traction Co.....	50	10,000,000	.....	...	.....	34½	35
Philadelphia City.....	50	1,000,000	J.—J.	7½	1859	155	160
Philadelphia & Gray's Ferry..	50	617,500	J.—J.	3½	1858	80	85
Philadelphia Traction (50 pd.)	50	7,000,000	M.—N.	3	1883	105	106
Ridge Avenue.....	50	750,000	Q.—J.	5	1872	227	235
Second & Third.....	50	1,060,200	Q.—J.	5	1853	207	210
Thirteenth & Fifteenth.....	50	1,000,000	J.—J.	9	1858	232	240
Union.....	50	1,250,000	J.—J.	9½	1864	199	200
West Philadelphia.....	50	750,000	J.—J.	10	1857	200	210
Metropolitan (N.Y.) Traction	100	30,000,000	Q.—F.	1	.....	114	114½
Baltimore Traction.....	25	5,000,000	.....	1	1889	16	16¼
Buffalo (N. Y.) Railway.....	100	6,000,000	.....	...	.....	52	54
Newark (N. J.) Passenger....	100	6,000,000	.....	...	.....	25	29
Pitts. & Birmingham Trac. Co.	50	3,000,000	J.—J.	...	.....	12½	12¾

BONDS.	Date of Issue	Amount Out-standing	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Baltimore Traction 1st Mort .	1889	1,500,000	M.—N.	5	1929	107¾	108¾
" " Imp.	1892	1,250,000	M.—S.	6	1901	101	102
Balt. Tr., No. Balt. Div., Gold	1892	1,750,000	J. & D.	5	1942	100¾	102
Germantown, 1st mort.....	.....	67,000	J.—D.	5	1904	105	.....
" 2d mort.....	.....	160,000	A.—O.	5	1899	103	.....
Hestonville, 1st mort.....	.....	300,000	M.—N.	6	1895	103½	.....
" " "	.....	124,500	J.—J.	6	1901	105	.....
" 2d mort.....	.....	75,000	M.—S.	6	1902	105	.....
People's, 1st mort.....	.....	219,000	J.—J.	7	1905	115	.....
" "	.....	285,000	J.—J.	5	1911	100	.....
" Cons. mort.....	.....	247,000	M.—S.	5	1912	95	.....
West Philadelphia, 1st mort..	.....	246,000	A.—O.	6	1906	117	.....

OMAHA STOCKS AND BONDS.—Corrected by RICHARD C. PATTERSON, Banker and Broker, 907 N. Y. Life Building, Omaha, Neb., June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Omaha St. Ry. Co.	100	5,000,000	M. & N.	....	Jan. 1, '89	60	.....
BONDS.	Date of Issue	Am't Out-stand-ing.	Inter'st Paid.	%	Principal Due.	Bid.	Ask'd
Omaha St. Ry. Co.	1889	2,250,000	M. & N.	5	M'y 1, 1914	95	98

PITTSBURGH STOCKS AND BONDS.—Corrected by JOHN B. BARBOUR, Jr., 306 Times Bldg., Pittsburgh, Pa., June 22. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Central Traction R. R. Co.	50	1,500,000	.....	...	.....	19¼	20
Citizens' Traction R. R. Co.	50	3,000,000	J. & J.	3	.....	61	62
Pitts. & Birmingham R. R. Co	50	3,000,000	.....	...	.....	12½	12⅝
Pittsburgh Traction R. R. Co.	50	2,500,000	.....	3	.....	...	65
Federal St. & Pleasant Valley	25	1,400,000	J. & J.	3	.....	19½	20¼
Pittsburgh, Allegheny & Man	50	3,000,000	.....	1¼	.....	39	40
West End R. R. Co.	50	200,000	J. & J.	...	.....	...	21
Second Avenue R. R. Co.	50	300,000	J. & J.	3	.....	.....	.....
Penn Incline Plane Co.	50	250,000	.....	...	.....	.....	.....
Monongahela Incline Plane Co	50	140,000	F. & A.	...	.....	...	.....
Fort Pitt Incline Plane Co.	50	60,000	.....	...	.....	.....	.....
Mount Oliver Incline Plane Co	50	100,000	J. & J.	3	.....	.....	.....
Pittsburgh Incline Co.	100	150.000	J. & J.	5	.....	.....	.....
Duquesne Traction Co.	50	3,000,000	.....	...	.....	26½	26¾
BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Citizens' Traction R. R. Co.	1887	1,250,000	A. & O.	5	1927	107	110
Pittsburgh Traction R. R. Co.	1887	750,000	A. & O.	5	1927	106	110
Pitts. & Birmingham Traction Co.	1892	.....	.....	5	.....	.....	.....
Pleasant Valley Ry.	1892	1,250,000	J. & J.	5	1919	.....	100
P., A. & M. R. R. Co.	1891	1,500 000	J. & J.	5	1931	103¾	104
Duquesne Traction Co.	1890	1,500,000	J. & J.	5	1930	103	103¼
Second Ave. Electric R. R. Co	1889	1,500,000	J. & J.	5	1909	.....	.....
Central Traction Co.	1889	375,000	J. & J.	5	1919	.....	.....
Union R. R. Co.	1881	100,000	A. & O.	5	1901	.....	.....
West End R. R. Co.	1887	75,000	J. & J.	5	1922	101	102
Birmingham, Knoxville & Allentown Tract. Co.	.....	.....	.....	6	.....	.....	.....
Suburban Rapid Transit.	.....	.....	.....	6	.....	.....	.....
Fort Pitt Incline Plane Co.	1881	30,000	.....	6	1901	.....	.....
Mount Oliver Incline Plane Co	1871	44.500	M. & N.	6	1901	.....	.....
Penn Incl'e Plane Co. 1st Mort	1883	125,000	.....	6	1903	.....	.....
Monongahela Incl'e Plane Co.	1887	50,000	A. & O.	5	1897	.....	.....
Pittsburgh Incline Co.	1889	250,000	J. & J.	6	1919	.....	.....
Manchester	.....	.....	.....	...	.....	103	103½

PROVIDENCE STOCKS AND BONDS.—Corrected by CHACE & BUTTS Bankers, Providence, June 19.

Company	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
United Traction & Electric Co.	100	.....	.....	...	.....	...	.....
BONDS.	Date of Issue	Amo'nt Out-stand'g	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
United Traction & Electric Co.	1893	8,000,000	M & S	5	1993	97½	100
Newport St. Ry. Co.	.....	50.000	J & D	5	1910	100	.....

ROCHESTER, BUFFALO, PATERSON, COLUMBUS, WORCESTER AND BOSTON STOCKS AND BONDS.—Corrected by E. W. CLARK & Co., 139 So. Fourth St. (Bullitt Building), Philadelphia, June 19.

Company.	Par.	Capital.	Period.	% last div	Date of Issue.	Bid	Ask'd
STOCKS.							
Rochester (N.Y.) Ry.	100	5,000,000	.....	...	1890	30	35
Buffalo (N.Y.) Ry.	100	6,000,000	.....	...	1891	60	61
Paterson (N. J.) Ry.	100	1,250,000	.....	...	1891	13	20
Columbus (O.) St. Ry.	100	3,000,000	Q.—F.	1	1892	39	40
North Shore Traction Co. (Boston) Pref.	100	2,000,000	A.—O.	6	1892	60	80
do do Common.	100	4,000,000	.....	...	1892	18	20
Worcester Traction Co. Pref	100	2,000,000	F.—A.	6	1892	68	80
do do Common.	100	3,000,000	.....	...	1892	15	20
Consol. Trac. Co. (N. J.)	100	.....	.....	...	1893	35	38
BONDS.	Date of Issue	Amount Out standing.	Inter-est Paid.	%	Principal Due.	Bid	Ask'd
Rochester (N.Y.) Ry.	1890	3,000,000	A & O	5	1930	93	95
Buffalo (N.Y.) Ry.	1891	5,000 000	F & A	5	1931	99	99½
Paterson (N. J.) Ry.	1891	850.000	J & D	6	1931	85	95
Newark (N. J.) Pass. Ry.	1890	6,000 000	J & J	5	1930	98	100
Columbus (O.) St. Ry.	1892	2,000,000	J & J	5	1932	90	95
Consol. Trac. Co. (N. J.)	1893	.....	J & D	5	1933	86	88

SAN FRANCISCO STOCKS AND BONDS.—Corrected by PHILIP BARTH, Broker, 440 California Street, San Francisco, Cal., June 19.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
California St. Cable Co.	100	1,000,000	Monthly	...	.....	.....	100
Geary St., Park & Ocean R.R. Co	100	1,000,000	Monthly	...	.....	.....	102
Market Street Cable Co.	.....	18,750,000	.....	...	.....	37½	38
Metropolitan Electric	.....	1,000.000	Monthly	...	.....	.....	35
Presidio & Ferries R. R. Co.	100	1,000,000	.....	...	.....	15	20
Sutter St. R. R. Co.	.....	2,000.000	Quart'ly	...	.....	90	.....
Bonds.	Date of Issue	Am't Out-stand-ing.	Interest Paid.	%	Principal Due.	Bid.	Ask'd
Cal. St. Cable R. R.	.....	.....	J. & J.	5	.....	.....	106¼
Ferries & Cliff House	.....	650,000	M. & S.	6	1914	107	.....
Geary St., Park & Ocean	.....	671.000	A. & O.	5	.....	102½	.....
Market Street Cable Co.	.....	3,000,000	J. & J.	6	1913	120¼	.....
Omnibus Cable Co.	.....	2,000,000	A. & O.	6	1918	114	.....
Park & Ocean R. R.	.....	250,000	J. & J.	6	1914	.....	116¾
Park & Cliff House R. R.	.....	350.000	J. & J.	6	.....	.....	106
Powell Street R. R.	.....	700.000	M. & S.	6	1912	111½	112
Sutter St. Cable Co.	.....	900,000	M. & N.	5	.....	107⅞	.....

ST. LOUIS STOCKS AND BONDS.—Corrected by JAMES CAMPBELL, Banker & Broker, Rialto Building, 218 N. 4th St., May 19. Stock quotations are prices per share.

Company.	Par.	Capital Issued.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Cass Ave. & Fair Grounds.	100	2,500,000	.....	...	1876	50	65
Citizens'	100	1,500,000	Oct. '93	4	1887	80	85
Jefferson Avenue.	100	112,000	Dec. '88	2	1885	125	150
Lindell	100	2,500,000	.....	...	1890	85	86
Missouri.	100	2,000,000	Q.—J.	2	1891	190	210
People's.	50	1,000,000	Dec. '89	50c	1899	20	25
St. Louis.	100	2,000,000	J. & J.	3½	1890	145	150
Fourth Street & Arsenal.	50	150,000	.....	...	1872	5	10
Union Depot	100	4,000,000	Jan. '94	8	1890	150	200
St. Louis & Suburban	100	2,500,000	.....	...	1891	10	20
Southern, Pfd.	.....	800 000	Jan. '94	3	.....	80	85
" Com.	.....	700,000	.....	...	.....	15	25
BONDS.	Date of Issue	Amount Out-stand-ing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Cass Avenue & Fair Ground.	1892	1,800,000	J. & J.	5	1912	98½	100
Citizens' Cable	1887	1,500.000	J. & J.	6	1907	104	106
Fourth St. & Arsenal	1888	50.000	J. & J	6	1898-1903	98	100
Lindell	1890	1,500.000	J. & J.	5	1895-1910	102	103
Missouri Cable	1887	500,000	M. & S.	6	1907	100	102
People's 1st mort.	1882	125,000	J. & D.	6	1902	99	100
" 2d mort.	1886	75,000	M. & N.	7	1902	100	102
People's Cable	1889	800.000	J. & J.	6	1889-1914	90	95
St. Louis Cable	1890	1,500,000	M. & N.	5	1900-1910	100	102
Union Depot	1890	4,000.000	A & O.	6	1900-1910	104	105
Southern	1884	200.000	M. & N.	6	1904	103	105
Southern	1889	300.000	M. & N.	6	1909	100	104
St. Louis & Suburban	1891	1,400.000	F. & A.	5	1921	84	86
St. Louis & Suburban (incomes)	1891	300,000	.....	6	.....	70	80

WASHINGTON STOCKS AND BONDS.—Corrected by CRANE, PARRIS & Co., Bankers, 1344 F Street, N.W., Washington, D. C., June 21. Stock quotations are prices per share.

Company.	Par.	Capital.	Period.	% last div.	Date of Issue.	Bid.	Ask'd
STOCKS.							
Wash'ton & Georgetown R.R.	50	500,000	Q. F.	5	1863	285	310
Metropolitan R. R.	50	750,000	Q. J.	2	1864	92	95
Columbia R. R.	50	400,000	Q. M.	1	1870	60	65
Belt R.R.	50	500,000	Q. J.	...	1875	39	.....
Eckington & Soldiers' Home.	50	352,000	.....	...	.....	32	.....
Georgetown & Tenallytown.	50	200,000	.....	...	.....	.....	.....
Rock Creek R. R.	100	401,700	.....	...	.....	.....	.....
Glen Echo R. R.	50	100,000	.....	...	.....	.....	.....
BONDS.	Date of Issue	Amount Out-standing.	Inter-est Paid.	%	Principal Due.	Bid.	Ask'd
Wash'tn & Geo'tn conv't. 1st.	'83-'99	3.000,000	J. & J.	6	1899-1929	.....	.....
" " " 2d	.....	500,000	J. & J.	6	1903-1943	.....	.....
Eckington & Soldiers' Home.	.....	150,000	J. & D.	6	1896-1911	.....	.....
Belt.	1921	240,000	J. & J.	6	1921	.....	.....
Metropolitan R. R. convert.	1901	200,000	J. & J	5	1901	.....	.....
Anacostia R. R.	.....	200,000	A. & O.	6	1901-1931	.....	.....

New York Street Railway Stock Market.

JUNE 26, 1894.

Despite the lack of activity attending all speculative markets, the street railway stock and bond market during the month now drawing to a close has not been unattended with developments of a character to lend individuality to the trading line. There has been a decided falling off in the last few weeks from the spirited demand from investment sources for street railway securities, at one time so marked a feature of the financial situation, but, when it is remembered that prices for this class of securities have, by reason of the discrimination made in

their favor as against steam railroad mortgages, been brought to a point where the returns on the capital invested are on the lowest basis known in years, it is not remarkable that the demand should evidence some slackening. The chief reason for the existing high prices for street railway securities—*vide* Third Avenue Railroad 5 per cent. bonds selling as high as 119—has been the easy money market. With call loan rates ruling at 1 per cent., the moneyed people have been seeking other safe fields for making their capital profitable, and a good deal of the idle money has been turned into the street railway field. Should money, however, become more active and rates consequently advance, banks and other money lenders will return to their ordinary business, and prices for street railway bonds, as for municipal bonds and other purely investment issues, must go lower. But it seems as if easy money must continue to rule for some time. The first of July is now on hand and it is figured that about $75 000,000 cash is needed for dividend and interest disbursements on that day, yet the holding back by banks of this enormous sum to meet these payments has not had the slightest effect. There is so much money that the hoarding of $75,000,000 for a few weeks plays no part at all. It is argued, moreover, that within a week all this money will be in circulation again and will itself be seeking investment. Hence, present prices for good local street railway shares and mortgages may be expected to rule for some time.

Third Avenue shares have been the chief source of attraction. In the first place Wall Street continues to be regaled with stories of big earnings It is undoubtedly true that the introduction of the cable has been a source of tremendous profit and, now that the excursion business has set in with the advent of hot weather, the road must coin money. Indeed, the payment of quarterly 4 per cent. dividends on the increased capital stock—and with something to spare—is ample substantiation of the management's claims. The large system of transfers inaugurated during the past six months is of the greatest value to the road, in that it has aroused the popular favor, and that means big business.

But the most interesting development of the month is the fight begun between the Third Avenue Railroad people and the big Metropolitan Traction Company for the acquisition of a franchise to operate a cable or underground trolley road on St. Nicholas and Manhattan Avenues between 125th Street and Kingsbridge. The Third Avenue made application to the Board of Aldermen for this franchise nearly a year ago and has secured the consent of a large number of property owners to the project. Counsel and the management of the road insist that they have the best claim and that they will win. On the other hand the Metropolitan Traction Company is just as confident of securing possession of this valuable territory, and, when it is remembered how the tremendous political "pull" which the big combine has with Tammany Hall has secured for it at other times, permission to lay tracks in the city when and where it lists, its boast of final victory in this fight must not be considered mere talk. The matter will not be definitely decided for some time yet, but the varying chances of success are in the meantime lending some zest to the speculation in either stock. Should the Third Avenue win it will be obliged to issue a few millions more stock or bonds to provide funds for the extension, but all necessary arrangements have already been completed to secure the capital needed.

It must not be thought that the dealings in the Third Avenue and Metropolitan Traction have overshadowed all the other street railway shares. Second Avenue still is traded in with "mystery on," as the Wall Street phrase has it. No one can accurately trace the source of the continued buying orders and the belief that some big syndicate—Metropolitan or a new one is hinted at—is quietly picking up a controlling interest meets with a deal of belief, and not without cause. Be this as it may, there is sufficient demand for the stock to keep it steady around 134. Then several of the crosstown stocks have been freely traded in. The air this month has been full of new consolidations and extensions, and, while no definite facts have developed, the very uncertainty has made the trading a trifle more exciting than is wont to be noticed. 42nd Street shares and the stock of the Dry Dock, East Broadway & Battery have been much sought after and quotations are all higher. Sixth & Ninth Avenue shares do not move much. They are now held so closely that very little of the stock comes to market, and, as their dividends are guaranteed, the facts concerning them are too settled to warrant of any speculation on future happenings. The same comment may be made as to the old Broadway stock.

Brooklyn and Long Island street railway shares have furnished more activity. The Brooklyn Traction and the Long Island Traction Companies practically divide the field across the river, and so all trading is practically confined to the dealings in these shares Long Island Traction, which is dealt in on the New York Stock Exchange, was rather weak at one time on free and easy sales by insiders, on the announcement that the old Flynn suit to break the lease of the Brooklyn City and other roads was to be pushed to an end, but nothing has come of this and the big earnings reported by the Brooklyn City Railroad, the Brooklyn Heights road and other branches have brought about a recovery from the low price scored in the beginning of the month. Brooklyn Traction quotations have not changed much and the dealings have been without significance.

With the hot weather now at hand, and with speculation in all directions devoid of public interest, the outlook for activity in the street railway stock and bond market is hardly satisfactory, but the easy money market assures the continuance of existing good prices.

Financial.

$500,000 first mortgage 5 per cent. gold bonds have been issued by the Westchester (N. Y.) Electric Railroad Company. The bonds are due 1943, and are guaranteed by the Union Railway Company of New York. The Mercantile Trust Company, of New York, is trustee of the mortgage.

$ $ $

A receiver for the Steubenville (O.) Street Railway Company has been asked by the Sprague Electric Railway & Motor Company and others.

$ $ $

Justice Vann has appointed Edward F. Rice as a second receiver for the Syracuse (N. Y.) Consolidated Street Railway Company. Ald. P. J. Much is the first receiver.

$ $ $

The stockholders of the Pasadena (Cal.) & Los Angeles Electric Railway Company, of Pasadena, Cal., were to vote July 2 on the proposition to issue $350,000 in bonds.

$ $ $

The following is a comparative statement of the operations of the Columbus (O.) Street Railway Company for the month of May: Gross earnings, 1894, $59 367.36; 1893, $47,546 79; increase, $1,820.57. Operating expenses, 1894, $23,055.81; 1893, $28,954 20; decrease $5 898.39. Net earnings, 1894, $26,311.55; 1893, $18,592.59; increase, $7,718.96.

$ $ $

The entire plant of the Tampa (Fla.) Street Railway & Power Company, it is reported, was sold June 4, at 1:45 o'clock, in front of the court house by T. C. Taliaferro, the receiver. It was purchased by J. Rush Ritter, a capitalist of Philadelphia, and a large stockholder in the company, for $70,055. There was but one other bidder, Edward Manrara.

$ $ $

The following is a comparative statement of the operations of the North Shore Traction Company for the month of April: Gross earnings, 1894, $88,421.21; 1893, $85,163; increase, $3,258 21. Operating expenses, 1894, $52,980.14; 1893, $63,137.58; decrease, $10,157.44. Net earnings, 1894, $35,441.07; 1893, $22,025.42; increase, $13.415.65.

$ $ $

The following is a comparative statement of the operations of the Brooklyn (N. Y.) Traction Company for the month of May: Gross earnings, 1894, $80,466.86; 1893, $74,196.55; increase, $6,270.31. Operating expenses, 1894, $50,880.47. From operation, 1894, $29,586,39. Miscellaneous receipts, 1894, $1,488.40. Net earnings, 1894, $31,074.79. We have no data showing the operating expenses and net earnings for the corresponding month of 1893.

$ $ $

The report of the Buffalo (N. Y.) Railway Company for May shows a gratifying increase in gross earnings of $5,250.43 over those of the preceding year. This increase is larger, by $1,740.79, than that shown for April. The report for May in full is as follows: Gross earnings, 1894, $132 654.04; 1893, $127,403.61; increase, $5,250.43. Operating expenses, 1894, $72,924.39; 1893, $76,744.05. decrease, $3,819.66. Net earnings, 1894, $59.729.65; 1893, $50,659.56; increase, $9,070.09.

$ $ $

The Worcester (Mass.) Traction Co. reports a gratifying increase in gross earnings for May. Through careful management the operating expenses were kept more than $8,000 less than last year, making a handsome showing in net earnings. The report in detail is given below:

	1894.	1893.		
Gross earnings.....	$32.927.45	$31,836.00	Increase,	$1.091.45
Operating expenses	14,467.22	22,758.90	Decrease,	8,291.68
Net earnings.....	$18,460.23	$9,077.10	Increase,	$9,383.13

$ $ $

The Governing Committee of the Baltimore Stock Exchange, upon application of the City Passenger Railway Company, of that city, has decided to list 100,000 shares, $25 each, or $2,500,000 City Passenger stock. The company, in its application, makes the following statement.

The earnings of the company have been as follows:

	GROSS.	NET.
1891.	$835,400.43	$86,233.40
1892.	780 388.29	85,712.54
1893.	794,450.24	128,102.89

There are 45 miles of completed road—21.6 cable, and 23.4 electric.

The equipment consists of 194 cars, used on cable and electric roads.

STATEMENT, MAY 25, 1894.

Assets.

Cash		$ 272,509.03
Property account		4,347,342 49
Circuit Railway Co		5.000 00
Consolidated Gas Bonds		7,000.00
Bills receivable		256.00
		$4,632,107.52

Liabilities.

Capital stock paid	$2,494,610	
Installments unpaid	5,390	
		$2,500,000.00
Bonds		2,000,000.00
Surplus		132,107 52
		$4,632,107.52

THE directors of the Brooklyn Heights Railroad Company decided at a meeting June 29 to default upon the payment of the quarterly dividend of 2½ per cent. to the stockholders of the Brooklyn City Railroad Company. President Lewis said that the default in payment would not affect the stockholders of the Brooklyn City Company, as they will receive their dividends as usual, there being a guarantee fund which can be used. The Heights Company deposited $4 000,000 as a guarantee of the payment of $1,200,000 rental, and $250,000 of this can be used to meet the default. The Heights Company has decided to avail itself of this. Owing to the reports of the default, the price of Long Island Traction stock went down from 14 to 12½, but it went up again to 13½.

$ $ $

THE Kansas City Railway Company, which was formed last month in Kansas City, Mo., by the consolidation of the Kansas City Cable Railway Company, the Grand Avenue Railway Company, and the Kansas City & Independence Rapid Transit Company, has elected the following officers: Pres. Walter H. Holmes, V. Pres. Victor B. Buck (Boston), Treas. Wm. B. Clarke, Sec. D. B. Holmes, Gen. Man. Conway F. Holmes.

By the consolidation agreement the stockholders of the Kansas City Cable Railway Company are entitled to receive, for every $100 of their present holdings $90 in the company's consolidated mortgage bonds and $10 in its preferred stock. Stockholders of the Grand Avenue Railway Company are entitled to $100 in preferred stock for each $100 of their present holdings. Stockholders of the Kansas City and Independence Rapid Transit Company are entitled to $50 of the company's common stock for each $100 of their present holdings. The company is capitalized as follows:

CAPITAL STOCK.—Common stock, authorized, $2,700,000, issued, $2,000,000; in treasury, $700,000; par value $100 per share. Preferred stock, authorized and issued, $2,300,000.

FUNDED DEBT.—Consolidated mortgage gold bonds, authorized, $5,000,000, now in progress of exchange; coupon, but may be registered; dated May 1, 1894, due 1909; denom. $1,000; int. 5 p. c., payable May and November, at office of Central Trust Company, of New York, trustee of mortgage.

The company has also assumed the principal and interest of the following bond issues of constituent corporations:

Kansas City Cable Railway Company's first mortgage coupon bonds, authorized and issued, $1,350,000; dated April, 1887, due 1897; denom. $1,000; int. 5 p. c., payable April and October, at office of New England Trust Company, of Boston, trustee of mortgage.

Grand Avenue Railway Company's first mortgage bonds, authorized and issued, $1,200 000; coupon, but may be registered; dated July 10, 1888, due July 10, 1908; denom. $1.000; int. 5 p. c., payable January 10 and July 10, at office of Central Trust Company, of New York, trustee of mortgage.

Kansas City & Independence Rapid Transit Company's first mortgage bonds, authorized, $1,000,000, issued, $800,000; coupon, but may be registered; dated March 1, 1889. These bonds have been exchanged for the company's consolidated mortgage bonds in the rates of $60 to $100 of consols.

The J. G. White Prize Competition.

The offer of $400 in prizes made, in our May issue, by J. G. White of New York, the well known electrical engineer, for the best essays on the construction of an inexpensive car house, and for the best method of operating a park in connection with a street railway system, has brought out, we understand, a large number of replies. The judges inform us that they have not yet been able to pass finally upon the relative merits of the papers submitted, but hope to be able to do so during the coming month. The result of the competition will be published in our August number if a decision is reached before the time of going to press with that issue.

"The Financial and Commercial Chronicle" to be Published by a Company.

The William B. Dana Company, publishers of the *Commercial and Financial Chronicle*, has been incorporated at Albany with a capital of $500 000. The incorporators are William B. Dana, Arnold G. Dana and Frederick R. Shepherd. William B. Dana is president, Arnold G. Dana treasurer and Frederick R. Shepherd secretary.

Arnold G. Dana is a son of Professor James D. Dana, of Yale College (brother of Wm. B. Dana), and has been connected for a number of years with the *Chronicle*, having in charge the quarterly "Investors' Supplement," published by the *Chronicle*. He has recently been associated with Redmond, Kerr & Company, bankers, of New York, but will, resume his former position in the fall. Mr. Shepherd is in charge of the City and County department of the *Financial Chronicle*. The first issue under the newly organized company was made June 23.

Map of the United States.

A large handsome Map of the United States, mounted and suitable for office or home use, is issued by the Burlington Route. Copies will be mailed to any address on receipt of fifteen cents in postage by P. S. Eustis, General Passenger Agent, C., B. & Q. R. R., Chicago, Ill. ***

The Lake Shore Route.

The Lake Shore Route, between Buffalo and Chicago, is celebrated all over the world as affording the embodiment of luxury in travel. Its new Day Coaches are sixty feet in length, and will seat fifty-eight people, comfortably. They are fitted with the Gould platform and automatic coupler, Westinghouse air brakes and signal, heated with steam taken from the locomotive, and at night are brilliantly lighted with Pintsch gas, for which purpose five elegant bronze chandeliers depend from the roof of the car.

The interior of the coaches is finished in mahogany, highly polished and paneled. Each coach has a nice lavatory and toilet. The latest models contain separate toilet rooms—one for ladies and one for gentlemen. The car seats are of the style known as the Mason tilting, with high spring backs and broad seats. They are richly upholstered in crimson plush. The windows, which are of plate glass, are large, and each is fitted with a spring-roller curtain, in shade to blend with the interior finish, and every feature is of the best.

The dining cars in service on the trains of the Lake Shore & Michigan Southern Railway are operated by the company. The cars are neat and tasty in all their appointments. Great care is exercised to provide the patrons of the Lake Shore Route with a service which shall prove satisfactory. As a result, dining on the trains of the road is accomplished in a very satisfactory and comfortable way.

The sleeping cars in service on the Lake Shore Route are of Wagner build. Ordinarily, they contain twelve sections a state-room, a smoking apartment, and toilets for ladies and gentlemen. In some instances, however, there are cars containing sixteen sections, the state-room being omitted. Every valuable device is embodied in their construction.

The Lake Shore operates a most perfect sleeping car service between the cities of Chicago, Cleveland Buffalo, New York and Boston, in connection with the New York Central and Boston & Albany Railways. This is not only the direct, best and only double track route between the cities mentioned, but the Lake Shore is the only line from Chicago conveying passengers into New York City without a ferry transfer. ***