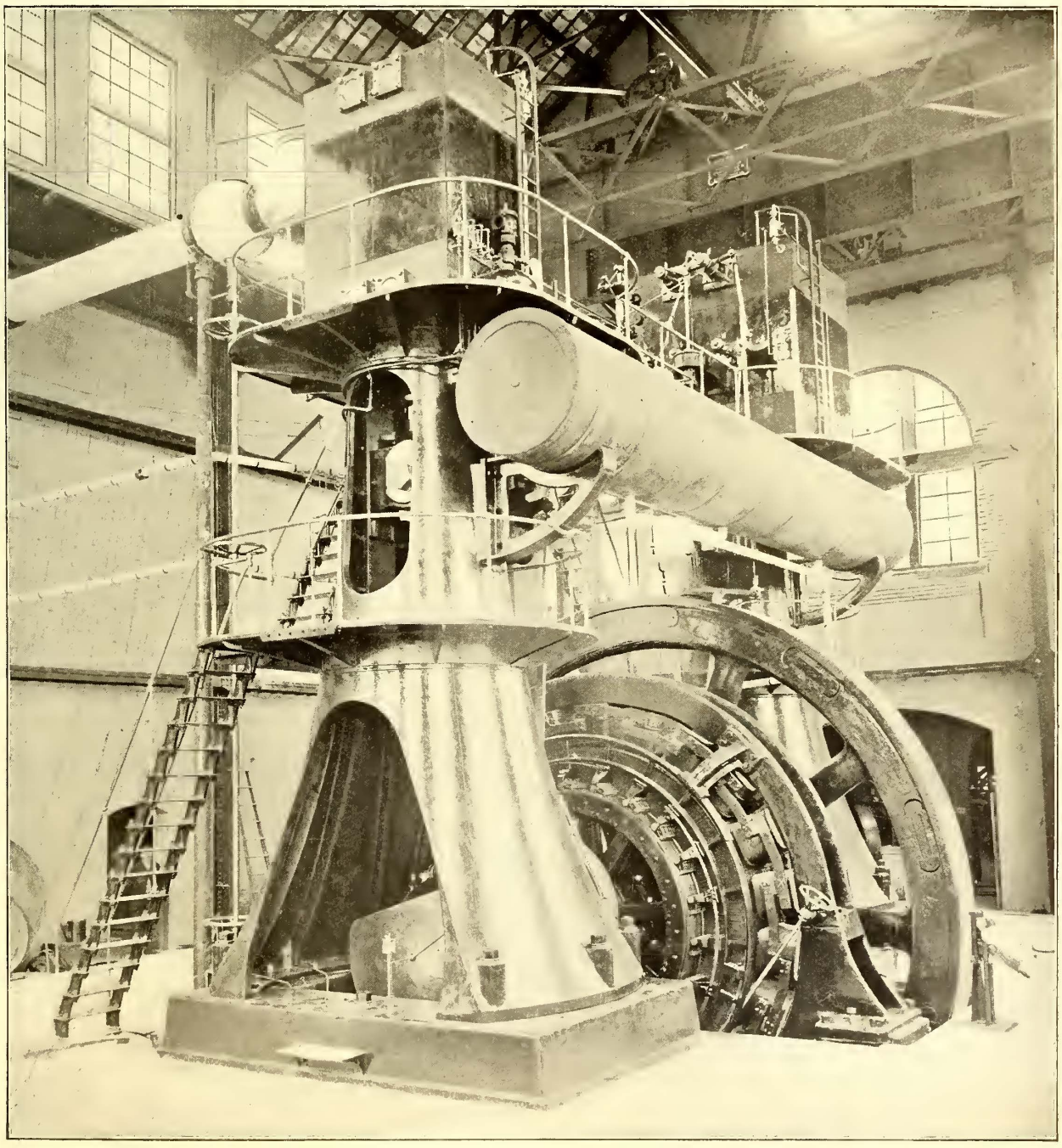
Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, APRIL, 1899. No. 4.

POWER STATION AND REPAIR SHOPS OF THE CLEVELAND ELECTRIC RAILWAY COMPANY

There are very few stations in this country where it is possible to find in operation equipments that illustrate in distinct stages the evolution that electric railway power houses have undergone since the introduction of this new power for transit purposes. Such a condition exists, however, in the station of the Cleveland Electric Railway Company, generally known as the "big consolidated" company. The principal interest in the station centers in the new engine and generator, illustrated on this page. This machine stands 32 ft. high above the floor line, and is artistically designed, all the curves being graceful, while strength is not sacrificed. The engine is direct coupled to a 2400-



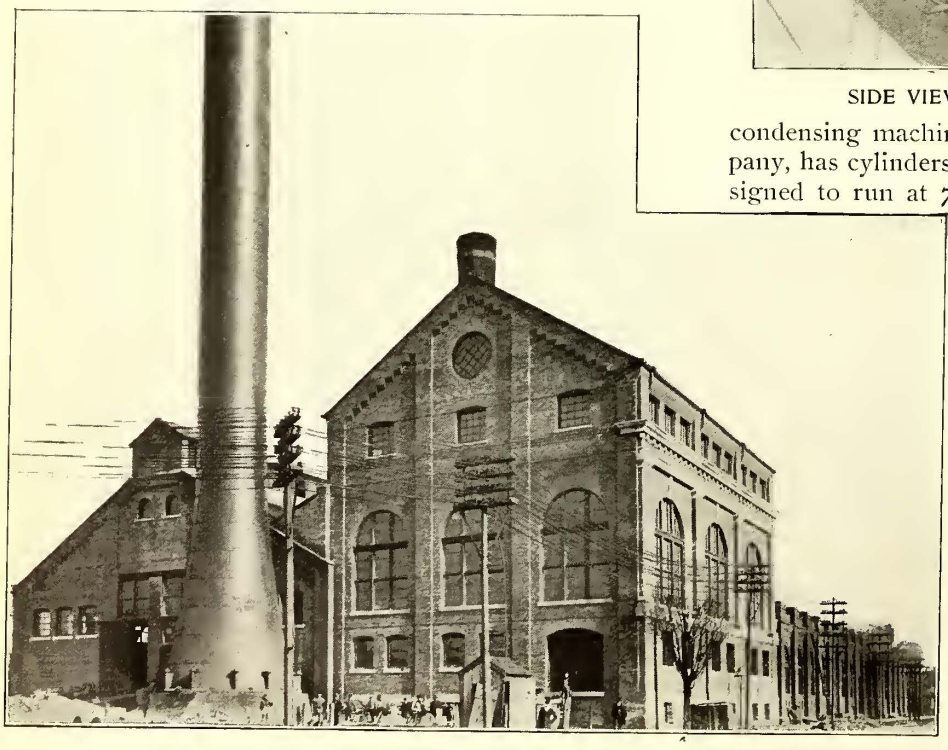
VERTICAL COMPOUND ENGINE AND 2400 KW. GENERATOR IN CLEVELAND ELECTRIC RAILWAY STATION

kw. twenty-two pole, railway generator, the armature of which is 12 ft. in diameter and 2 ft. across the face.

The generator is of the General Electric make, wound for 550 volts and 4300 amps. The magnet frame is of cast steel of highest permeability, and is heavily ribbed, to give great mechanical stiffness. It is provided with feet of large area, in order that the machine will rest firmly on the foundations. The pole pieces are of laminated sheet iron, and are rectangular in cross section. The poles are so shaped that the eddy current losses are reduced to a minimum. The spools are composed of heavy brass flanges, the body of the spool being of two thicknesses of sheet iron. The spools are thoroughly insulated by means of veneer board flanges, oiled cotton and mica. The series winding consists of copper strip, and the shunt winding of triple cotton-covered wire.

The armature spider is of such construction that all shrinkage strains are obviated. The spider is made in halves, in order to facilitate assembling on the engine shaft. The spider arms are hollow, to give the greatest strength with the given amount of material. The laminations are thoroughly insulated from one another by means of japan. The slot insulation consists of alternate layers of oiled muslin, paper and mica. The armature bars are of such a shape that the only joints occur at the commutator leads. That is, the bars have no joint at the flywheel end. The armature bars are held in position by means of wooden wedges, thus doing away with binding wire over the laminations.

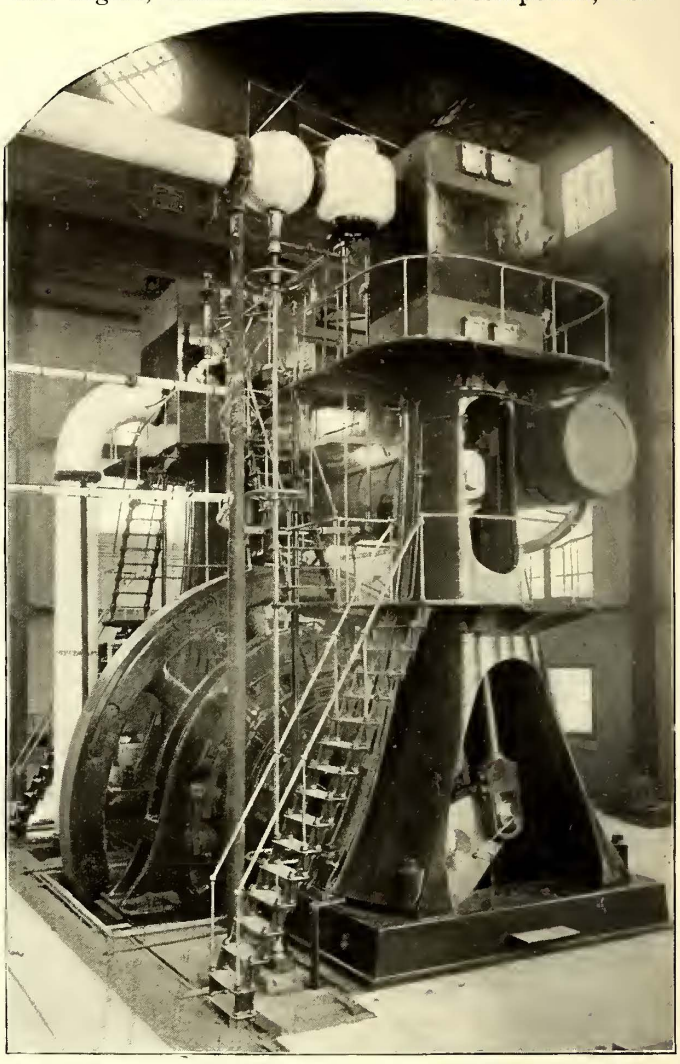
The commutator shell is supported on an extension of the armature spider, to avoid any possibility of movement between the commutator spider and the armature spider. The bars are hard-drawn copper, insulated from one another and from the spider with the best grades of selected mica. The commutator is of such a size that a large number of brushes can be used. This gives low current density in the brush with attendant low heating. The brushes are supported by means of a heavy cast-iron yoke, which is operated by suitable worm gearing.



EXTERIOR OF POWER STATION

The main dimensions of the generator only are: width, 270 ins.; length along shaft, 61 ins.; diameter of shaft, 27 ins.; total weight, 180,000 lbs.

The engine, which is a vertical cross-compound, non-condensing machine, was made by the E. P. Allis Company, has cylinders 40 ins. and 68 ins. x 60 ins., and is designed to run at 75 r.p.m. with 160 lbs. initial pressure. The valves are in the cylinder heads, and a separate governor is used for operating an automatic safety stop. The main throttle valve is operated from the different platforms by means of hand wheels attached to a vertical shaft, and each cylinder is approached by steps, as shown in the illustration. The flywheel is 25 ft. in diameter and weighs 160,000 lbs. The shaft is 25 ft. long, and at the center where it carries the armature it is 26 ins. in diameter, but reduced to 24 ins. at the bearings. The bearings are 48 ins. long, and made with shells supported by ball-joint bearings, thus insuring perfect alignment.



SIDE VIEW OF ENGINE AND GENERATOR

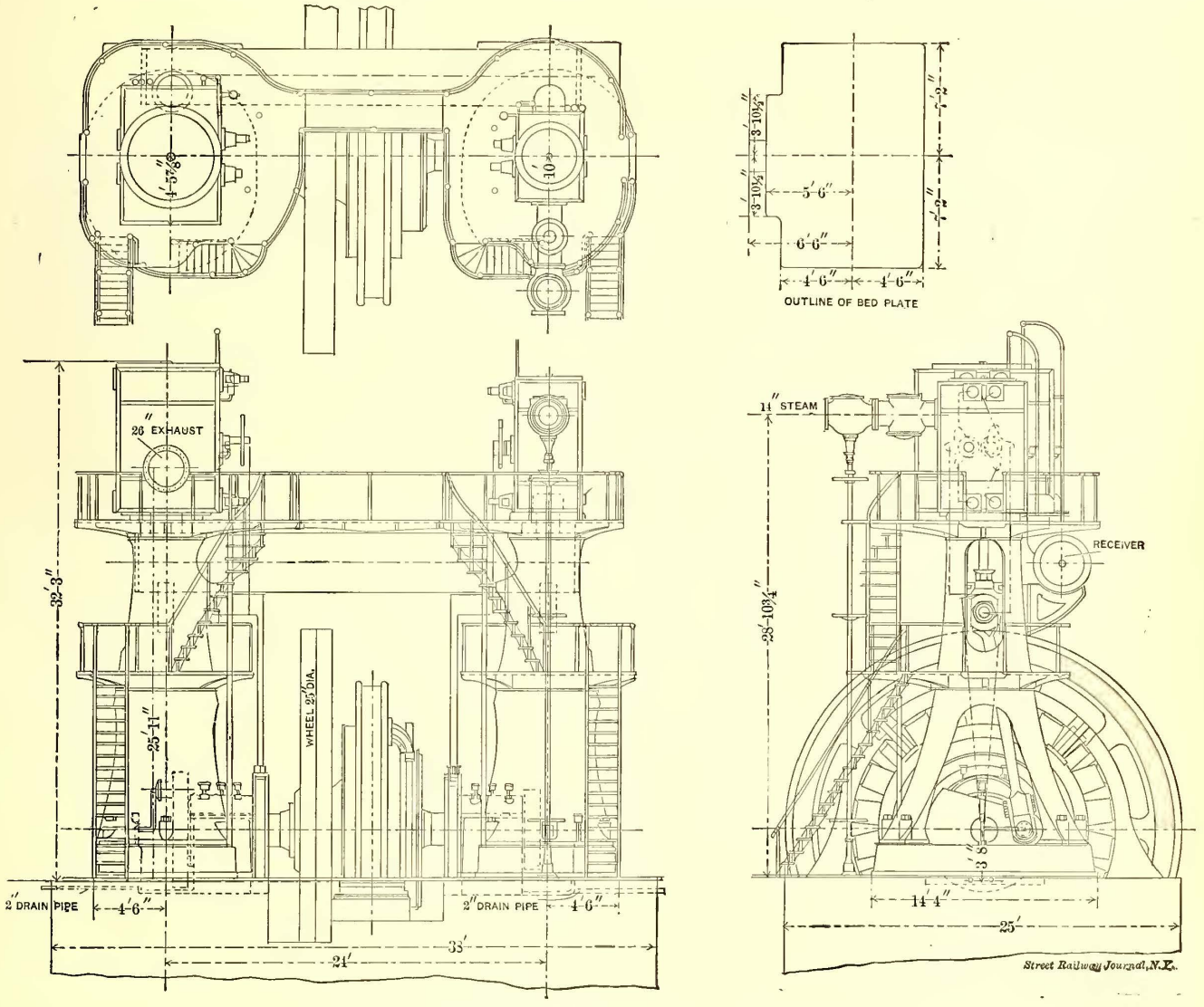
While the engine is rated at 3500 h.p., it is capable of being worked up to nearly 5000 h.p. for short periods. The engine room is supplied with a 30-ton electric traveling crane having three motors of the railway type. This crane is carefully designed in every detail, even the forged hook of the hoist being hung in ball bearings, so that it swivels easily. The crane was designed and manufactured

by the Brown Hoisting & Conveying Machine Company, of Cleveland.

The auxiliary steam equipment consists of duplicate pumps of the Worthington manufacture, and is located in the engine room. The valves are all of Chapman manufacture. There is a complete automatic oiling system and other detailed features that embrace the very latest in power house design.

The boiler room adjoins the engine room, and both are extensions of the old plant, but at a higher level. The new boiler equipment consists of ten water-tube boilers of the B. & W. type, each rated at 264 h.p. at 30 lbs. evaporation. These boilers are arranged in batteries on each side of the boiler room floor, there being six on one side and four on the other. These are each equipped with the B. & W. the stop valves to the boilers are placed. The main header is supported on a steel platform built out from the walls of the station just above the back of the boiler. This is guarded by a railing, and the header, except at the center, is supported on small steel trucks, which are designed to move back and forth to accommodate expansion and contraction. In order to prevent these trucks from vibrating the weight is supported on small journals, while the surface of the rollers, which are about 3 ins. in diameter, rests on a plate, so that because of the different diameters a sort of breaking power is obtained. A 15-in. curved pipe leads out from the top of the header, and, passing through the wall, leads directly to the throttle of the high-pressure engine.

Drain pipes are attached to the valves and lead across



SIDE AND END ELEVATIONS AND PLAN OF ENGINE

type of chain grates, which are operated from a horizontal shaft above the boilers, and which in turn is actuated by special engines.

The steam piping is all of lap-welded type, and is bent in suitable curves in order to avoid as much as possible fittings, and at the same time provide for expansion. The boilers are connected by 8-in. pipes, which lead directly into a 20-in. steam header. Those from the boilers on the off side of the room pass over the area between the boilers and just below the coal bunker, when, coming alongside of the pipes from the other boilers, they bend in pairs on the same curves and are attached to the top of the steam header. The connection is made through a specially designed T, having two openings on top, in which into the bends of the steam pipes to provide for automatic drainage. From the bottom of the steam header short loops connect with a drip header, which is located beneath the main header, and from this the drip is returned to the end of the boiler with the use of any special appliances. The sections of pipe are provided with weldless soft steel flanges manufactured by the Latrobe Steel Company. These are faced and beveled to a slight taper, the greatest diameter being at the face where the pipe is flanged and peaned into a groove in the face of the flange. The pipe is then faced off so that it affords a smooth seat for the gaskets, so that the greatest pressure comes directly on the end of the pipe, all pipes from 8 ins. and upward being peaned in this manner. The feed water pipes are attached

to the front of the boilers above the stoker in a peculiar manner, as shown, and provide for expansion, the pipes being bent to 90 degs. and a 1½-in. pipe leads down to an automatic stop check valve. The main header is ⅜ in. in thickness, and all the pipes are of standard weight, except those for feed water and blow off, which are extra heavy, to provide for corrosion.

The exhaust pipe from the low pressure side leads down and bends beneath the floor and enters the feed water heater, which is of the Goubert type.

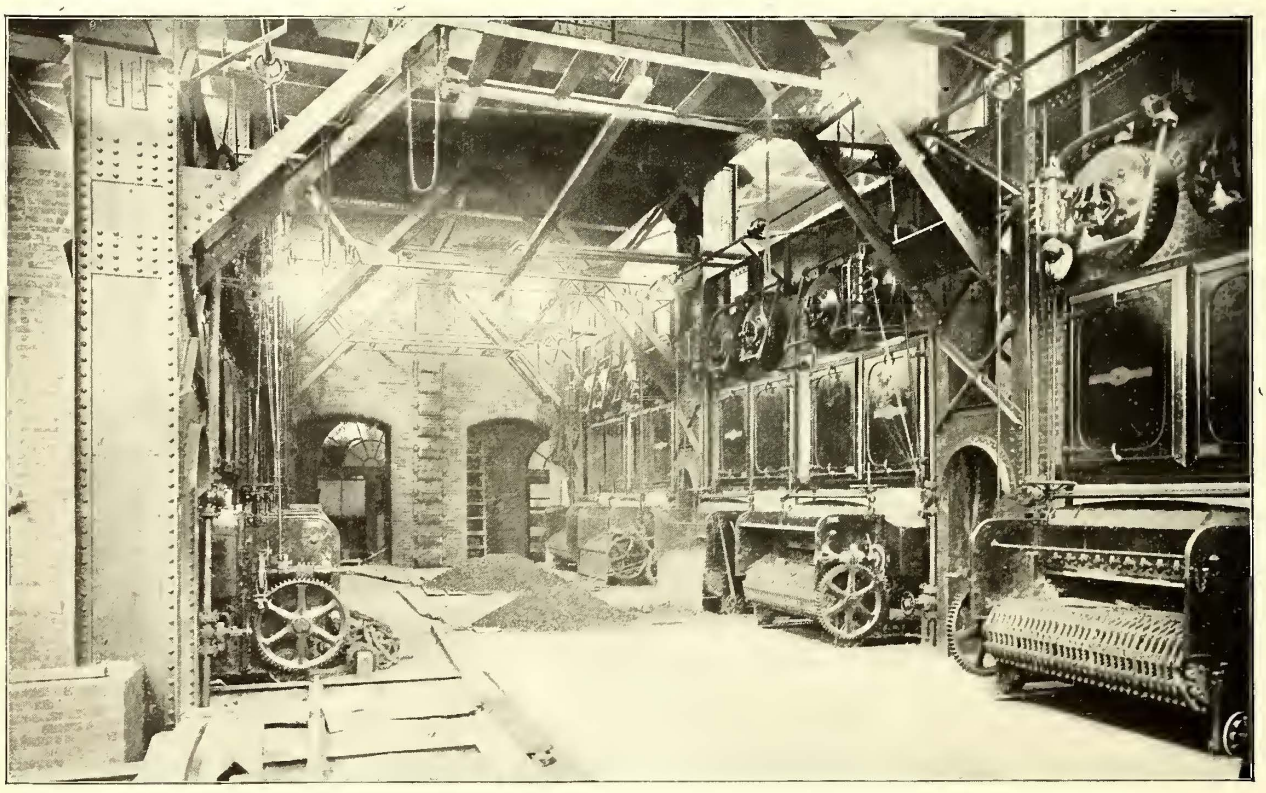
The steam pipe leading to the pumps is provided with a check valve which automatically regulates their action. This is known as the Foster valve, and avoids the use of the ordinary type of regulating valves.

The exhaust from the high pressure cylinder is led into a cylindrical connecting chamber about 4 ft. in diameter, from which it is directed to the low pressure cylinder. This chamber, as well as all the steam piping, is thoroughly covered with magnesia heat insulation material, manufactured by the Keasby & Mattison Company, of New York, but installed by the Cleveland branch of that company.

The coal handling equipment is very complete, and consists of a steel bunker located above the boiler room, having a capacity of 11 tons to the linear foot, or a total storage capacity of about 900 tons of coal. From the bunker coal is delivered to the chain grates by chutes. The bunker is lined with brick to prevent wear. Coal is received direct from the steam railways in bottom hopper cars, and dropped into a receiving bin underneath the track, which is also brick lined, whence it is conveyed by means of a trough belt conveyer part way across the station, when it is transferred to a bucket conveyer running underneath the boiler room floor, and making the circuit along the sides and above the coal bunker. The belt conveyer is of the Robbins Company's manufacture, and the bucket conveyer of the C. W. Hunt type. Cast iron is employed for these buckets, because it is less liable to rust than rolled steel. Both are driven by independent electric motors. The bucket conveyer serves for handling the ashes as well as the coal, and these are delivered into an elevated hopper placed at one end of the room in line with the boilers, and of sufficient height to allow of trolley construction cars being run under the spout, so that the ashes are loaded direct without any shoveling. These ashes are employed along the line of the road as ballast.

The extension of the building for the accommodation of the additional equipment above described is of brick, and quite artistic in design. The engine room has a ground dimension of 55 ft. x 82 ft.; the walls are 58 ft. to the eaves, and the roof is supported by steel trusses having curved lower chords. The boiler room is 85 ft. wide, and of the same length as the engine room, but is not as high, although there is a peculiar combination of the steel structural work in both departments, as it was necessary to carry the wind strains of the engine house through to the boiler house in order to get to the ground.

Two flues lead out from the boilers under the floor and communicate with the smoke stack, which is located against the end of the building. This is self-supporting, brick-lined and of steel. The base is bell shape, 25 ft. in diameter, and thoroughly anchored to the foundations, as shown in the illustration. The trunk of the stack is 13 ft. in diameter, and the flue is 10 ft. 6 ins. inside diameter. The total height above the base is 225 ft.



INTERIOR OF BOILER ROOM

An interesting feature should be noted in connection with this new equipment to account for the engine being run non-condensing. It is proposed to employ the exhaust steam in the evaporating appliances of a neighboring salt plant, which is located about 800 ft. from the power station, The steam will be carried in an underground conduit, suitably insulated, and delivered as above noted to the salt works under an agreement from the salt manufacturing company to pay one-half the cost of fuel required to run the station. In this connection it is interesting to note that these works have recently drilled three wells, 2000 ft. in depth, where is found a bed of salt which underlies, it is supposed, the whole city. The process of mining con-

sists in forcing a stream of water down one of the tubes of the well. This dissolves the salt, which is then forced out through another pipe. The salt is then extracted by an evaporating process.

The first power equipment consisted of two high-speed 125-h.p. Armington & Sims engines, each belted to a No. 32 Edison generator. The next installation consisted of three 225-h.p. engines of the same make, each belted to two No. 32 Edison bipolar generators. The third installation introduced the jack shaft, and this was driven by three Cooper Corliss engines, each having cylinders 28 ins. x 48 ins., one being attached by belt to each end of the shaft, and the second to an intermediate pulley. From this shaft, by means of belts, seven No. 60 Edison generators are driven. The fourth step included the installation of four Cooper Corliss engines, each belted direct to a 500-kw. multipolar G. E. generator. A fifth installation consisted of an E. P. Allis Corliss engine, which drives by means of two belts from the flywheel two No. 60 Edison generators. The sixth and latest installation is the direct-coupled unit described above. All of these equipments are now in use, except the first.

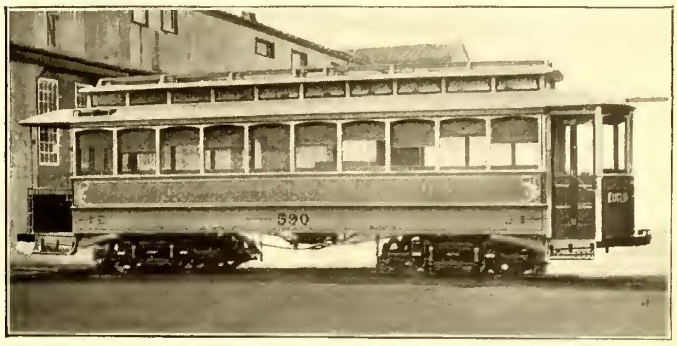
The boilers of the original plant are horizontal return tubular, but are equipped with Murphy stokers. The entire output of the old station is 6500 amps. at 550 volts. There is also a supplementary station on Canal Street of 2200 amps. capacity, consisting of Ball engines and old D 62 T. H. generators, which are still in service.

The current from the new equipment is directed to a temporary switchboard near the middle of the old station, the principal features of which are an automatic circuit breaker of the capacity of 6000 amps., which is of the G. E. manufacture, and the new static meters of the same make.

The new plant was designed by E. J. Cook, the company's electrical engineer.

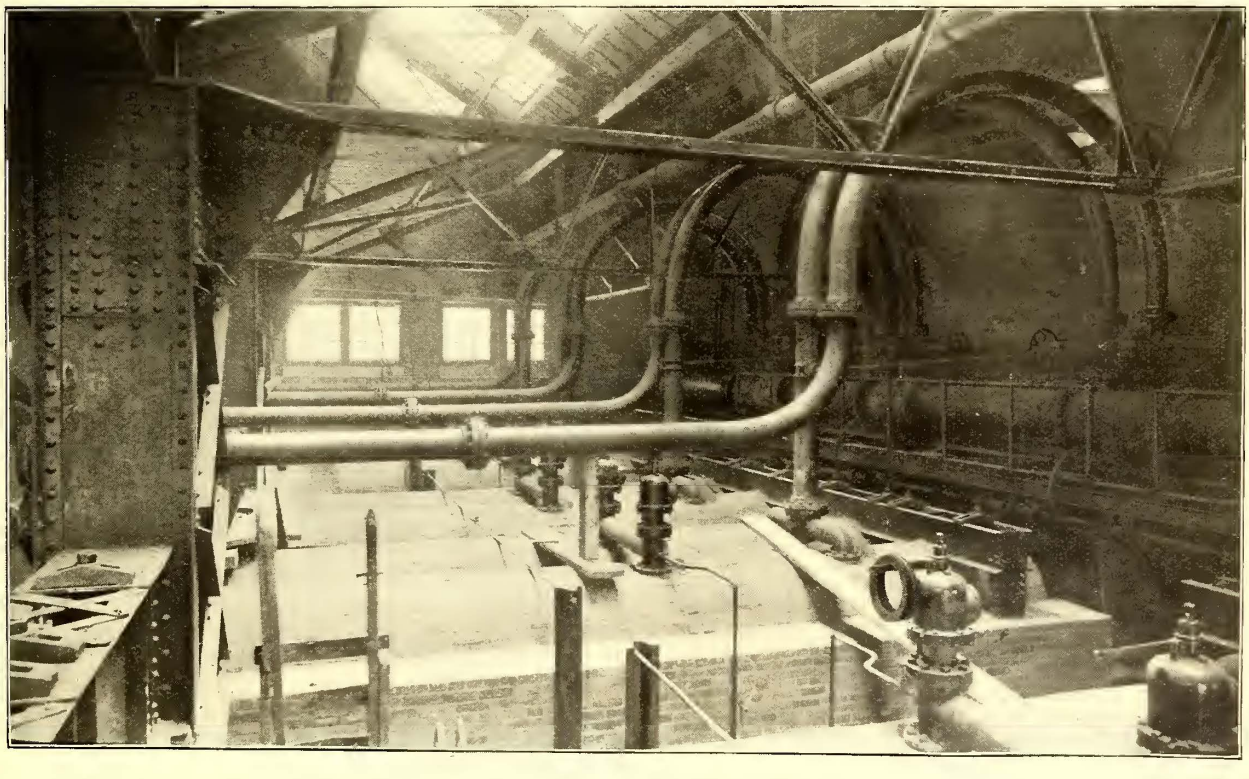
REPAIR SHOP.

The principal repair shop of the system is located at Lakeview, well on the outskirts of the city. All the repair work for the system is done here, and the large cars of two of the suburban railways of Cleveland are also brought to these shops for painting. Just at present part of the work at these shops consists in changing one of the eight-wheel high-speed cars and making it over for use as a



STANDARD CAR

funeral car. One compartment of the car is being furnished with four drop doors on the side, through which the caskets are to be loaded. The floor of the car is fitted with sunken rollers to facilitate handling of the caskets. The second compartment is designed for carrying the friends and attendants, and it is intended to run in connection with this car special funeral trains. The car is suitably designed and decorated, the exterior being black with gold trimmings. The expense of refitting this car is to be borne jointly by the two principal companies controlling the city lines, and the car is designed to run to all the principal cemeteries, of which, at present, there are six. These cars are to have the right of way, and suitable switches are being put in near the entrance gates of the cemeteries. New signs have recently been designed, which are to be carried by such cars as pass the different cemeteries.

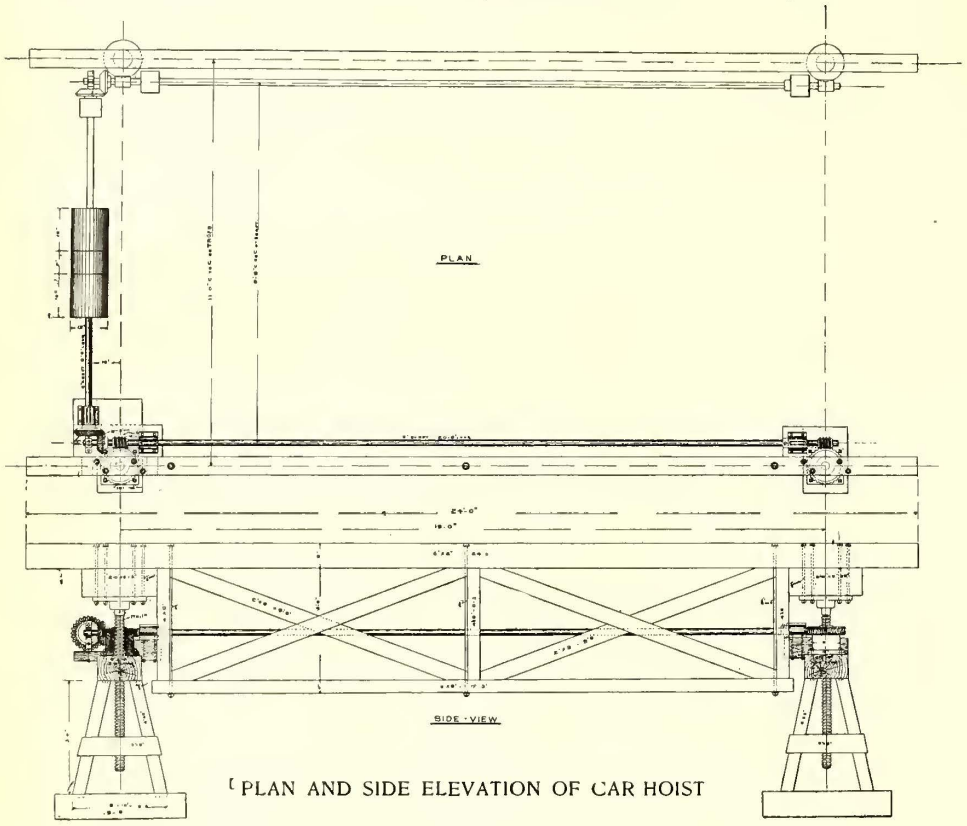


VIEW OVER BOILERS SHOWING PIPING

The company is also rebuilding a number of its six-bench open cars and making them into eight and ten-bench cars. The sills and floors will be entirely new, and

the end posts, while the old intermediate posts and the seats are retained.

The company has recently ordered 100 new eight-wheel cars. Fifty of them are to be fourteen-bench open cars, 34 ft. in length, and the others closed cars with side seats. The closed cars are to be 28 ft. over all. Six of these cars have already been built, five of them being from the John Stephenson Company and one from the J. G. Brill Works.



PLAN AND SIDE ELEVATION OF CAR HOIST

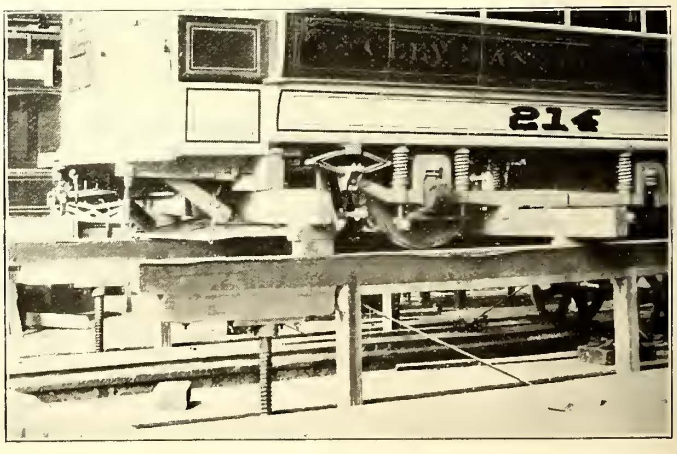
Five cars are mounted on Brill trucks and one on Peckham trucks. These cars are modeled after those employed on the Metropolitan Street Railway Company's lines in New York, and are all painted canary yellow. This is to be the standard color for all cars on the Cleveland electric system, and the present equipment is being repainted as fast as it comes into the shop. A number of box motor cars are being fitted up and equipped with two No. 49 Westinghouse motors, which will haul trailers and will be used for picnic parties, but it is the intention of the company to replace all its trains with long cars, so that within a year it is expected that the practice of running trailers will be discontinued, and the present side-door cars will also be replaced with long cars. A dozen new trucks, designed by the master mechanic and manufactured in Cleveland, but known as the Dorner truck, have recently been substituted for another truck formerly employed under the side-door cars.

The company has also recently ordered 200 new motors of the No. 49 Westinghouse type, which will replace a number of the motors now running. A number of Westinghouse No. 12 motors that formerly had center suspension have been made over in the shop for nose suspension. These motor cases have also been equipped with new armature bearings, or rather, blocks for supporting the bearings. It is now the practice of the master mechanic to cast his motor bearings, solid or cylindrical, of babbitt metal and use them without shells. When worn, the bearings are recast, and at each remelting a letter is stamped in the end of each bearing which indicates how many times the metal has been recast. After it becomes too hard for use as armature bearings, it is employed for the axle bearings, and when all the wear is out of it the metal is scrapped.

Illuminated signs are carried on all cars, one on the hood, which indicates the principal street or avenue on which the car runs, the other on the dash, which indicates the terminal point. In the closed cars the socket for the illuminated sign is on the end of the dashboard, while on the open cars it is in the middle.

Four dismantling devices are employed in the motor repair department of the shops. Each of these consists of a timber bent or truss of the same length as the car, and one is placed on each side of the repair pits. When not in use the top of these trusses comes flush with the floor, but they are designed to be elevated by means of screws, which are placed one under each end of each truss. These screws are connected together with beveled and worm gear, and are driven by an electric railway motor, so that the two trusses are lifted at the same time. By placing timbers from one to the other under the car body the car is readily lifted and held firmly in position, when the axles and motors are readily run out and a new set substituted, while necessary repairs are being made. Two of these dismantling appliances are placed near together along the same pit, so that one motor operates two. By means of a friction gear either set is operated.

Another convenient device employed in this department is an armature shifting truck, which consists of a pair of small wheels with long handles, which terminate on one side of the truck in curved hooks, the whole being so designed that the hooks may be placed under the ends of the armature shaft, when, by pressing down on the handle, the armature is lifted and can be readily rolled to any position. The repair pits are also equipped with a portable hydraulic armature removing device, which has previously been illustrated in these columns.



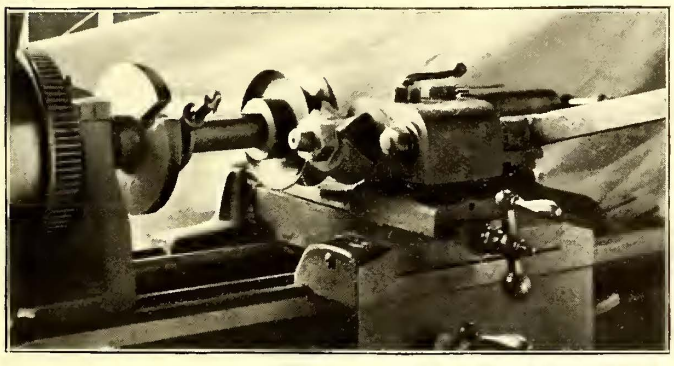
SIDE VIEW OF CAR HOIST

In the winding department only six men are employed for all the repair work, with the exception of the commutator repairs. These are refilled and new ones pur-

chased from some one of the armature repair companies and commutator builders in the city. All armature repair work is done by the piece, the price being fixed for every part of the armature. Coils are made and taped, and all other work done as indicated above. Piece work is found to be more satisfactory both to the company and to the employees, as each man is held responsible for his job, and if it is not satisfactory is required to do it over. A large galvanized iron oven with folding top is used for baking the armatures and coils. The heat is generated by means of a number of electric heaters of the Consolidated Company's type. Self-heating soldering irons are also employed; in these a stream of gas and compressed air is delivered to the head through suitable flexible pipes, so that no time is lost in waiting for an iron to heat.

The warehouse and storeroom to which all material is delivered is located on the second floor of the building, and is served by an elevator, by means of which the material is received and delivered. All material is dealt out on an order, which is made out by the man in charge of a piece of work. All orders are then countersigned by one of the foremen, so that not even a screw can be gotten from the storeroom without a proper order. By this means a careful record of all material is kept, and it is charged up to particular jobs. Cars are shifted between the paint shop and the other departments by means of an electric transfer table, which operates in a sunken way and takes its current from a third rail. This table is to be enlarged, and to make room for it the side wall of the paint shop is to be set back.

The iron-working department is equipped with a good complement of iron-working tools, to which has recently been added a wheel-boring mill, made by Henry Bickford, Lake Port, N. H., but was purchased from the W. H. Patterson Supply Company of Cleveland, Ohio. Among the labor saving devices in the shop is noted a turning head for turning out the groove of trolley wheels, which is automatic in action, and when set on one flange bores



LATHE FOR TURNING TROLLEY WHEELS

down the side and around the groove and up the other side without attention, so that all wheels are turned to an exact diameter.

The shop tools are operated by a 75-h.p. electric motor, which is located in one corner of the room and housed in for protection. It is the practice in the shops to prepare and press on all wheels, and for this purpose there are a hydraulic press and other suitable appliances. In connection with the repair department should be noted a wheel grinder of the Murphy type.

The affairs of the Cleveland Electric Railway Company are now under the direction of Henry Everett, president and general manager. Mr. Everett is also interested in a number of cross country lines which reach out from Cleveland, and in which department of street railroading Cleveland has until recently taken the lead.

Cast Welding Joints in New York

When the Third Avenue Railroad Company decided to change over its horse and cable lines to conduit electric construction the most careful consideration and thought were given to the subject of joints; in fact, this company's experience with joints on its cable construction had been so unsatisfactory that more attention was given to this point, perhaps, than to any other one feature. The cable track was laid in 1893 in accordance with the best engineering practice known at that time. It consisted of 7-in. 80-lb. rail laid on the concrete structure of the conduit. The rail rested upon cast-iron yokes spaced 5 ft. apart, but between these supports the concrete was packed tight under the base of the rail. The splice bars were 30 ins. in

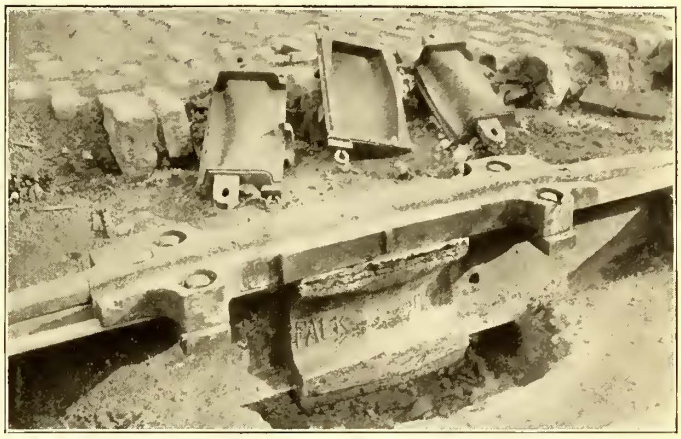


FIG. 1.—BRIDGE FOR COVERING JOINT

length and connected through the web with six $\frac{3}{4}$-in. bolts. The joints were suspended and broken. Owing, however, to the enormous traffic passing over these cable lines, this construction has not proven effectual. The joints have gone down $\frac{3}{8}$ in. in some places, and the rail itself has become badly worn, not only on the head and tram, but also underneath both, owing to the action of the splice bars. Some of the curious results of this heavy traffic on the joints and rails were described in the Street Railway Journal for July, 1898

In view of this experience, and also taking into consideration that the traffic on the new electric construction will undoubtedly be heavier than it was on the cable lines, it can be seen that the problem of properly supporting the rails and joints in the new work was a most serious one. The type of conduit construction finally decided upon was shown and described in the Street Railway Journal for December, 1898, and it was also there stated that the company would cast weld a large number of the joints according to the Falk system. The contract for part of this work was made some time ago, and the Falk Company has been at work for several months cast welding joints on the Amsterdam Avenue line, and also on the main line on Third Avenue. The first order was for welding over 10,000 joints, or about 65 miles of track.

In order to meet the peculiar conditions existing in New York, the Falk Company made a number of important changes and improvements in its method, a description of which will be of interest.

On a large portion of the system it was absolutely impossible to interrupt the car service for any length of time during the twenty-four hours of the day, and it was therefore necessary to devise a method of welding the joints while cars were passing over the rail. This was accomplished by means of a bridge, which is shown in Figs. 1 and 2. This bridge is carefully fitted to the rail and is se-

curely held in place by bolts. Long, tapering approaches are furnished at both ends, so that cars have no difficulty in passing over without interfering in any way with the joint underneath. The mould proper is of a new design, and consists of three main parts. These are shown upon the ground in Fig. 1, and attached in place to the joint in Fig. 2. The parts can be placed in position around the joint ready for the pouring in a very few minutes. They are held together by bolts, and in addition a small clamp is used for supporting the under piece.

Before the moulds are placed in position the ends of

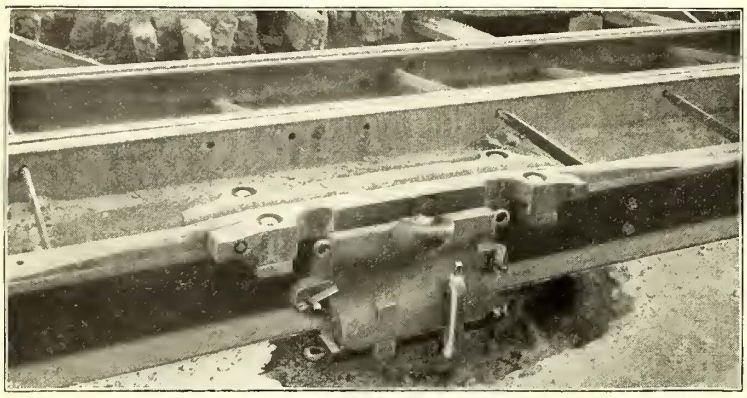


FIG. 2.—JOINT READY FOR CASTING

the rails are carefully cleaned and polished by means of a sand blast, which is also of recent design. This blast is operated by a gas engine, and with it the rails can be burnished and made absolutely clean in about a minute. The

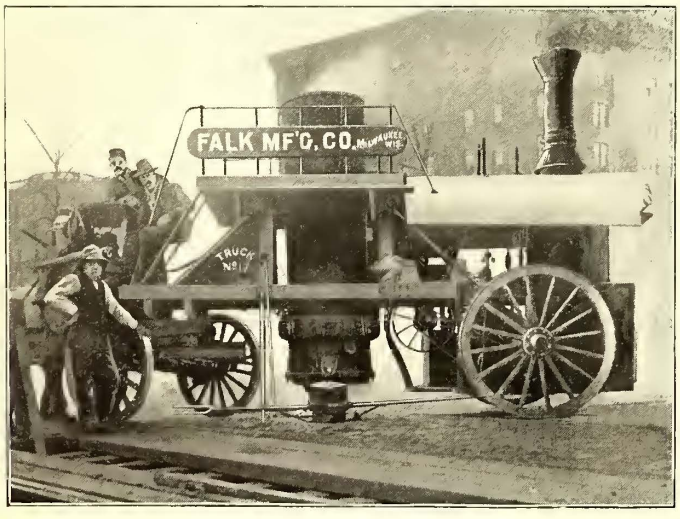


FIG. 3.—CUPOLA IN OPERATION

very best grade of sand obtainable is used with this machine. This blast opens the pores of the steel at the ends of the rails, thus giving a better opportunity for the welding or fusion of the cast iron and steel.

The cupola for heating the metal is illustrated in Fig. 3, and the method of pouring is shown in Fig. 4. The cupola contains a number of improvements, and is giving excellent satisfaction. The process of pouring is very simple, although quite ingenious. The ladle or pot for holding the molten metal is attached to two long rods, one of which has two branches at its end, as shown in Fig. 4. The rods are carried by means of two wooden poles, having at their centers an eye or staple, through which the rods are inserted. Five or six men are required to carry the ladle from the cupola to the joint to be welded, and four men are employed in the actual process of pouring; two to support the ladle, one to tip it, and the other to closely watch the process and regulate the flow of metal. From 200 lbs. to 205 lbs. of cast iron are poured into each joint.

The finished joint is shown in Fig. 5. After the metal has become thoroughly cooled, which occurs in a very

FIG. 4.—CASTING JOINT

few moments after the pouring, the bridge and mould are taken off, and the joint is carefully trimmed and smoothed with heavy files. Concrete is then thrown under the base of the joint and the ends of the rails, and carefully tamped into place so as to support the entire joint.

In a recent interview, Mr. Robertson, superintendent of the Third Avenue Railroad Company, expressed himself as very much pleased with the results so far obtained with the Falk joint. He stated that a large number of the joints had been installed since the first of January, 1899, and since that time had been exposed to a change of temperature from 8 degs. below to 50 degs. above zero, and

FIG. 5.—COMPLETED JOINT

during this period not a single joint had broken, while the rail has kept in perfect alignment throughout the different changes of weather, although there has been no paving done of any account.

The annual convention of the Southwestern Gas, Electric and Street Railway Association will be held in Austin, Tex., on April 19-21, 1899. In connection with the convention, an electric, gas, water-power, light and heating exhibition, lasting from April 19 to the 29th, will be held under the auspices of the Austin Commercial Club. Much time and labor has been expended in the effort to make this convention unusually valuable.

Electric Street Railway in Bahia

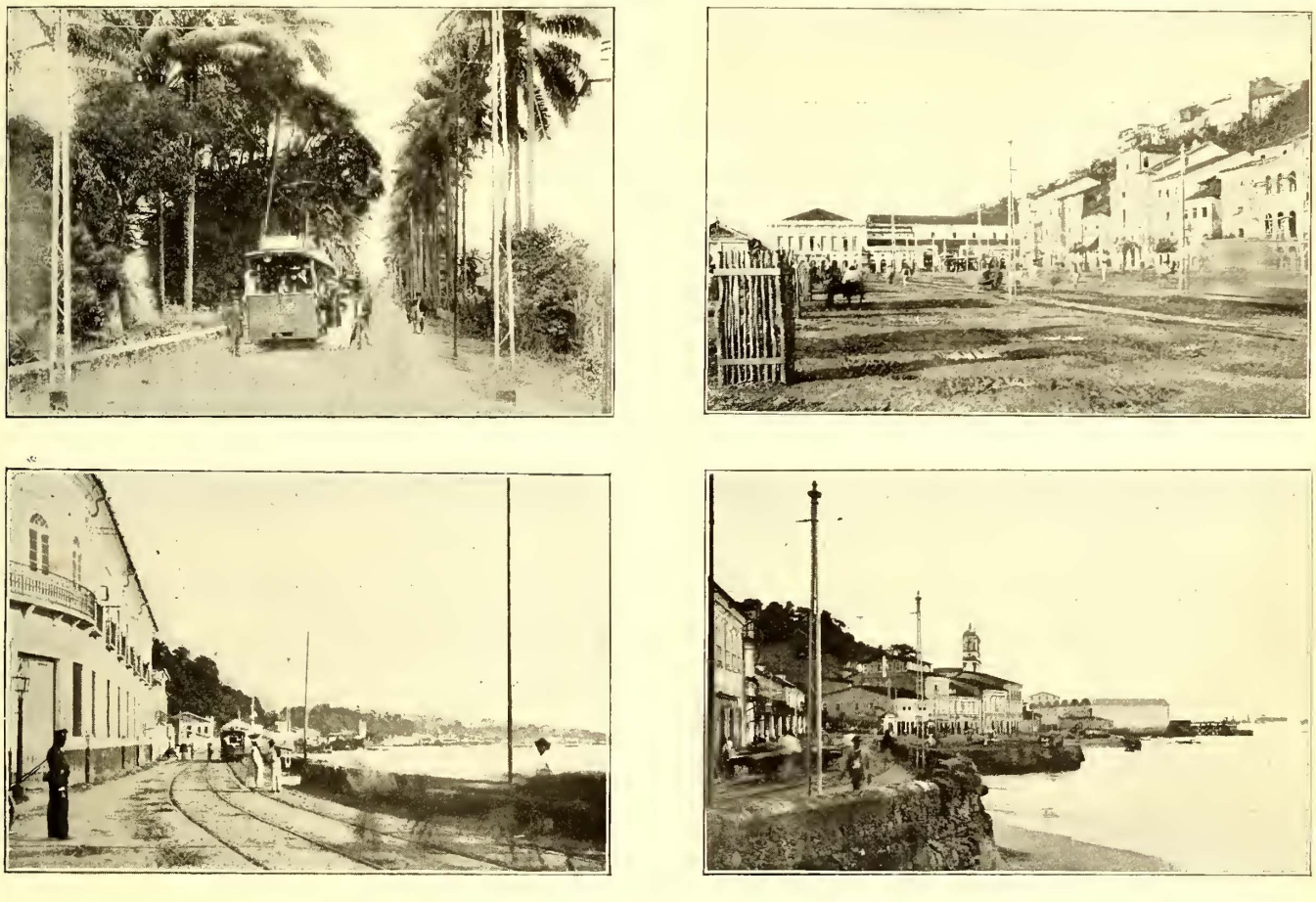
Sao Salvador de Bahia, the principal city of the Brazilian province of Bahia, is about 800 miles north-northeast of Rio de Janiero, and has a population of about 250,000 inhabitants. The city is the terminus of a number of railway lines, and possesses an enormous export trade in the many staples of the country, such as tobacco, coffee, cocoa, sugar and hides. The harbor is one of the best in America and is crowded with steam and sailing vessels of all nations. The Hamburg South American Steamship Company, the North German Lloyd, Royal Mail, Lambert & Holt and other steamship companies run regular lines to this place. A large part of the import and export trade is in the hands of German merchants.

The city, when seen from the sea by the approaching traveler, presents a beautiful panorama, consisting of the upper and lower city. The former lies for the greater part upon a long half-moon shaped plateau, rising from a narrow strip along the coast about 1 mile long and 700 ft. wide, on which is the lower city. Here is located the business district, including the warehouses of the merchants, the custom house, arsenal and railroad station of the Sao Francisco Railway, which connects the city with the interior. Further along the shore of the bay this narrow strip contracts until the base of the hills forming a plateau seems almost to meet the sea. The streets in the lower city extend parallel to the bay for a distance of about 1½ miles, when they terminate in a mountainous peninsula on which are located the rich suburban towns Bom Gosto, Roma, Boa Viagem and Itapagipe, as well as the famous Bom-Fim Church, or cathedral, the objective point of many pilgrimages on every holiday. In January, when the great Bom-Fim festival occurs, the traffic toward this cathedral is enormous, both day and night.

The upper city is situated at a height of from 200 ft. to 300 ft. above the lower city, and contains the residential quarter, being cooler, dryer and luxuriant with orange and banana orchards. Here also are the principal government buildings.

The upper and lower cities are connected by hydraulic cable inclined railways, steps for foot passengers and a few roads with an average grade of 5 per cent for vehicles.

The favorable impression made by the view of the city as seen from the sea is dispelled as soon as the traveler lands in the lower city. He finds here no regularly laid out quays, no wharf cranes, such as one is accustomed to associate with the handling of merchandise, and no regular arrangement of the streets. The buildings look as if they had been erected by Indians, and the hoists for loading vessels are operated by treadmills, with negroes as motive power. A striking contrast to this conglomerate appearance is afforded by the upper city, which is laid out with beautiful streets lined by handsome villas.

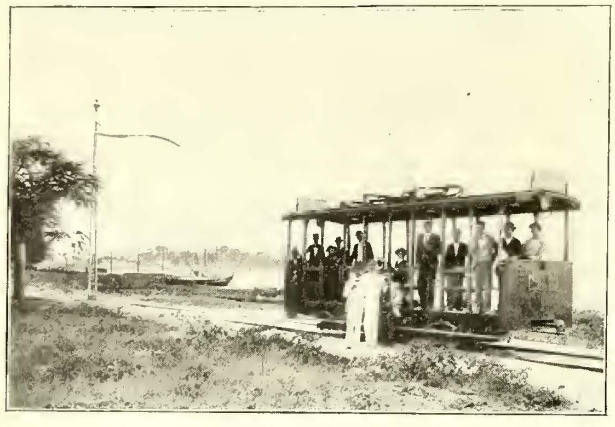


VIEWS OF BAHIA ELECTRIC RAILWAY

The tramway system of Bahia consists of a single line traversing the lower city, running parallel to the sea, and extending to the outer terminus of the Itapagipe peninsula. It has a total length of 13.7 miles of track, occupying 7.7 miles of street, and is owned by the Companhia Carris Electricos, formerly the Companhia Vehiculos Economicos. When using animal power this company had considerable difficulty in taking care of its traffic, especially on Sundays and holidays, when the demand for transportation is always great. Moreover, about three years ago the stock of mules which was formerly used suffered from a severe epidemic, so that the question of electrical equipment immediately became an imperative one, and the company gave a contract for its electrical equipment to the Siemens & Halske Aktien Gesellschaft, of Berlin,

In June, 1896, the contractors began their work of electrical construction, which proved to be no easy task, on account of the heavy falls of rain which occur in South America during the tropical winter, which commences in March and extends until August, as well as the difficulty of securing intelligent and desirable labor. These difficulties were aggravated by others, including that of securing transportation of materials. In Bahia only one kind of wagon or truck is used, namely, two-wheeled carts called *carossas*. These wagons are mounted on enormous wheels and can carry at most only about 35 cu. ft. of merchandise, so that transportation is exceedingly expensive. Added to these natural drawbacks, there were others which augmented materially the difficulty of installation. The existing track on this railway was in an extremely bad condition, so that an attempt to repair it would have entailed much more labor than the laying of new track. In addition, a considerable portion of the line extended through the small streets of the lower city, already mentioned. These streets had a width of only 16 ft., and lying between the sea and the base of the hills, formed the only connection between the lower city and the populous suburbs which it was desired to reach. In this narrow space were located the warehouses of the tobacco exporting firms, which, with their *carossas*, practically blocked the street and prevented the laying of track. All efforts to do this and thus interfere with the existing order of things were naturally followed by streams of invective poured upon the tracklayers by the native truckmen, as well as frequent quarrels and disputes.

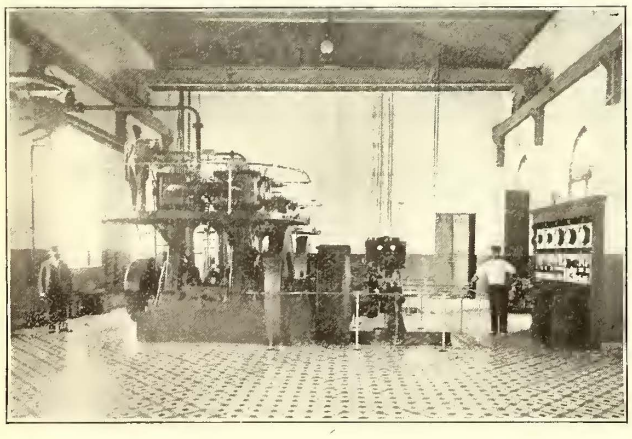
In spite of all these difficulties and the hindrance caused by them, half of the railway, the Roma-Itapagipe section, was put in operation in the early part of March, 1897, and the opening of the entire line followed on June 6, 1897. On part of the old route the existing track was used. This consists in part of chair construction, the chairs containing jaws in which the rail is held by means of a wedge. Opposite chairs are connected together by a tie rod. Besides this there are 6½ miles of new track laid with T rail, with angle plates and metal ties.



VIEWS OF BAHIA ELECTRIC RAILWAY

No feeders are used in the overhead system. The trolley wire is carried partly on span and partly on bracket poles, and partly on wall rosettes. The poles are set in concrete.

The power station is located about the center of the line, at Roma, and is 700 ft. from the sea. It is on the corner of two streets, is of hewn stone, and contains a stack 130 ft. high. Adjoining the power station is the car house, with room for twenty motor cars and pit room for nine cars, behind which is a storeroom and repair shop.



INTERIOR AND EXTERIOR OF POWER STATION

In the power house are two vertical compound con-

densing engines of 150 h.p. and 180 h.p., built by Burmeister & Wain, of Copenhagen, with direct-coupled type J 76 machines. The engines make 190 r.p.m., have Corliss gear, and cut-off controlled by a flywheel governor. The sea water for condensing is taken from the bay through a duplicate set of pipes, which extend 250 ft. into the sea in order to secure deep and clear water. In this distance they pass a coral reef, within which the water at ebb tide is too low, and during storm too tempestuous, to be used. The pipes terminate in a crib of wood, which is also used as a dock for the receipt of fuel.

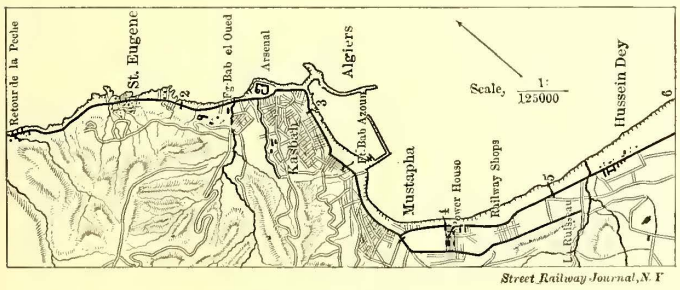
The boilers are of the water-tube type, built by the Babcock & Wilcox Company. The feed water is taken from a spring which is near the boiler house. Both engine and boiler room have space for 300 h.p of additional equipment.

At present there are twelve motor cars, which, on account of the climate, are open. Of these ten are equipped with one 20-h.p. and two with two 15-h.p. motors. Each motor car holds twelve passengers. Experience has shown that the number of motor cars is not sufficient to carry the traffic, and orders have been placed for six additional motor cars and a third engine.

The electric system is very popular with the inhabitants, especially since none of the fears first felt in regard to the use of electric power have been realized. The European system of fares is in force, by which each passenger is given a fare receipt, which he keeps, and which is afterward inspected by a controller. The operation has been carried out with great regularity and safety, even during the continuous festival of the Bom-Fim in January, with an enormous traffic, and many encomiums were passed on the excellence of the equipment.

Electric Railway in Algiers

The Société des Chemins de Fer sur Routes d' Algérie is the title of a French company, which operates an interurban railway system in Algiers, Africa, connecting that city with a number of neighboring towns. The line, which is operated mainly by steam power, has a total length of 170 km. (107.4 miles), but in addition several important extensions are projected and in part under way, which will considerably increase the total amount of track. The government concession for this railway was given May 1, 1891, but on March 9, 1897, was so modified that the company was permitted to use electricity on that part of its system



MAP OF ALGIERS

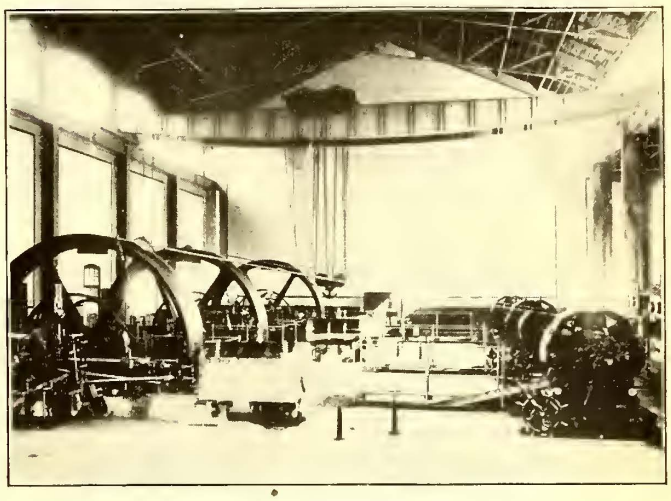
which connects St. Eugéne, on one side of the city, with Le Ruisseau and Hussein on the other, and including the connecting link in the city itself. The contract for the necessary equipment was awarded to the Société Anonyme Electricité et Hydraulique, of Charleroi, Belgium, which, with its corresponding French company, the Société Anonyme Transmission, Transport et Traction, commenced work toward the end of 1897.

Electric operation of the line was begun commercially on Sept. 23, 1898, after considerable delay occasioned by the complete loss of the structural iron for the power station, which sank on the "Gallia" Feb. 1, 1898, while being carried to Algiers. This disaster necessitated the duplication of this part of the plant.

TRACK AND OVERHEAD CONSTRUCTION

The entire length of the sections upon which electric power has been substituted for steam power is 15.7 km. (9.7 miles). The principal line, which connects Deux-Moulins with Nouvel-Ambert, has a length of 12.3 km. (7.6 miles), and is double tracked, with the exception of a short distance near each end.

The cities of Algiers, St. Eugéne and Mustapha are located on the Bay of Algiers, the shore of which, a short distance from the water, rises rapidly, leaving a narrow band only of comparatively flat territory between the base of the hills and the sea. This circumstance confines all



INTERIOR OF STATION

the traffic between the cities to near the coast, with the result that the new electric line enjoys an extremely large business. When formerly operated by steam, trains were run every fifteen minutes, but the headway of the electric cars is now five minutes, each car drawing a trail car.

The climatic conditions of Algeria are not particularly favorable to the operation of electric cars. In summer the prevailing winds are from the south, especially during the season of the *sirocco*, and, coming from the Sahara, are laden with a fine dust, which penetrates everything, and, getting in the journals of the cars, and, in fact, of all machines, materially shortens their life. On the other hand, in winter the country is subjected to almost continuous rains, which, falling with tropical fury, frequently convert the streets into regular rivers. As a result, the cars often have to run for a half mile or more in water half a meter (20 ins.) in depth. Again, certain parts of the track are in constant danger of being undermined by the sea during a storm. During the month of March, 1898, the rails were torn up for a distance of more than 100 meters (330 ft.), and often the spray from the waves is thrown against the electric cars.

The profile of the road does not present any remarkable features. The steepest grade is about 4 per cent for a distance of about 132 meters (425 ft.). The minimum curve radius is 28 meters (91.6 ft.).

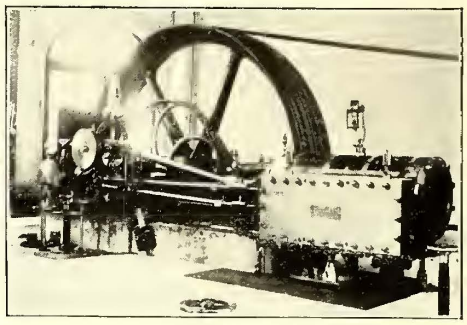
The track in the center of the city is laid with Broca rail weighing from 36 kg. to 44 kg. per running meter (72.7 lbs. to 88.9 lbs. per yard).

The ties, which are 1 m. wide x 0.1 m. deep (39 ins. x 3.9 ins.), are of metal and spaced 2 m. (6 ft. 7 ins.) apart. They are bolted to the rails and intended to keep the gage perfectly accurate. The track is laid on a continuous bed of concrete with hydraulic cement.

Outside of the city the company uses a Vignole or T rail of 20 kg. per m. weight (40 lbs. per yard), laid on wooden ties spaced 0.8 m. (2 ft. 7 ins.) apart. The gage is 1.055 m. (3 ft. 6 ins.), and on a double-track road the distance, center to center, is 3 m. (9 ft. 11 ins.).

Each joint is bound with two copper bonds of 8 mm. diameter (No. 0 B. & S.), connected to the rail by conical bonding chucks. Every 30 m. (98 ft.) the two rails of the same track are cross connected by a wire of the same size. On certain sections of a single track where the Vignole rail is used, the conductivity of the return circuit has been increased by the use of a return conductor made up of old rails buried in the soil, and bonded in the same way as the regular track. The use of buried bare cables as return conductors has not been looked upon with favor by the engineers. The return circuit as installed has been satisfactory, and on no part of the line has any difference of potential between the rails and the earth of over 3 volts been noticed.

A map of the line is given on the preceding page. The station is located at *C*, which is 8 km. (5 miles) from one of the termini. On the entire length of the route, even where single track is used, two trolley wires are employed, of 8 mm. diameter. The overhead system is divided into six sections of about 2.5 km. (1.5 miles) each. Three of these, viz.: one to two, two to three, and five to six, are supplied with separate feeders; in the case of the first two, by 150 mm. sq. (300,000 c.m.), and in the latter, where the difficulty is less, 50 mm. sq. (100,000 c.m.). The other three sections have no feeders. In the open country the feeders are bare wire, carried on porcelain insulators, but within the city they are buried, insulated by a layer of jute and paper, saturated with asphalt and protected by a lead sheath and outside steel wire armor. In spite of the excessive heat, which in summer is sometimes as high as 38 deg. C. (110 deg. F.) in the shade, the insulation of the cables has remained in good condition. It is doubtful whether a rubber insulating cable would have given such good results under the same conditions of temperature. The length of the underground feeders is 7400 m. (24,000 ft.), and they were supplied and installed by the Société Industriele des Telephones, of Paris. Each of the six independent sections into which the overhead line is sub-divided is protected at the power station by an automatic circuit breaker, so that any short circuit on one section will not interfere with the operation of the rest of the system. The overhead line is constructed for the use of the Dickinson trolley, and the distance between the wire and the car axle in no case exceeds 2½ m. (8 ft. 3 ins.). About 9.1 km. (5.6 miles) of overhead line is span construction, the other 6.6 km. (4 miles) bracket construction. All poles, even those in the suburbs, are steel tubes.



VIEWS IN ALGIERS

POWER STATION

Owing to the difficulty in finding a convenient site large enough to accommodate the power station and car houses together they have been located at different points along the line. The station occupies an area of 1600 sq. m. (17,200 sq. ft.), of which 710 sq. m. (7630 sq. ft.) are taken by the engine room, 550 sq. m. (5910 sq. ft.) by the boiler room and coal storage bin, and 340 sq. m. (3650 sq. ft.) for the court occupied in part by the cooling plant and the base of the stack, which has a height of 45 m. (148 ft.) and an internal diameter at the top of 2 m. (6.5 ft.). In the basement under the engine room are located all the feed and steam pipes.

The boilers, to the number of six, are connected in batteries of two each, of the French or elephant (bouilleur superposé) type. The heating surface for each boiler is

100 sq. m. (1076 sq. ft.), and the grate surface is 2.56 sq. m. (27.5 sq. ft.). This type of boiler was adopted after considerable investigation, as being the best adapted to steam generation in any country like Algeria, where the greatest simplicity of construction and ease of operation and maintenance are necessarily of great importance. They maintain the steam pressure very constant in spite of rapid variation in the load. The normal evaporation is 1200 kg. (2640 lbs.) per hour per boiler. Four other boilers of the same type are being installed.

One feed pump of the Worthington type is used, with an injector installed as a reserve, each having sufficient capacity for the entire plant. The feed water is taken from a well, a sheet-iron reservoir carried under the roof of the boiler, or from a cistern with a capacity of 200 cu. m. (52,800 gals.). The normal steam pressure is $7\frac{1}{2}$ atmospheres. The boilers are guaranteed to 9 atmospheres and tested to 15 atmospheres. The piping is of steel and copper, and is duplicate.

The engines are of the simple condensing type, with steam-jacketed cylinders, and the cylinder dimensions are 500 mm. x 1000 mm. (19.7 ins. x 39.4 ins.); they run at 100 r.p.m.; the steam admission for 100 h.p. is 0.04; for 200 h.p., 0.12, and for 300 h.p., 0.25. The fly-wheel has a weight of 12,000 kg. (26,400 lbs.), and the diameter of the shaft is 20 cm. (7.9 ins.).

The condensing apparatus is placed in the basement, but all valves are to be operated from the engine floor. In case of necessity the condenser can be cut out of use and the engines made to operate automatically with free exit.

The air-pumps discharge the hot water into several small hot wells constructed between the foundation pillars. From there it is taken by a small centrifugal pump operated directly by a steam engine, and pumped to a height of 12 m. (39 ft.) into a cooling tower. This apparatus is composed of 540 triangular tubes 7 m. (23 ft.) in height and surrounded by cloth. They are placed vertically in a framework of wood. The hot water, arriving at the top, is spread over these pipes, and is cooled by running slowly along the cloth. A large zinc tank catches the cooled water, which then flows into a cistern, from which it is again pumped by the condensers.

The engines are belted to three six-pole, compound wound generators of 200 kw. each, turning at 450 r.p.m. The output is 350 amps. at 575 volts.

The switchboard is of the panel type, and carries automatic circuit breakers, ammeters, etc.

ROLLING STOCK

The company has in actual service thirty motor cars and eighteen open trail cars. The motor cars contain seats for twenty passengers and room for eighteen standing passengers. The car body is divided into three compartments. The wheel-base is 1.80 m. (5 ft. 11 ins.). Each car is equipped with two 30-h.p. motors, permitting the motor car to draw two open trail cars if necessary. Fully loaded, the weight of the entire train is about 20,000 kg. (44,000 lbs.). The controllers are of the series parallel type.

CAR-HOUSES

The car-houses are situated on the line of route of the road, and adjoining them is a repair shop equipped with all tools necessary for ordinary repairs, and driven by an electric motor.

The change from steam to electric traction has been followed by a large increase in the receipts. The report of the system for the month of December, 1898, shows the following figures; coal per train-km., 2.150 kg. (7.8 lbs. per train-mile); coal, per kw.-hour at the switchboard, 2.5 kg. (5.5 lbs.).

The Breakage of Car Axles

BY J. F. THOMPSON.

Opinion among manufacturers of car wheels and axles differs as to whether iron and steel axles crystallize in service, but, taken as a whole, seems to be against the theory, or, at all events, that the cause for failures in street car axles is not due to crystallization, but to insufficient inherent strength. While this cannot be said to have been proved, the advocates of the theory of non-crystallization claim that if axles break in use and the fracture shows crystallization, that the same axles if tested before being put into service would have shown the same characteristics. It is certainly true that new axles, upon being broken, do show a crystalline structure, proving that service is not necessary to acquire it. On the other hand, a great many axles which have been in use for some time have broken suddenly where the fracture, though fresh and bright, showed no sign of crystallization.

It should be remembered that the car axle, when in place under the car, with the motor attached, is practically rigid, and unlike that under steam railroad cars, because it cannot bend or take up any shock in the middle. When, therefore, an unusual strain or shock occurs, the break in the axle comes at the weakest point, which is sometimes on the

FIG. 1.—FRACTURE OF FINE STEEL AXLE

outside of the wheel next to the journal, and sometimes on the inside, according to the style of motor used. In all cases in the use of steel axles, shoulders and sharp corners should be avoided by the use of fillets as far as possible. In many cases the key-way is cut at a point so that it extends up to the inside hub of the wheel, and if the wheel is fitted to a shoulder, the axle frequently breaks at this point.

The accompanying engravings, which are full size reproductions of actual fractures of car axles, will give an idea of the appearance of the fracture of different kinds of axles. In each case the axle has been turned down somewhat to admit of breakage, so that the diameter in the engraving is not that of the original axle.

Fig. 1 shows the surface of a broken axle from an electric car. The diameter of the wheel fit was $3\frac{5}{8}$ ins.; diameter between hubs, $3\frac{1}{2}$ ins; diameter of journal, $3\frac{1}{2}$ ins. The axle broke back of the hub. A piece of the axle, 15 ins. long, could not be broken under a drop hammer of 1850 lbs. falling 12 ft., although the hammer was reversed several times. It will be noticed that the grain of the steel is quite fine. The material is fair and the axle undoubtedly broke because of the shoulder at the back of the hub where the axle was turned down $\frac{1}{8}$-in. smaller than the wheel fit. Fig. 2 is a sample of a broken motor axle from a street railway company in Pennsylvania. This axle had a $3\frac{3}{4}$-in.

wheel fit and 3-in. journal and it broke at the end of the journal next to the dust guard. It will be noticed that the grain of the metal is coarser than that shown in Fig. 1. Fig. 3 is a sample from the driving axle of a traction engine and was 4 ins. in diameter back of hub, with wheel seat turned down to $3\frac{1}{2}$ ins. This axle broke back of the wheel at the key-way, which was $\frac{1}{4}$-in. deep. The wheels were 30 ins. in diameter and the gage of track 3 ft. It will be noticed that the grain of the metal is about as coarse as that in Fig. 2.

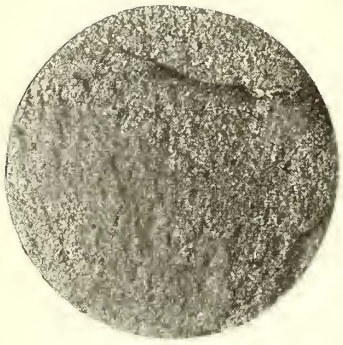


FIG. 2.—FRACTURE OF STEEL AXLE

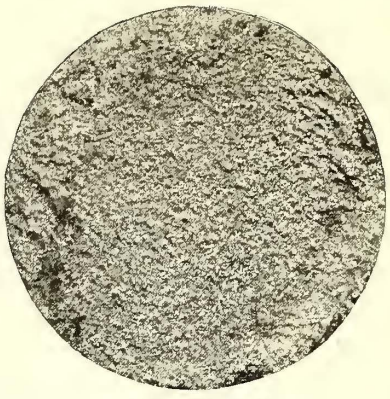
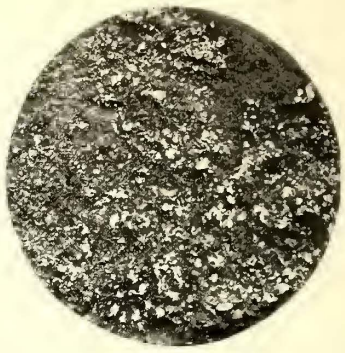


FIG. 4.—FRACTURE OF STEEL AXLE



FIC. 5.—FRACTURE OF HAMMERED IRON AXLE

Fig. 4 is an engraving from a photograph of a new $3\frac{3}{4}$-in. steel axle. As will be seen the grain of this metal is a little coarser than that in Fig. 1, but finer than that in Figs. 2 and 3.

Fig. 5 shows a sample of a hammered iron axle cut from a 4-in. diameter journal. It will be noticed that the fracture shows large open crystals.

It is a well known fact that iron castings will stand a better physical test a year or two after they are made than they will soon after casting. It is claimed that at the time of casting, the molecules are disarranged and that it takes time for them to readjust themselves. The evidence is all in favor of this theory, as observations show that where chilled cast iron car wheels break in service from other causes than wrecks, it is quite early in the life of the wheel. It is very rarely than an old car wheel breaks in service unless the flange or thread has become worn very thin. An examination which has been made of a large number of 33-in. steam car wheels that have been in service from fifteen to twenty years, has shown that they were tough under the wheel breaker and were free from cracks or flaws, seeming to prove that there is not only no tendency to crystallize, but that, if anything, the effect of age is to increase the structural strength of the iron. If this theory of the readjustment of molecular formation is correct as to cast iron, it would also seem reasonable to suppose that it holds true also of hammered iron or steel.

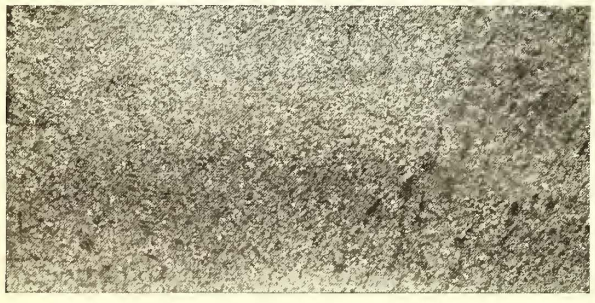


FIG. 3.—FRACTURE OF STEEL AXLE

A great deal could be written upon the importance of employing for the purpose of car axles the best material, and here, if anywhere, a "penny-wise and pound-foolish" policy will tell in the long run against the user of poor material and small axles. The most economical policy is to be generous in the size and material of axles installed, so as to avoid as much as possible any danger of breakage. The curves on electric railways are often of very short radius, and as most of the axles are driving axles, the entrance into these curves at speed may have the effect of twisting off the axle, as well as of breaking the wheel flanges. The latter form the soundest part of a wheel casting, as they are the drag or bottom side in casting, and any strain in curving where flanges generally break, sufficient to break them off, or tending to do so, must cause a severe torsion on the axles.

The axles in most common use are the hot rolled steel and cold rolled steel, both of which have shown excellent results in service. An effort has also been made to employ hammered iron, which has a number of advocates. In iron, fibre is generally considered an indication of strength, and to secure this one manufacturer builds up iron axles by placing together four or nine bars of 2-in. square iron, with a top and bottom piece $4\frac{1}{4}$ ins. x 1 in. or $6\frac{1}{4}$ ins. x 1 in., with corners chamfered to prevent the pile from being overheated. This, it is claimed, will avoid heat cracks, which are almost unavoidable when axles are made from square corner piles. The effect of this axle in use is claimed to be a freedom from breakage, but in point of wear it would probably not have as long a life as a steel axle.

Hollow steel axles have been employed to a considerable extent in steam railroad service, but outside of the third-rail roads of the New York, New Haven and Hartford Railroad have not been employed in surface electric railroading.

It is a common practice on some roads when pressing wheels on axles to leave them wide in the gage, making the flange run close to the rail. The object of this is to prevent the lateral play of the car as much as possible, and the practice is a good one when the tracks are kept in good condition, are straight and level and the rail joints are kept up well. But the railway manager should remember that the practice of a close working flange is severe on the axle, as the crowding of the flanges against the head of the rail has a constant tendency to bend the axle and wear the flanges. Where there is trouble from either of these two causes, theory would dictate that in pressing on the wheels, a little lateral play should be allowed between the flange and the rail. This should be especially followed on a road where a small-sized axle is in use, and where the labor and

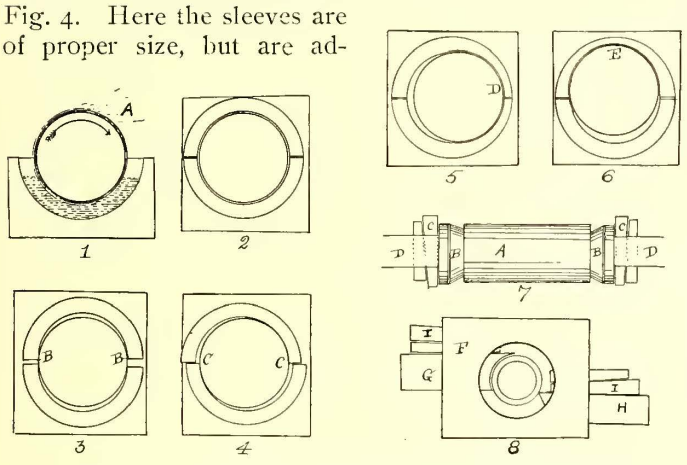
expense of changing the sizes of axles, reboring gears and motor frame boxes and probably the motor frame between the boxes as well, would be so great as to practically prohibit any change in the size of the axle.

Lubrication of Street Railway Car Bearings

BY J. F. HOBART

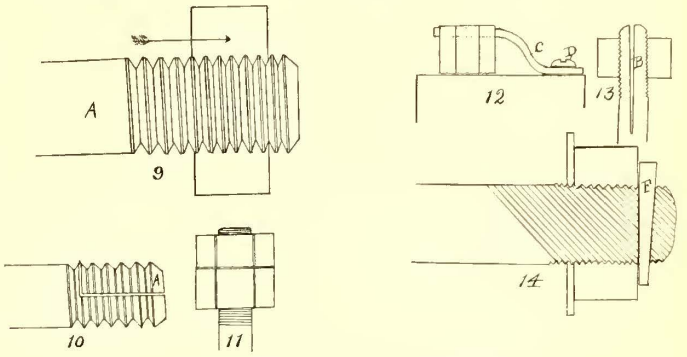
If a revolving shaft is set up in a reservoir of oil after the fashion shown in Fig. 1, the shaft will take on film after film of oil until the centrifugal force begins to throw the oil off as at *A*. From three to a dozen films of oil will form, according to the conditions. This, as is known, is the theory of all journal lubrication. It is mentioned in this connection simply because the proper lubrication of street railway car bearings has often been prevented through defective mechanical factors. If the sleeves of the car journal fit the axle properly, as in Fig. 2, the oil films can form on the entire bearing surface, and friction, wear and heating are avoided. But sometimes the sleeves of the box are a little too small, so that the edges are in contact with the axle at *B B* Fig. 3, resulting in a scraping off of the oil films as fast as formed. Grinding, wearing, heating and loss of power follow. Oil loaded with grindings will soil the exterior of the box, and, as is often the case, the fault will be attributed to the non-efficiency of the lubricant. The remedy consists either in providing new sleeves of right dimensions or in turning down the small ones to right size.

Another character of defective work is represented in Fig. 4. Here the sleeves are of proper size, but are adjusted incorrectly, as the lower one is not in line with the upper. Two scraping surfaces are therefore produced at *C C*, and wearing, grinding, heating, etc., result. This evil is easily remedied by resetting the sleeves so as to have upper and lower even. The type of worn bushings, illustrated in Fig. 5 at *D*, is a familiar sight to all street railway mechanics. The flow of dirty oil, the rattling of parts, the irregularity of motion and loss of power through friction are the symptoms. Oil films may form readily enough on the contacting surfaces, but with one side of the bushings gone, as at *D*, the best lubricants obtainable cannot operate to advantage. The only remedy is to substitute new bushings or rebabbit the box, providing the box is of the kind that will permit this operation. The same remark is applicable to illustration No. 6, in which the top sleeve is worn at *E*. This is frequently noticed in car bearings, and frequently can be fixed by merely putting in a new upper sleeve, the lower one being all right.



GOOD AND DEFECTIVE BEARINGS AND METHOD OF TRUING BEARINGS

Barrel bushings often cause trouble by expanding or losing their shape through heating. Fig. 7 shows a good way to true such bearings. The bearing *A* is held by means of coned collars, *B B*, on either side. These collars are loose on the shaft *D* and are held tightly against the ends of the bearing by means of steel keys *C C*, the latter being driven into seats cut in right places in the shaft. The bearing is now in condition for truing in a lathe, as the shaft *D* can be secured in the chuck. For a cutting tool, the form shown in Fig. 8 can be used, which tool is available for truing many round shapes. The form *F* is of tool steel and is cut out at one side for the cutting tool *H*, and at the other for the straddling tool *G*. Both tools are held in place by means of keys *I I*.



METHODS OF LOCKING NUTS

So much depends upon the adjusting nuts and set bolts in street railway car journals that a brief discussion of them in this connection may be advisable. Necessarily the threads of bolts taper toward the end from which the thread was cut, and if the bolt is struck at *A*, Fig. 9, with a hammer, it will be observed that the nut, unless prevented by something, will turn a little at each blow. After several blows it will be seen that the nut has moved a little in the direction of the arrow. If the blows are continued, the nut will follow the thread and finally drop off from the end of the bolt. This tendency is overcome, of course, by tightening the nut against something, as the cap of the box, for example. Railway men have considerable trouble with loosening nuts and bolts, owing to the jar. Several ways to prevent nuts and set-screws loosening of their own accord are shown next. Fig. 10 shows a split-bolt tip. The split part *A* is cut from an ordinary bolt by means of a hack saw. The loose piece assumes the form of a wedge and will usually prevent the nut from working loose.

The two-nut, or lock-nut form, illustrated in Fig. 11, is too well known to need describing. The pivoted spring *C*, as shown in Fig. 12, has also been employed with good results. The spring is set-screwed to the cap of the box at *D*. The head of the cap-screw is grooved and the spring slipped into this groove as shown, thus preventing the screw from turning of its own accord. The divided shaft is shown in Fig. 13. The shaft is simply cut down about an inch below the seat of the nut. The sides are sprung out a little, and when the nut is in position, the expansion of the sides tends to retain the nut in place. The keyed form is shown in Fig. 14, in which the place for cutting the key-way is nicely calculated, and when the key *F* is in place the nut is firmly secured from turning off.

A recent compilation in the "Railroad Gazette" places the number of accidents of all kinds on street railways in the United States for the year 1898 at 133; persons killed, 27; persons injured, 378.

Motor-Dynamos or Accumulators

BY ALTON D. ADAMS

It has been truly shown for electric car lines long enough to make the cost of feeders prohibitive, with an ordinary per cent of loss—that an accumulator plant at the end of long feeders may be cheaper to install and operate than a small additional generating plant. Were the only choice, in cases like the above, between an accumulator plant and an additional station, the battery up to distances of 10 or 15 miles would in most instances be selected, but the fact is that a third means is at hand to produce the desired result, and in most cases will be found more desirable than either of the other two; this means is the motor generator.

The accumulator has no power to furnish an increasing pressure in compensation for line loss, and when used to maintain pressure at the end of long feeders must be placed at the point where constant pressure is desired. This isolated position of the battery involves a constant outlay for interest on real estate or rent, and for attendance, though not to the same amount in a given case as would a new generating station.

The average efficiency of the battery under working conditions can hardly be expected to exceed 85 per cent, so that the line must deliver to the battery 1. ÷ .85 = 1.17 times the energy required by the car motors. The average loss in the feeders between the generating station and the battery should be decided according to the cost of copper and of power, without regard to the battery, except that the loss of energy in feeders will be somewhat greater, their size being the same, when the battery is used, as 1.17 times the watt hours must be transmitted that would be required without the battery. The drop of pressure in feeders between the station and battery must be compensated for at the station, but this drop, at its maximum, will not be so great with as without the battery, because the battery furnishes current at times of maximum demand, being charged at times of minimum demand, the result being that the average amperes flowing through the feeder is greater, but the maximum current less with the battery in use. As the battery acts at the time of maximum demand, it is an addition to station capacity, but an expensive one, as the price of a battery, plus the value of real estate on which to install it, is quite a number of times that of a dynamo of equal capacity.

A motor generator must be installed at the station so as to raise the bus bar pressure enough to compensate for the drop in the battery feeder and to charge the battery. The battery at the far end of a long feeder may be charged and discharged alternately during the entire working time of the central station each day, or it may be charged only during the time of light load and no load on the trolley, and discharged during the entire time of medium and heavy load. It is also possible to send all of the energy transmitted by feeder into the battery and draw the entire supply for the trolley wire from the battery. The plan of intermittent charge and discharge will allow the smallest battery to be used and give the highest efficiency, as the least energy will then pass through the battery, and be subject to its loss, and the battery may always be nearly charged. It should be evident from the above that a battery at the far end of a long feeder serves simply to compensate for momentary fluctuations in pressure, as it does when used in the central station, but cannot supply a pressure to make good that lost in the feeder, a motor-dynamo being necessary for this last purpose.

Taking a case where the loss is any desired per cent in the feeder on the average, with no battery in use, it is clear that the addition of a battery must lower the efficiency of transmission between power house and trolley, without saving anything in the cost of feeder, the average loss in the feeder being at least the same as without the battery, and the battery loss being added to the average feeder loss.

The above facts may be illustrated by the case of a long feeder delivering current to the trolley wire at 500 volts, and with a loss in the feeder of 20 per cent at average load, with no battery in use. Since the average loss in this feeder is 20 per cent, the pressure at the power house must be 500 ÷ 0.8 = 625 volts at average load, and no battery in use.

If the maximum load on this feeder is twice the average load, the pressure loss in the feeder at maximum load will be doubled, or (625—500) × 2 = 250 volts, and the pressure at power house must be 500 + 250 = 750 volts at maximum load. Since the volts lost in the feeder and the current or amperes flowing in it are each twice as great at maximum load as at average load, the capacity of the motor-generator must be four times as great for the maximum load as for the average load. The total power or energy lost in the feeder is equal to the average loss, that is, the loss at average load, and the maximum loss simply serves to fix the capacity of motor-generator necessary.

Suppose, now, a battery is installed at the trolley end of above feeder, and so arranged that all of the energy from the power house goes into the battery, the average efficiency of battery being 85 per cent. Taking the most favorable view for the battery, suppose the average ampere load on the feeder remains the same as without the battery, and that the loss in battery is entirely made up by increased pressure at the power house. Since the battery is to deliver 500 volts to the trolley with 85 per cent efficiency, the pressure at which current is delivered to the battery must be 500 ÷ .85 = 582 volts, and the pressure at the power house at average ampere load on feeder, which is the same as average ampere load without the battery, must be volts lost in feeder, plus volts lost in battery, plus volts delivered to the trolley wire, that is 125 + 82 + 500 = 707 volts at power house. The efficiency of transmission between the power house and trolley when no battery is in use is 500 ÷ 625 = .8, or 80 per cent, while when the battery is used the efficiency of transmission is 500 ÷ 707, equal to 70.7 per cent.

The loss between power house and trolley without the battery in use is 125 volts, and with the battery 207 volts, so that the loss with the battery is 207 ÷ 125, equal to 1.65 times as great as without the battery. If it is desired to put the same total average loss with the battery in use, that is 207 volts, into the feeder with no battery in use, the relation between the area and weight of the feeders required for the two cases may be found as follows, when A = amperes flowing through feeder at average load in each case, L = total length of feeder wire in feet, and 11 = resistance in ohms of a mil-foot of the conductor. Then the areas of the feeders will be:

$$\text{C.M.} = \frac{\text{L 11 A}}{125} \text{ and } (\text{C.M.})_1 = \frac{\text{L 11 A}}{207}$$

$$\text{Therefore C.M. : (C.M.)}_1 :: \frac{\text{L 11 A}}{125} : \frac{\text{L 11 A}}{207}$$

$$\text{C. M.} \frac{\text{L 11 A}}{207} = (\text{C.M.})_1 \frac{\text{L 11 A}}{125}$$

$$\text{C.M. (125)} = (\text{C.M})_1\ 207 \qquad \frac{(\text{C.M.})_1}{\text{C.M.}} = \frac{125}{207} = .60.$$

That is, if the battery is not used in above case, and the total average loss of 207 volts that would take place in the battery and feeder combined, concentrated in the

feeder, the area and weight of feeder will be only 60 per cent of what it would be with the battery in use. Should it be desired to maintain the same loss in feeder without as with the battery, the weight of feeder will remain the same, and as the efficiency of transmission is 80 per cent without the battery and 70.7 per cent with it, the amount of power required in each case when 1000 h.p. is delivered at the trolley is with no batteries in use, 1000 ÷ .8 = 1250 h.p. delivered to the feeder at the power house, and with the batteries 1000 ÷ .707 = 1413 h.p delivered to the feeder at the power house. When batteries are used, therefore, additional power to the extent of 1413 — 1250 = 163 h.p. must be applied to the feeder, beyond what would be required without batteries. Assuming the average power to be required during 6000 hours per year and that the cost of power is 1 cent per h.p. hour, the yearly value of the additional power lost by the use of batteries is found from 6000 × 163 × .01 = $9,780.00 per year.

As the above computations are based on the assumption that all of the energy on feeder from the power house goes into the battery, and is subject to the battery loss, the results obtained will vary from the above when only a part of the energy from the power house goes into the battery and the remainder directly into the trolley wire. In case but half the energy from power house goes into the battery, the possible saving in copper and the extra cost of power above found will each be reduced one half. In order to maintain a pressure of 500 volts on the trolley wire at the end of a long feeder, a motor-generator must be used to supply the entire loss of pressure between the power house and trolley, at the maximum load, whether a battery is used or not. The capacity of the motor-generator in any case must equal the maximum current in amperes on its feeder multiplied by the maximum loss in volts between the station bus bars and the trolley wire.

In the case above taken of 125 volts lost on feeder, at average load, with no batteries, assume the maximum load twice the average load in amperes, and let A equal the amperes at average load, then the capacity of motor-generator for average load is 125 A, and at maximum load, with twice the amperes flowing in the feeder and twice the volts lost in it, the capacity of motor-generator is 2 (125) 2 A = 500 A; that is motor-generators must be four times as large as needed at average load in order to maintain pressure of trolley wire for the maximum load.

When a battery is used at the trolley end of above feeder, as assumed, the load on the feeder need not rise above the average, and if all the energy is sent from the feeder into the battery, the total loss of pressure will be 207 volts, as computed, and the capacity of motor-generator must be 207 A, the amperes being the same as with average load and no battery.

For the assumed conditions, then, the motor-generator without battery must be 500 A ÷ 207 A = 2.41 times as great as when a battery is used.

The losses in the motor-generator will be about the same whether a battery is used or not, and while a larger motor-generator is required when no battery is used, the actual energy in kw. hours furnished by the motor-generator must be greater with the battery in circuit, and the same size of feeder, since the motor-generator furnishes the total loss, which is greater with the battery in use.

It should be held clearly in mind that the total loss for either system is the loss of *average load*, and though the loss fluctuates more between its highest and lowest point, so as to require a larger motor-generator without batteries than with them, the system without batteries has a smaller *average loss*, and is more efficient or else requires a smaller feeder.

Portable Electric Stone Crusher

A rapid and economical method of stone ballasting track has been in use for some time on the lines of the Scranton Railway Company, Pa. The method involves the handling of the stone only once by the use of a portable crusher. The general arrangement of the crushing and distributing car is shown in the accompanying engraving.

An ordinary single-truck freight car is equipped with a trolley pole, stone crusher and three No. 3, 30-h.p Westinghouse motors—two to operate the car and one to drive the crusher, to which it is connected by a 6-in. rubber belt. The car is loaded with stone from the quarry, and is then run to the point of the track which it is desired to ballast, the track having previously been left with exposed ties. The crusher is then set in operation by means of the stationary motor, and the pieces of stone fed into the jaws of the crusher, the broken stone dropping into place between the ties as the car proceeds slowly. The capacity of the car is 6 cu. yds. of stone, and that of the crusher is 50 cu. yds. in 10 hours. The crusher will receive stone 8 in. x 14 in. The weight of the crusher alone is 7000 lbs. After the car has passed the stone is raked into place and tamped under the ties by hand.

PORTABLE ELECTRIC STONE CRUSHER—SCRANTON

Changes in Washington, D. C.

Announcement has been made that the stock of the Metropolitan Railroad Company and the Columbia Railway Company of Washington has been sold to a syndicate organized for the purpose of effecting a consolidation of the electric lighting plants of the District of Columbia, the gas companies of Washington and Georgetown, and all the street railway lines in Washington.

It is understood the price paid for the Metropolitan property was in the neighborhood of $4,000,000, and for the Columbia about $1,000,000. It is understood the capital stock of the new combination will be not less than $25,000,000.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as Reported by the A. S. R. A. Committee, III

Schenectady Railway Company,
Schenectady, N. Y., March 19, 1899.

Editors Street Railway Journal:

Continuing the comparison and analysis of the "Standard Rules and Regulations" of the A. S. R. A. committee, we wish to know:

Sixth.—Are they free from contradictions either within themselves or with one another? They are.

Seventh.—Are they in accordance with general usage, experience and observation? This point has already been discussed in the previous article (under the third head) and several instances given where they were *not*. There are one or two instances that need a more extended discussion, and the first and most important of these is the matter of "Bell Signals."

The matter of signals between the conductor and the man who runs the car (as he is called the "motorman" in the rules under discussion we will call him that) is an important one in a general set of rules, and if only one thing were made "standard" that one thing should be the bell signals. To a conductor or motorman who serves for any length of time on a road or roads where similar signals were used, they become a language to him; "two bells" are not two separate and distinct strokes on the signal bell—they are the words "go ahead" as plainly as if spoken by human voice, and when, for any reason, he has to work under another system of signals they are more confusing to him than a command in an unknown tongue.

To the traveling public, also, the ordinary and most-used signals become a like language, very often influencing their actions while boarding, moving around on, or leaving a car. Twice within the writer's knowledge has an unfamiliar signal nearly caused an accident to a passenger hearing and misunderstanding it. It may be urged in regard to the employee that a proper training of a few weeks under the new signals would eliminate the old ones from his memory, but the difficulty is that the long observation of certain signals becomes *more* than a memory; it becomes almost an *instinct*, and takes a long time to supplant with a new system. In a case which occurred under the writer's observation, a motorman who had been trained under "one bell, stop at next regular stopping point," was running on a road where "one bell" meant "stop instantly." He had been in training over two months under the new signals and yet, at a critical instant, when "one bell" had been given him as a signal he involuntarily obeyed the old signal, did not stop instantly, and had a bad collision. The same is true of the conductor—upon seeing the need of a certain action to be performed by the motorman his hand will involuntarily give the signal most familiar to him *at that moment*. To a lesser extent this principle is also true of the other traffic employees and of the traveling public, and illustrates the need of a standard and universal system of signals on all surface railways using bell signals.

It may be urged that to have a full and complete set of signals that can be used on any road is as impossible as to formulate a set of complete rules for the same. Such a complete set of signals is not necessary; all that is necessary is a set of signals for the "traffic messages" (between the conductor and the driver of the car or train) that are common to all surface roads. Special messages, due to peculiarities of the driving apparatus or to local conditions of track, traffic, or rules, can easily be added in each case—as will be shown later.

These standard signals should be easy to learn and ring, should be as simple as possible, and—if it is possible to do so—should be so arranged that awkwardly or incorrectly given they do not cause delays, complications nor accidents. Those requiring instant action should be the very simplest and quickest to give and receive, while those requiring action not so prompt may be more elaborate, and those demanding attention should be in the nature of alarms. At the same time there are a few signals like "two bells—go ahead," "three bells—come back," that are standard and universal, and will have to be recognized and left unchanged even if they somewhat disarrange the order and conditions as just noted.

The actual number of general "traffic messages" necessary to be used between the conductor and motorman is not very great, and can be easily covered with one, two, three or four taps of the signal bell, or with a few repetitions or combinations of these numbers. To find out what is really necessary in the number of these signals, let us see what are the necessary general messages between these two employees.

The car being stopped, the conductor may require the motorman

1. To start it forward.
2. To hold it stopped until some other than the regular starting signal is given.
3. To start it backward.

The car being in motion, he may require the motorman

4. To stop it instantly.
5. To stop it at some pre-determined point.
6. To get ready for a stop (*i. e.*, to shut off motive power or to slow down).

The car being either stopped or in motion, he may require the motorman

7. To come to his assistance.
8. *Not* to stop for passengers desiring to ride.

There are, therefore, at the most, only eight general signals necessary from conductor to motorman—three for use when car is stopped or stopping, three when car is in mo-or is just starting, and two at any time. Four distinct signals—such as one, two, three or four taps of the bell, with a repetition of one of them as an alarm signal, will cover the whole ground. As already stated, two of these signals are already in universal use and must be considered standard, and there is *one* that is not standard but should positively be made so, that is the signal for "Stop instantly." Under the "bell signal rules" of the committee we find this given as "three taps of the signal bell while car is running." This is the practice of a number of street railways, many of them quite large ones, but nevertheless it is *not* a universal one, *nor is it the correct one*. It is an undisputed fact that it is necessary on any and every surface street railway to have a signal that will stop the car as quickly as possible; it is as undisputed a fact that on all such roads such a signal is liable to be a danger or emergency signal. It should, therefore, be the signal that is the simplest and quickest to give and to understand, that can be given in any emergency by any one within reach of the signal cord, that will be given correctly and in full, even if the signal apparatus is broken in giving it—and the only signal fulfilling this and all necessary conditions is that of "one bell"—or one tap of the motorman's, driver's or gripman's bell. Any other number or combination or repetition of numbers, given under the excitement of an impending or happening accident may be wrongly given, may be given so rapidly as to confuse or mislead the hearer, or may be misunderstood even if given correctly; but the single "*clang*"

gives no chance for mistake on the part of the giver, nor for misconception nor misunderstanding on the part of the receiver. In time of danger a convulsive and almost instinctive clutch at the bell-cord will give the desired signal —even if it breaks the apparatus—where the more elaborate and unnecessary "three taps" could not be given, completed nor understood.

It has been urged that on surface railways having fixed stopping points the use of "one bell" as a signal for stopping instantly would make many unnecessary stops during rush hours or at other times when the cars were so crowded that the conductor was not easily "get-at-able" by a passenger inside the car, as such passenger would be very liable to give "one bell' when his—or her—desire was only to have the car stop at its next regular stopping place. This is true, and until the new signals were thoroughly standard such a thing would very probably happen, but its frequent occurrence could be easily prevented in many ways, and as the proper signal became better known it would gradually cease. In any event, its occurrence could only cause delay; under no circumstances could it—on a well-managed road—cause an accident.

Therefore, with the above signals fixed, the others arrange themselves very quickly, and the necessary general signals from the conductor to the motorman would be as follows:

(1) One bell, while car is stopped, "Do not start until some other signal than 'two bells' is given."

(2) One bell, while car is running, "Stop instantly."

(3) Two bells, while car is stopped or directly after one bell or three bells have been given, "Go ahead."

(4) Two bells, while car is running, "Get ready for a quick stop."

(5) Three bells, while car is stopped, "Back car."

(6) Three bells, while car is running, "Stop at next regular stopping place."

(7) Four bells, at any time, "Do not stop to take on any passengers."

(8) A succession of quick single taps, or a continuous ringing of the bell, "Come to me instantly."

From the motorman to the conductor the same signals will need to have a different meaning, and from the fact that the same signal cannot be used for two different messages (depending on whether the car is stopped or moving), the signals will have to be a little more complex than those from the conductor to the motorman.

The motorman may desire the conductor

1. To come to him instantly.

2. To put on the rear brake or some other safety or car-holding or car-stopping device.

3. To shut off the motive power.

Or he may wish to inform the conductor

4. That he desires to back the car.

5. That the motive power is cut off from him.

6. That uncollected fares are on the front platform, or have entered car by front door.

7. That some switch, signal, or safety device, known to the conductor and operated by him, is not set or properly arranged.

There are, therefore, at the most, only seven necessary general messages from the motorman to the conductor, and, as stated, these have to be made up of not only single signals of one, two, three, or four taps of the bell, but also of repetitions and combinations of them. With these facts in view the necessary general signals from motorman to conductor would seem to be as follows, at any time and whether car is stopped or stopping, running or just started:

(1) One bell, "Come to me instantly."

(2) A succession of single taps or a continuous ringing of the bell, "Put on rear brakes (or any other safety or stopping or holding device)."

(3) Two bells, "Uncollected fare or fares on front platform, or have entered car by front door." This signal to be followed by slower single taps, giving the number of such fares.

(4) A succession of two bells, or double taps, thus: — — — — — —, "Motive power cut off from me."

(5) Three bells, "I wish to back the car."

(6) A succession of three bells, thus: — — — — — — — — —, "Switch or signal or safety device on line or track not set or not operating."

(7) Four bells, "Shut off motive power."

Any special or local signals can be added to the above lists by additional number of taps, or by other combinations of them than those used above.

The signals as suggested above are the result of a long course of inquiry and observation on this point and are believed to be simple, easy to learn, to ring and to understand. There is a good reason for each one, and for the arrangement as a whole, and the writer would be glad to have them studied and criticised.

No attempt has been made to deal with the signals made by the alarm, or foot-gong, as signals should never be made between the conductor and motorman in this way except in a case where the signal bell or bells are broken so that they cannot be used, and with a double system of bells on each car and with a few feet of bell cord, with "patent splicers" in the locker, there is absolutely no occasion for this to occur. The specific reason for not using the foot-gong as a signal between conductor and motorman is that the sound of the gong is liable to be so overpowered by outside noises as to be inaudible to persons on the car, and the strokes on the gong are also liable, if heard, to be confused with those of other cars passing, thus leading to confusion, mistakes and accidents. Outside its use as an instrument of warning and alarm, the gong should be used only as a signal to a car behind, in front, or passing; as an acknowledgement by the motorman of the receipt of the conductor's signals, and to ask permission of the conductors to start the car. For the first of these purposes there is no need of any general or standard set of signals, the use of the gong for this purpose will be entirely local and special, and can therefore be arranged by each road for itself. For the second of these purposes the use of the gong should be insisted upon, and should be made part of the general rule for "signals," as follows:

"He (the motorman) will always acknowledge the receipt of all signals from the conductor by repeating them *at once* on his gong, and *exactly as received by him.*"

This not only gives the conductor the opportunity to know that his signal has been received and correctly understood, but it lessens the chance of careless mistakes on the part of the motorman—such as receiving and understanding one signal and putting into effect another one—by making him repeat the signal himself and thus bring it more clearly to his own attention. It also calls the attention of a car or of vehicles or of pedestrians in front of the car to the signals and enables them to take advantage of it in crossing, not crossing, or getting off the car track. In case, also, that the motorman receives from the conductor a signal that it is impossible to obey, or that he *knows* is wrong, the reiteration of it on the gong will be the best and speediest method of calling the attention of the conductor to his mistake. For the third of these purposes—that of asking the conductor for permission to start, when for any reason the motorman has stopped without a signal—a part of the general rule for "signals" should be made to apply to it, as follows:

"If for any reason the motorman has stopped the car

without a signal from the conductor to do so or if the car has been stopped on signal from the conductor, and the motorman may desire for any reason to move the car, he must *in no case* start it until he has asked permission of the conductor to do so by ringing on his own gong the signal he desires, and *has received that signal from the conductor*."

The committee has given duplicate rules on this subject (No. 18 for conductors and motormen, and No. 12 for motormen), but has not included in either the matter of asking for the signal by the alarm-gong. With the gong used for these three purposes, the alarm and warning signals should be limited to a succession of rapid single strokes for an alarm warning, a succession of slow single strokes when running in a crowded or narrow street, or when turning a corner, and a combination signal, such as —— ——— for a cross-street warning.

Rule No. 10 for motormen reads—"Signals: Before reaching a curve the conductor will signal you by ringing your bell twice to go ahead if he has the trolley cord in his hand. Should you fail to receive the signal ring the conductor's bell twice. If you fail to get the go-ahead signal, stop your car until you do."

In the first place, the caption of the rule is misleading and incorrect, as its subject is "curves," and it has less to do with "signals" than many others of the rules not so headed. In the next place, there is absolutely no use for such a rule. The "right of way" around curves has been defined in a preceding rule, so it cannot be for that purpose that this rule has been framed. If it is on account of the fact that the overhead work on curves is in such bad shape that it necessitates the conductor hanging on to the trolley cord before the car can proceed around it, the sooner such road discharges its line boss and gets one that will build curves that *can* be run, the better. A rule is no substitute for proper and correct work, and in such a case it is a patch on top of a patch! If the object of the rule is to have the car stop at every curve in order to prevent a collision at the end of it, such object is an unnecessary one for a general rule. *All* curves are not dangerous, even on any one road all curves are seldom dangerous ones. Where curves on any road are dangerous, it will be the special province of that road to make its own special rules for the occasion—no general rule must try to *explicitly* cover local conditions.

Eighth.—Are they reasonable?

Ninth.—Are they just and equitable?

These two heads will be considered together, as most of the rules coming under one come also under the other.

The eleventh paragraph under "General Requirements" states that "All employees should make a deposit of at least ten dollars for the badge furnished them and twenty dollars for cost of uniform." If the idea is to reimburse the employer for the loss, destruction or injury of the badge, the exaction of a ten-dollar deposit for an article worth from fifty cents to a dollar and a half is scarcely reasonable, and is certainly neither just nor equitable. If the idea is to make the sum a *penal* one, it is still less reasonable, as any amount beyond the value of the article could not be collected by law, and its retention by the employer should certainly be resisted by the employee. The just and reasonable method is to make the amount of the deposit the exact cost to the employer of the articles entrusted to the care and used on the person of the employee —such as the badge or badges, the uniform buttons, punch, tickets, transfers, book of rules, etc. Anything further than this is unwise, unjust and unreasonable. Street railways fight tooth and nail against "exemplary damages" when applied to themselves; they should not, therefore, make a precedent by trying to apply them to their own employees.

As to the deposit for uniforms, the language of the rule does not show explicitly whether the committee believes in the railway furnishing the uniform or not. If the former is the case the idea is a mistaken one, as it is now the feeling of both officers and employees of street railways that the employees should always own their own uniforms. Leaving aside the fact that the province of street railways is the carrying of passengers, mail or freight, and not the running of second-hand clothes shops, no employee with any self respect likes to be forced to wear the second-hand and perhaps misfit uniform of another and mayhap dirty predecessor. Every trade necessitates an investment of some sort—of time or tools or materials—on the part of the person learning it, and the investment made by the conductor or motorman is the time given to learn the trade *and* the uniform. For the benefit of itself the employer has the right to require that the uniforms in use *are uniform*, and therefore it should prescribe their exact material and makeup. For the benefit of both itself and its employees, it should make certain that such materials and makeup are the very best for the purpose, and furnished at as low a cost as is possible under such conditions. This having been done, it has the right to insist that the seller of the uniforms be made secure in the payment for them and without responsibility to itself; therefore it has the right to exact a deposit of the exact cost of such uniform, and to pay the seller such cost, thus making certain the fact of payment. Further than this it cannot go in reason and justice, and further than this it owes the employee two other duties in the matter of uniform—*one* is, *not* to require the investment by the employee in a uniform until that employee's situation with the employer is an assured one; and the *other* is, *not* to make the uniform so odd in makeup or material that it cannot be used as "plain clothes" by the substitution of plain buttons and the taking off of the lace or bullion. In speaking of the uniform the cap is, of course, not included; its cost is inconsiderable; it is the one very distinctive feature of the uniform—in fact, in a crowded car it and the cap-badge are the only "outward and visible signs" of the employee—and it can therefore be made as distinctive as the taste of the employer may suggest, without reference to its private use and without financial injustice to the employee.

The single paragraph under "Receivers" and Rule No. 1 under "General Rules for Conductors and Motormen" shows that the committee does not believe in the Biblical maxim as to serving two masters—this point will be touched on later.

Rule No. 8 under same states that "in case of sickness word must be sent to starter at depot by special messenger. No telephone or telegraph messages will be accepted." There are several very minor reasons why this latter condition may be necessary, but they are so minor that the unreasonableness and injustice of the rule as a whole—and especially of a general rule—are apparent at once. The rule should be as follows: "Rule No. —; Absence from Duty.—No conductor or motorman will be excused from duty except his name is posted on the excused list, or except in cases of personal sickness, or of severe sickness or misfortune or death in the family, or for other *unavoidable* cause. In *any* event, he must send word to the starter in such manner as to reach him at least —— minutes before his time of going on duty, and before he goes on duty again he must file with ———————— a written statement of the cause of his absence and be excused by the starter."

This makes the matter a reasonable and equitable one. Under the rule presented by the committee an employee

may have his house burning or burned, his wife in the throes of childbirth or a child at the point of death, he may be drawn as a coroner's juror, detained as a witness, or locked up on a mistaken charge, and, under the rule, he will not be excused from duty. If he is personally sick he must hire a "special messenger" and send "word"—not a written excuse—by him, and all is well. It is true that this may cost him from twenty-five cents to a dollar, whereas a message by a relative, a friend, a fellow-employee, or by a neighbor's telephone would cost him nothing—but that is a small matter to a man who is sick or in trouble, and who is earning from a dollar and a half to three dollars a day.

Under the rule as suggested certain specific reasons and one general one are allowed as an excuse for absence without leave. The employee has, however, a duty to perform toward the employer, viz.: to notify him of his forthcoming absence in time to enable that employer to obtain and place a temporary substitute to perform his duties, and this duty of the employee *must* be fulfilled, but the manner of fulfilling it should not be made onerous nor unreasonable. To prevent undue advantage being taken by the employee of the allowances for absences he is required to present to a specific official a personally written and signed reason for his absence, this specific official to judge of the validity of his excuse, to verify it in case of doubt, to allow him to return to his duties in case he believes it to be bona fide, or to reprimand, suspend or otherwise punish him in case the excuse is not sufficient, valid nor true. The employer is protected in his rights and dues, the employee is treated reasonably and justly.

H. S Cooper.

(To be Continued.)

Formula for Train Resistance

London, March 4, 1899.

Editors Street Railway Journal:

The article in the February number of the Street Railway Journal on Mr. Lundie's new general formula for train resistance seems to call for some remarks from those interested in this subject.

Mr. Lundie's formula is characterized by two marked departures from existing formulæ. It says (1) that the first power of the speed only is involved, and (2) that for equal speeds the resistance involves a term varying inversely as the weight of the train.

With respect to the first; such a radical departure from the present method of estimating train resistance should be substantiated by full accounts of the experiments by which such results are obtained, so that it may be possible to follow the steps by which the conclusion is arrived at. Mr. Lundie gives two sets of plotted results, (a) twelve points being the average of results on a 21-ton car," and (b) ten points, being a "series of actual results, 82-ton train." One would have to know how the different experiments were made, and what governed the selection of the observations by which the twelve points (a) were obtained, before accepting this "average" as the basis for a "straight line" law, especially since the (b) series of observations do not agree with a straight line law, and indicate a law involving a higher power of speed than the first.

Mr. Lundie may have unpublished results which confirm his opinion, but those observations which appear in the figure referred to in the article do not all "cluster around straight line curves," and do not therefore justify the conclusion of the existence of a "straight line" law. In fact the (b) series of observations in Fig. 1 confirm the results of previous investigators, that a higher power of the speed than the first is involved. Those interested in this subject should examine the speed curves obtained by Messrs. Curtiss and Pond, and published in the "Street Railway Review" of July, 1896. These gentlemen made a series of experiments on the Buffalo & Niagara Falls Electric Railway by the "coasting" method, identical with that employed by Mr. Lundie.

With respect to (2), the article refers to Mr. Lundie's experiments on trains of different *weights*, without saying how the trains in question were made up. It would seem that the trains were made up of one, two, three, four and five cars, weighing about 20 tons each. If this were so, the resistance opposed by the air to the passage of the different trains would have an important bearing on the results.

Probably the most reliable experiments that have been made on the subject of the resistance offered by the air to the motion of trains are those made by Professor Goss of Purdue University, and published in recent numbers of the technical journals, *e. g.*, in the "Electrical Review" (London), of Oct. 7 last. According to Professor Goss, the resistances offered by the air to the motion of trains made up of one, two, three, four and five cars is proportional to the numbers 12, 13, 15, 17 and 19 respectively, for equal speeds, and varies with the square of the speed when the speed varies. Hence the resistance in pounds *per ton* is much less for long, and, therefore, for heavy, trains than for short, and, therefore, light, trains. Thus, in trains made up of one, two, three, four and five passenger cars, each 33 ft. long, and weighing 20 tons each, the resistances per ton at 20 miles per hour are 2.4, 1.2, 1.0, 0.8 and 0.7 pounds respectively. If similar calculations were made at other speeds we should find that the longer, and, therefore, the heavier, train had the smaller resistance per pound at all speeds.

It would appear, then, that if Mr. Lundie's experiments were made with trains made up of different numbers of similar cars, like those alluded to, there would be a difference of nearly 2 lbs. per ton between a 20 and a 100-ton train at 20 miles an hour in favor of the heavy train. It is difficult, therefore, to avoid the conclusion that the difference in the resistances found by Mr. Lundie for trains of different weights at equal speeds is not altogether due to the difference in weight, but mainly to the varying air resistance.

Speaking generally, it would seem that the second power of the speed is involved, at least for air resistance, and that for equal speeds the variable depends on the size and the number of the cars more than on their weight.

Chas. A. Carus-Wilson.

The following letter is from the chief engineer of a well-known steam railroad company:

Feb. 27, 1899.

Editors Street Railway Journal:

I have read Mr. Lundie's formula very carefully, and, while it seems plausible, I am not prepared to say that I think it will give a correct train resistance in all cases. I have had so much practical experience with tests for train resistance that I have about given up any hope of a general formula which will cover all cases. I do not doubt that Mr. Lundie's formula is correct so far as trains coasting is concerned, but I doubt very much if it will apply to the general and very varying conditions under which different railroads must operate. I know of one case of a test train where a consolidation engine, weighing about 120,000 lbs., was given its maximum loading over a

long grade of nearly 4 miles, which averaged practically 1 per cent for the entire distance. I have not the figures with me to show just how many tons or how many cars were hauled in each case, but in the first case we took out the heaviest loaded cars we could find, and we will say that the engine hauled 700 tons in sixteen cars. Then we began to take off some of the heavily loaded cars, substituting more cars with lighter loads, and found that the engine would not haul as many tons as it did with the heavily loaded train. Then, in the place of the light loads, we substituted empties, and we found that the engine hauled a still lighter load. This went on until we had reduced the train loading to nearly 600 tons; but when we came to take off all the loads and put on all empties we found that the engine would haul more than 700 tons. Now, this only applies in that one case, and I never saw it in any other; and it is just such things as this, which I have never been able to explain, and for which I have never seen any satisfactory explanation, that makes me doubt any general formula for train resistance. The conditions vary so much on the different railroads for curves, for grades, for wind and for many other things, that I believe each railroad, and, further than that, that each railroad division has got to work out its own train resistance from practical trials in order to arrive at anything satisfactory.

Chief Engineer.

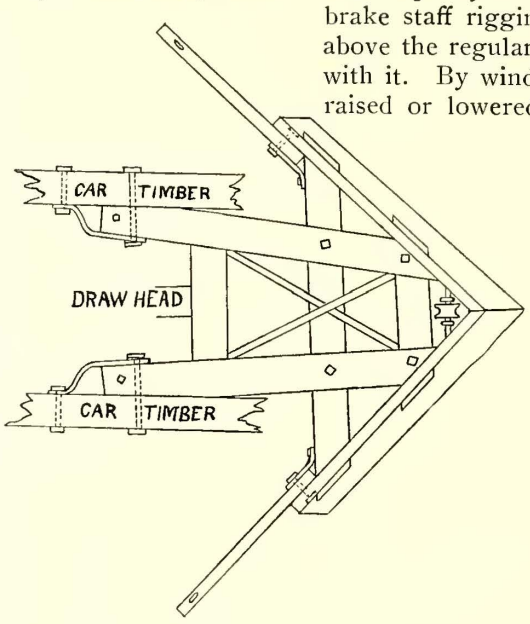


FIG. 1.—PLAN OF PLOW

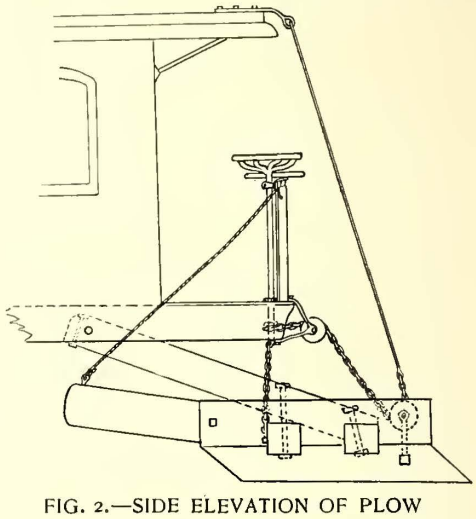


FIG. 2.—SIDE ELEVATION OF PLOW

A Cheaply Constructed Snow-Plow

New Paltz and Walkill Valley Railroad Co.,
New Paltz, Ulster County, N. Y.,
Feb. 21, 1899.

Editors Street Railway Journal:

Our homemade snow plow did such good work in opening up our road after the blizzard of Feb. 13 and 14, and was so simply and cheaply constructed that I believe the idea will appeal to other suburban electric road superintendents.

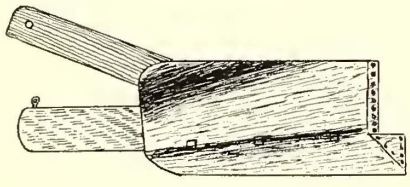


FIG. 3.—PLOW COMPLETE

The sides of the plow are made of 3 in. x 10 in. oak planks, two planks high, the lower planks sloping out, as shown in Fig. 1. The sides are 6 ft. long, and form an angle of 90 degs. at the nose. They are braced by two 6-in. x 8-in. yellow pine timbers (old ties). The back brace is provided with angle irons (not shown), which help hold the bottom side planks in place; two other ties were used for the arms, which are rigidly secured to the plow as shown. On these arms the plow is pivoted to the car body timbers. A header across the arms is so placed as to bear against the drawhead of the car, and thus take part of the pushing strain.

The hood of the car is braced by a pipe from the door header to the end of the plank, which runs the entire length of the car, on which the trolley bases are fastened, Fig. 2. At the end of this plank is secured a rod, which runs to the nose of the plow, where it is attached to a chain, which chain leads around a pulley at the nose and over a second pulley extended from the car platform to an extra brake staff rigging. The wheel of this staff is elevated above the regular brake staff wheel, so as not to conflict with it. By winding or unwinding this staff the plow is raised or lowered with ease. By this arrangement the nose rises faster than the back, which I find not a bad fault, as, when running, if the nose clears an obstacle the back portion will ride up over it.

The wings are of 3-in. x 10-in. oak, 4 ft. long, and are raised by ropes. They do good work in snow up to 3 ft., as they may be raised at an angle and slope the bank, but are not used in 5-ft. or 6-ft. banks.

PLOW IN USE

Fig. 3 shows the plow completed. The sides are covered with $\frac{1}{8}$-in. sheet steel 3 ft. high (made from an old smoke flue). The sheets were shaped by placing them on the track and running one of our 22-ton cars over them. The back upper corners are turned over, and are braced to the arms of the plow. A plow was placed on each end of one of our freight cars, which is equipped with four Westinghouse No. 49 35-h.p. motors and Christensen

air brake. This car was then loaded with 15 tons of railroad iron, and with it we had no trouble in running through snowbanks 5 ft. and 6 ft. high. Our road runs along a side bank nearly its entire length, and we had a continuous drift from 3 ft. to 6 ft. high. The plow opened up the whole road, except a portion in New Paltz, where we have a girder rail on which we could not get traction, and so had to dig this portion open. The rest of the road was of T rail, steam road construction. The accompanying photograph shows one of the largest banks the plow went through, without using a shovel. I estimate this plow saved our company $1,000 during this storm.

E. E. Hawkins, Superintendent.

Armature Hoists and Jacks

Montreal Island Belt Line Railway,
Montreal, Feb. 20, 1899.

Editors Street Railway Journal:

I inclose sketches of two very handy appliances used on our road. Fig. 1 consists simply of a pair of light wheels on which is mounted a frame carrying a chain hoist. This machine is used over the pit in handling motors, armatures, etc., or in transferring motors from one pit or track to another. This takes the place of an overhead crane or derrick. Fig. 2 is a hydraulic pump, and is somewhat similar to a pump described in your columns some time ago. It consists of a lower table mounted on four flat wheels, and an upper rising table lifted by an ordinary hydraulic pump. At each corner of the lower table is a 1½-in. pipe, which slides inside a 2-in. pipe on the corresponding corner of the upper table, keeping the two in line, and making the table very steady. The pump should have a lift of 2½ ft. The tables are of wood, and the entire machine is home made, excepting the jack. I may say that the jack is removable and can be used for jacking cars or any purpose. The wheels of the hoist are flat, so that no rails are required, and any pit can be served. The machine shown in Fig. 2 is all that is needed for the general handling of such motors as the G. E. 1000. With Fig. 1 and Fig. 2 together the G. E. 800 style of motor is easily manipulated.

In shops that are not provided with the necessary cranes, etc., these two contrivances will be found to make a very cheap and good substitute. C. H. W.

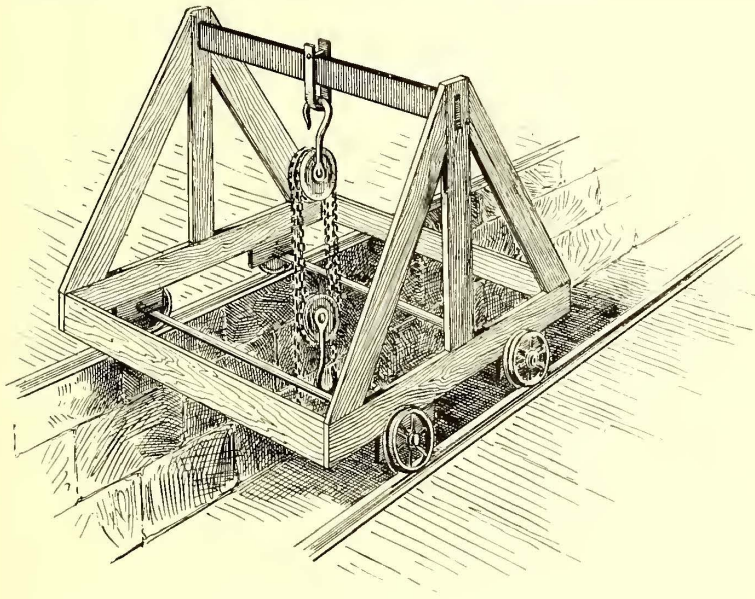


FIG. 1.—PIT HOIST

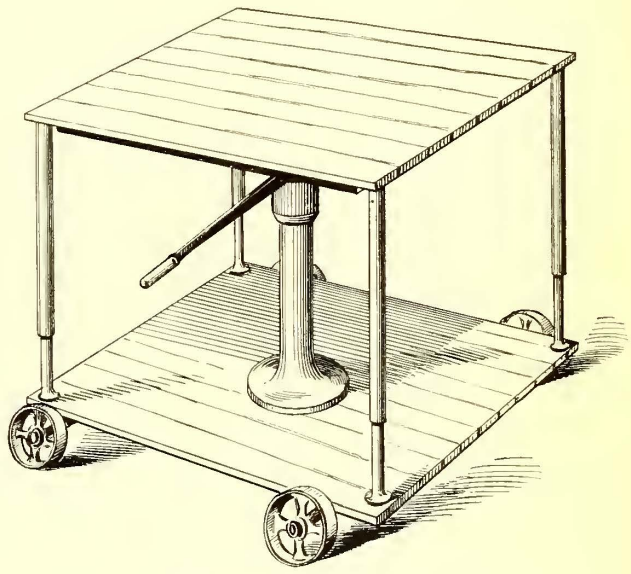


FIG. 2.—PIT JACK

The Man Behind the Controller

Philadelphia, March 6, 1899.

Editors Street Railway Journal:

Observing people who ride frequently in trolley cars have, no doubt, often wondered why there should be such great difference in the motion of different cars running on the same tracks. Sometimes, for example, a car glides along so smoothly that newspapers may be read with ease and passengers may enter and leave the cars without being jostled. At other times the same car (it may be) seems to be possessed with a spirit of evil, causing it to behave in a most erratic and incomprehensible manner, stopping with a violent jerk and starting with a sudden jump. The effect upon the unfortunate passengers, at least those hanging on to the straps, of this alternate jumping and jerking is most unpleasant, and often ludicrous to the observer who may have secured a seat. What is the cause of this strange misbehavior on the part of the otherwise admirable and usually tractable trolley car?

On one of the main lines of the system in a city which is, perhaps, more completely equipped with trolleys than any other—at least in the number of miles of tracks, which occupy nearly every street—there are two motormen, one of whom usually follows immediately after the other, but they do not always have the same cars; yet, constant riders on the road have learned by experience that a car operated by one of the motormen always glides along, in winter or summer, so smoothly that the skimming motion is positively pleasurable, while a car operated by the other motorman often reminds one in its actions of the famous "Swedish Movement Cure Apparatus." From daily observation of these facts it would appear that the difference in behavior of the cars, operated by the same electric force, is due to the difference in degree of skill of the motormen; in other words, the "personal equation" is a more important factor in the manipulation of these modern conveyances than is generally supposed. A well-known mechanical engineer has stated that the increased wear and tear upon the rolling stock, due to sudden and often needless application of brakes, and the waste of electrical energy by unskilled or nervous motormen, sometimes equals, if it does not exceed, the amount of wages paid to the skilled man.

By the aid of a little "inertia indicator," which may be carried in the pocket and rested on the window-sill of a

car, some interesting tests have been quietly made during the past few months without the knowledge of the motormen—or even of the company—which will go far to substantiate these statements when they shall have been compiled into tabular form.

It is a remarkable fact that in almost all large business corporations there appears to be a certain lack of close attention to small details such as this, and it has often happened, therefore, that economies and improvements which should naturally have suggested themselves to those most familiar with the business, have come from outsiders whose very unfamiliarity with the details seems to aid them, in that they are apparently more observant of such minor defects. As an illustration, a single case may be mentioned here.

Some time ago a daily commuter on a suburban steam railroad wrote a somewhat humorous communication to a newspaper calling attention to the annoyance caused to passengers by the constant slamming of the car doors by conductors and brakemen in cold weather. Nearly two years before that time he had expressed the same views politely in a communication to the proper official of the company without any notice having been taken thereof. Recently, however, several of the cars on this road have been equipped with silent air-cushion springs on the doors to the great delight of the passengers.

The conclusion to which this somewhat discursive note points is, that it would, doubtless, pay every large corporation catering to public patronage to employ some person (perhaps a bright woman) simply to examine into these "little things" and to see that every practicable improvement looking to the comfort and convenience of the patrons should be adopted. It is, in fact, largely owing to the introduction of many such little conveniences for shoppers that the modern department store owes its great financial success A. E. O.

Electrical Resistance of Rails

Kioto Traction Company,
Kioto, Japan, Jan. 16, 1899.

Editors Street Railway Journal:

Your December issue contains a paper by Mr. A. B. Herrick on "Some Fallacies Regarding Electrolysis," which I have carefully read over with great interest.

In this paper he has tabulated some electrical resistances of different iron pipes and rails, of which those of rails are very useful to me, as well as to those who use their track as return circuit. However, I have noticed that his resistances of rails are greatly at variance with those which I have calculated to show a fair average.

I mention here my results in ohm per 1000 ft.

A 45. lb. rail	0.01104	ohm and single track of			45. lb. rails	0.00552	ohm
A 50. lb. rail	0.00993	"	"	"	50. lb. rails	0.00497	"
A 60. lb. rail	0.00828	"	"	"	60. lb. rails	0.00414	"
A 70. lb. rail	0.00709	"	"	"	70. lb. rails	0.00355	"
A 80. lb. rail	0.00621	"	"	"	80. lb. rails	0.00311	"
A 90. lb. rail	0.00552	"	"	"	90. lb. rails	0.00276	"

Mr. Herrick's resistance of single rail somewhat resembles that of corresponding single track, calculated by me, or, in other words, his resistance is only a half of mine.

When, several years ago, Mr. J. H. Vail read a paper on "The Importance of Complete Metallic Circuit for Electric Railways" before the National Electric Light Association (see the Street Railway Journal for March, 1894), he gave the following table:

	56 POUND RAIL.		70 POUND RAIL.	
	One Rail.	Single Track of Two Rails.	One Rail.	Single Track of Two Rails.
Area in sq. inches	5.4874	10.9748	6.8593	13.7186
Equal in area to circle whose diameter is in inches	2.642	3.735	2.95	5.90
Equivalent in cir. mils to	6,980,000	13,960,000	8,702,500	17,405,000
Resistance per foot B. A. units	.00000845	.00000422	.00000679	.00000339
Equivalent to copper resistance in cir. mils	1,175,000	2,350,000	1,463,000	2,926,000
Equivalent to copper rod whose diameter is	1.13	1.533	1.21	1.71
Safe carrying capacity of iron reckoned at ⅓ that of copper in amperes	390	780	488	976

NOTE.—In the above statement the areas of rails have been determined by use of the planimeter. The ampere capacity of iron has been based upon the most reliable data obtainable. The resistance of iron is taken as 5.63 times that of copper.

This table coincides quite closely with my results. These differences, though of only minor importance to the subject of Mr. Herrick's paper, are never negligible when investigating track resistance and conditions of rail bond, etc. I should like to hear from him as to how he got his results and to learn whose figures are the most reliable.

Ichiro Goto, E. E.

Mr. Herrick's Reply

The following is Mr. Herrick's reply to this letter:

New York, March 25, 1899.

Editors Street Railway Journal:

In answer to Mr. Ichiro Goto's communication I have to thank him for calling my attention to the omission made in transcribing this table. The resistances given are for 1000 ft. of single track, so for single rail resistance the value would have to be one-half that given. There are a great many values given for rail resistances, but no observers have as yet considered the element of temperature. A good steel rail has a temperature coefficient of about 0.48 per cent for each degree of centigrade rise.

The following values have been given for 90-lb. single rail for 1000 ft. in ohms:

Bell	.00666
Goto	.00552
McTigh	.00660
Vail	.00528
Herrick	.00521

The composition of the rail plays a very important part in this resistance. Generally speaking, an increase in carbon is accompanied by an increase in electrical resistance, but by a decrease in the temperature coefficient.

Albert B. Herrick.

Repair Records in Chicago

In June, 1897, G. W. Knox, electrical engineer of the Chicago City Railway Company, instituted a system for carefully checking and recording all cases of trouble with the electrical equipment on the cars of the road with which he is connected. The records of these electrical troubles are sent in by the conductors and motormen on whose cars the breakdowns occur, and Mr. Knox carefully investigates and verifies these reports by consultation with the barn foreman and repair men. The records are kept separately for each car house, of which there are four, and the electrical engineer is thus able to tell not only the different kinds of troubles that occur and the most common ones, but is also able to tell the relative efficiency of the different car houses in keeping their equipments in good repair. The following tables contain the records for the entire system only, and not for the different barns separately.

In Table No. 1 is shown the total number of each kind

of trouble with electrical equipments reported for the year ending Dec. 31, 1898, and also the percentage of each kind of complaint to the total number of all complaints reported:

TABLE No. 1—REPAIRS TO ELECTRICAL EQUIPMENTS.

	Total Number Cases Reported.	Per Cent Each Kind Repairs to Total Electrical Equipm't Repairs.
Repairs to Armatures	217	24.6
" Controllers	50	5.7
" Lights	24	2.7
" Wires	119	13.5
" Brush Holders	196	22.2
" Rheostats	12	1.4
" Miscellaneous	40	4.6
" Trolleys	193	21.9
" Fields	27	3.1
" Lightning Arresters	3	.3
Total Repairs to Car Equipments	881	100.0

Average number of cars operated 351.9.

TABLE No. II—ARMATURE REPAIRS.

NATURE OF REPAIR.	TYPE A.		TYPE B.		TYPE C.		TYPE D.		Total Each Kind Armature Repairs.	Per Cent Each Kind Armature Repairs to Total Armature Repairs.
	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.	Total Number Cases Reported.	Per Cent to Total Number Repairs on Same Type.		
Turned	115	72.3	355	86.8	117	59.1	45	81.8	632	77.0
Grounded	16	10.1	19	4.7	20	10.1	3	5.5	58	7.1
Open Circuited	7	4.4	16	3.9	27	13.6	1	1.8	51	6.2
Burnt Out	7	4.4	7	1.7	19	9.6	2	3.6	35	4.3
Duck Head Off	5	3.2	0	..	1	.5	0	..	6	.7
Oil Ring Loose	3	1.9	4	1.0	5	2.5	0	..	12	1.5
Short Circuited	1	.6	3	.7	3	1.5	0	..	7	.8
Commutator Loose	1	.6	0	..	2	1.0	0	..	3	.4
Bands Off	4	2.5	4	1.0	2	1.0	1	1.8	11	1.3
Shafts Bent	0	..	1	.2	1	.5	0	..	2	.2
Shafts Loose	0	..	0	..	1	.5	2	3.6	3	.4
New Commutator	0	..	0	..	0	..	1	1.8	1	.1
Repairs of all kinds to armatures	159	100.0	409	100.0	198	100.0	55	100.0	821	100.0

NOTE.—Type "D" motors are in use on winter cars only and are in operation about half as many months in the year as the other types.

Table 2 gives the different kinds of repairs made upon armatures for each of the four different types of motors in use, together with the percentage of each kind of repairs upon each type of armature to the total number of the same kind of repairs upon the same type, and also to the total number of armature repairs.

Table 3 gives the total number of motors used and total number of armatures reported, as well as the comparative age of the motors :

TABLE No. 3—MISCELLANEOUS.

	Type A.	Type B.	Type C.	Type D.	Total.
Total motors used	129	505	104	84	822
Total armatures repaired	159	409	198	55	821
Number of years motors have been in use	6	2½	4	3	....
H.p. of motors	25	25	30	25	....

New Construction in New Orleans

The New Orleans & Carrollton Railroad Company, which has recently purchased all the property and franchises of the Canal & Claiborne Railroad Company, is contemplating some important extensions to its system, including not only additions to its power stations, but also to its mileage and rolling stock. During the last month this company has placed, through its engineers, Mesrs. Ford, Bacon & Davis, orders for sixty G. E. 1000 double-motor equipments, an 850-kw. General Electric generator, a 1275-h.p. Allis-Corliss cross compound condensing engine with Allis condenser, and track and special work for 15 miles of track. The latter will probably be the heaviest T-rail construction ever laid for electric railway service.

The rail, which is of the A. S. C. E. section, 5¾ ins. high, will weigh 100 lbs. to the yard, and will be supplied by the Pennsylvania Steel Company, in 60-ft. lengths. A departure from usual New Orleans practice will be made in this track construction, which will consist of creosoted-plank flooring, supporting crushed stone ballast, upon which will be laid the 100-lb. rails on 6 in. x 8 in. x 8 ft. creosoted ties. The T rail special work will be supplied by the Pennsylvania Steel Company, and the girder rail special work by the Lorain Steel Company.

This company is about to order sixty new cars and 1000 h.p. of boilers. The generating apparatus will be installed in the Claiborne power station, and a double-track extension will be laid to connect the terminus of the Tulane avenue line with the terminus of the Carrollton line, thus making a loop or belt line between the two systems back of the city.

New Association in Virginia

A State association of prominent street railway and electrical men was recently formed in Virginia, and will be known as the Virginia Street Railway & Electrical Association. Its avowed object is the acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street railways and electric plants, and the diffusion of this knowledge among the members of the association, with a view to promoting the street railway and electric interests, improving the service and reducing its cost; the establishment of a spirit of fraternity among the members of the association by social intercourse, and the encouragement of cordial and friendly relations between its members and the public. The constitution provides for an associate membership consisting of manufacturers and dealers in street railway and electrical supplies, engineers and contractors, etc. The officers of the association are: President, R. D. Apperson, Staunton; vice-president, E. R. Williams, Richmond; secretary and treasurer, H. P. Woodson, Lynchburg; executive committee, R. D. Apperson, Staunton; R. L. Williams, Norfolk; D. W. Flickwir, Roanoke; H. P. Woodson, Lynchburg; E. R. Williams, Richmond. The next meeting of the association will be held at Richmond May 16, 1899.

STREET RAILWAY JOURNAL

APRIL, 1899

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

MAIN OFFICE:
NEW YORK, HAVEMEYER BUILDING, 26 CORTLANDT STREET.

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....929 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
COPENHAGEN.....V. Faber-Madsen, 9 Valby Langgade.
BERNE.....Chas. Rochat, 15 A Falkenburg.
MILAN.....Guido Semenza, Via Paleocapa, 4.
VIENNA.....E. A. Ziffer, I Giselastrasse, 9.
MOSCOW: Alexander L. Lineff, 9 Gt. Tchernishevsky Pereulok.

Long Distance Telephone, "New York, 2664 Cortlandt,"
Cable Address, "Stryjourn, New York."

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr

Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

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

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

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

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

Address all communications to

The Street Railway Publishing Co.,
Havemeyer Building, 26 Cortlandt St., New York.

Notice of Removal

On April 15 the offices of the Street Railway Publishing Company will be moved from 26 Cortlandt Street to 120 LIBERTY STREET, New York. Our new offices occupy half of the eleventh floor of the Beard Building, which is in the center of the "Electrical District" of lower New York city, and is very conveniently located as regards the Sixth and Ninth Avenue elevated lines, the surface railways and all the North River ferries. As in the past, we shall be glad to have our subscribers and friends use our office as their headquarters during any visit to New York. Remember the new address, 120 LIBERTY ST.

The "automobile" has, almost in a day, emerged from comparative obscurity to a position of the utmost importance in the world of transportation. Until the past year, far more interest has been taken in automobile work abroad than in America, but now "operations," both in stocks and in physical accomplishments, are on the largest scale. Electric vehicle companies and compressed air "autotruck" companies, parent and territorial, have been formed in New York and several of the principal American cities, and capital is rushing into these new fields with ardor and enthusiasm. Disappointments may be in store for over-sanguine investors, but at the foundation of the automobile industry lies the indisputable fact that the horse power thus sought to be displaced is intrinsically costly to a degree such that almost any form of mechanical motive power, even if not theoretically high in efficiency, should show an advantage over horses warranting initial and subsequent expenditures for experimentation. In other words, it is quite probable that the pioneers in this industry will make enough money, even with imperfect apparatus in original installations, to purchase the new and better equipment of later days with further profit.

The possibilities of automobile work, particularly in the line of cabs, omnibuses, carriages, etc., should be regarded by street railway managers with close attention, if not with concern. Electric cabs in New York have become instantly popular and are in constant and pressing demand, the supply being so far totally inadequate for the requirements. Electric cabs will do double the daily mileage of horse cabs. They are under perfect control, running smoothly and silently through the streets, and weaving in and out among vehicles far more easily and with greater saving of time in blockades than can be done where horses are used, and it has been proven possible to equip these cabs with batteries small in compass, but powerful enough to propel the cab for from 20 to 25 miles. Fresh batteries can be placed in cabs within three or four minutes, and a new lease of life secured. Finally, the assumed advantage of electricity over horses has been, as usual, divided between the operator and the public, so that the public is getting a service far superior to the old and at a lower price. What has not been so far demonstrated, however, is the actual amount of this advantage over horses. No figures have yet been given out as to operating expenses of the cab service, and in the nature of things, some elements of these expenses cannot be known for a year or two to come. Depreciation of the batteries is one of these uncertain elements of expense, and the cost of maintaining the heavy and expensive pneumatic tires is another. But, all drawbacks and uncertainties aside, it seems probable enough that initial difficulties will be overcome and the industry will develop into a profitable one. Street railway companies will do well to investigate the financial opportunities afforded by a local electric cab service with a view to making such a service a part of a complete city transportation system under their control. One of the principal advantages of this action would be found in the possibility of greatly increasing the load factor of street railway power stations by operating them at their full capacity during the lighter hours of the day, using the surplus power for charging batteries for the cab system. By this means the cost of electric power per kw.-hour output can be greatly reduced, while a transportation profit far exceeding the power profit ought also to be possible.

The economical distribution of railway current over long distances can be effected by boosters, accumulators, or the use of polyphase apparatus, and with the increase in the number of long distance lines the question of determining which of the three methods is the most economical, under a given set of conditions, is an important one. Elsewhere in this issue a careful summary of the relative advantages of continuous current distribution from a number of separate stations and that of alternating current distribution from one central station is carefully considered by Mr. Parshall. The particular system studied is that of the city of Glasgow, but the same principles can be applied, with certain important modifications, to properties elsewhere. The relative cost of installation and maintenance is carefully considered, but the problem in Glasgow, as will be seen from Mr. Parshall's treatment of the subject, was largely affected by the determination to keep the potential drop on the return circuit within a maximum of $3\frac{1}{2}$ volts, or one-half that allowed by the British Board of Trade. This restricted the distribution from any one station to a maximum of $\frac{1}{2}$-mile radius, and as this limitation does not exist in the United States, and as the cost of labor and apparatus is somewhat different, the conclusion reached by Mr. Parshall would not apply directly to installations in America. In an article by another writer in this issue, the relative advantages of motor dynamos or accumulators is considered, from the standpoint of efficiency. The writer assumes the use of both methods of boosting under similar conditions, and then draws a comparison between the relative first cost and operating charges of the rotating booster and the accumulator booster. The increasing use of accumulators shows, however, that relative efficiency is not the only criterion for judging this problem, but that the effect of the battery in increasing the load factor, thus reducing the necessary station capacity for a given load, is a most important consideration. It will be remembered that an increase in the load factor with the same output not only reduces the first cost of installation, but also raises the mechanical efficiency of the station by making the load more steady, and thus rendering it possible to operate the engines more continuously at the point of maximum economy. In this connection we might say that the relative efficiency of station apparatus, operating under different load factors, with the highly varying momentary fluctuating loads which exist in electric railway stations, has never been so thoroughly discussed as many of the other problems in electric railroading. We hope in an early issue of the Journal to publish some statistics on this subject, taken from actual practice, and think that they will throw considerable light upon the subject of the possible economy of railway power stations.

The selection of schedules for high speed city transportation service is not, and should never be a mere matter of guess work, or be regarded as one of the incidental problems. It is, on the contrary, *the one great problem of the installation*, in comparison with which all others, including those of the details of the electrical equipment, are entirely subordinate. In order to operate any given property at a given frequency and a given schedule speed, a certain investment is required and certain operating expenses will be incurred. In a given range of possible schedule speeds, as, for example, 10 miles to 20 miles per hour, there will be maximum and minimum investments and maximum and minimum operating charges. The most careful detailed estimates, covering both investment and operation, should be made by trained engineers specially delegated for this work, and from their calculations when presented to the managers should be selected the schedules best adapted for the traffic conditions. Without such investigation, the electrical equipment of a high speed transportation line is a leap in the dark, and if as a result of insufficient study of the problem presented, a schedule speed be selected lower than what is economically possible to obtain, the disaster is private as well as public, and is likely to be accompanied with the most serious consequences in the matter of profits, particularly if a shrewd and far sighted competition exists, able to take advantage of all mistakes.

The New York Rapid Transit Proposition

The citizens of New York have reason to regard with almost complete satisfaction the proposition just made to the Rapid Transit Commission (given in full on page 230 of this issue) by counsel representing the Metropolitan Street Railway interests. For nearly a decade the problem of rapid transit in New York has engaged the close and anxious attention of the many able citizens on the commission, but their efforts have until now been fruitless, owing to causes more or less beyond their control, and New Yorkers had almost come to despair of any tangible results to their labors.

In the letter transmitting this proposition to the Rapid Transit Board, it is clearly pointed out that the reason why capital has not hitherto responded to the long continued invitation of the city to take the risk of constructing an underground road, is that there is not sufficient probability that such a road could be profitably operated without surface collecting and distributing facilities. These facilities the Metropolitan Street Railway Company alone has, and is therefore enabled to make a proposition which cannot be duplicated by any other transportation agency, or by individual capital. It is also made clear that the real obstacle to rapid transit lies in the congested district in the lower part of the city, and by localizing traffic in the streets of this district and putting all through or longer-distance business into the tunnel, the streets may be relieved of much of their burden, and better transit even on the surface may be secured.

It is hard to speak of a plan of this broad and far reaching character without enthusiasm. The "Metropolitan Syndicate" has given to the people of New York, in the last few years, many evidences of largeness of conception, breadth of view and generosity of action—qualities which, when found in any group of individuals dealing with questions of intense public interest, always bring about the greatest possible benefits to a community. This new proof of the ability and acumen with which transportation matters can be handled by those who understand thoroughly the financial and operating possibilities, is now superadded to the old. Who, in noting the halting and irresolute way in which such problems are dealt with in other cities of the world, can say that New York is not indeed fortunate

in having in its service private capital which, while always and necessarily seeking profits for itself, has, at the same time, so broad and generous a confidence that the people will respond almost immediately to the increase and perfection of transportation facilities, as to warrant enormous present outlays, upon which the more or less remote future must be called upon for dividends?

From an operating standpoint, the keynote of the entire plan lies in the specification of a ten-cent fare for express service, and from the public standpoint, the justice and wisdom of granting this concession cannot be for a moment denied, for not only are the express trains, as defined in the proposition, to be run at schedule speeds of from 20 to 30 miles an hour, which is extremely costly work, but it will always be within the option of the intending passenger to choose a five-cent fare ride over the same distance as that covered by express trains, and at an average speed which will doubtless be at least one-third greater than are the present Manhattan schedules. Moreover, the total traffic will be better distributed between express and local trains than is the case on the New York elevated roads at present, since those who can better afford to pay the higher price for "first-class" service may do so and leave better accommodations in the local trains for those who must use the latter perforce; and finally, the express train passenger has the privilege of using the surface cars, without additional charge, for reaching his very door.

It is now a part of the settled policy of the State of New York as expressed by general legislation to grant street railway franchises for twenty-five years only. It is obviously impossible to impose any such conditions upon an enormously costly enterprise of this character, and we feel that inasmuch as the Metropolitan Street Railway franchises are in themselves practically perpetual, having been granted many years ago before the passage of the general legislation just referred to, and inasmuch as almost the entire value of the proposition depends upon the surface connections with the Metropolitan Street Railway Company, the demand on the part of the latter for a perpetual franchise is not unwarranted, and will be favored even by those who are ordinarily opposed on principle to grants of this general character. The *quid pro quo* offered to the city is worth some sacrifice to obtain, and no alternative offer of equal advantage from other parties is a possibility. New York has sighed for rapid transit through so many years, that now when it is actually within reach on an equitable basis, it is inconceivable that it should be rejected on more or less theoretical grounds.

One other feature of the proposition, that of securing to the tunnel company and its lessees the right to use and lease what are practically subway rights, has excited comment and a little adverse criticism on the part of the press. It would be absurd to refuse this right, however, not only because by placing pipes, wires, etc., in a tunnel of this character, the best interests of the city are served; not only because the transportation profits, pure and simple, are problematical, as has been shown by the reluctance of capital to make to the city any proposition for the building of such a tunnel line, and therefore collateral profits should be permitted when not interfering with the city's best interests; but also because the financial interests which are making this rapid transit proposition to the city are owners of practically all the high tension subway rights so far given in the city, and have presumably a further right to construct new subways irrespective of that to be conferred upon the tunnel company.

The many complicated and important engineering problems which will be raised in this new transportation in New York city will be of widespread interest to the engineering public. The press of New York has done no more than justice in saying of the management of the Metropolitan Street Railway Company that the general public knows how well and quickly it carries through its work, and the fact that, doubtless after most careful estimates by its engineers, it is proposed to complete the four-track tunnel south of 104th Street, together with the three-track west side branch north of that street, in thirty-six months from the time that the franchises are perfected, is a commentary upon the possibilities which lie in thorough organization for the accomplishment of a given end. It is evident that there will be work in New York city for all who want it within the next few years.

The new rapid transit plans for New York city leave the present elevated railway system in a peculiar position. Hitherto its principal claim upon traffic has been its ability to carry passengers over the longer distances in the city with a decided time saving. Now its aggressive rival, the Metropolitan Street Railway Company, proposes to enter into competition with it for this class of traffic on a basis which can hardly fail to be effective. It cannot hope to run express trains on its elevated structure as rapidly as the underground express trains, it cannot hope to run its local trains faster than the underground locals, and it will have no collecting or distributing agencies on the surface unless it should acquire, or be acquired by the Third Avenue Railroad Company. It will still carry passengers, and many millions of them, and it still has its future destiny measurably within its own hands, though within far narrower limitations than ever before, but consummate wisdom and ability and a complete change of attitude toward the public will be necessary if even moderate financial success is to be attained. It has as competitors those who believe that more money is to be earned by increasing gross receipts than by reducing operating expenses, and to this end the best possible service of the public is none too good. If, as has been reported, it is not the intention of the Manhattan Company to greatly increase its present schedule speeds when electricity is adopted, but to depend more upon making a saving in operating expenses upon but slightly faster schedules, the Manhattan Company is out of the race and will remain so. If, on the contrary, it will wisely determine to give to the people of New York an elevated railway service such as has never before been seen in any city, there is some chance that a large proportion of the city travelers will prefer a ride in the air to the "hole in the ground."

Announcement was made last month of the incorporation at Trenton of the Consolidated Street Car Company with a capital of $18,000,000. It is said to be the combination of a number of the principal builders of street cars in the United States, and seems to be a confirmation of the rumors, which have been persistent during the last few months, that several of the builders of street railway cars were contemplating a general consolidation. The names of the companies whose properties will be acquired by the new corporation have not yet been made public.

Gross Receipts Per Capita and Per Mile of Track in the Principal American Cities

The accompanying table has been carefully compiled, with a view to showing the comparative patronage by the peoples of the principal cities of the United States of their street railway systems. The table covers the population served, the miles of track, the gross receipts, the gross receipts per mile of track, and the gross receipts per capita served.

NAME OF CITY.	Street Railway Systems.					
	Population Served.	Number Included.	Miles of Track.	Gross Receipts.	Gross Receipts Per Mile Track	Gross Receipts Per Capita.
New York City—						
Manhattan and Bronx.				$	$	$
Elevated Lines		1	109	9,183,542	84,252	4.26
Surface Lines	2,156,000	8	368	16,044,332	43,597	7.44
Total		9	477	25,227,874	52,910	11.70
Brooklyn.						
Elevated Lines *f*		3	75	2,481,730	33,090	2.07
Surface Lines	1,197,000	4	412	8,522,142	20,684	7.12
Total		7	487	11,003,872	22,597	9.19
Queens.						
Surface Lines	128,000	..	92	491,969	5,347	3.86
Richmond.						
Surface Lines	65,000	..	59	293,004	4,966	4.51
New York City.		..	1,115	37,016,719	....	....
Elevated Lines		..	184	11,665,272	63,397	3.29
Surface Lines	3,546,000	..	931	25,351,447	27,229	7.14
Total		16	1,115	37,016,719	33,199	10.44
Chicago—						
Elevated Lines		3	70	2,766,982	39,529	1.48
Surface Lines	1,875,000	7	625	12,347,121	19,739	6.59
Total		10	695	15,114,103	21,747	8.06
Philadelphia	1,250,000	3	484	11,452,999	23,663	9.16
Eastern Massachusetts	1,250,000	39	894	12,330,666	13,793	9.86
Boston	*a* 788,000	3	349	9,106,108	26,091	11.56
St. Louis	*a* 675,000	10	302	5,836,242	19,324	8.65
Eastern New Jersey	*d* 603,000	11	400	4,863,897	10,216	8.07
Baltimore	600,000	1	354	4,020,900	11,357	6.70
Pittsburg—Allegheny	*ad* 528,000	15	390	4,351,694	11,160	8.24
Cleveland and Suburbs	520,000	7	330	3,386,000	10,261	6.51
Minneapolis—St. Paul	*a* 405,000	1	230	2,145,000	9,327	5.30
Cleveland City	400,000	2	204	2,927,000	14,348	7.31
Buffalo and Suburbs	400,000	14	300	2,276,546	7,590	5.69
Detroit	365,000	2	163	1,597,666	9,803	4.38
San Francisco	350,000	7	273	4,841,284	17,733	13.83
Lynn	*e* 319,000	1	154	1,431,936	9,299	4.49
New Orleans	300,000	7	187	2,219,089	11,867	7.40
Milwaukee	*a* 280,000	1	158	1,761,500	11,152	6.29
Providence	*a* 280,000	1	140	1,776,695	12,693	6.34
Washington	*b* 275,000	10	178	2,198,277	12,348	7.99
Louisville	*a* 275,000	1	140	1,297,394	9,264	4.72
Montreal	250,000	1	85	1,342,368	15,792	5.37
Troy—Albany	*a* 224,000	4	94	1,198,047	12,745	5.35
Kansas City, Mo	*c* 200,000	1	136	1,942,852	14,287	9.72
Indianapolis	*c* 194,000	1	100	978,964	9,790	5.05
Rochester	*a* 190,000	3	105	835,190	7,954	4.40
Toronto	180,000	1	110	1,210,618	11,000	6.73
Denver	167,000	..	..	.....	....	7.50
Toledo	*c* 145,000	1	99	921,998	9,313	6.35
Worcester	*a* 138,000	3	96.	761,520	7,932	5.52
Columbus, O	*c* 135,000	1	64	680,173	10,628	5.04
Syracuse	130,000	3	61	482,243	7,905	3.71
Scranton	125,000	1	35	383,727	10,963	3.07
Albany	*a* 124,000	2	49	647,943	13,222	5.23
Atlanta	123,000	2	85	497,733	5,855	4.04
Fall River	102,000	1	34	306,115	9,003	3.00
Richmond	100,000	2	66	561,906	8,514	5.62
Nashville	*c* 100,000	1	47	493,186	10,493	4.93
Troy	*a* 100,000	2	45	550,104	12,224	5.50

a Including suburbs reached by street railway lines whose gross receipts are given. *b* Estimated. *c* Principal system. *d* Population partly estimated. *e* Comprising populations of twenty-one cities and towns tributary to the cities of Lynn and Boston. *f* Including receipts, mileage, etc., of New York and Brooklyn Bridge.

It is most difficult to obtain reliable figures of the population between census years, and the accuracy of those found in this table is by no means guaranteed. They are, in most instances, given on the authority of the Mayors of the different cities, and are usually based on some form of local census taken for police, school, or taxation purposes. Judging from past experiences, however, it is more than probable that next year's national census will show that these estimates are somewhat too high in many, if not in most instances. They are, however, the best figures obtainable at the moment.

Where a city street railway system can be isolated from its suburban connections, the population of the city alone and the mileage and receipts of the city system are given. In many cases, however, city lines operate in the suburbs also, and wherever this occurs the population of the suburban cities and townships connected by street railway lines with the principal city, together with the mileage and receipts of all suburban lines distinct from the central system, are also included. The number of street railway systems included in the group of cities is given in the third column.

"Miles of track" means total track mileage, counting one mile of double track as two of single, and including sidings, turnouts, etc.

"Gross receipts" means in nearly every instance receipts from passengers only, but occasionally it has been found impossible to separate the passenger receipts from the receipts from operation, which are slightly greater than the passenger receipts.

As street railway mileage and receipts are both theoretically functions of population, the cities and groups contained in this table have been arranged in the order of their population, the largest city of all, New York, being first in the list. By this means the peculiarities and apparent inconsistencies of the statistical results are quite clearly brought out ready for explanation.

The largest gross receipts per capita are obtained by the street railway systems in the following cities and groups:

	Population.	Gross receipts per capita.
San Francisco	350,000	$13.83
New York (Manhattan and Bronx)	2,156,000	11.70
Boston (and immediate suburbs)	788,000	11.56
Greater New York	3,546,000	10.44
Eastern Massachusetts	1,250,000	9.86
Kansas City (principal system)	200,000	9.72
Philadelphia	1,197,000	9.19
New York (Brooklyn Borough)	1,250,000	9.16
St. Louis	675,000	8.65
Pittsburg-Allegheny	528,000	8.24
Eastern New Jersey	603,000	8.07
Chicago	1,875,000	8.06

The largest gross receipts per mile of track are shown by the systems in the following cities and groups:

New York (Manhattan and the Bronx)	$52,910
New York (complete)	33,199
Boston	26,091
Philadelphia	23,663
New York (Brooklyn Borough)	22.597
St. Louis	19,324
San Francisco	17,733
Montreal	15,792
Eastern New Jersey	10,216

Strange to say, New York city, though by far the largest in the country, does not lead the list in point of gross receipts per capita, but this honor is reserved for San Francisco, which shows $13.83 percapita, as against $10.14 for Manhattan and the Bronx. On investigation it is seen that San Francisco has a very heavy density of traffic as compared with other cities of about the same size, but has a much greater mileage in proportion to its population than has New York. It is evident that the people of San Francisco are liberal in their patron-

age of the street railway system, and it is also a fact that while the traffic density in Greater New York is very large, there are immense areas of comparatively unsettled territory still to be served by street railways, and in spite of the great traffic density on the existing lines ($33,199 per mile of track), especially in the boroughs of Manhattan and the Bronx ($52,910 per mile of track), much more mileage is needed in Greater New York, and the city transportation systems are destined to show much larger gross receipts per capita.

In the boroughs of Manhattan and the Bronx, New York city, the elevated lines obtained (during the year ending June 30, 1898,) 35.4 per cent of the total traffic, leaving the remainder to the surface lines; in the same financial year the elevated lines of Brooklyn carried but 22.5 per cent of the total traffic. In both instances the returns for the present year now being made will doubtless show a considerable diminution of the percentage obtained by the elevated railways, with increasing competition from the surface lines. In Chicago the elevated lines are obtaining 31.5 per cent of the total traffic, a decidedly good result considering the different conditions under which they are working.

The seventy cities and towns of the "Eastern Massachusetts group" are earning as a whole $9.86 per capita, an extremely large figure considering the extent of territory covered and the excellent service given by competing steam railway suburban lines in this territory. It will be seen, however, by comparing the figures of this group with those of Philadelphia, which has a population almost exactly equaling that of "Eastern Massachusetts," that these large gross receipts per capita are due to the immense mileage in the area, and not to density of traffic on that mileage, the results per mile of track being for "Eastern Massachusetts" but $13,793, as against $23,663 in Philadelphia, and the track mileage being nearly double that of Philadelphia. It is almost equally remarkable that metropolitan Boston, which includes the city proper and about a dozen cities and towns immediately surrounding it, should have larger gross receipts per capita than Philadelphia, but as a matter of fact the territory contained within Philadelphia city limits is not greatly different in character from that of Boston suburbs, except that there are no such large population centers in the former as are found, for example, in Cambridge, Somerville, etc., in the latter.

The great manufacturing district which contains Pittsburgh, Allegheny and many small townships, has almost exactly the same population as is found in Cleveland and suburbs, but the character of the district is far different, nearly all the manufacturing interests being in and about the city proper of Cleveland, while in the Pittsburgh district they are scattered over the entire area of the group. The Cleveland suburbs are largely residential in character, and are situated at considerable distances from the city. For these reasons it is not surprising that in the Pittsburgh district the street railways should earn $8.24, as against $6.51 in the Cleveland district. San Francisco, New Orleans, Washington and Denver are earning considerably more per capita than Detroit, Milwaukee, Providence, Louisville, Montreal, Indianapolis and Rochester, cities of approximately equivalent sizes. Some of the reasons why San Francisco shows its remarkable earnings have already been given; another is the conformation of the city, which is peninsular in character, with the business district at one end of the peninsula and the residential and pleasuring sections far removed therefrom. Toledo stands out among nearly all the cities of its size as having large receipts per capita, but its receipts per mile of track are not extraordinary.

The effects of overbuilding of track are seen in the low receipts per mile found in Detroit, Rochester, Syracuse and Atlanta, and the smallest receipts per capita in the entire list are obtained by the street railway systems of Fall River, Scranton and Syracuse.

Rapid Transit in Dense Centers of Population

BY JOHN LUNDIE

The following important maxim has been well borne out by repeated experience—"Increase of good transportation facilities will carry with it its own traffic in a populous district."

An instance of the truth of this maxim might readily be appreciated by a study of the suburban traffic of the Illinois Central Railroad Company at Chicago. The southern part of the city of Chicago has within recent years been practically honeycombed by electric street car lines. In addition, the South Side Elevated Railroad has also been an important factor in seeking South Side traffic. Both the street car lines serving the territory near Lake Michigan and the elevated road have given remarkably good service, and as a result have obtained a traffic commensurate therewith. Notwithstanding, however, this apparent inroad on territory served by the Illinois Central Railroad, the suburban traffic of this road has continued to show a healthy increase. The reason for this has been that the management of the road has been alive to the exigencies of the situation, and has given a service at all times second to none. This by way of illustration of the above maxim.

In contrast to development of traffic by increase of good transportation facilities there could readily be pointed out numerous instances of loss in traffic by transportation companies through neglecting to recognize the needs, if not the rights, of the traveling public, by the short-sighted policy of restricting transportation facilities on the slightest indication of traffic being diverted to other channels, intending thereby to reduce expense so as to make a good financial showing in spite of the reduction of traffic.

Transportation service and traffic are mutually interdependent. Primarily, a service ought to be suited to a known or expected traffic, and thereafter the service ought to be conducted in such a manner as to seek and hold the appreciation of its patrons. Then the traffic will react on the service, and will justify its continued improvement by healthy increase.

Short-haul and long-haul traffic are only comparative terms; but whether the terms be applied to traffic on a trunk line or to that within the comparatively short distances covered by rapid transit lines in or near a great city, the principles governing the handling of short and long-haul traffic remain practically the same. Passenger traffic in a great city naturally follows the lines of least resistance. Thus, a passenger going only a short distance will almost invariably prefer even a comparatively slow, frequent street car service to that of an elevated road. Reluctance to undertaking the effort of climbing an elevated railroad stair, or the effort involved in consulting a timetable and waiting for a train, readily explain why short-haul traffic naturally becomes tributary to street car systems, even though private right of way systems may seem equally convenient.

From the standpoint of a transportation company the value of a service is its ultimate net revenue. This, however, is wholly dependent on the traffic which it is able to secure from the traveling public.

From the standpoint of the traveling public the induce-

ment to use any service is dependent, primarily, upon four principal conditions, viz.—*fare, frequency, comfort* and *speed*.

Comparing, for example, the street car lines and the elevated lines in New York City, it is at once noted that they have corresponding elements of fare and frequency. The element of comfort (which is an important one) might be said to be in favor of the elevated, but this is offset by the objection to stair climbing. Thus, it would appear that the elevated service has no advantage whatever over the street car service in the elements of fare, frequency, or comfort; so that there remains only the element of speed in its favor. Unfortunately, especially at times of heaviest travel—morning and evening—the speed of the elevated trains is so reduced as to tell severely against patronage which would otherwise belong to the service without question.

Were there only a few distinct centers of traffic distribution within the territory served by the elevated roads in New York City, so-called "express" service might secure and retain long-haul traffic. The centers of distribution, however, are practically scattered along the whole lengths of the lines.

"Express service" is only a relative term. As a matter of fact, all elevated service might be designated as "express" when compared with that of street cars. Stations on such lines are, or become, centers of distribution, and if the traveling public is distributed along a given length of the line with fair uniformity, the mistake must not be made of cutting out frequent stops without due justification; otherwise, the street car service will attract an undue proportion of longer haul traffic on the principle of its being the direction of the least effort to the passenger.

In seeking an advanced solution of the rapid transit problem in New York, it is to be feared that the question of competition between transportation companies is apt to unduly govern progress. The maxim before quoted as to "increase of good transportation facilities carrying with it its own traffic in a populous district" would be found to be a more certain guide to success in considering the interests of both the transportation companies and the public, than by simply watching "the other fellow" and trying to do just a little better than he is doing.

Street car service and high speed service ought to be complementary instead of antagonistic, and whether the lines are owned by different corporations or by the same, there ought to be but one policy, viz., that of offering unquestioned transportation facilities on both classes of service. It being understood that elevated or similar service is essentially for the handling of comparatively long-haul traffic, such service to be successful must cater to the appreciation of its patrons. It may be said broadly that the only excuse for the existence of an elevated structure is the possibilities which it presents for high speed. Such possibilities do not exist with street cars. It is thus apparent that speed is the one prerogative of the elevated lines, or of lines having a private right of way, and it is by virtue of this element of speed that such services may expect to retain or increase the traffic naturally tributary to them.

Rapid transit is the most important element in the building up of a residence territory comparatively remote from a business center. Were the owners of property in an outlying district the owners of a railroad they could not afford to do otherwise than adopt the highest practicable rate of speed on the line, as, by so doing, the values of property would be thereby increased, approximately in proportion to the speed, seeing that outlying points would thus be virtually brought just so much nearer to the business center.

There is naturally a physical limit to the speed which can be made over any line, with given station distances, gradients, curvature, or other restrictions to free running, whether such restrictions be natural or arbitrary. A change of motive power is not by any means *per se* a panacea for the loss of traffic by express lines of transportation which have lost the right to the term express, unless such change of motive power should conduce to improved service. Thus, to operate elevated lines electrically on the schedule rates of running existing with steam operation might be rather an apparent than a real economy, and might readily illustrate the remark heretofore made as to attempting to recoup lost traffic by reduction in expense, instead of by improvement of the service. Operation electrically, after the novelty of the thing had worn off, could not of itself be expected to increase traffic. Speed is the one element of paramount importance which should place the express lines where they ought to stand, as most important factors in the necessary transportation facilities radiating around a great center of population.

In seeking to reach a decision as to motive power a consideration of variations in speed is all-important The expression "schedule speed" is apt to be rather confusing, unless the points between which the run referred to is made are stated. In considering the subject of variation in speeds it is well to bear in mind some simple definitions, which, while seemingly perfectly understood, are sometimes confused one with another.

Schedule speed may be defined as the average rate of running between any two points, obtained by dividing the total distance by the difference in time between that of starting from one point and that of arriving at the other, inclusive of all intermediate stops.

Average running speed is, of course, somewhat higher than schedule speed, and is obtained by dividing the total distance by the difference in time between that of starting from one point and that of arriving at the other, deducting the time consumed in all station stops.

Maximum speed is the greatest speed attained between any two successive stops, and for the same average running speed may vary within very wide limits.

The two extremes in performing any given average running speed are—

1. Accelerating up to the point of braking.

2. Accelerating as rapidly as possible to something above the average speed, and then either coasting, or practically holding this speed to the point of braking.

In the first case it is evident that the maximum speed must be very much higher than that in the second case, in order that the total distance may be covered in the same time. Thus, it is necessary to make a careful study of variations in speed in the performance of any given schedule, as on such variations depend—

(*a*) The necessary weight on the driving wheels required to give sufficient adhesion for acceleration.

(*b*) The power and capacity of the necessary motor equipments.

(*c*) The total energy to perform the movement.

In the case of the first method mentioned, viz., accelerating up to the point of braking, in making a given distance in a given time, the least powerful motors are required, but, on the other hand, the maximum amount of energy is used in performing the service.

In the case of the second method, viz., accelerating as rapidly as possible to something above the average speed, and then either coasting or practically holding this speed to the point of braking, the most powerful motors are required, but the minimum amount of energy is used. Thus, the consideration of the advisable acceleration to be given to trains in performing a given service is

governed, in a great measure, on the one hand by the capacity of motor equipments required to perform the service, which increases as the acceleration becomes greater; and, on the other hand, by the amount of energy required to make the run, which increases as the acceleration becomes less.

The first cost and subsequent operating expense of motors and power stations are not, however, the only factors of expense which vary with speed and method of train movement. For a given starting schedule on any line, *i. e.*, for given train intervals and given numbers of cars per train, the net car mileage on the line will simply be the total number of cars started multiplied by the length of the round trip. This is independent altogether of the speed which the trains make, as the number of cars passing a given point in a given time remains constant. As the speed is increased the same train schedule can be performed with a smaller number of cars; and while the car mileage remains the same the net car hours (being the net car mileage divided by the schedule speed) will vary inversely as the schedule speed.

As the wages of motormen and trainmen are practically on a time basis, it is evident that as the speed is increased these elements of cost of train operation will diminish in inverse proportion. This also is true with such elements as train lighting and heating. Cost of regulation and other matters also require careful consideration.

It will thus be seen that in order to reach a satisfactory decision as to improved service along modern lines, there are many elements to be considered, even before that of so-called motive power itself is taken up, and, in fact, the purely electrical engineering problems involved in a change of motive power are but one element in the economics of train movement calculated to serve given or prospective traffic requirements.

The management of any transportation enterprise of this character will naturally ask the following questions:

What object is to be attained by making a change in transportation methods?

What is to be the influence on revenue by making changes in a service?

What are such changes going to cost for varying conditions of service?

What is it going to cost to operate under the varying conditions of service suggested?

Satisfactory answers to these questions will involve a full knowledge of the whole range of possibilities of high speed operation. With this information before those whose money is to be spent, a decision can readily be reached as to advisable changes from a politic or an economic standpoint. On the other hand, the mere assumption that electric operation of a service, however applied, will solve the rapid transit problem, might, if carried out under certain conditions, be wofully disappointing.

The New York City Rapid Transit Proposition of the Metropolitan Street Railway Company

For several years past the Board of Rapid Transit Railroad Commissioners appointed by the Governor of the State of New York to consider the burning question of rapid transit on Manhattan Island have labored faithfully, though without result, for the accomplishment of the purpose for which the board was created. Their last proposition was that the city of New York should itself construct a tunnel and lease the right to operate it to private capital for a term of years, by which means it was hoped that through the city's excellent credit the fixed charges might be kept at a minimum. This proposition failing, others were made to the Manhattan Railway Company, looking to the extension and increase of facilities of the elevated railway system, but the Manhattan Company refused to accept the plans and suggestions of the commission, and again failure was met.

On March 27 the Rapid Transit Commissioners received from the counsel of the syndicate which owns a controlling interest in the Metropolitan Street Railway Company the following remarkable proposition:

To the Board of Rapid Transit Railroad Commissioners:

Gentlemen—We are authorized to make the following proposal in behalf of clients interested in the Metropolitan Street Railway Company:

They are willing to organize a new corporation, hereinafter called the Tunnel Company, which shall agree with satisfactory guarantees of performance to build with private capital and maintain and operate the underground rapid transit road on the route and plans of the commission, with some possible modifications in detail, as to space for stations, places of access, width of tunnel, etc., which may be suggested by engineers and approved by your board, and upon the following terms:

1. The road to be constructed in two sections.

(*a*) The first section, from the southern terminus to a point between Fort George and the ship canal, to be constructed immediately, the work to be commenced within three months and to be completed within thirty-six months after the right is acquired.

(*b*) The second section to comprise the remainder of the entire route on both branches, to be commenced as soon as the net earnings from the operation of the railroad upon the first section shall be sufficient to pay 5 per cent upon the actual cost of construction and equipment, and to be completed within twenty-four months thereafter.

Reasonable provision to be included in the contract for extensions of time in case of litigation or other delay for which the Tunnel Company is not responsible.

2. The railroad to be operated in connection with the Metropolitan Street Railway and to be leased to the Metropolitan Street Railway Company in perpetuity, or for a term practically equivalent thereto, for a rental to the Tunnel Company of 5 per cent upon the actual cost of construction and equipment.

3. The fare on all cars or trains, except those hereinafter described as express, to be five cents. This to include all cars or trains run on the outside tracks. All passengers carried for five cents to be entitled to be carried over the surface lines of the Metropolitan Street Railway Company for an additional three cents. Conversely, all passengers over the surface lines of the Metropolitan Street Railway to be entitled to be carried over the tunnel road on cars and trains, other than express, for a fare of three cents in addition to the present surface railway fare.

Such carriage of passengers over the joint lines of the Metropolitan Street Railway Company and the new road to be by continuous car passage as well as by transfers, unless it shall be determined that the running of the same cars on both roads would unduly interfere with the capacity or speed of the tunnel road.

Track connections with the surface lines for the continuous passage of cars to be made (or special transfer stations to be established):

(*a*) At or near Thirty-second Street for the Lexington Avenue, Second Avenue and Thirty-fourth Street and Long Island Ferry lines by bringing in tracks from those lines through private property to be purchased by the Tunnel Company between Thirty-second and Thirty-third Streets and Fourth and Lexington Avenues.

(*b*) At or near Forty-second Street for the Madison Avenue line.

(*c*) At or near Fifty-ninth Street for the Eighth Avenue line and the Fifty-ninth Street crosstown line.

(*d*) At or near Fifty-fifth Street for the Columbus Avenue line and the Boulevard and Amsterdam Avenue line.

Special provision is to be made for delivery of passengers to and taking passengers from the lines of the steam railroads using the Grand Central railroad station at Forty-second Street, and joint traffic arrangements to be made with the New York & Harlem, New York & New Haven and New York Central (provided those companies consent) for carriage of passengers between all points on their lines within the city limits and the southern terminus of the new road.

4. Express trains to be run on the tracks marked as express tracks on your plans, and upon them the fare to be ten cents, provided that the passengers upon all such trains shall be entitled to be transferred to and carried on all other cars or trains on the new road without payment of any additional fare; and to be transferred to and carried upon all connecting lines of the Metropolitan Street Surface Railway without the payment of any additional fare; and that passengers on all other cars and trains on the tunnel road shall be entitled to be transferred to such express trains on the payment of five cents additional fare; and that passengers on all connecting surface lines of the Metropolitan Street Railway shall be entitled to be transferred to and carried on said express trains on the payment of five cents in addition to the present street surface railway fare.

No train to be deemed an express train except one which is scheduled to run and, barring accidents, does customarily run, over its entire route below Ninety-sixth Street at the rate of 20 miles an hour, and for at least two miles below Forty-second Street at the rate of 30 miles an hour.

5. Provision to be made for a third track on both the eastern and western branches above Ninety-sixth Street, so that express trains may be run down in the morning and up in the evening over the entire road.

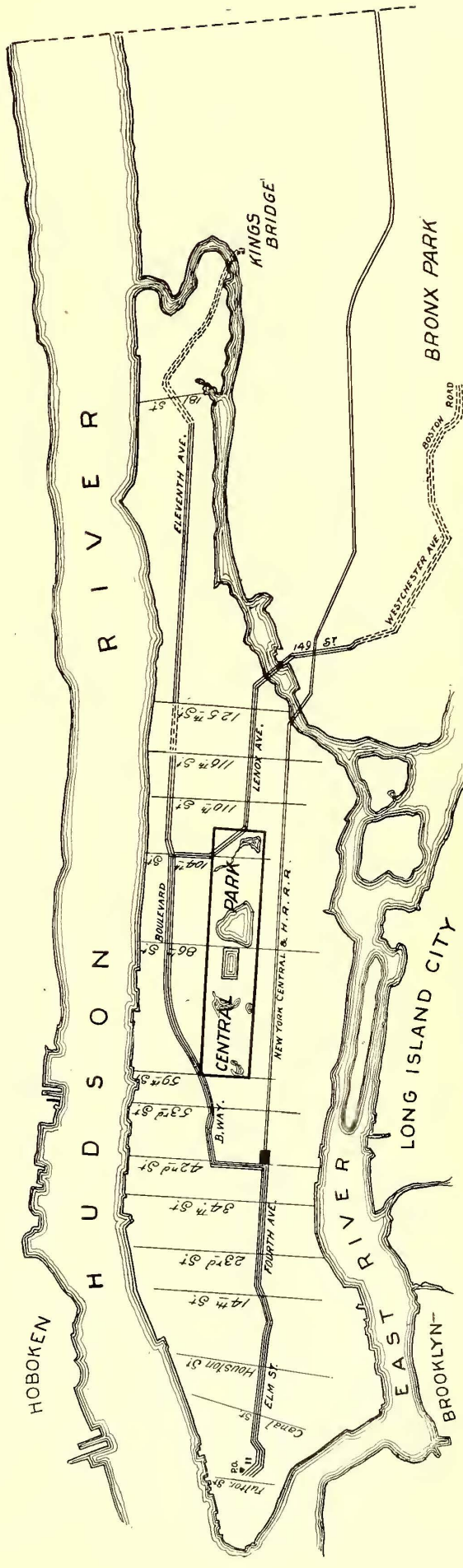
6. The new company to be entitled to use the side galleries and other spaces in the tunnel not necessary for railroad purposes for any wires, tubes or conductors authorized by law, belonging either to itself or others, and to receive to its own use any rentals which may be derived therefrom.

7. The city to receive as compensation, in addition to the services rendered and in lieu of all other charges upon the franchise granted hereunder, an annual rental equal to 5 per cent on the gross receipts from the operation of the new road; provided that whenever any such payment shall leave the receipts insufficient to pay the rental of 5 per cent on cost of construction and the operating expenses, including taxes, the percentage to be paid shall be abated accordingly.

8. The real and personal property forming part of said railway to be exempt from taxes until it pays 5 per cent, as provided in section 15 of the rapid transit act, with the amendments proposed by the commission in the bill now pending before the Legislature.

9. Adequate station room to be given under City Hall Park, without interfering with the surface, except for access from the street and park, which is to be given by sufficient stairways. Similar provision to be made for underground stations, and sufficient access from the open spaces at the junctions of Broadway with Seventh and Eighth and Columbus and Amsterdam Avenues.

In all matters not covered by the present construction plans, such as crossings and connections with surface lines, not heretofore contemplated by these plans, the construction to conform to the requirements of the commission's engineers in all matters relating to the public safety or to the use of any portion of the streets, avenues or public



Underground sections are shown by solid lines, viaduct sections by dotted lines.

PROPOSED ROUTE OF RAPID TRANSIT RAILWAY, NEW YORK

places of the city. All sewers, pipes or other sub-surface structures now in the streets, and which may be interfered with by the construction of the tunnel, to be relocated and provided for at the expense of the Tunnel Company, in accordance with your plans and to your satisfaction.

10. The cost of construction to be deemed to include the cost of all private property purchased for connections, stations, etc., and a fair proportion of the costs of any power houses, machinery, or other plant constructed or acquired for the joint operation of the new road and the surface roads of the Metropolitan Street Railway Company, the expenses of organizations, plans and contracts and interest during construction. The accounts, vouchers, and payrolls showing the cost of construction and the earnings of the new road to be at all times open to your inspection.

11. The earnings of the new road to be ascertained by taking all the fares received for the separate business of that road and by an equal division between the new road and the Metropolitan surface road upon all joint business. In case any difference should arise between the Tunnel Company or the Metropolitan Street Railway Company and your board, or the city of New York, under the contract, the question to be submitted to the determination of three arbitrators, one to be selected by yourselves, one by the Metropolitan Street Railway Company, and the third chosen by the two so selected.

This proposal is subject to the approval of the stockholders of the Metropolitan Street Railway Company in the manner provided by law. Very respectfully,

Root, Howard, Winthrop & Stimson.
Jay & Chandler.

New York, March 27.

Accompanying this memorandum was the following letter of explanation giving the company's reasons for making the offer:

POSITION OF THE METROPOLITAN EXPLAINED

Alexander E. Orr, Esq., President Board of Rapid Transit Railroad Commissioners:

Dear Sir—We inclose a memorandum of the terms upon which gentlemen interested in the Metropolitan Street Railway Company will undertake to form a corporation to construct the underground rapid transit railroad, on the route and plans proposed by you, and to provide for its maintenance and operation in connection with the Metropolitan Street Railway system. The memorandum has been submitted to the Metropolitan Street Railway directors and has their approval.

You will perceive that the plan contemplates the construction of the road by private capital, and giving transportation on it without any additional charge beyond the cost of transportation, to all passengers on the Metropolitan system of roads, which now extends through about 250 miles of streets, and carries about 900,000 passengers daily. The only exception to this practically free use of the tunnel road would be in the case of express trains, running for long distances without stops, and therefore without the short-haul business, from which alone the profits of street railroads are now made, and running at a high rate of speed, which necessitates greater headway and fewer trains, and therefore smaller returns. As to this class of business a fare is stipulated, which would be practically a fare of five cents for the use of the tunnel road, added to the fare of five cents upon which the same passengers would be entitled to travel over the surface lines.

The regular fare provided for passengers not desiring to use the surface roads is five cents.

This plan results from the following considerations, suggested to our clients by their experience in street railroad transportation in New York:

1. That the reason why capital has not responded to the long-continued invitation of the city to take the risk of constructing an underground road is that there is not sufficient probability that such a road, in view of its great cost, could be operated profitably on an independent basis as a trunk line without branches or feeders.

2. That such a road, without any means of collecting and distributing passengers over surface lines, would afford only very partial and unsatisfactory facilities to the people of the city, most of whom would either be obliged to walk long distances to reach the stations, or pay double fares on independent surface lines.

3. That since the introduction of the underground system of electric traction, the real obstacle to rapid transit is to be found in the congested condition of the streets in the lower part of the city, and that if the same electric cars now used, or similar cars connecting with them, could be propelled swiftly through a tunnel from Harlem to the City Hall, the tunnel road being used as a trunk line, while the surface roads are used for local traffic and the collection and distribution of passengers for the trunk line, real rapid transit would be attained.

4. That while the tunnel road itself would afford to the most northerly districts of the city the convenience they have so long sought, its combination with the surface roads would give much needed relief to the great population extending from Forty-second Street to Harlem, and especially to the residents between the line of the Central Park and East River, who would otherwise receive little benefit from the new road.

5. That the close connection of the underground road from the City Hall to Forty-second Street with the New York Central, New York & Harlem and New York & New Haven Road at that point would, in effect, make a rapid transit route from the City Hall to every point within the city limits on the four lines of the railroad companies mentioned.

6. That the increase of business which would result from the increase of facilities thus afforded would probably justify the assumption of a burden by the Metropolitan Company for the construction of the new road, which would be altogether beyond the possibility of profitable investment if the road were to be built and operated independently; and that the Metropolitan Company could probably operate the new road more economically and effectively than any independent company, and might thus make a profit where such another company would fail.

7. That the special facilities which the Metropolitan Company now has as lessee of the New York & Harlem's right to the Fourth Avenue tunnel between Thirty-fourth and Forty-second Streets, and through owning or controlling large tracts of land immediately available for use, and especially in the possession of plant for the production of power, containing provisions for large increase of future requirements, and which it has been engaged for years in construction, put that company in such a position that it can have a rapid transit road in actual operation long before that would be possible for any one else, even if any one else were now willing to undertake it.

It is now several years since the people of this State adopted a new policy regarding city railroads by repealing the statutes which prohibited, and passing laws which favored, the consolidation of street railways on condition that greater facilities should be afforded to the public in the way of transportation over the combined lines without additional fares. The result of the new policy in this city as compared with the former system of numerous inde-

pendent lines presents a most remarkable exhibit of public benefit. The Metropolitan Company is now carrying upon transfers for which no payment is made, over lines which would, under the old system, have been entitled to two separate fares, about 400,000 passengers daily. The money which would be paid by the people of the city for this service, which they now get for nothing, would, if the old system still continued and the people received the same service, amount to over $7,000,000 annually. The average fare paid to the Metropolitan Company for each single ride, such as would have been given for five cents under the old system, is now but three and one-half cents per passenger. What this means to the business of the city, in the convenience of access to its stores for the purposes of trade, in the freedom of its working people as to the selection of their homes without being tied down to the immediate locality where their work is to be done, in the equalization of rents and in the convenience to the public generally, it is impossible to estimate. The plan which we propose is but a continuance of the same wise policy.

We are satisfied that this offer presents to the people of the city advantages superior to any plan hitherto suggested and fully commensurate with any benefits to be derived by the new company or by the Metropolitan Street Railway Company, and that it will produce for New York a system of urban transportation far better than that now existing in any great city of the world. The difficulties and risks involved are such that no one can safely assume them without popular support, and we make the offer in the belief that the people of the city of New York will regard the arrangement proposed as fair and advantageous to them, and will be ready to give it their genuine approval and support. Very respectfully,

Root, Howard, Winthrop & Stimson.
Jay & Chandler.

H. H. Vreeland, the president of the Metropolitan Street Railway Company, said the proposition is the final word of the company on the subject.

"This is the second proposition we have made to the Rapid Transit Commission," he said, "and our letter to them contains our final decision in regard to the plan of an underground rapid transit tunnel. On our part the case is closed, and we are waiting for the verdict. There cannot be any haggling over the proposition, so far as we are concerned, for we have examined the whole project in all its details, and have decided exactly what we are able to do. This has been embodied in the communications to the Rapid Transit Commission, and our conclusions and offer are before them to accept or reject. The proposition before them is final.

"The details of our plan are fully explained in the letters to the board. If our offer is accepted, we shall endeavor to use the tunnel for the through traffic first, and for as much local traffic as can be accommodated in it without interrupting or delaying the express traffic. Whether there will be any objection to the grant of the franchise in perpetuity I cannot predict, but if the matter is considered practically a person must see that it would be ridiculous to ask us to risk so great an amount of money on a short leasehold."

Asked if the control of the rapid transit tunnel by the Metropolitan Company would not lead to the absorption by that company of all lines of other companies in the boroughs of Manhattan and the Bronx (including the elevated system), Mr. Vreeland said: "I believe that eventually all of the railway transportation lines on Manhattan Island will be under the control of one company. It may be the Metropolitan Street Railway Company, or it may be some other company. It seems to me that conditions and circumstances are tending in the direction of concentration of control. If there is to be a perfect system of passenger transportation on this island such as the people want, it naturally must be under one management. Of course, I cannot foretell what is going to happen years hence, and know of no definite plans beyond the fact that the Metropolitan Company stands ready to carry out its proposition to construct and operate the tunnel.

"Is it not significant that in all the years that underground rapid transit has been discussed here in New York no combination of capitalists has been able to figure out financial success in the project? It is the Metropolitan Company's peculiar position that enables it to undertake this great work with hope of financial success. We already have 228 miles of surface lines in operation, and each succeeding year the pressure of traffic is increasing. At certain hours of the day we are unable to carry all of the people who want to ride. It is by making the proposed rapid transit tunnel a part of our system—the trunk line, if you please—that we are able to see a profit in its construction and operation.

"The tunnel road will undoubtedly relieve the surface lines of practically all the long-haul traffic, thereby enabling us to carry all of the short-trip passengers on our surface lines at all hours of the day. At the present rate of increase in traffic, the relief thus afforded by the tunnel will, two or three years hence, be an actual necessity. You can readily see, therefore, that the operation of a great trunk line tunnel, with express and local trains, in connection with our otherwise far-reaching system, would naturally lead to the control of the passenger transportation facilities of this island by one concern."

President Vreeland said that if the franchise for constructing the tunnel was given to the Metropolitan Company, he thought that cars could be run through at least one section of the tunnel within two years from the time of beginning work. "I do not mean," he said, "that we would build the tunnel a section at a time, for we should begin the work at several different points and push it as expeditiously as possible all along the line. But in case one section should be completed before the others, it would not be necessary for the completion of the whole tunnel to begin the running of cars. There is where one great advantage of the Metropolitan Company as the constructor of this tunnel is manifested. We have sufficient electrical power to enable us to operate cars in any part of the tunnel just as soon as a section can be opened. For instance, should the sections between the City Hall and Thirty-second Street be completed before the sections further up town, we could make a physical connection between the tunnel and our Lexington Avenue line and run cars through the tunnel and over the surface lines from City Hall to Harlem.

"The Metropolitan Street Railway Company owns the block bounded by Fourth and Lexington Avenues and Thirty-second and Thirty-third Streets. The grade of Lexington Avenue is so far below that of Fourth Avenue that, by an easy incline, connection between the surface line and the tunnel could be made at this point. So you see that the people of New York would be able to enjoy the advantages of partial underground rapid transit without waiting until the entire tunnel is finished. In most cases, as different sections of the tunnel were completed, they could be operated in a similar manner.

"As has already been stated, the transfer system as it now prevails on the Metropolitan lines would be applied to the tunnel, with the exception that three cents additional fare would be charged for each transfer to and from the tunnel. This extra charge we feel bound to make in order

to get a profit out of the operation of the tunnel. On all local trains in the tunnel, however, the fare will be five cents. I do not believe that any reasonable objection can be urged against our charging extra for the fast express train service in the tunnel."

Mr. Vreeland reiterated that work would probably be begun in the construction of the tunnel within three months after the details of the franchise have been closed up by the contracting parties. He said: "We know just what kind of ground we have got to cut through, and just how many feet of rock must be blasted. All of this information has been ascertained by competent engineers, and the data and specifications on which to proceed with the work are at hand."

RAPID TRANSIT BOARD MEETS

The Board of Rapid Transit Commissioners held a special meeting March 29, at noon, in the rooms of the Chamber of Commerce, for the purpose of considering the proposed memorial to the Legislature and the amendments to the rapid transit bill, which the proposition to build the underground road by means of private capital has made necessary.

The commission considered very fully the proposed memorial and amendments, and took such action as will result in the placing of both before the Legislature by the evening of March 30. After the discussion of the memorial, the following resolution was offered by Mayor Van Wyck:

Resolved, That it is the sense of this board that it is in the public interest that, in addition to the powers already possessed by the board, the Legislature should grant to the board the power to contract for the construction and operation of the Rapid Transit Railroad by private capital.

This resolution was unanimously adopted.

Mr.Starin then offered a resolution that the president and secretary be authorized to execute the proposed memorial as drafted in behalf of, and under the seal of, the board, and to forward the same to both houses of the Legislature. This motion was also carried.

Proposed New Subway in Boston

A new subway, beginning approximately at the Boston end of the Harvard Bridge and extending along the water front back of the Beacon Street houses, up under Beacon Hill to Scollay Square, with convenient entrances and exits, has been proposed by Mayor Quincy of that city in a hearing before the State legislative committee on metropolitan affairs.

Such a subway would cost about $2,500,000, and would do away with the necessity of running surface cars on Marlboro Street to accommodate the people of the Back Bay. With a surface line on Boylston Street and a subway along the southerly shore of the Charles River, the residents of that section bounded by Arlington Street, Boylston Street, Massachusetts Avenue and the Charles would have ample facilities for reaching the business portion of the city. More than that, the proposed subway would entirely relieve the congestion which now exists in and about the present subway.

Into the new tunnel would be sent the electric cars which come across the Harvard Bridge from Cambridge, and also those from Newton, Brighton and Allston, which now run down Beacon Street to Massachusetts Avenue, where they go on the same track used by the Cambridge cars. Every one of these cars, under the conditions which now exist, continues its course down Boylston Street and into the subway at the Public Garden. All these cars could be run in the new subway. Thus the old one would be relieved of more than half of its burden.

There would be no longer any agitation for the replacing of car tracks on Tremont Street. Such a step would not be necessary.

The construction of this subway is but one, although it may be in some ways the most important, feature of a plan for the improvement of the south bank of the Charles River. The subway would not have been suggested if it had not been for the esplanade which is to be built back of the houses which face on Beacon Street. Under that esplanade the subway will be.

This esplanade has been for a long time contemplated. Last year a bill providing for the construction of such a plat was presented to the Legislature. This measure, which provided for the erection of a new river wall 40 ft. north of the present wall, and for the filling in of the space between the two walls, was advocated by Mayor Quincy, assented to by the adjacent landowners, who were to pay about one-half the cost, and approved by the harbor and land commissioners. But the Legislature of 1898 referred the bill to the next General Court, the Legislature of this year. Mayor Quincy now proposes to build the esplanade 75 ft. wide, and under it to construct the subway.

Blood's Formula for Train Resistance

Owing to a typographical error which occurred in the article by Mr. Blood, on train resistance, in the last issue of the Journal, after the page was read by the editors, the exponent n of the speed M in the third term of Mr. Blood's general formula, was omitted, although the formula is correctly given later on, when a value is selected for n. The correct reading for Mr. Blood's general formula is, therefore, as follows:

$$R = B + W M + A\frac{M^n}{T}$$

Where

R = resistance.
M = speed.
T = weight of train.
B = journal coefficient.
W = wheel and rail coefficient.
A = air resistance coefficient.
n = exponent of air factor, which should be determined by experiment.

So the smaller companies, while they may not be quite as extensive as some of the more prominent ones of this association, certainly are just as wide and broad in their possibilities of growth and development as any that are now recorded upon our roster.—From address at the Atlanta, Ga., Convention, 1894.

From these comparisons, we see that with the lives assumed, cypress will cost 48 per cent more than creosoted timber. Oak will cost 92 per cent more than creosoted timber. Pine will cost 111 per cent more than creosoted timber.—From paper read at the Montreal Convention, 1895.

Sans Souci Park, Chicago

Chicago has a grand system of public parks, large and small, located in all parts of the city, and with a connecting system of boulevards which is the pride of every resident.

FIG. 1.—FLOWER VASE PARTLY COMPLETED

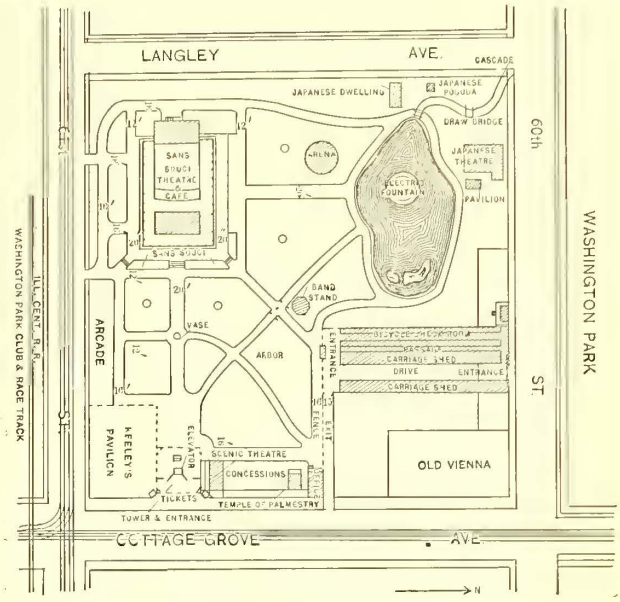


FIG. 2.—PLAN OF PARK

The large parks are all situated advantageously to the street railway companies, and it is doubtless that this fact has heretofore deterred the street railway companies from creating amusement resorts such as have been established in other cities.

Sans Souci Park, which is now in preparation, is the first amusement resort of any magnitude in Chicago which has for its object the stimulation of street railway traffic. It is located on the Wabash Avenue line of the Chicago City Railway and well out toward its terminus. The Sixty-first Street electric line of the Chicago City passes along one side of the park, and the Alley L and Illinois Central are within a block. The park and buildings will cover the entire block, extending east from Cottage Grove to Langley Avenue between Sixtieth and Sixty-first Streets. This location will be remembered as being at the southeast corner of Washington Park, and at the entrance of the Midway, which is now one of the most popular boulevards of the city. In summer the surrounding drives are filled with bicycles and carriages. It is doubtful if there exists within the city limits a better available location for a street railway park.

The park is square, with an inclosed area of nearly ten acres. The buildings and rubbish which occupied the ground were all removed, except "Old Vienna," itself a summer resort, which stands on one corner; the lease to the present occupants of "Old Vienna" has yet two years to run, after which the building will be removed and the park extended over the space occupied.

The park has been laid out with fine walks, the general arrangement of which, with entrances, buildings, etc., is shown on the diagram Fig. 2. The lawns, which are now covered with a heavy coating of manure, will soon be sodded. There were originally no trees on the ground, but a goodly number have already been transplanted. A strong high fence will surround the park, and a small admission fee is to be charged.

FIG. 3.—THEATER BUILDING AND BAND STAND

The principal attractions will be the Sans Souci open-air theater and café and the electric fountain. The pavil-

ion, or theater building (Fig. 3), is an attractive two-story frame structure, painted white, except the roof, which is of red tile. The extreme dimensions of the building are 145 ft. x 180 ft. In the eastern end the lower floor will be occupied by a buffet, 50 ft. x 70 ft., and directly over

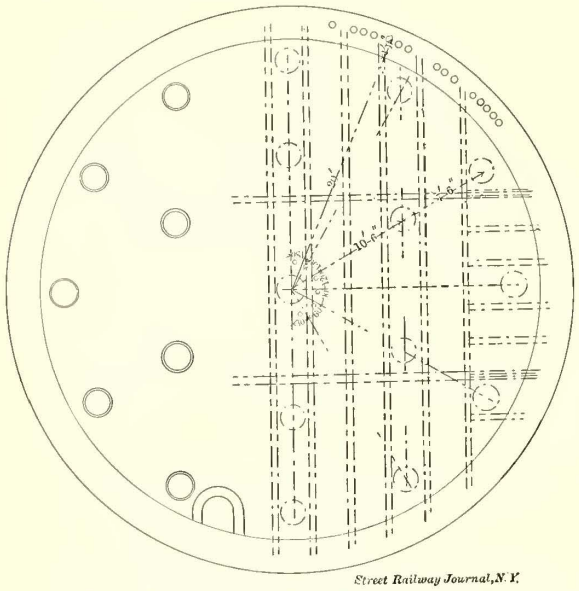


FIG. 4.—PLAN OF ELECTRIC FOUNTAIN

this, in a room of the same size, will be the kitchen. At the other end of the building is a stage 30 ft. x 42 ft., dressing rooms and large, well-furnished public lavatories. In the center of the building is the auditorium of the theater. It connects with the broad porticos on either side, which are continuous on three sides of the building. The stage is in full view of the verandas and the promenades connecting them; visitors will be free to view the performances from the verandas, but a charge will be made for the reserved chairs in the parquet and balcony, which are inclosed by a light railing. The seating capacity of the pavilion, exclusive of the theater auditorium, is 2500; the latter will be furnished with 850 chairs. Accommodations for seating nearly as many more people will be made in the park surrounding the band stand and fountain.

Judging from the popularity of the small fountain in Lincoln Park, it is expected that the electric fountain at Sans Souci will prove a great attraction. This fountain, a plan of which is shown in Fig. 4, is circular in shape, with a diameter of 48 ft. The outer wall is laid with blocks of steel slag, and this is surrounded by a small lake, as shown in the plan (Fig. 2). The fountain is one of the largest ever constructed, and will have eighteen wells.

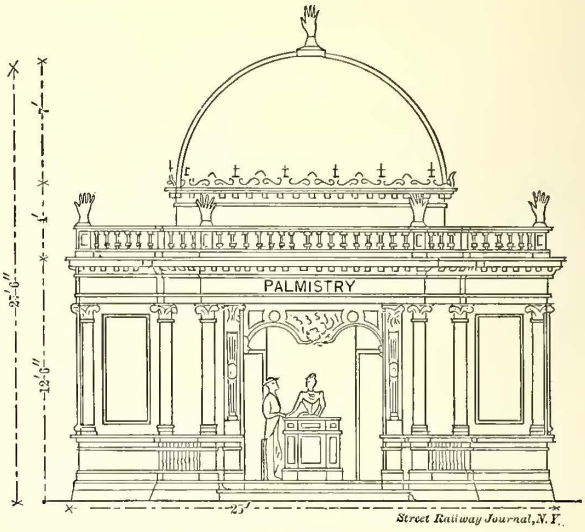


FIG. 5.—THE TEMPLE OF PALMISTRY

The operating machinery will not be controlled, as is usual, by attendants in the base of the fountain, but from the power house. This is a small building, 16 ft. x 20 ft., three stories high, built at the edge of the surrounding lake. In the basement will be installed two Quinby screw pumps, with a capacity of 1000 gals. per minute. Each pump will be direct connected to a 75-h.p. Westinghouse motor. Current for operating the motors will be taken from the trolley circuit.

On the second floor of the power house will be a switch board with some 380 push buttons, the manipulation of which will vary the colors of the fountain, and small controlling valves for governing the Crane hydraulic lift valves, which in turn govern the water display. The manipulation of the fountain will require the attention of but one attendant. The third floor of the power house, with stairways leading up to it, will be an open pavilion. It is the intention to operate the fountain each evening during the summer months.

The fountain was designed by Messrs. Moore and Riley,

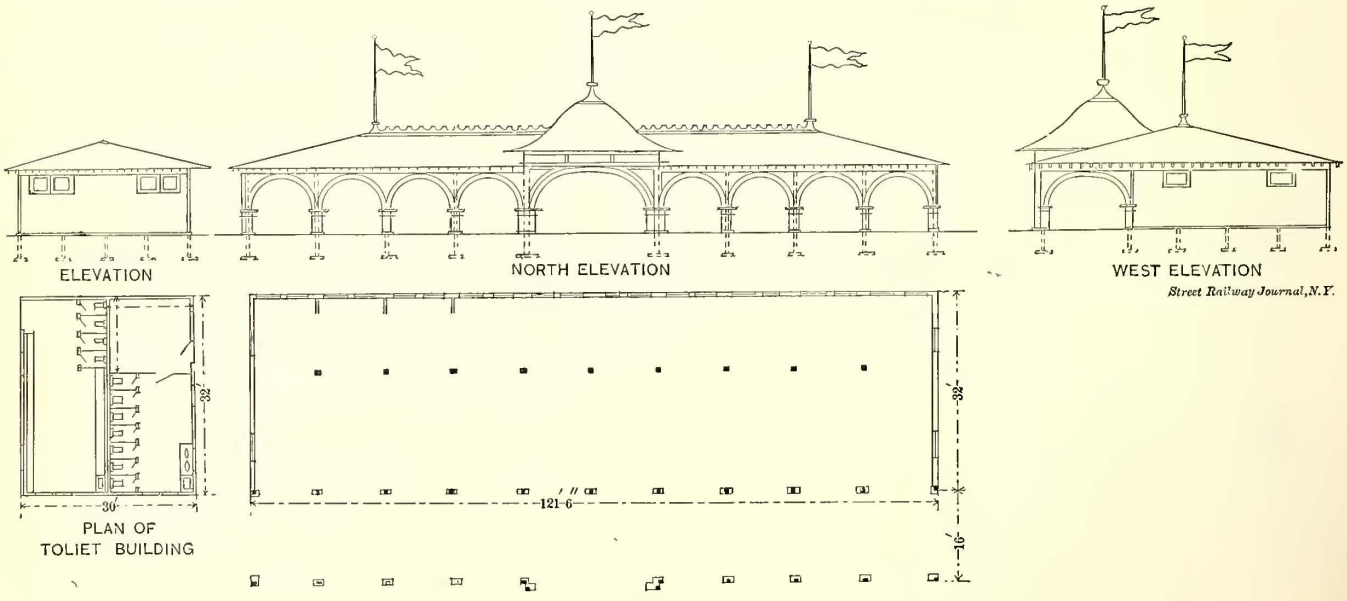


FIG. 6.—PLAN AND ELEVATIONS OF ARCADE

of the Chicago City Railway, and the machinery and parts have nearly all been made in the company's shops. Its cost in round figures is $25,000.

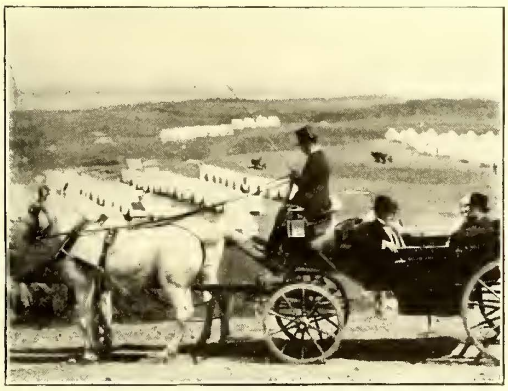
The band stand, which is shown in Fig. 3, is octagonal, 24 ft. in diameter. Band music will be a practically continuous feature of the park's attractions. Fig. 1 shows a large flower vase that is being erected. In one corner of the grounds will be located a Japanese theater and tea garden. Two of the principal buildings at the park will be the "Arcade" and the Temple of Palmistry, plans of which are shown in Figs. 5 and 6. The Arcade will be a well-constructed building, 121 ft. 6 ins. long x 48 ft. wide. It is proposed to sublet floor space in this building for various booths and attractions, as photograph galleries, candy stands, cane, knife and shooting galleries, etc. No partitions will be built in the building at first, but these will be added to suit the different tenants. The Temple of Palmistry is a neatly-designed pavilion, and will be used for telling fortunes and reading characters.

The park has been promoted by the Chicago City Railway Company, but W. H. Carter is the proprietor and manager.

Attractions for Parks

The Biograph

The increasing number of street railway parks makes the subject of park amusements particularly interesting to street railway companies, and for this reason a number of those attractions, which have proved most popular, have been described in these columns. In this series some particulars of the biograph will undoubtedly be of interest, as this machine, which has been so successful as a theatrical attraction for the past four years, last summer entered the field of summer parks and demonstrated its crowd-drawing qualities in a notable way.

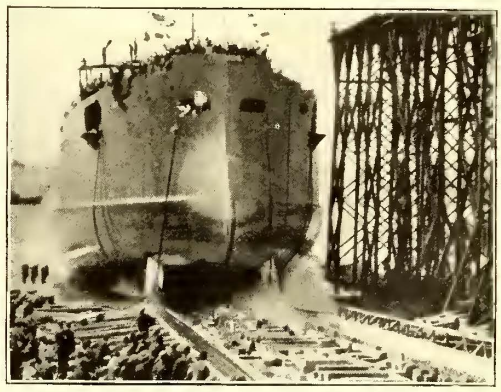


PRESIDENT MCKINLEY AT CAMP WYCKOFF

At the Denver City Park the American biograph was shown, last summer, as a free attraction by the Denver Consolidated Tramway Company. Park Commissioner Gallup is quoted as saying that the biograph attracted to the park between 300,000 and 500,000 people. In the Denver City Park the screen was placed upon a barge moored out in a lake, the projecting apparatus being placed upon the shore. In this way the pictures were viewed by an immense crowd, and during the intermissions between the biograph shows the screen was rolled up out of the way and the barge utilized as a band stand. It is not necessary to darken the park or to do away with any of the illuminations, as the biograph requires only a darkened screen.

There are many strong arguments in favor of the biograph as an attraction for summer parks. It draws a large number of people who, for various reasons, are not interested in ordinary vaudeville entertainment, and, at the same time, its pictures are so varied that it appeals forcibly to the regular summer park patrons. It is claimed for the biograph that on consecutive evenings it gave the same programme on the Bowery and at the Waldorf-Astoria in New York city; in each case the audiences showed the same enthusiastic approval. In parks where refreshments are sold, the biograph commends itself particularly as an attraction which augments the ordinary café trade. A crowd seated about tables or promenading can enjoy the pictures as well as one seated in a hall, and no amount of conversation or laughter can interfere with the success of the programme. Of course, the biograph is equally adapted to indoor work. It is to be recommended particularly, however, as a free outdoor attraction for the purposes of drawing crowds and holding them. In order to do this two shows are given, one at 8 o'clock, at the conclusion of which it is announced upon the screen that another and entirely new set of pictures will be shown at 10 o'clock. This method has always proved very successful. The biograph should not be confused with other moving picture projecting machines. It operates on a much larger scale, throwing a clear, steady picture 30 ft. sq. and uses a film 2¼ ins. wide, which is said to be seven times greater than that used in other apparatus. The American Mutoscope Company, of New York, which owns and operates the biograph exclusively, is affiliated with similar companies in London, Paris, Berlin and other foreign capitals, and the films obtained by any one of these companies is at the disposal of the others; thus the American Mutoscope Company has been enabled to show in America such scenes as the Victorian Jubilee Parade, the Coronation of Queen Wilhelmina, of Holland, the Inauguration of President Loubet, of France, etc., even before the illustrated papers have had their illustrations. The engravings which are shown herewith give an idea of the variety of subjects and of the general character of the pictures shown by the biograph.

A ROTARY SNOW PLOW IN ACTION



LAUNCHING THE U. S. BATTLESHIP ILLINOIS

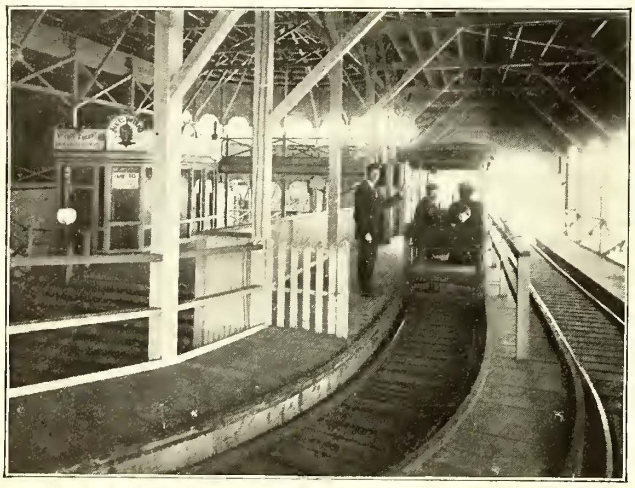
Scenic Railway at Coney Island

One of the most popular attractions at Coney Island, itself one of the most popular pleasure resorts in the world, is the scenic gravity railway. This is situated near the west iron pier, and although somewhat out of the way in its location, it has nevertheless been discovered and patronized by over a million people during the past three seasons, and it is a noteworthy fact that those who take this ride never fail to express their appreciation of this amusement.

The structure consists of four parallel tracks, each one about 800 ft. long, making a total ride of about 3200 ft. The tracks are built with alternate elevations and depressions, giving the cars a wavy motion which is novel and agreeable. At the outer end of the railway is a large auditorium through which the four tracks pass, and it is here that the scenic effects are produced. The railway depends for its popularity on the surprise and wonderment occasioned by the suddenness with which the scenic effects are

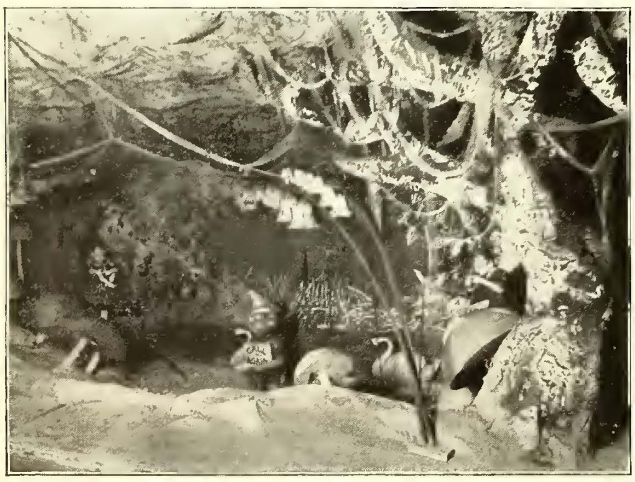
brought into operation. This is accomplished by making the approaches and exits to the rooms in which the scenic features are located, long dark tunnels. The tracks for several feet before reaching these rooms are carefully bonded and are at all times connected with a source of electricity, but the circuit is not closed, and there is, of course, no current in the rails. As soon as the car approaches these points, however, the wheels and axles complete the circuit from one rail to the other and immediately the car is surrounded by a brilliant illumination disclosing on all sides the most weird and surprising scenery. The car dashes through this illumination and suddenly all is darkness again. The scenic effects on the four tracks are different, so that the excitement is kept up during the whole trip. Some of the scenes installed are shown herewith.

Every precaution is taken to make the operation of the cars absolutely safe, powerful track brakes being placed upon each car. In addition to this, an automatic safety signal block system is in use, making rear end collisions impossible. Each car is in charge of a competent attendant.



STARTING ON THE RIDE

WINTER SCENE



VIEWS IN ONE OF THE CAVERNS

This scenic railway was installed and is owned by the L. A. Thompson Company, of New York, it being one of a number of these attractions which this company has installed throughout the country. In addition, this company has built scenic railways at Bergen Beach, Woodside Park, Philadelphia; Toledo, Ohio; Riverside Park, Baltimore; Midland Beach, Staten Island, and Chester Park, Cincinnati. Orders are also being received from foreign countries, a complete railway with all the necessary materials, accessories, etc., having just been shipped to Para, Brazil.

Dramatic and Vaudeville Attractions

The difficulty of obtaining good vaudeville and dramatic attractions at short notice for parks, summer gardens, etc., has led Daniel Packard, of New York city, to open a general headquarters for this class of artists.

Mr. Packard has the addresses of and is in business relation with a very large number of the leading musicians, singers, lecturers, pianists, magicians and vaudeville artists in the country, and is prepared to furnish entertainments for one evening, or for any length of time, of any class desired. He will furnish a quartette, a singer, a magician, a minstrel first part, a singing soubrette, or an entire vaudeville or opera company. He has had twenty years' experience in organizing summer attractions, and has given special attention to the requirements of open-air theaters. He supplies all the necessary costumes and music, and attends to all the rehearsing and preliminary arrangements.

Large Contracts in New York

The Third Avenue Railroad Company, of New York city, in addition to the contracts mentioned in the Street Railway Journal for January, 1899, has recently awarded the following: St. Louis Car Company, of St. Louis, 100 cars; Peckham Truck Company, of New York, 100 pairs 14-B short wheel-base trucks and 60 pairs Peckham maximum traction trucks; Standard Air Brake Company, 160 Standard air-brake equipments; E. F. DeWitt & Co., Lansingburg, N. Y., sand boxes for 160 cars; Hale & Kilburn Manufacturing Company, Philadelphia, car seats.

Municipal Ownership in Detroit

The Michigan Legislature on March 23 passed a bill providing for the municipal ownership of street railways in the city of Detroit. The bill states that three commissioners shall be appointed by the Detroit Common Council to arrange the terms of purchase, which are to be ratified by the Common Council before the agreement is closed.

It is understood, however, that the Detroit companies' franchises are so worded as to prevent the carrying out of the provisions of the new bill.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge Jr., and Robert Ernest, of the New York Bar

Bribery and Perjury in Accident Cases

The role of Cassandra is neither grateful nor popular. Even the pessimist, who confines himself to a doleful view of existing conditions and does not attempt to prophesy or to point out the probable result of growing tendencies, is not generally listened to with favor, and often is not credited.

But both the existing conditions and the tendency to corrupt practices in the trial of negligence cases, especially in the courts which are crowded with them in the large cities, is becoming so apparent and notorious that it is felt that a note of warning will not be out of tune with the general knowledge and thought of our readers.

A somewhat extensive inquiry addressed to a number of lawyers who, in our large cities, devote their time, some of them to the defense and some of them to the prosecution of negligence cases, especially against street railways, has resulted in a practically unanimous verdict that corrupt practices are increasing. A difference of opinion emerges only when the inquirer seeks to obtain an opinion from men, who look at the matter from different standpoints, as to whether the plaintiffs or the defendants are the greater sinners.

Our own view of the matter is, that, where a great volume of business is transacted of any sort, and one side or class of men seek to attain their ends by trickery or fraud, that the other side will, in a very great number of cases, seek to justify themselves in stooping to similar means on the ground of self-defense and self-preservation. It has been the experience of most men in the profession that the plaintiffs' attorneys are generally the first to sin, and have the least excuse. They deal oftentimes with ignorant people; they have but few cases as compared with the attorneys for the railways; they come into personal contact with both client and witnesses, and they can give personal attention to details and, presumably, can secure, at first hand, reliable information as to the honesty and justice of their cases. It takes a very stupid lawyer, who can give his attention, personally to the investigation of an accident case, to be deceived by witnesses who propose to perjure themselves for the benefit of the plaintiff.

On the other hand, the temptation offered to an attorney, especially if he be poor, to make sure of a large verdict, in a flimsy case, is great, for the stake is large, and the whole matter is of so speculative a nature as to present the attractions and temptations of a gambling transaction, with what seems to be a small fortune in view in case of success, and actual loss in case of failure.

Now and then the public is apprised of the facts, which are more surprising and startling to them than to the lawyer, who often suspects, from what he sees in the courts, trickery and dishonesty he cannot prove.

Recently in New York a case came before one of the trial courts where the plaintiff's attorney placed witnesses on the stand who testified; that an employee of the defendant was driving a large truck, heavily laden, through a crowded thoroughfare, and by his side sat a boy some seventeen years old; that the plaintiff, an infant, was standing in the middle of the street, watched by his mother on the sidewalk; that the wagon ran over the child, and that at the time the driver was reading a book, while the boy at his side was holding the reins and driving.

The defendant's testimony was to the effect, that the driver had the reins and had no book, and that he called to the child, and that thereupon the mother rushed into the street and the accident happened. The jury brought in a verdict for ten thousand dollars in favor of the plaintiff, who had been severely injured. After entry of judgment the attorney for the defendant learned that one of the witnesses for the plaintiff had stated in conversation that he had sworn falsely at the trial. Investigation followed, which resulted in the indictment and arrest of this witness, and of several others, who confessed, some to the district attorney and some to the attorney for the defendant, that they had been guilty of perjury at the trial; that some of them had not been near the scene of the accident at the time it happened, and that the others gave a perverted account of what they saw. They stated in their confessions that the plaintiff's attorney read to them a carefully prepared version of the accident, including an account of the book and of the boy having the reins in his hand, and they testified to what had been read to them, and not to what they had seen.

Meanwhile an appeal from the judgment had been taken to the appellate court, and the verdict had been sustained; but the judgment of affirmance was not entered promptly by the plaintiff, and a rather interesting state of facts must be recited as the cause of the delay.

It appeared that the attorney for the plaintiff had a large financial interest in the case, and in several other actions (for loss of service, etc.) arising out of the same accident. To save expense, the plaintiff had brought his action as a poor person, and the plaintiff's attorney had made the necessary agreement to prosecute without compensation, but after the decision of the appellate court he refused to enter up the judgment of affirmance until the guardian of the infant plaintiff would agree that he should receive full costs, allowances, expenses, and several thousand dollars out of the verdict.

These facts were presented to the judge who presided at the trial, and the defendant's counsel made a motion that the judgment be vacated and a new trial ordered. In granting the motion the court severely criticised the plaintiff's attorney, and in his written opinion stated that he believed that the plaintiff's attorney not only knowingly presented perjured testimony to the court and jury, but actively participated in its manufacture. The indictment of the attorney for the plaintiff by the grand jury followed, and he is now awaiting trial.

Where facts of this character become known or are suspected there is a strong temptation on the part of the defense to look solely to their own convenience and financial interest, and be satisfied with a release, while there are the strongest and most potent reasons on the score of public duty to impel them to go to much inconvenience and some expense in bringing matters of this character to the attention of the criminal, as well as the civil courts, as was done in this case.

The other side of the question we have already suggested, and we infer from investigations that we have made that practices of this sort, especially in some of our Western cities, have resulted in defensive measures on the part of large corporations which are not always compatible with the strictest integrity. There are hangers-on about the court houses in some large cities who seem to be constantly in conversation with the jury panel, and who have no apparent means of livelihood, but who always seem to be flush of money. Coincident with their presence about

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

the court house are stubborn jurymen, who, in cases of clear liability, cause disagreements. The zeal of the adjuster (who is in a way a sort of detective and open to the same sort of temptation that makes a detective's testimony of doubtful value), is in great part to blame.

We regret to notice that the accident departments of some of our large railway companies stir up bad blood and give the attorney for plaintiff good cause for complaint which bears fruit in his justifying himself, to himself if to no one else, in departing from professional ethics. The counsel and the accident adjusters of the railway company should not set up by their conduct a low standard of professional tactics, if for no other reason than because it is bad policy. We refer to the growing practice of settling cases after suit is brought, behind the plaintiff's attorney's back. The counsel for the company excuse themselves to their brethren at the bar by saying that they cannot control their client, the company, and its adjusters —an excuse which, if ever available, certainly is not valid until they have exhausted every effort to compel the company to be as righteous as they desire, and have a right to expect, their opponents to be.

But it is believed, that the loss departments of most of our street railways are run upon the very sound proposition that "Honesty is the best policy." The courts and jurors and the character of the counsel who ordinarily are employed to try the cases for our street railways is so high, that the adjuster who tries trickery or bribery in order to attain success as a shrewd employee must not only fool the court and jury, but must fool the shrewd and honest counsel under whose direction he is supposed to act.

Where any other policy prevails it must in the end arouse such a wave of popular indignation as to be reflected, if nowhere else, certainly in enhanced damages in cases wherein the plaintiffs recover verdicts from indignant juries. H.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

ALABAMA.—Electric Railroads—Injury to Telephone Company—Injunction.

1. While prior occupancy of a street by a telephone company may not confer superior privileges over an electric railway company seeking to construct a line in such street, it may be considered in denial of the latter's usurpation of superior rights in said street.

2. To entitle a telephone company to enjoin an electric railway company from operating a line, under a legislative grant, on a street occupied by the former, damages in the nature of an abuse of the franchise, and not mere incidental damages, must be proved.

3. An electric railway company will be enjoined from erecting its wires in a street in such a manner as to short-circuit the wires of a telephone company, and prevent messages being sent over them, where such damages can be avoided by a proper construction of the line, as such damages would be continuous, and tend to a multiplicity of suits.

4. And for the further reason that a court of equity will interfere to keep such corporations within the line of their authority, and prevent such damages.—(Birmingham Traction Co. vs. Southern Bell Telephone & Telegraph Co., 24 So. Rep., 731.)

ILLINOIS.—Municipal Improvements—Assessment—Property Subject.

1. Under City and Village Act, art. 9, authorizing special assessments for local improvements on property contiguous thereto, the tracks and right of way of a street railroad company in a public street may be assessed for contiguous local improvements therein; and this, even where its franchise is only an easement for a term.

2. Revenue Law (Rev. St. 1893, c. 120), sec. 15, providing that the track, road, or bridge of street railroad companies shall be deemed personal property, and assessed as such in the town or district where located or laid, does not prevent the assessment of the track and right of way of a street railroad for contiguous local improvements.—(Cicero & P. St. Ry. Co. vs. City of Chicago, 52 N. E. Rep., 866.)

ILLINOIS. — Municipal Corporations—Ordinances—Constitutionality—Contracts—Ultra Vires.

1. Under Rev. St. p. 219, sec. 3, providing that a city may permit the construction of a street railway upon such conditions as it deems best for the public interest, a city may require a street railway to pay an annual tax on each mile of its track as a condition to its right to construct and operate its line.

2. It will not be presumed that because an ordinance, authorizing the construction and operation of a street railway, requires the payment of a license fee on each car, that another provision, requiring the payment of an annual tax on each mile of its track, is an improper attempt to raise revenue for the municipal government.

3. An ordinance requiring defendant street railroad to pay an annual tax on each mile of its road, as a condition to its right to construct and operate its line, does not deprive defendant of its property without due process of law, in contravention of the fourteenth amendment to the constitution of the United States and sec. 2 of the bill of rights of the State constitution.

4. An ordinance requiring defendant to pay an annual tax on each mile of its track is not in conflict with Const. art. 4, sec. 22, prohibiting the enactment of special laws where a general law is applicable, though the ordinance applies only to defendant, and not to other street railway companies.

5. Defendant, who accepted a license to construct and operate a street railway, and received its benefits, cannot, as against the city, avoid payment of an annual mileage tax on the ground that the license imposing it was ultra vires of the city.—(Chicago Gen. Ry. Co. vs. City of Chicago, 52 N. E. Rep., 880.)

KENTUCKY.—Taxation of Corporate Franchises—Repeal of Statute—Conclusiveness of Finding of Board of Valuation.

1. Ky. St. secs. 4273-4275, enacted prior to the present constitution, so far as they authorize the board of equalization to equalize assessments upon any other basis than that of the cash value of the property assessed, are in conflict with Const. sec. 172, and Ky. St. sec. 4020, enacted thereunder, and were to that extent repealed thereby.

2. A corporation, whose franchise has been assessed at its fair cash value by the board of valuation and assessment, cannot complain of the inequality caused by the fact that other officers have, in violation of the constitution and statutes, assessed property at less than its fair cash value.

3. The question as to how far the value of the franchise of the corporation is affected by the fact that it is to exist only for a limited time is for the board of valuation and assessment, and its finding as to that matter is final and conclusive.

4. In fixing the value of the franchise of a corporation for assessment, it is proper to deduct the value of the tangible property of the corporation assessed in the State from the value of the capital stock; and, in fixing the value of the capital stock, the board may take into consideration the gross and net earnings of the corporation.—(Louisville Ry. Co. vs. Commonwealth, 49 S. W. Rep., 486.)

NEW YORK.—Conversion—Judgment—Satisfaction—Title of Property.

1. Where the owner of coupons in the possession of another elected to waive their return, and sued as for conversion, and recovered judgment, which was satisfied, the coupons became the property of the wrongdoer.

2.—Evidence—Presumption.—Possession of coupons by the person liable thereon, where there was evidence they were unpaid, raises no presumption that they were received under any agreement preventing the owner from collecting them.

3.—Same—Burden of Proof.—Where, in an action on coupons, plaintiff showed that they had been duly issued by defendant, that plaintiff had become the owner of them, and that they were not paid, the burden was on defendant to show whether any defense existed against the right to recover; and this, though the coupons were in defendant's possession.

4.—Judgment—Notice—Estoppel.—Where the person ultimately liable on coupons was served with notice of the commencement, trial, entry of judgment, and appeal of an action involving their ownership, value, and existence as legal obligations, though not a party, he is concluded as to these issues in a subsequent action on the coupons.

5.—Limitation of Actions—Bonds—Coupons.—Interest coupons of bonds therein described are not outlawed until the bonds are, though they are detached from the bonds.—(Kelly et al. vs. Forty-second St. M. & St. N. Ave. Ry. Co., 55 N. Y. Suppl., 1906.)

NEW YORK.—Bills and Notes—Defenses—Want of Consideration.

1. Where a note was given in settlement of a suit for the infringement of certain patents, apparently valid, and both parties acted in good faith, the maker cannot avoid payment on the ground of want of consideration, because the patents were subsequently adjudged void in another suit.

2.—Same—Payee's Right to Sue.—The fact that the payee of a

note, given in settlement of a pending suit, was not a party thereto, does not affect his right to recover thereon.

3.—Same—Consideration.—A note was given in settlement of a suit for the infringement of patents on electric car equipments to a company not a party to the suit, which also agreed to promptly furnish the maker any trolley equipment it might require. Held, that though the patents were invalid, there was a sufficient consideration for the note moving from the payee in this additional agreement.—(General Electric Co. vs. Nassau Electric R. Co. et al., 55 N. Y. Suppl., 858.)

NEW YORK—Location—Objections by Landowners—Waiver.

1. Railroad Law, secs. 6, 90, provides that a street surface railroad corporation, before constructing its road, shall file a map and profile of the route, and notify occupants of lands over which the route passes; that any occupant may, within fifteen days after notice, apply to a justice of the Supreme Court for relief against the route designated, and alteration of the same; and that the corporation shall not proceed to condemn until the fifteen days have expired, nor until final determination of any application for change of route. Held, that an occupant who fails to object to a proposed route within fifteen days cannot afterwards attack it.

2.—Same—Petition for Condemnation—Sufficiency of Description.—If the center line of a proposed street surface railroad extension is staked out on the ground, or otherwise ascertainable by inspection, without reference to the map of the route, or already known, it is a monument that may be referred to in the "specific description of the property sought to be condemned, and its location by metes and bounds," required by Code, sec. 3360, subd. 2.

3.—Same—Right to Condemn—Agreement with Owner.—Where an adult asserts undivided ownership in land sought to be condemned by a street surface railroad company, and several infants claim an interest therein, and there are liens on the property, the company may resort to condemnation proceedings, under Railroad Law, sec. 90, authorizing that course when the company is "unable to agree" for the purchase of the land.—(Stillwater and M. St. Ry. Co. vs. Slade et al., 55 N. Y. Suppl., 966.)

NEW YORK.—Municipal Corporations—Proceedings to Open Street—Notice.

1. Syracuse City Charter, sec. 167, provides that notice shall be given of the application for the appointment of commissioners to ascertain and report the compensation to be paid to person, owning or having an interest in property proposed to be taken for a street and shown to be benefited. Held, that notice to a mortgagee of a railroad might be dispensed with in a proceeding to take railroad property, where the mortgage is so insignificant in proportion to the value of the road that the lien will not be impaired in the slightest degree by the proceeding.

2.—Same—Statutes—Partial Invalidity.—The fact that said section does not provide, in express terms, that notice shall be given to the owners of property taken and not benefited, does not permit the city to take lands without due process of law, as against owners of lands benefited.—(In re Opening of Oneida St., City of Syracuse vs. Syracuse, B. & N. Y. R. Co., 55 N. Y. Suppl., 959.)

NEW YORK.—Streets—Obligations to Pave.

1. General Railroad Law, sec. 98 (Laws 1890, chap. 565), as amended by Laws 1892, chap. 676, providing that every street surface railroad corporation, so long as it shall use any of its tracks in any street in a city, shall keep in permanent repair that portion of such street between its tracks, the rails of its tracks, and two feet in width outside thereof, as and whenever required by the local authorities to do so, applies to every street surface railroad company, whether incorporated prior or subsequent to the act.

2.—Same—Exemption.—The omission, in a charter of a street railroad company, of a provision compelling it to pave streets along its tracks, does not vest in it or its successors a perpetual exemption from such obligation subsequently imposed by the Legislature under the power given it by Const., art. 8, sec. 1, providing that all general laws creating corporations may be altered from time to time.

3.—Same—Vested Rights.—The term "vested rights" relates to property rights only, and does not embrace an immunity or exemption created by an omission, in a statute incorporating a street surface railway company, to impose a liability on it to pave parts of streets occupied by its tracks.

4.—Same—City Council—Power to Exempt.—A city council has no power to exempt a street railroad company, by contract or otherwise, from the provisions of General Railroad Law, sec. 98, as amended by laws 1892, chap. 676, requiring all street surface railroads to pave certain portions of streets occupied by their tracks.

5.—Same—Exemption Contract—Legalizing Statute—Constitutionality.—Laws 1893, chap. 231, legalizing a contract between the city of Binghamton and the Binghamton Railroad Company exempting it from part of the provisions of General Railroad Law, sec. 98, as amended by Laws 1892, chap. 676, requiring it to pave certain portions of streets occupied by it, is not void as a grant to the company of an "exclusive immunity" forbidden by the constitution.

6.—Same—Repeal.—Nor was such legalizing act repealed by implication by Laws 1893, chap. 434, sec. 90, passed a month thereafter, providing that the general law requiring street railroad companies to pave certain portions of streets along their tracks shall apply to every corporation, however organized; nor by Laws 1895, chap. 933, which, in amending the general railroad law in other unrelated respects, necessarily re-enacted section 90.

7.—Same—Validity.—Laws 1893, chap. 231, legalizing a contract between the city of Binghamton and the Binghamton Railroad Company, exempting the latter from liability to pave parts of streets occupied by it, was not void because it validated a contract void for want of power in the city to make it, since the Legislature may confer such power by retrospective legislation.—(Wood vs. Common Council of City of Binghamton et al., 56 N. Y. Suppl., 105.)

SOUTH CAROLINA.—Municipal Corporations—Laying Railroad Tracks in Street—Consent of Abutters—Condemnation.

Under Acts 1894, p. 1002, sec. 14, authorizing the town council of Gaffney City to close up, widen, or alter a street by condemnation in case the abutters refuse consent, the council has no authority to permit a railroad to lay its tracks in a street, where consent was refused, without condemnation and compensation.—(Wilkins et al. vs. Town Council of Gaffney City et al., 32 S. E. Rep., 299.)

TEXAS.—Municipal Corporations—Change in Grade of Streets—Delegation of Authority—Liability to Abutters—Council—Proceedings—Committees—Joint Tort Feasors—Evidence—Instructions.

1. Where a railroad company raises the grade of a street through a contractor, pursuant to authority granted to it or to the contractor by a city acting under the power conferred by charter to alter the grade of streets, the city alone is liable to an abutter for damages resulting from the change.

2. An alderman testified without objection that he gave a railroad company authority to change the grade of a street, "for the council recommended it," and that he "suggested the matter to the council, but *could* not state how the vote stood there." Held, that the question whether the council authorized the change was for the jury.

3. The necessity of submitting the question to the jury was presented by a request to charge the erroneous proposition that such authority might be given without a formal order passed by the council in session.

4. A street committee of a city council has no authority to authorize a railroad company to change the grade of a street, unless conferred by charter or by the council.

5. Where a railroad company raised the grade of a street through a contractor without authority from the city, and the contractor authorized the engineer of the company to specify where the dirt should be placed, and the engineer gave directions thereunder, the company and the contractor were not joint tort feasors, so as to preclude the latter from recovering over against the former in an action by an abutter for damages.

6. The Denison City Charter provides that the council shall hold regular meetings; that its voice shall be ascertained by vote; and that the city secretary shall attend every meeting, and keep accurate minutes of the proceedings, and record votes. Held, that authority to change the grade of streets, which is conferred on the council by charter, cannot be granted by the consent of each member of the council individually. The council must act as such.—(Denison & P. Suburban Ry. Co. vs. James et al., 49 S. W. Rep., 660.)

LIABILITY FOR NEGLIGENCE.

ILLINOIS.—Contributory Negligence — Instructions — Error Cured—Damages—Pleading.

1. Where plaintiff did not begin to alight from defendant's car until it had stopped, and when it stopped she was holding on with both hands, and had one foot to the ground, and the car jerked after she put the foot on the ground, and before she had time to lift the other foot, she exercised ordinary care.

2. If an instruction that if plaintiff, while alighting from defendant's car, was using reasonable care, and defendant negligently caused the car to be set in motion, and plaintiff was thereby injured, the jury should find defendant guilty, is objectionable in omitting the question whether the negligence of plaintiff was the proximate cause of the injury, the objection is obviated by a subsequent instruction that, if plaintiff was negligent in alighting, and such negligence was the cause of the injury, a verdict of not guilty should be returned.

3. If such instruction is objectionable in not defining "reasonable care," the objection is obviated by a subsequent instruction

that a person attempting to alight from a street car is bound to use ordinary care to avoid injury, under any and all circumstances, and if she fails to use such care, and is injured by reason thereof, she cannot recover.

4. In an action for personal injuries, a recovery for any disability rendering plaintiff less capable of attending to her business may be had without an averment of special damage, where plaintiff is a common laborer, since the damages necessarily result from the injury.—(North Chicago St. R. Co. vs. Brown, 52 N. E. Rep., 864.)

INDIANA.—Special Verdict—Objections—Injuries to Trespassers—Constitutional Law—Title of Act—Jury Trial.

1. The question of the validity of a special verdict is not raised by an objection to the filing of defendant's request for a special verdict, where no demand was made that the jury be directed to bring in a general verdict, and no objection was made on the return of the special verdict, nor any request that the jury be sent back with instructions to make a general verdict.

2. Where a boy, being unable to get on an open electric car, stands upon the side of the car, on which strips extend to prevent the egress or ingress of passengers, placing his foot on the boxing of the axle, and rides thereon for some distance without paying a fare or offering to do so, and without being asked for his fare, he not being seen by any employee of the railroad company, though he had money in his pocket with which to pay such fare, if asked for it, and falls off and is run over by the wheels of the trailer, the railroad company is not liable for injuries received, the place where the boy was riding being very dangerous.

3. Plaintiff, while so riding, was not a passenger to whom the carrier owed a safe carriage and immunity from injury.

4. The fact that plaintiff was a child about nine years old did not make him less a trespasser on the car, if the other facts compelled the conclusion that he was wrongfully on the car.

5. Act March 11, 1895, amending the practice act, and providing for special verdicts, sufficiently expresses the subject in the title, "An act to amend section 389 of an act concerning proceedings in civil cases, approved April 7, 1881, and designated as section 546 of the Revised Statutes of 1881."

6. Act March 11, 1895, providing for special verdicts, which act, except as to form, did not change the law governing special verdicts as it had existed in the State since 1852, is not unconstitutional, as violating the right of trial by jury.

7. Where an application for a special verdict is made under Act March 11, 1895, and 144 interrogatories are submitted to the jury, covering every material fact, exclusion of others tendered, calling for mere opinions and for conclusions of law, was proper.

8. Where a special verdict is requested, no instructions are proper, except such as are necessary to inform the jury as to the issues, the rules for weighing evidence, who has the burden of proof, and whatever else may be necessary to enable the jury clearly to understand its duties.—(Udell vs. Citizens St. Ry. Co., 52 N. E. Rep., 799.)

INDIANA.—Defective Street—Duty to Repair—Special Finding—Presumption—Contributory Negligence—Instructions—Review.

1. It cannot be presumed that a person injured did not exercise any care, from a special finding that the evidence did not show "what care" he was using when the injury occurred.

2. In the absence of knowledge to the contrary, one driving over a street is entitled to presume that it is in a reasonably safe condition for travel.

3. One injured by reason of a defective street, which he knows to be unsafe, is not guilty of contributory negligence, if he uses care proportionate to the known danger.

4. On an issue as to what would constitute constructive notice of a defect in a street, the court charged that a very short time might be sufficient, considering the location, character, and permanence of the defect, "and such other things as throw light on the question," and added that what the facts were and the interferences to be drawn therefrom were for the jury to determine, under all the evidence and circumstances. Held, in view of the closing clause, that the instruction was not erroneous, as authorizing the jury to consider facts not shown by the evidence.

5. Since a street railroad company is bound to so maintain its tracks as not to impair the safe condition of the street, whether required by ordinance or not, an instruction that, if a street railway company accepted an ordinance imposing such obligations, a violation thereof rendering the street dangerous would be negligence, which, if the proximate cause of another's death, who was exercising due care at the time, would render the company liable therefor, was not error.

6. A verdict of a jury cannot be disturbed on appeal where there is some evidence to support it.

7. It is not error to refuse requested instructions covered by those given.—(Citizens St. Ry. Co. et al. vs. Ballard, 52 N. E. Rep., 729.)

LOUISIANA.—Contributory Negligence—Infants—Motoneer—Damages—Personal Injuries.

1. A plaintiff's act or omission, when only a remote cause, or a mere antecedent occasion or condition, of the injury inflicted, is considered not to be contributory negligence.

2. A child of three and one-half years is, of itself, incapable of contributory negligence.

3. No man should be in charge of an electric car as motoneer, running along populous thoroughfares of a city, who has not the full and complete use and sight of both eyes.

4. No doctrine or rule exists here that the negligence or imprudence of a plaintiff, while not of the proximate character to defeat his recovery, may yet be looked to by the jury or court in mitigation of damages.

5. Nevertheless, this court has constantly exercised its reasonable discretion of increasing or diminishing the sums awarded for damages, according to its judgment, operating on the facts, prompted in given cases.

6. It has never been the intention to fix by rule specific sums for different classes of injuries, nor for varying grades and duration of anguish and suffering.

7. In this respect, each case is considered independently, on its merits, and on the state of facts peculiar to it, a due regard, however, being always had to the proper observance of a reasonable uniformity of jurisprudence on general lines.—(Rice et ux vs. Crescent City R. Co., 24 So. Rep., 791.)

LOUISIANA.—Injury to Passenger—Contributory Negligence.

1. The West End passenger train of the defendant company came to its stopping place on Canal Street, where it was when plaintiff walked up to the train, and turned to the right, in order to board the smoking car at the end of the train. An electric car of the defendant company ran on its track, which was near the steam train. The projection of the electric car and the projection of the steam train (toward each other) made very narrow the path upon which plaintiff was walking, with his back to the electric car, by which he was knocked down, and greatly injured. The rule as to looking and listening had no application. About midday, defendant's motorman did not see plaintiff, who was walking in front, in a dangerous position, because of his advancing car. It was his duty to keep a sharp lookout, and see pedestrians at the place on their way to board the cars. No gong was sounded, and no alarm.

2. There was no proper care on the part of the employee in charge of the defendant's electric car. Such care and diligence must be exercised at dangerous places on a railway, to avoid inflicting injury, as the proper manning of a car requires.—(Conway vs. New Orleans City & Lake R. Co., 24 So. Rep., 780.)

MASSACHUSETTS.—Liability for Injuries—Acts of Fellow Passengers—Knowledge of Passenger's Infirmity.

1. A carrier is not liable to a passenger for injuries received by the fall of another passenger, who was jostled by the conductor while removing a drunken passenger from the car in the exercise of due care.

2. Where a passenger was injured through the carrier's attempt to remove a drunken passenger from the car, the carrier, if liable at all, was liable only for the consequences of the injury, and not for any fright or other injury suffered by the passenger through the drunken man's presence, or the attempt to remove him.

3. The conductor's knowledge of a passenger's infirmities does not increase the carrier's obligations to her.

4. A carrier whose servants committed a battery on a passenger is liable for all damages sustained by him, even though the injury to a normal person would have been less.—(Spade vs. Lynn & B. R. R., 52 N. E. Rep., 747.)

NEW YORK.—Negligence of Driver.—The failure of the driver of a horse car to observe a boy when he slipped on the track, on a dark night, four feet in front of the horses, at a part of the road not a crossing, does not justify an inference of negligence.—(De Ioia vs. Metropolitan St. Ry. Co., 56 N. Y. Suppl., 22.)

NEW YORK.—Injury to Person Near Track—Question for Jury.—Evidence showed that plaintiff was standing on a crosswalk between the tracks of a street railway, preparatory to taking a south bound car, when he was struck by a north bound car, which was in full view of him while approaching. The drivers were instructed to slow up or stop when approaching a car near or on a crosswalk receiving passengers, but the driver of the north bound car approached the place where plaintiff was standing, without checking his speed. Plaintiff, being about to take the south bound car, was facing in that direction, and did not notice the approach of the other car. Held, sufficient to authorize the submission of the case to the jury.—(Boentgen vs. New York & H. R. Co., 55 N. Y. Suppl., 847.)

Arguments Against the Vestibuling of Cars.

The following interesting letter was addressed by John W. McNamara, general manager of the Albany Railway, to the committee of railroads of the New York State Assembly, arguing against the passage of several bills pending before the railroad committee in relation to vestibuling or inclosing platforms of cars of street railways:

To the Honorable Committee of Railroads of the Assembly:

Gentlemen.—The Albany Railway respectfully opposes the passage of any of the proposed measures providing for the vestibuling or inclosing platforms of its cars, for the following reasons:

I. The Appellate Courts of the several States of the United States and the Supreme Court of the United States have laid down the law in relation to the care to be exercised by persons or corporations operating street railways. According to the several decisions, the operator of a street car, especially if it is impelled by cable or electric power, is bound to keep a constant watch for persons and vehicles on the street, and although he is not bound to anticipate that foot passengers will attempt to cross otherwise than at regular crossings, and he, therefore, need not maintain quite the same degree of vigilance, he is always held responsible for failing to see even persons crossing at other places if he would have seen them had he been in the exercise of ordinary care.—Sherman and Redfield on Negligence (5th ed.), section 485c.

1. This being the law, street railway managers are obliged to select able-bodied, competent operators of their cars. The operator must be able-bodied, and physically able to promptly control all the appliances usually on cars for the purpose of starting and stopping them. His eyesight must be good, so that he may be able to see obstructions on the track, or at points along the line see those who are about to cross the track. His hearing must be good, so that he may be able to hear all signals given to him by the conductor and promptly obey them; and the warnings and signals of pedestrians or persons desiring to board cars. He must be able to speak, and preferably to speak the English language. His habits must be good. No one known to habitually use intoxicating liquors can legally be employed as the operator of a car.—Railroad Law, section 42, and Liquor Tax Law, section 41. Penal Code, section 420.

II. The law requiring the utmost vigilance on the part of those operating street railways is being constantly enforced by the courts in actions brought by persons suffering damages either to person or property. It would seem, therefore, unjust to require street railways, first, to take the greatest care in the selection of the operators of its cars and the greatest vigilance on their part, and then, second, to compel them to place such operator in such position that having ears he cannot hear, having eyes he cannot see, and having a tongue and voice he cannot use them. That is just what each one of the bills we are considering requires street railways to do. It requires the operator to be inclosed in a vestibule, so that his ability to see and hear and make himself heard is abridged.

1 As cars are now operated in Albany, the operator is in a position where he can be seen by all persons traveling on the street; where he himself can see all persons who are crossing, or attempting to cross, the track upon which he is driving his car; and he is in a position to hear warnings given to him by others; and is also in a position to give warning himself to those who may inadvertently place themselves in danger.

2. It is not saying too much to say that hundreds of persons have been saved from serious injury by reason of the ability of the operators of the cars of the Albany Railway to make themselves heard.

III. The experience of electric railways and other railways using vestibules is that the vision of the operator is very much obscured, and the percentage of accidents happening by reason of this interference with vision is consequently larger.

1. It is impossible to keep the glass portion of the vestibule clear in cold, foggy or stormy weather. It is found at night that in order to enable the operator of the car to see at all, it is necessary to cover the front part or front windows of the car proper with a curtain. The effect of this, of course, is to prevent the passengers riding in the car from seeing the operator. For aught they know, he may have been taken with a fit and be lying senseless on the platform.

2. The hearing of the operator of a car while inclosed in a vestibule is very much impaired by reason of the resonating effect of the vestibule. All the noise made by motors and wheels on the track seems to be concentrated and intensified in the vestibule.

3. The conductor of the car, who occupies the rear part, is handicapped by the vestibule. If the trolley goes off, which is quite a common occurrence on all overhead trolley roads, it is necessary for him to get off the car to put the trolley on.

4. The present platforms enable persons to see the conduct of the driver, both from the inside of the car and from the outside of the car, during an impending accident. Many an operator of a car has been able to prove his great vigilance by aid of the testimony of persons standing on the sidewalks or sitting in the car which he was operating, when, if he had been inclosed in a vestibule, as these bills propose to inclose him, it would be impossible for him to do so.

5. The motion of his hands in throwing off power and putting on brakes is plainly visible. If he were inclosed in a vestibule, no one would be able to see whether he made any effort to stop the car or not.

6. The open platform enables inspectors of operation to readily see the position and condition of the operator.

IV. Unless, therefore, the Legislature is prepared to relax the rule of law established by the courts, and give the operators of street railways the same right to operate their cars as is now enjoyed by steam railroads, they, the railways, should be permitted to manage the operation of their cars in such a way as to secure the least possible damage to the persons and property of others.

V. The reason given by the proponents of the several bills for their passage, namely, their sympathy for those engaged in operating cars, does not take into account the much larger number of persons interested in preserving their lives. For instance, the number of operators of cars employed by the Albany Railway does not exceed one hundred and fifty, while the population of the cities through which the cars of the Albany Railway are operated exceeds two hundred thousand. It is, therefore, a question whether it is better to conserve the health and comfort of one hundred and fifty persons who may be exposed to wind and storm for a few days in each year, or to jeopardize the limbs and lives of thousands of people who have occasion to use the streets through which the cars run.

1. The Albany Railway and the Watervliet Turnpike and Railroad Company have operated street railway cars in the city of Albany and vicinity since 1863. During that time there is no record that any operator of either a horse or an electric car contracted any disease while operating such cars which caused his death or hastened his death. The fact is that the drivers of cars are among the healthiest of the employees of a street railway.

2. The lives of persons run down by street railway cars are as precious to their fathers and mothers, or, in the case of parents, to their children, as the lives of the operators of street cars are to those who are related to them. With all the care which it is possible now to exercise, many annually lose their lives by reason of being struck or run over by street cars. It would seem, therefore, that any legislation which tends to increase the number who thus annually lose their lives should be restrained and withheld.

3. It is well known that pedestrians and drivers of vehicles on streets through which street railways are operated rely upon the vigilance of the operators of street cars to warn them of the approach of the car, and to stop the car if necessary to prevent a collision or accident.

4. A car with a human being in plain sight on an open platform seems less like an engine of destruction than a car with an inclosed platform, the operator of which is concealed from those using the streets as pedestrians or drivers of vehicles.

VI. The fact that the operators of street cars—motormen and gripmen—want vestibules; or the fact that corporations owning railways do not want them, should not influence the decision of the question.

1. Many who advocate the vestibuling of cars do so simply from the standpoint of sympathy for the operator of the car. All other considerations are ignored or forgotten.

2. It is barely possible that some operators of cars may desire vestibules, forgetting for the moment how a vestibule would handicap them in the operation of their cars.

VII. The question, therefore, whether any of the bills providing for the vestibuling of cars, or the modification of any of them, should be reported by your committee is respectfully submitted to you for consideration on all the facts which have been laid before you.

Dated March 2, 1899.

A subscriber to the Street Railway Journal wishes to purchase about 450 horses.

Annual Reports

ATLANTA CONSOLIDATED STREET RAILWAY COMPANY, ATLANTA, GA.

The report of this company for the year ending Dec. 31, 1898, is as follows:

Receipts from passengers	$404,529
Receipts from other sources	3,868
Total receipts	$408,397
Operating expenses	222,441
Earnings from operation	$185,956
Deductions from Earnings.	
Interest	$108,682
Taxes	10,433
Net income	$66,841
Per cent, operating expenses to total receipts	52.4

Balance Sheet. Dated Dec. 31, 1898.

Assets.		Liabilities.	
Plant	$4,446,380	Capital stock	$2,000,000
Cash	232,623	Funded debt	2,250,000
Material on hand	15,066	Bills audited	14,930
Unearned insurance	715	Suspense	6,800
Bills receivable	758	Pay rolls	10,439
		Dividend	904
		Profit and loss (surplus)	412,468
Total	$4,695,542	Total	$4,695,542

INTERURBAN ROADS.

The following annual reports of five of the leading interurban roads in the country will be of interest:

TWIN CITY RAPID TRANSIT COMPANY, MINNEAPOLIS, MINN.

Year Ending Dec. 31, 1898.

Receipts from passengers	$2,145,093
Receipts from other sources	25,623
Total receipts	2,170,716
Operating expenses	1,019,392
Earnings from operation	$1,151,324
Deductions from Earnings.	
Interest on funded debt, and dividends on preferred stock	$713,454
Taxes	64,214
Net income	$373,656
Per cent, operating expenses to total receipts	46.96

CINCINNATI, NEWPORT & COVINGTON RAILWAY COMPANY, CINCINNATI, OHIO

Year Ending Dec. 31, 1898.

Gross receipts	$681,672
Operating expenses	302,201
Earnings from operation	$379,471
Fixed charges	318,144
Net income	$61,327
Per cent, operating expenses to total receipts	44.3

CLEVELAND, PAINESVILLE & EASTERN RAILROAD COMPANY, CLEVELAND, OHIO

Year Ending Dec. 31, 1898.

Gross receipts	$105,360
Operating expenses	58,880
Earnings from operation	$46,480
Interest	25,000
Net income	$21,480
Per cent, operating expenses to total receipts	55.8

LORAIN & CLEVELAND RAILWAY COMPANY, CLEVELAND, O.

Year Ending Dec. 31, 1898.

Gross receipts	$73,037
Operating expenses	33,665
Earnings from operation	$39,372
Interest	35,000
Net income	$4,372
Per cent, operating expenses to total receipts	46.

AKRON, BEDFORD & CLEVELAND RAILROAD COMPANY, CLEVELAND, OHIO

Year Ending Dec. 31, 1898.

Gross receipts	$96,054
Operating expenses	65,171
Earnings from operation	$30,883
Interest	19,221
Net income	$11,662
Per cent, operating expenses to total receipts	67.8

QUARTERLY REPORT OF BROOKLYN HEIGHTS RAILROAD COMPANY, BROOKLYN, N. Y.

Quarter Ending Dec. 31.

	1897.	1898.
Receipts from passengers	$1,297,346	$1,439,848
Receipts from other sources	66,203	20,558
Total receipts	1,363,549	1,460,406
Operating expenses	766,538	886,579
Earnings from operation	$597,011	$573,827
Fixed charges	569,108	535,002
Net income	$27,903	$38,825

Change in Brooklyn, N. Y.

The Brooklyn Rapid Transit Company has secured control of the Brooklyn Union Elevated Railroad, formerly the Brooklyn Elevated Railroad Company. It is stated that transfers will be given to passengers from the surface cars to the elevated trains, and also that the elevated will be equipped with electricity in the near future. The property of the Brooklyn & Brighton Beach Railroad Company has also been recently purchased by the Brooklyn Rapid Transit Company, and it is reported that the purchase of the Kings County Elevated Railroad will soon be consummated.

Changes on the Manhattan Elevated Railway

It has been officially announced by the directors of the Manhattan Elevated Railway Company, of New York, that the third rail system will be employed when the road is equipped with electricity. In addition to the changes in officers mentioned in the last issue of the Street Railway Journal, L. B. Stillwell has been appointed consulting electrical engineer for the company. Mr. Stillwell has been for about six years in charge of the electrical plant of the Niagara Falls Power Company at Niagara Falls, N. Y.

NEWS OF THE MONTH

The South Bend Street Railway Company, of South Bend, Ind., was fined recently for placing salt upon its tracks to clear them of snow and ice. It is claimed this was in violation of a city ordinance.

A curious accident happened on March 19 on the electric railway at Yarmouth, N. S. In order to clear the tracks of snow and ice two motor cars were started, one immediately behind the other and touching, but not coupled. While proceeding in this way under full power, the bumper of the rear car in some way got under the back bumper of the front car and lifted it. Immediately the front car left the track at an angle on a slight declivity. and rushed at full speed onto the sidewalk and part way into a brick building, tearing away a heavy iron pillar and considerably damaging the contents of the building. There were no passengers on the car at the time.

A bill has been introduced in the Missouri Legislature prohibiting the municipal authorities of cities in that state from granting franchises for constructing street railways along the streets of cities except upon petition of the people owning one-half of the frontage along such streets.

The consummation of the consolidation of all the street railways in Buffalo and vicinity was effected on March 22. A new company, to be known as the International Traction Company, has been formed, and it is stated a new mortgage for $30,000,000 will be issued. J. P. Morgan & Co., of New York city, are the prime movers in the deal. The companies affected by the consolidation are as follows: The Buffalo Railway Company, the Buffalo Traction Company, the Buffalo, Bellevue & Lancaster Railway Company, the Buffalo & Niagara Falls Electric Railway Company, the Buffalo & Lockport Railway Company, the Niagara Falls Park & River Electric Railway Company, the Niagara Falls & Clifton Bridge Company and the Lewiston & Queenstown Heights Bridge Company. It is stated that the Buffalo Railway stock was purchased for $100 per share, the Buffalo & Niagara Falls at $75, and the Buffalo & Lockport at $50.

The Joliet Street Railway Company, of Joliet, Ill., has voluntarily increased the wages of all its employees 10 per cent. The action was taken as the business of the company has rapidly increased and the prospects for the coming year are better than ever before.

One of the best examples of rapid and healthy growth of a street railway system is given in the case of the Milwaukee Electric Railway & Light Company. The management of this property have made their plans on broad lines, and the result is that tracks have either actually been constructed or franchises have been secured for making one of the finest interurban systems in the country, with cars running in and connecting all the prosperous manufacturing towns along the lake between Milwaukee and Chicago.

A large brewing company has recently been incorporated at St. Louis and will immediately proceed to the erection of an extensive brewing plant. Among the schemes included in this new organization is the running of electric refrigerator cars upon the street railway system, thus doing away with heavy hauling wagons.

The employees of the Keokuk Street Railway & Power Company, of Keokuk, Ia., went on strike recently, owing to a new order requiring them to work longer hours at the same rate of pay.

The management of the New York & Queens County Railway Company, of Long Island City, has decided to adopt the service stripe system for its employees. There is some discussion among the men as to whether they prefer stripes on their sleeves or brass buttons to mark the years of service.

On Wednesday evening, March 15, Alexander Wurts, of the Westinghouse Company, delivered a lecture on lightning arresters before the Cleveland Electric Club, at the Electricity Building of the Case School of Applied Science. The lecture being a popular one, the hall was well filled with an appreciative audience. Mr. Wurts spoke of the decadence of the lightning rod as a means of building protection, and said that they were now rarely found except on very old buildings, or on a few very high buildings or towers, like the Capitol at Washington and the Washington Monument. The lecture was illustrated by practical experiments, and showed in detail the steps that led up to the use of non-arcing metal in the construction of lightning arresters, or lightning diverters, as the lecturer said they should more properly be called.

The Cleveland Electric Railway Company has let the contract for a funeral car, which will be rented for $10, and will be run over any line in the city. The car will be divided into two compartments, one for the coffin and the other for the mourners.

The postmaster at Hartford, Conn., has devised a street railway mail box, which will be used experimentally on the lines in that city. The box is strongly made of cast-iron, and is attached to the rear dasher in such a way that letters may be dropped therein whenever the car stops. It is thought that this system, if adopted, will greatly reduce the time of delivery of letters addressed to local points.

The meeting of the Franklin Institute at Philadelphia on March 28 was devoted to the subject of electric railways. The following papers were discussed: "The Multiple Unit System of Electric Railways," presented by Frank J. Sprague; "The Electric Inspection of Street Car Equipments," by Albert B. Herrick; and "Some of the Larger Transportation Problems in Cities," by Edward E. Higgins, editor of the STREET RAILWAY JOURNAL.

The Cincinnati & Hamilton Electric Street Railway Company, of Hamilton, Ohio, has published a neat descriptive folder and time table of its lines between Hamilton and College Hill, Cincinnati. The pleasures of a trip over this road are told in an interesting manner, and a number of points of interest along the line are briefly mentioned. The folder contains a number of advertisements of local firms.

In the course of a recent conversation with a prominent supply man, he stated that the water from the Chicago River contained less scale-forming ingredients than any other water he ever saw used for steam boiler purposes.

A curious incident occurred in the final transaction completing the filing of the mortgage of the United Railways & Electric Company, of Baltimore. The mortgage is for $38,000,000, and about $25,000 internal revenue stamps had to be attached to the original copy. The revenue officer at Baltimore was unable to supply the stamps and had to secure an extra supply. The mortgage was printed in pamphlet form, with every other page blank, and the revenue stamps covered half of the blank pages and the margins of half of the printed pages.

The Meadville Traction Company of Meadville, Pa., has just commenced the erection of a large pavilion and summer theater at its Oakwood Park. The pavilion will be 136 ft. x 74 ft., and two stories high. It will have an iron truss roof, arched at the center, with a tower at each corner of the building. Verandas 12 ft. wide will surround the entire building at both stories. The theater will be on the ground floor, and will be 100 ft. x 50 ft. The theater will be tastefully finished with comfortable seats and everything necessary to make it pleasant and attractive. A ballroom 100 ft. x 50 ft. will be built on the second floor, and the ceiling of the theater and floor of the ballroom will be supported by separate sets of joists, so that the progress of a ball will in no way interfere with the play or opera. The balance of the building not occupied by the theater and ballroom will be taken up with offices and reception rooms.

The Brooklyn Heights Railroad Company is considering the advisability of making two rates of fare from the bridge to Coney Island. It is thought that a great many people would prefer to pay ten cents fare and avoid the large crowds going to the beach on pleasant days, and the company is therefore thinking of introducing a ten-cent fare in addition to the five-cent service.

The city officials of Syracuse, N. Y., and the managers of the Syracuse Rapid Transit Railway Company have not been on very good terms of late. The city made a number of demands which the company refused to consider. The Mayor then gave notice that he would enforce every ordinance touching the speed of the cars and their sanitary condition, and would bring into effect many laws which have for a long time been considered dead letters. On the evening of March 26 there was a snowfall of over 6 ins. at Syracuse, and this gave the Mayor an unlooked-for opportunity. The next morning the company had out its snowplows and pushed the snow from the tracks, piling it up along the street beside the tracks to a considerable height. An old ordinance states that snow shall be carted away, and as this was not done the commissioner of public works was ordered to get out his men and shovel the snow back on the tracks. So effectually was this carried out that in less than an hour after the order was issued almost the entire system was tied up.

Street Railway Accountants Association

The next annual convention of this association will be held simultaneously with, and in the same building as the meeting of the American Street Railway Association, at Chicago, Oct 17-20 Papers will be read on the following important subjects: "Car Mileage," "Blanks and Forms," "Materials and Supplies Accounts," "What Does the General Manager Want to Know from the Accounting Department?"

The secretary of the association has recently received the following letter showing that the department of blanks and forms has become a reality and is appreciated. The letter reads: "I am sending you to-day by express the blanks loaned to this company by the department of blanks, and I desire to say I am most gratified as I found among the blanks sent me precisely the ideas for which I had need."

A New Foundry at Schenectady

The great Schenectady (N. Y.) works of the General Electric Company have been constantly expanding from year to year with a steady increase in the company's business, and the pressure upon these shops has been such that hardly had the new extensions been completed before their increased capacity has been reached and it has been proven that the total requirements have again been underestimated. The latest addition to the works is an immense foundry, which was opened for work on Jan. 5 last, after a period of construction extending over about ten months. Large as this foundry is, and however confidently it was expected to fulfill the company's requirements for some years to come, it is, even so soon, worked to nearly its full capacity many days, and the prospects for extensions within a year to come seem good.

As many novel and interesting features have been included in this new building, a somewhat detailed description of it and of its equipment will be of interest to manufacturers and to such street railway companies as are doing their own repair work on a large scale.

The immense main building in which the melting, moulding and pouring are done in undivided space is 140 ft. x 503 ft. Separated from this building is the cleaning room wing, 120 ft. x 103 ft., in which all the cleaning and drying of castings is done. By having this cleaning done away from the main foundry, the possibility that flying chips and dust may reach the moulds and interfere with perfect castings is avoided. Exhaust rumblers are provided for carrying all dust outside the buildings, and there are complete arrangements for opening windows and ventilators in the monitor so as to thoroughly clear out the atmosphere. The result is that there is very little of the characteristic "foundry smell" in the building. Also attached to the main building is a large lean-to 38½ ft. x 243 ft., and a small lean-to 11ft. x 152 ft. The height of the side walls is nearly 24 ft. and of the main gables 58 ft. The entire structure contains 3,250,000 cu. ft. of air space.

The most prominent characteristic of the foundry is the magnificent light obtained in all sections through the large area of skylight surface, namely, 23,336 sq. ft. It was determined to depart from the usual practice of dark and dingy foundries and to avoid the use of artificial light as much as possible. The skylights are composed of glass mounted around wire netting in such a way as to make breakage difficult, and the dropping of glass from the netting, even in case of breakage, practically impossible. The glass is also lightly ribbed to secure better diffusion of light. For artificial lighting, one arc light is provided for every 2600 ft. of floor space, and this makes good night work entirely possible.

The transportation facilities within the building are unusually perfect. Tracks are laid through the main and many of the side aisles, and tram cars can pass to almost any part of the floor, conveying supplies of all kinds, such as sand, coke, pig iron, scrap iron and the smaller castings. Two immense electric cranes span the center aisle, and five others operate in the building, while eventually there will be six jib cranes put in position for local work, and portable jib cranes will also be used.

The equipment of the foundry consists of the following apparatus:

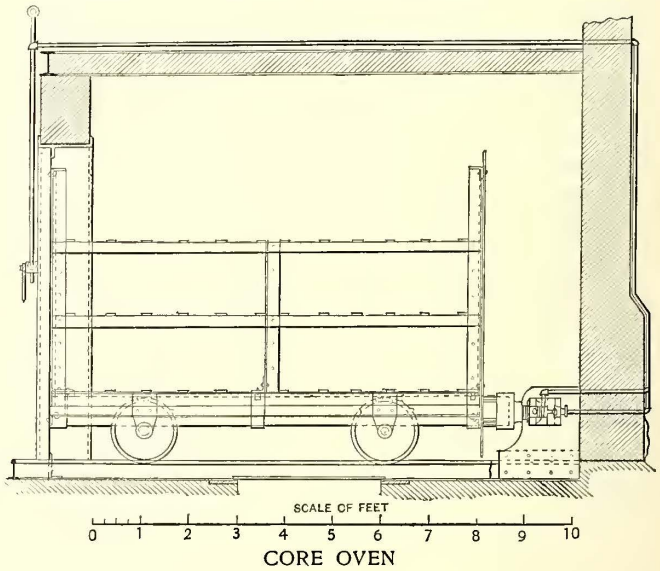
Three Calliau cupolas of 18, 11 and 7 tons melting capacity per hour, respectively.
Seven ladles of 15, 10, 6, 4, 3½, 2, 1½ tons capacity, respectively
One Root blower, capacity 660,000 cu. ft. of air per hour at 95 r.p.m.
Nine exhaust rumblers.
One Buffalo Forge Company heating fan, blast wheel (steam coils 27,500 sq. ft. surface), 14 ft. diameter x 6 ft. wide.
One Buffalo Forge Company heating fan, blast wheel 14 ft. diameter x 7 ft. wide.
One 2200 lbs. hydraulic elevator.
One Sellers sand mixer.
One 10-ton Fairbanks' scales.
One 40-ton Morgan crane, 65 ft. span.
One 10-ton Morgan crane, 65 ft. span.
One 10-ton Morgan crane, 47 ft. 2 ins. span.
One 7-ton Box crane, 32 ft. span.
Three 5-ton Box cranes, 32 ft. span.
Three 5-ton jib cranes, 21 ft. swing.

ELECTRIC MOTORS

One 60 h.p. for cupola blower.
Two 35 h.p. for heating fans.
One 50-h.p. for rumblers and wheels.
One 7 h.p. for cupola rumbler.
One 7 h.p. for flask making.
One 3 h.p. I. B. for sand mixer.
One C. P. 10, for air compressor.
One G. E. 51, for 40-ton crane.
Two G. E. 52, for 40-ton crane.
One 5 h.p. I. B. for 40-ton crane.
Two G. E. 52, for 10-ton cranes.
One 5 h.p. I. B. for 10-ton cranes.
Four L. W. P. 5, for 5-ton and 7-ton cranes.
Four 3 h.p. I. B. for 5-ton and 7-ton cranes.
Three L. W. P. 5, for jib cranes
One 5 h.p. I. B. for coke conveyor.

The loading floor of the cupolas in the cupola room is large enough to make room for an ample quantity of coke, pig and scrap iron, which is brought from the yards, weighed on the lower floor and conveyed to the loading floor by an elevator. All the small work done in the foundry is carried around in cupolas, the object being to avoid the necessity of carrying small ladles by hand for any great distance. The larger ladles are conveyed by electric cranes to the more distant portions of the shop.

The core ovens of the foundry are unique in that through special



CORE OVEN

methods, their capacity is hardly one-quarter that ordinarily required for a foundry of this size. The ovens are kept at the baking temperature day and night, and the process of baking can be carried on at all hours instead of, as usual, at night. This is accomplished as follows: There are four large doorways to the core ovens. Through these pass tracks which end outside a few feet away from the oven. Over these tracks passes a car containing shelves or racks, on which the cores are placed ready for baking. This car terminates at each end in a large door which completely fills the opening in the core oven so that when the car is inside the oven, one of its ends closes the opening, and one is outside the other end. In this way the only chance for the escape of the hot air of the oven is in the short time when the car is passing in and out. These cars are worked by compressed air and the operation of moving in and out is very rapidly accomplished.

The foreman's office is elevated and is so located as to command the entire floor of the main building, so that the entire operations of the foundry are in plain sight. There are extensive lavatories in one of the wings of the foundry, provided with shower baths, basins and wire lockers, one for each workman. Altogether, this is one of the most complete and perfectly appointed foundries in existence to-day.

The structural iron for this foundry was supplied by the Hilton Bridge Construction Company, of Albany, N. Y.

Report of the Glasgow Corporation Tramways

The following report on the proposed power station and methods of distributing electrical energy was submitted under date of Feb. 28, 1899, by H. F. Parshall to the sub-committee on traction and works of the Glasgow Corporation tramways committee.

REPORT.

Complying with your request of Feb. 6, I have studied the conditions under which the Glasgow tramways have to be worked, and beg to submit the following report as to the most efficient and economical method of generating and distributing electricity for the overhead trolley system of electric traction:

1. Increase of Traffic with Electric Traction.—You are at present working in Glasgow 380 cars by horse and 27 by electric traction. Having reference to your proposed extensions and the usual growth accompanying the conversion of horse traction systems into electric traction systems, 600 cars may be taken as a reasonable number to provide for in your generating and distributing arrangements. In fixing upon 600 cars as a basis, it might be well that I should emphasize the fact that such an increase in the number of cars is not unusual, and that the above contemplated service is not excessive. In the city of Boston, U. S. A., which is of somewhat less population and of not greater area than the city of Glasgow, double this number of cars is being operated at a profit. It would be a short-sighted policy to install a system of generation and distribution which did not provide for such a growth as has been found usual, for, when the traffic has grown beyond the capacity of the plant originally installed, it is commonly found that provisions for an increased supply of water cannot be made except by an expenditure greatly beyond that which would have been originally required had the first arrangements been adequate.

2. Capacity of Generating Plant.—The consumption of power per car mile varies in different cities with the conditions of the permanent way, frequency of stops, gradients, etc. In your city the track construction adopted is admirably suited for electric traction, since the rails are of the best possible cross section, and of ample weight. The policy of charging low fares which you have adopted increases the number of passengers carried per car mile, as well as the number of stops, the result being that the amount of power which would be consumed in Glasgow is greater than that which is consumed in many other cities.

From actual measurements taken on your present electric traction works, I find your average consumption of power at the car is 7.2 kw., or 9.65 h.p. I have gone over the other lines in the city, and, having considered your traffic arrangements, have concluded that the above figure is a fair one to take for the whole system in general.

Taking, therefore, 600 cars as the number to be reckoned upon, the amount of power to be delivered to the car for average working conditions is, approximately, 5800 h.p. In traction systems the ratio of the average to the maximum load varies greatly at different hours of the day, on account of the stops for passengers and the number of passengers carried, also on different days according to the weather and other conditions. I have before me the load curve of a number of cities, and from these, as well as from your own experience, conclude that 60 per cent should be added to the average working load to provide for the maximum load that would occur under normal working conditions in Glasgow. This means that the capacity of your machinery must be such as to deliver 9250 h.p. to the cars, or, allowing for loss in transmission and distribution, approximately, 11,500 electrical h.p. must be generated as a maximum working load at the power station. Taking 85 per cent as the ratio of electrical h.p. at the bus bars to the indicated h.p. of the engine, the engine capacity for the maximum working load would amount to, approximately, 13,500 h.p. Allowing a safe margin for spare plant, an aggregate of 17,000 indicated h.p. will be required in the generating station.

3. Conditions of Electrical Distribution.—Having determined the amount of power required for working the tramway system, it remains to be decided, having regard to the distribution of cars and frequency of service, whether the supply of energy to the cars can be more efficiently controlled and economically supplied from one central point or from several points. I have come to the conclusion that, in order to meet the conditions obtaining in Glasgow, you would require several centers of distribution, for the following reasons: 1. The distances to which energy has to be conveyed are so great and varied as to preclude an economical supply of 500 volts. 2. The maintenance of your own property in gas and water mains, and the conditions to be complied with in regard to difference of potential on the rails specified by the Board of Trade, would entail in the case of a single center of distribution an elaborate and complicated return system, involving great outlay in cables and machinery, which would necessarily require subdivision into several comparatively small units in order to meet the varied conditions and the distances to which the cables would need to be carried.

The importance of this point—that is, as to the working of the earth circuits under safe conditions—will be apparent when it is considered that in many American cities incalculable damage has been done to gas and water pipes owing to electrolysis, which is brought about by the current straying from the rails. The amount of current that would be returned through your rails in Glasgow to a central point would be sufficient to eat away 50 tons of iron per annum from the pipes, which is a sufficient demonstration that the earth return is a point of primary consideration, if not the primary factor, in determining the nature of your distributing system. This becomes more evident when we consider that the maximum voltage drop allowed by the Board of Trade is 7 volts, and that in some of the central streets in Glasgow, with the increased traffic contemplated, the drop would amount to 15 volts per mile, or double that which is allowed by the Board of Trade. Practice has demonstrated that, under such conditions as those existing in Glasgow, a maximum voltage drop of not more than one-half of that permitted by the Board of Trade, namely, 3½ volts, is all that should be entertained. In other words, having reference to the safe conditions to be maintained in the track and return, in many cases in Glasgow the current should not be taken for more than half a mile from any point of distribution. Being satisfied that more than one center of distribution is an economical necessity, I find, upon further investigation into the distribution of cars throughout the system, that your present requirements can be fulfilled from five centers of distribution.

4. High-Tension Generating Station, with Sub-Stations, vs. Several 500-Volt Generating Stations.—Having determined the probable increase in traffic, the amount of power necessary to meet the demand, and that at least five centers of distribution are necessary, it remains to decide whether the energy can be the more economically supplied from a single station generating polyphase currents at high voltage, to be transformed into continuous currents at 500 volts in a number of sub-stations, or from the same number of generating stations, suitably located, and generating continuous currents at 500 volts. I have no hesitation in advising that, under the circumstances, the first, viz., the three-phase high-tension generating station, with sub-stations, is the more advantageous from every point of view.

The following is a summary of the advantages of the three-phase system over the other:

(*a*) Less capital expenditure in buildings, generating plant, and in real estate investments.

On the one hand, you have to provide a site for a generating station, in the choice of which there is a considerable latitude, inasmuch as there are several sites available at such a distance from the center of Glasgow that the power can be economically transmitted at moderate cost in transmitting mains, and where you will be able to obtain the advantages of good coal delivery by more than one railway system, and also to provide for extensions. Another consideration of importance is that the sites now used as car sheds and stables are suitably located for sub-stations. No alterations would be required in the existing buildings, and the transforming apparatus would only occupy a small portion of that at present available.

On the other hand, the separate generating stations scheme would involve the purchase of four or five sites, the choice of which would be limited, if fixed with due regard to the proper working of the tramway system and suitable railway sidings for coal supply.

(*b*) The three-phase system has the advantage of less working cost and repairs. On the one hand, there is a skilled staff at the generating station, together with the unskilled labor at the several sub-stations. On the other hand, there is a skilled staff at each of the generating stations, which are equal in number to the sub-stations. It has been conclusively shown at Niagara, Dublin, Middlesboro, and other places, which have now been working a sufficient length of time so that reliable conclusions can be drawn, that rotary converters require less attention than ordinary 500-volt railway generators, and that no skilled labor is required.

There will also be a saving in supplies and repairs, owing to the use of a few large steam generating units instead of numerous smaller ones. The concentration in load also effects a saving in fuel and water. Also better facilities as to coal-handling arrangements can be afforded in a single large station than in several smaller ones. I have made a careful comparison between the two

systems, both as regards fixed charges and working costs, and append the statement to this report.

(*c*) The three-phase system has greater flexibility, and is better adapted to the requirements of future extensions. Should your lines extend further in any direction into the country, sub-stations can be installed at any convenient point or points. These sub-stations do not require special buildings; and to show the small space occupied, I may say that the 2500-h.p. stations of the Central London Railway are contained in two vertical cylinders, each 22 ft. in diameter and 100 ft. below the surface of the ground.

(*d*) In considering the transition from horse to electric traction the question of time is of great importance. The single generating station which I have recommended can be installed and put in working order more quickly than several stations. The loss through delay can be estimated upon the basis of your present working. The cost for horse traction is 3½d. per mile, on a mileage of 9,000,000 per annum; taking the working cost for electric traction on the same basis as to maintenance, etc., the saving, assuming no increase in traffic, amounts to £112,000 per annum.

In addition to the above, in installing a multiphase station you would be following the very latest and most approved practice, and you would have a type of plant that would be less likely to be superseded than a 500-volt type of apparatus, and which would have to be installed in several minor steam generating stations. This is clearly demonstrated by the experience gained in New York, Chicago and Brooklyn, where under the original arrangements the area was served by several small stations. It has been found that these small stations can be worked with greater economy by multiphase currents transmitted from a single generating station. I have before me the works cost of some of these installations, and there can be no doubt as to the economy gained.

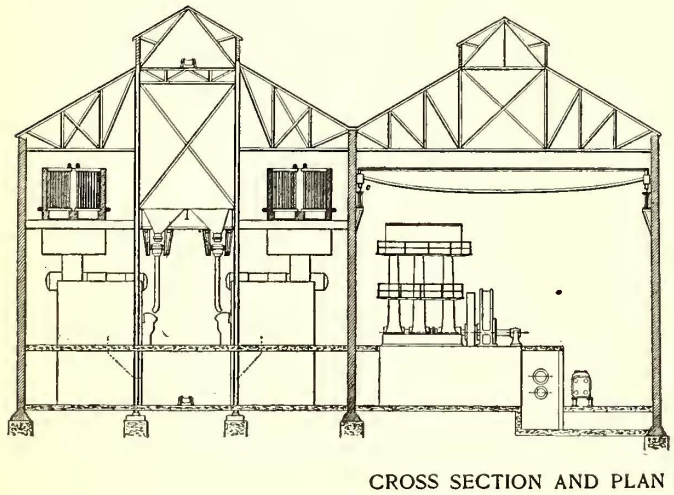
The engines should be direct connected to tri-phase generators of the fly-wheel type, with rotating magnets and stationary armatures. Machines of this type have been constructed, with entirely satisfactory results, for as high a working pressure as 13,000 volts. Having reference, however, to the comparatively short distance of transmission, and the small investment in copper required, 6500 volts is a satisfactory working pressure, all conditions considered, and the calculations as to the cost of the three-phase machinery and transformers are made up on this supposition.

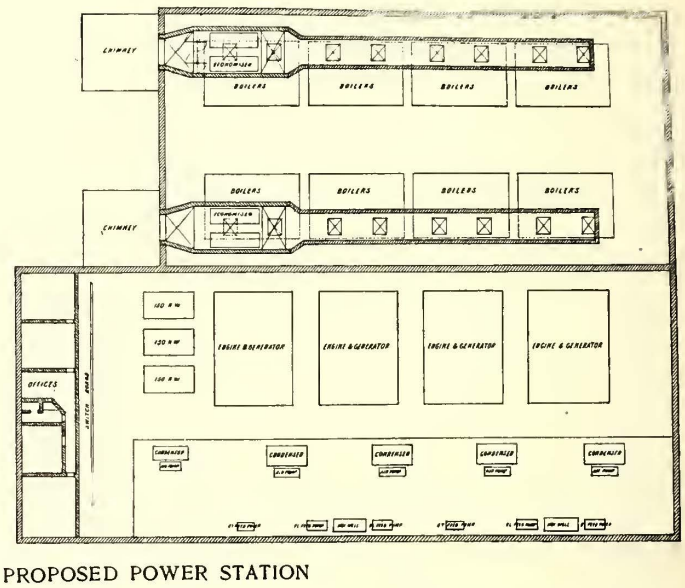
The station should be provided with a coal conveyor, so that the coal would be automatically conveyed from the railway trucks, or other means of transport, and distributed to different boilers, or stored in bunkers.

The station should be designed with electrically-driven auxiliaries throughout, thereby securing the greatest possible economy. The switching arrangements in the generating station would be comparatively simple, owing to the small number of generating units, and to the feeders being comparatively few in number, depending on the number of the sub-stations.

These suggestions are embodied in a plan and elevation annexed hereto.

The method of distributing the energy from a single station need not occupy much space in this report. The method you have already adopted in Glasgow, namely, of drawing your cables into ducts with manholes approximately 100 yds. apart, represents the best practice in electric traction. You will find that at a density of from 400 to 600 amps. per square inch, according to the distance, high-tension cables can be run through the same set of ducts, but where they enter the same manhole, the manhole should be of ample size, so that the high-tension cables could be carried on one side, and clear the low-tension cables.





CROSS SECTION AND PLAN OF PROPOSED POWER STATION

5. Recommendations as to the Nature and Arrangement of Plant in Generating Station.—In the event of my recommendations as to a single generating station being adopted, the following further recommendations as to the arrangement of the plant may be of use: For your traction purposes there would be consumed in Glasgow, approximately, 26,000,000 of Board of Trade units per year, or, approximately, four times as much as that generated by the largest lighting company in London. Owing to the small ratio between the average and maximum load—that is, to the load factor common to traction systems—this amount of electricity would be generated in a plant of nominal capacity of not more than one-third at which it could be generated in a lighting station, owing to the machinery working at its full capacity for many hours per day. In Glasgow you would be working the cars, approximately, sixteen hours per day, at full service, and four or five hours per day additional at one-third service. This distribution of load for so many hours per day would be very satisfactory, in that your generating station could be designed with but few units working at the best economy during all hours in the day. I find that four generating sets would give the best result—three of these to be worked during normal conditions of load, and the fourth unit to provide for abnormal conditions and emergencies.

With regard to the engines, I would recommend the use of three-crank tandem compound engines, provided with massive fly-wheels so as to give a uniform turning moment, and to provide the maximum effort for fluctuations of load. In order to obtain the best results these engines should not work beyond 75 r.p.m., and should be specially constructed, having in view the nature of the load and the conditions peculiar to an electric traction system.

6. Comparison of Lighting and Tramway Plants.—In reporting upon the generation of power for the tramway department, it is scarcely possible to avoid reference to the question of joint supply of electricity for the two purposes of traction and lighting. I find that on a large scale the two systems can be kept separate with advantage, owing to a difference in the nature of the plant and in the supply of power. The following are points which militate against a joint supply from lighting stations:

(*a*) On many days in the year the maximum load in lighting, and that in traction, occur at the same time, so that the same maximum total capacity in plant has to be provided, whether or not the supply is from a common station.

(*b*) Owing to the difference in the nature of the loads, the capital cost for a given watt-hour production is three or four times as great for lighting as it is for traction. In other words, the traction plant is worked at its greatest capacity three or four times as many hours in the year as the lighting plant; consequently it can be of a more substantial type with advantage.

(*c*) The machinery of a different type is commonly used for lighting, and the switching appliances are absolutely different. In the Glasgow lighting stations numerous small high-speed engines are in use; such engines are unsuited for the generation of current for your electric traction purposes. I have yet to find the engineer of extended experience in dealing with traction matters who

would propose the use of high-speed engines for such loads as you have to consider in Glasgow for electric traction.

(*d*) The electrical arrangements for electric lighting are neeessarily much more complicated and elaborate than is the ease for electric traction. Electric lighting has to be carried on with reference to the delicacy of the human retina; in other words, the voltage at the point of consumption has to be regulated to a nicety. In electric traction the same conditions do not obtain, since uniform aceeleration and speed of the car can be obtained to the satisfaction of the passenger within a much greater range of voltage.

(*e*) From a business point of view the different conditions in electric supply are sufficiently shown by the difference in cost of energy between electric traction and electric lighting. The eost of energy for electric traction, owing to its better load factor, would not be more than 25 per cent of that for lighting. The present cost of electric lighting in Glasgow is 1.26d. per Board of Trade unit, which compares favorably with that of lighting for other cities. This figure is 4.8 times as high as would be expected in the traction service outlined. When you consider that in Edinburgh, according to published accounts, eurrent is generated cheaper than in any other city in the United Kingdom, and when even the cost is 2.95 times that which I predict for your traction system, the difference in the nature of the load is apparent.

(*f*) It has been suggested that economy in staff will be gained in a joint station. This does not apply provided the tramway business is attended to as a business by itself. In the station which I have outlined this staff will, as I have said, be regularly employed during sixteen hours of the day at practically full load, and for five more hours at one-third load, so that the staff would be fully occupied during the hours of working. Owing to the difference in the nature of load, a different class of attendants would be required for the two classes of work.

7. Combined Stations Elsewhere.—A combined station for lighting and traction was the subject of consideration by the Bristol Tramways and Carriage Company, Limited, and by the Corporation of Sheffield. I was asked to report on the former installation, and found that there would be direct disadvantages in such a joint supply. This report subsequently received the indorsement of Lord Kelvin and the late Dr. John Hopkinson. The general absence of such eombined stations sufficiently indicates that they are not in demand, as does also the fact that plant of a type now commonly used for lighting, which was originally installed for traction purposes, has been superseded by slow-speed machinery. There are two prominent examples of such plant which have been from time to time discussed, viz., the one at Toledo, Ohio, U. S. A., and the other at Hamburg. The former makes use of the slow-speed engines of a type suitable for electric traction. To the main shaft of these engines are coupled direct connected railway generators. The fly-wheels of these machines are connected by a rope-drive to countershafts, from which are driven several different types of machines, principally alternators and arc-lighting machines. The station is exceptional in character, wasteful in floor space, and employs a method of driving lighting machines which has been generally superseded in England, and could not be followed out exeept by mechanical arrangements which are necessarily wasteful and objectionable. The station originally worked in Hamburg has been the subject of frequent comment. This station did supply current for both lighting and traction. The plant, however, was of a type specially suitable for electric traction, and liberal use was made of storage batteries. This station has now been replaced by two stations, one supplying the energy for the electric tramways, and the other the energy for the electric lighting. It will therefore be seen that the installations above referred to cannot be considered as suitable examples to be followed by Glasgow. The established practice the world over for such large installations as you are considering is to separate the traction generating station from the lighting station.

8. Conclusion.—The conclusion arrived at in this report may be summarized as follows: Having regard to the nature of your tramway system as a whole, a single generating station, with high-tension multiphase transmission to sub-stations located in some of your existing car sheds and stables, will be found the most economical to work, involving less capital outlay, taking less time to install, lending itself to compliance with the Board of Trade requirements and to the safety of your property in gas and water mains, and being of a type least likely to be superseded when further demands are made, either as an increase in the area to be served or increase of traffic over the existing system. In following my recommendations your tramway system will be equipped with an installation of the highest class, and will not be handicapped by an attempt to make use of plant or arrangements that are either obsolete or unsuited for the economieal working of your system of eleetrie tramways.

Horace Field Parshall.

COMPARISON OF THE COST OF CONSTRUCTION, INCLUDING BUILDINGS AND PLANT, BETWEEN A THREE-PHASE GENERATING STATION, WITH CONVERTING SUB-STATIONS, AND A SYSTEM OF SEVERAL GENERATING STATIONS.

(*a*) Cost of eonstruction of a three-phase generating station containing four 2500 kw. units, including buildings and plant, together with plant for sub-stations located in existing ear barns and stables, and including high-tension cables.

Generating station building, including exeavation, foundations, steel work and brick work, foundations for engines, chimney stacks, including excavation, foundation, steel construction work, and brick lining..	£45,000	
Generating station equipment, including steam units, boilers, coal conveyors, steam mains, condensers, pumps and electrical plant, including delivery and erection.....	180,000	
Sub-stations—Cost of equipment complete of five rotary converters sub-stations, including supply, delivery and erection of rotary eonverters, transformers, switchboards and auxiliaries	70,000	
Three-core high-tension cables for transmission, at 6500 volts.....	21,000	
Total		£316,000

(*b*) Cost of construction for five generating stations of approximately 2000 kw. capacity, each consisting of four 500-kw. railway units.

Buildings, including excavation, foundations, steel work, brick work, foundations for engines, chimney stacks, including excavations, foundations, steel construction work, and brick lining—at £30,000 each.....	£150,000	
Generating station equipment, including steam units, boilers and conveyors, steam mains, condensers, pumps, electrical plant and auxiliaries—at £48,000 per station....	240,000	
Total		£390,000

Note.—This comparison is exclusive of the cost of ground and railway connections, which, if included, would bring out a result much more favorable to the single generating station.

COMPARATIVE STATEMENT OF COST, IN PENCE, PER KW.-HOUR, DELIVERED TO CARS ON THE BASIS OF 600 CARS RUNNING FOR SIXTEEN HOURS PER DAY, WITH 200 OF THESE RUNNING BETWEEN FOUR AND FIVE HOURS ADDITIONAL PER DAY, TAKING AN AVERAGE OF 7.2 KW. PER CAR.

(*a*) A three-phase generating station containing four 2500 kw. units, with transmission at 6500 volts, and five sub-stations containing 500-kw. and 800-kw. units, and located in present car depots.

Power Expenses.	Generating Station. D.	Sub-Station. D.	Generating and Sub-Stations. D.
Coal delivery and handling.....	0.1240	—	0.1240
Water, at 4d. per 1000 gals.....	0.0082	—	0.0082
Oil, waste and supplies.....	0.0088	0.0053	0.0141
Labor	0.0500	0.0360	0.0860
Total power expenses.....	0.1910	0.0413	0.2323
Maintenance	0.0257	0.0028	0.0285
Fixed Charges.			
Depreciation, interest, insurance, rates and taxes.....	02081	0.0616	0.2697
Totals	0.4248	0.1057	0.5305

To the above figures must be added the cost of maintenance, depreciation, and interest upon the high-tension cables for connecting the generating station to the sub-stations, amounting to 0.019. This makes the total cost of the three-phase scheme 0.5495.

(*b*) Five generating stations containing 500-volt railway generating plant.

Power Expenses.	D.
Coal, delivery and handling.....	0.1550
Water, at 4d. per 1000 gals.....	0.0103
Oil, waste and supplies.....	0.0110
Labor	0.2000
Total power expenses.....	0.3763

Maintenance	0.0350
Fixed Charges	
Depreciation, interest, insurance, rates and taxes	0.3254
Total	0.7367

Note.—The above figures do not include interest on the cost of sites and railway connections.

The difference as between .5495d. for the single multiphase station and .7367d. for the five 500-volt stations, based on 600 cars, amounts to £20,280 per annum as the saving in working costs in favor of the single multiphase station.

REPORT OF SUB-COMMITTEE

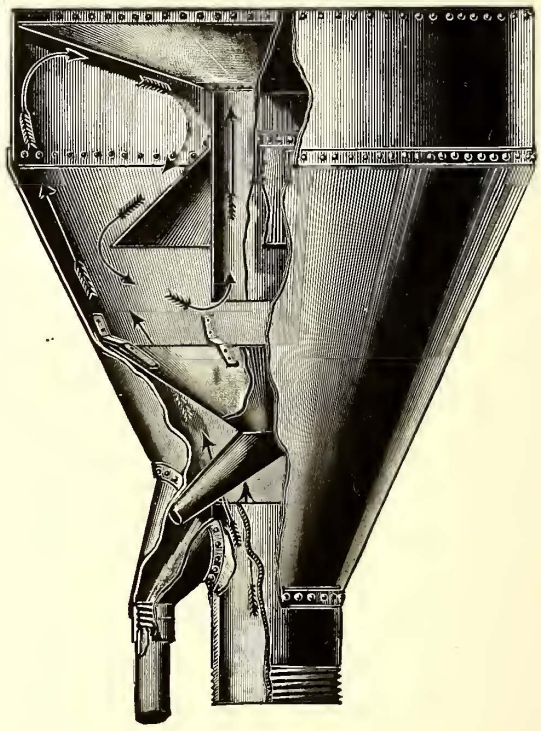
The sub-committee of the tramways committee on the generating and distributing of electric power for tramway traction drew up the following report on Mr. Parshall's recommendation, and the tramways committee, at a meeting held the same afternoon, unanimously approved of it.

The sub-committee's report was as follows: From our study of the report, and of the subject generally, we believe the advice given is sound from the economic as well as from the engineering point of view, and it clearly points to the tramways committee generating, distributing, and controlling their own power, and we think that, in view of the information contained in the report, it is scarcely necessary for us to report at any great length. We are quite convinced that the power will be produced cheaper by having one generating station for the tramways at, say 6500 volts, with district sub-stations in our present tramway depots, as suggested, each of which would form a distributing center, than by having separate installations of plant at several power stations generating current at 500 volts. We think it is also established that, for the tramway system of the near future, which will extend, at numerous points, to a considerable distance beyond the city limits, a high-tension station with sub-stations, as suggested, will be most efficient, and will best fulfill the requirements of the Board of Trade, and avoid electrolysis of the water and gas pipes. We have also before us the important fact that the maximum loads for lighting and traction occur at the same time. From the information now before us, it is evident that for the most economical as well as best mechanical results, entirely separate and different machinery is required for traction and for lighting purposes respectively. It also seems obvious that the undertaking which each of the departments in question has before it at present is sufficiently large of itself to admit of the adoption of the most economical generating units and the production of current at the lowest possible cost. That the electricity committee could supply current for the tramways need not be questioned, but so far as we know they do not claim that they will be able to supply it either better or cheaper than the tramways committee could produce for themselves. They could only produce it as cheaply as the tramways committee by putting down special traction machinery for the purpose, and in that case, in order to arrive at the exact cost, the power for traction would require to be produced and accounted for as a separate undertaking, just as if the tramways committee were producing it for themselves. It is clear that the supplying of power for the tramways by the electricity committee could be of no possible benefit to them unless they were to do so at a profit, which is quite inadmissible. After the fullest consideration of the whole circumstances of the case, our conclusion is that to have the power stations for lighting and traction combined would be of no benefit to either committee, but that, on the other hand, any such arrangement would be a great disadvantage to the tramways department. As pointed out in Mr. Parshall's report, with a continuous traction load for over twenty hours out of the twenty-four, as against only a few hours' continuous lighting load, the tramways committee can take about four times the work out of their plant that can be taken out of the same amount of plant for lighting. In addition to what has already been suggested, this gives the tramways committee another distinct economic advantage in putting down their own plant and producing and distributing their own current on the lines indicated. A still greater advantage is clearly obvious in the matter of administration. The responsibility for the operating of the tramway system should undoubtedly carry with it the control of the power, which is the mainspring of the whole concern. Whoever controls the power controls the tramways. The tramways department, being a commercial undertaking, has always been self-contained, and, in our opinion, should remain so. The tramways committee have supplied the horse power. They have also supplied the electric power for the sectional demonstration. Now they are in a position to begin generating their electric current for the whole system on the best known principle, and with the most up-to-date machinery for this special purpose. Keeping in view the magnitude of the operations confronting both committees, we can see no benefit whatever to be gained, but quite the reverse, by any combined arrangement, which would mean two separate committees being engaged in carrying out the powers of the Tramway acts, one committee supplying the power and another working the tramways. Any such dual control should, in our opinion, be avoided. We have, therefore, pleasure in recommending that the tramways committee, who are responsible to the corporation for the efficient working of the corporation tramways, be still entrusted with the supplying and distributing of their own power for electric traction, and that it be remitted to that committee to proceed to convert the tramways and arrange for the supply and distribution of power on the general lines indicated by Mr. Parshall.

The report was later adopted by the Glasgow Corporation by a vote of 56 to 4.

Exhaust Heads for Power Plants

Marlin & Co. of Pittsburgh are making some of the largest exhaust heads ever installed in this country. All of the heads manufactured by this company are of the best galvanized steel, thoroughly riveted and soldered, and in their operation are as follows: The exhaust steam in rising passes by a conical shaped drip pan,



EXHAUST HEAD

then passes near the outside of the head, and finally into the atmosphere through a central outlet. In its passage a considerable part of it is condensed, the water from condensation being all led off through a drip. The head is built on a piece of welded steam pipe, which extends inside far enough to form a channel that connects with the drip. The diaphragms for presenting a large condensation surface are held in position by heavy wrought-iron braces. The drip is so arranged that it cannot become clogged or frozen. It separates the water and oil from the steam, and exhausts the dry steam, thereby avoiding damage to neighboring walls and roofs. It is claimed that these exhaust heads cause no back pressure on the engine, and are noiseless in their operation.

Interesting Electrical Publication

The March issue of the Electrical Engineer and Telephone Magazine, a paper published in Chicago in the interests of electrical and telephone engineering, contains a number of articles of special interest. Among these are "The Drake Selector System," by Thomas C. Drake; "The Algebra of Electricity," "The Inspector and the Trouble Man," by the Inspector; "A Trip to the Pole Country," and a "Digest of the Telephone and Kindred Patents," by Edward E. Clement.

The Harrisburg Standard Self Oiling Engine

The Harrisburg Foundry & Machine Works, of Harrisburg, Pa., after long experience in steam engineering, have designed a system of engines now known as the "Standard" or "Harrisburg Standard," which they believe will meet all possible requirements for high, medium and slow speed engines up to units of 3000 h.p. The name of the Harrisburg Foundry & Machine Works has long been a familiar one to steam users, through their engines known as the "Ide" and "Ideal." More recently, the "Harrisburg Standard" has been evolved from the experience had with the other engines, embracing the good points of the others.

The "Harrisburg Standard System of Engines" include simple engines, and tandem compounds with single valves; and simple tandem and cross compound engines with four valves, medium and slow speed, the latter of the "Corliss" rocker type. The accompanying engravings illustrate in turn these new machines, commencing with the Harrisburg Standard simple valve engine. A peculiar feature of the new engine is that they are all constructed with side cranks, requiring only two main bearings, whether designed for direct coupled or belted service, and thus many of the disturbing elements, such as excessive friction from bad alignment, that attend the operation of three or four bearing engines, are removed, the friction in these engines being in many cases as low as 2 per cent.

The simple engine is made up to 36 ins. diameter and stroke, and, as will be noted in the accompanying illustration, Fig. 1, is compact and graceful in design and its high efficiency is due to a combination of features, none of which are experimental, however. These salient features include, in addition to the above, an automatic oiling device, by which the crank disc, connecting rod and cross head are enclosed, the latter provided with a hinged hood which may be turned back, and a plate on the side, which may be easily removed for inspection, and adjustment of reciprocating parts, as shown in Fig. 2. This arrangement of hood makes removal unnecessary as all adhering oil drains back into the engine frame. By the revolution of the disc in the oil, the rim of which touches its surface, it is splashed over the wearing parts, including the cross-head, and by means of a lateral trough across the inside of the cover a large portion of the oil is led through a pipe and directed in a stream upon the main bearing adjoining the crank disc. The lubrication of the crank pin is accomplished in a very ingenious manner, by means of an eccentric annular chamber, recessed in the face of the disc around the main shaft next to the main bearing, from which a diagonal hole is drilled through the disc, coming out about the middle of the surface of the crank pin, so that by centrifugal force instead of by the too uncertain force of gravity, a constant volume of oil is provided for its lubrication, completing the circulation from reservoir to crosshead, main bearing, crank pin, and finally draining to reservoir again.

The patented governing mechanism is also a special feature of these engines. It is of the fly-wheel, technically termed, centrally balanced, centrifugal-inertia type, and is claimed to be sensitive to regulate to 0.5 per cent in load variations from zero to 125 per cent. Roller bearings are provided in the governor bearings and the principal mechanism consists of two balance levers, which are connected to an eccentric sleeve which surrounds the shaft, and which is pivoted at one side, so controlling the throw of the eccentric rod to a nicety.

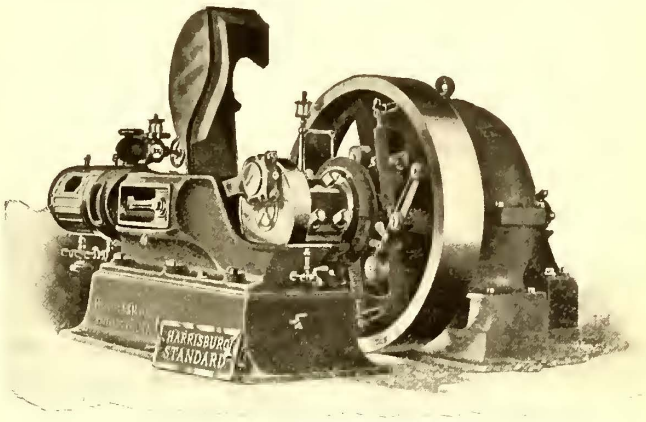


FIG. 2.—VIEW OF ENGINE, SHOWING OILING DEVICE

The pillow blocks for the crank shaft have the cover fitted in a diagonal position, and the shell is provided with an oil chamber with recesses for the oiling chains. The engine frame is extended with stuffing box exposed in such positions as to provide for constant use and easy access, and prevents the water of condensation from getting into the oil supply, should a leak occur. The oil is prevented by a guard from getting on the piston rod. In the process of manufacture, the pistons, piston-valves, pins and other parts are all ground to an accurate fit, and micrometer records made of each piece, so that any part of an engine can be duplicated

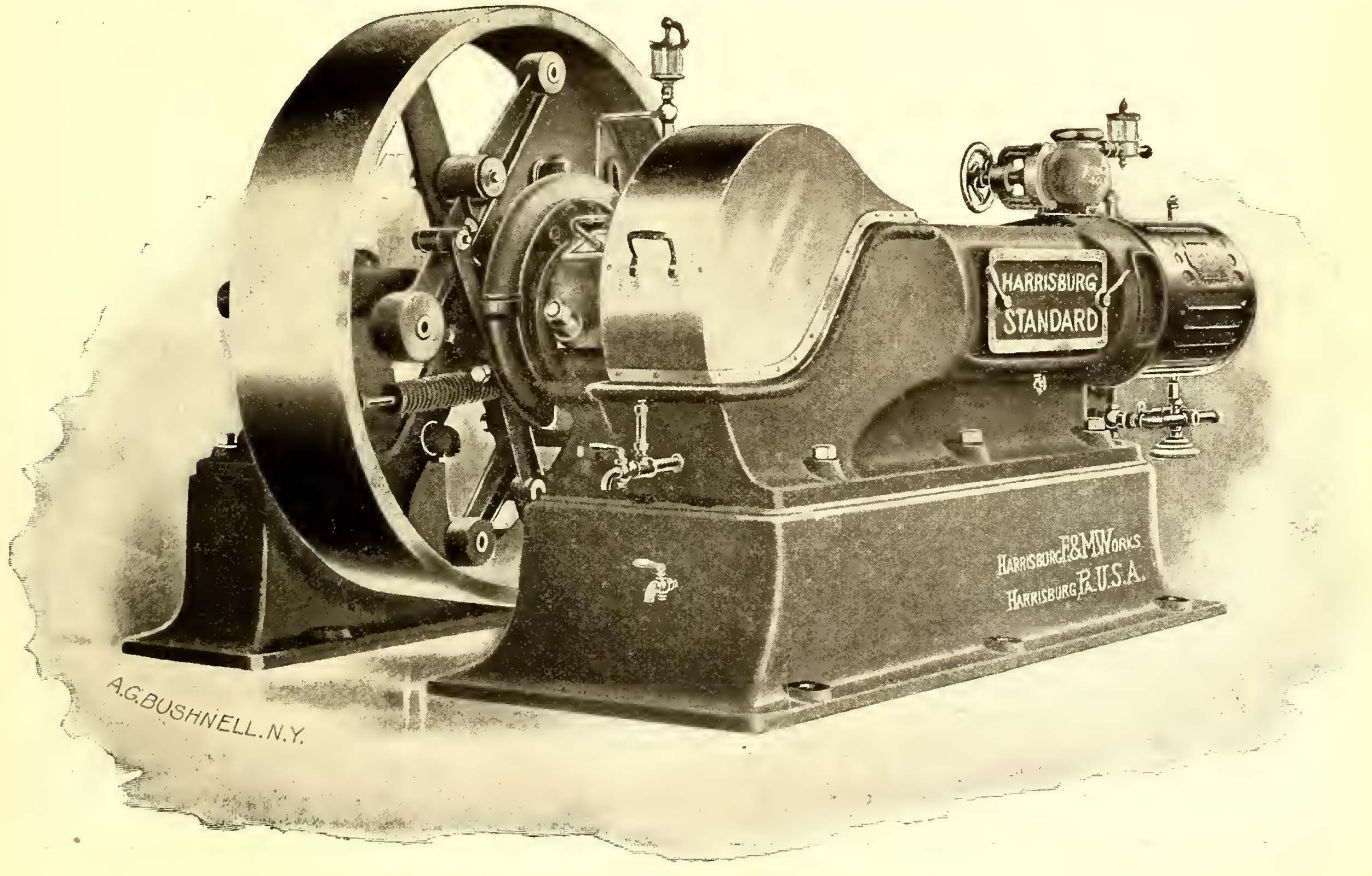


FIG. 1.—VIEW OF SIMPLE STANDARD ENGINE

at any time after it leaves the works. The crank disc, including the pin, is cast in one solid piece of steel, the mould being placed in a horizontal position, with the pin down, producing a dense metal in the pin. This is afterward turned and properly fitted, when the disc is shrunk on the shaft and keyed in position.

Every engine is thoroughly tested before it is shipped, and for this purpose metal bed plates on heavy masonry are provided with suitable channels for clamping them in place. When in position for testing, the engine bed is supported on metallic points, and the machine is first run for adjusting the governing and valve mechanism. Next, the fly-wheel is accurately corrected to a running balance, and finally each engine is so perfected that it is run upon the metallic points without fastening. Very accurate and elaborate tests are made to perfect the governing mechanism of each engine, and when the machines leave the shop, a guarantee can be given as to their exact performance.

It is a principle in these works never to turn out a second grade article, and the general workmanship, material and construction of the new engines are all up to the highest standard.

Although the "Harrisburg Standard Engine" was designed but a year ago, there are already in operation nearly a hundred of these machines, with orders for thirty more in the shop.

The Harrisburg Foundry & Machine Works also manufacture road-rollers to a considerable extent, and also tubular boilers, and in order to meet the growing demands of their trade, are erecting extensive shops at West Harrisburg, for which the walls and stack are nearly up. The ground dimensions of the main building are 300 ft. x 140 ft., and it is intended that all departments, including the foundry, shall be under one roof. The designs show that this is to be an up-to-date establishment in every particular, and the equipment will embrace the latest improved machinery, suited to this class of work.

The affairs of the company are under the management of W. R. Fleming, who was induced to give up his engineering business in New York for this purpose and who has had much to do with the designing of the "Standard" engine. Mr. Fleming took charge of the company's affairs Jan. 1, 1898, since which time the output of the establishment has shown an increase of 45 per cent over the previous year.

Handsome Interurban Cars

The accompanying photographs show both interior and exterior views of interurban cars recently manufactured by the St. Louis Car Company for the St. Louis & Belleville Electric Railway Company, which operates between St. Louis and Belleville, Ill. The cars are 46 ft. over all, with steam coach roof and closed vestibules at each end, and are mounted on the St. Louis Car Company's No. 18, high-speed, double-motor trucks. The cars are also equipped with Christensen air brakes, and four G. E. 57 motors to each car, and weigh complete about 48,000 lbs. each. The cars have a partition at one end, measuring about 9 ft., with a seating capacity of twelve passengers, which will be reserved as a smoking compartment. The seats are St. Louis Car Company's patent, leather covered, "walk-over" type, twelve on each side of aisle, with a seating capacity of forty-eight passengers to the car.

The cars have nine double sash on each side, with six closed panels from outside, as shown in the illustration. The panels on the inside of the car are fitted with large French beveled mirrors, and all sash is fitted with French plate glass. The vestibules have five drop sash, and are provided with a folding door on one side.

The interior finish of the cars is of solid mahogany, finished in natural color, and all mouldings, head pieces, etc., are handsomely hand carved, and all inside trimmings, which are solid bronze,

FIG. 1.—INTERIOR VIEW OF CAR—BELLEVILLE, ILL.

stand out in bold relief, and present an extremely tasteful appearance. The curtains are of red silk faced pantasote, mounted on spring rollers, and provided with St. Louis Car Company's wire cable fixtures. There are also twenty-four electric heaters in each car, one placed under each seat, thus insuring plenty of warmth for passengers.

The ceilings are of a very delicate blue, ornamented in gold, and the electroliers, of fancy design, are in five-light clusters, with opalescent globes in center. Cars are also furnished with electric signal bells, push buttons being placed at every seat.

The outside construction of the car, as can be seen, is of steam railroad type, with straight sides, heavy truss rods, etc. The cars are also equipped with two Wagenhals electric arc headlights, one at each end, of 5000 candle power each, which enables the motorman to see an obstruction on the track as well at night as day.

In addition to the air brakes, the cars are also equipped with St. Louis Car Company's solid bronze ratchet hand brake, and are also supplied with an air whistle, instead of a gong, as is ordinarily used on street cars. The cars are painted Aurora red and light

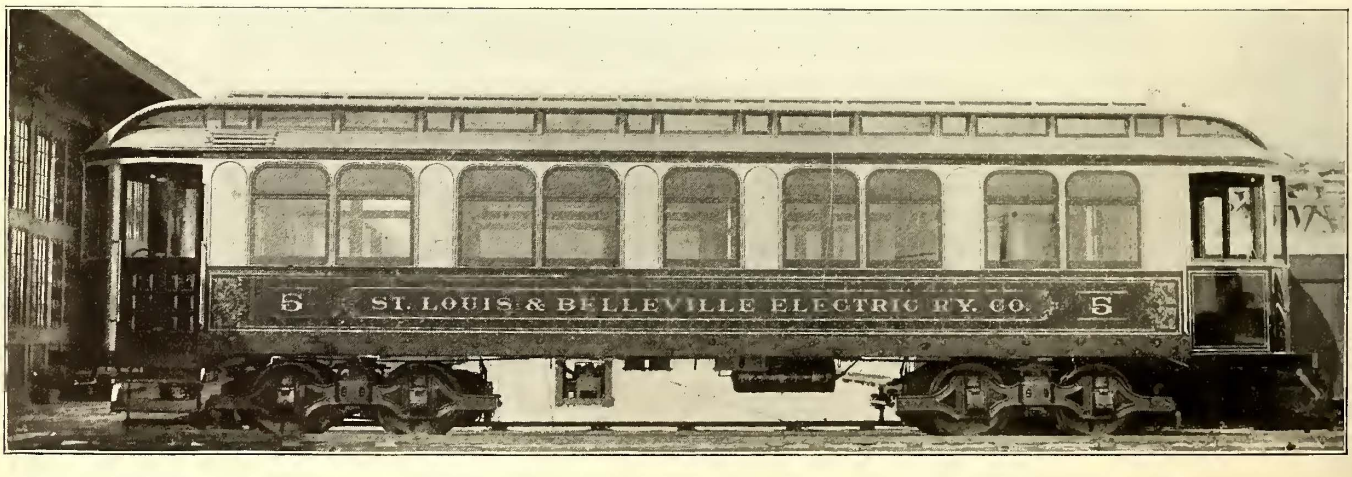


FIG. 2.—EXTERIOR VIEW OF NEW INTERURBAN CAR—BELLEVILLE, ILL.

lemon yellow, a very pretty combination, with neat lettering and ornamenting on the sides.

Fig. 3 shows an electric locomotive which was built by the St. Louis Car Company for the San Antonio Brewing Company, San Antonio, Tex., and which is equipped with automatic freight car couplers, and four G. E. 57 motors, mounted on St. Louis Car Company's No. 15 double trucks. This locomotive is capable of handling from ten to twelve car loads of freight, with the utmost ease.

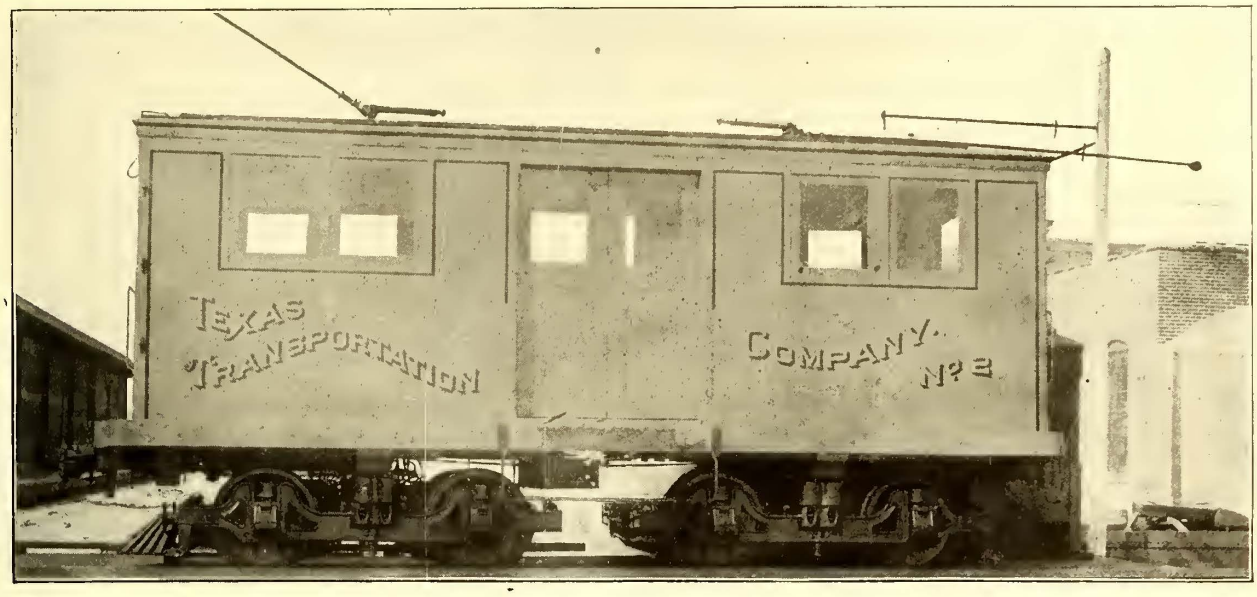


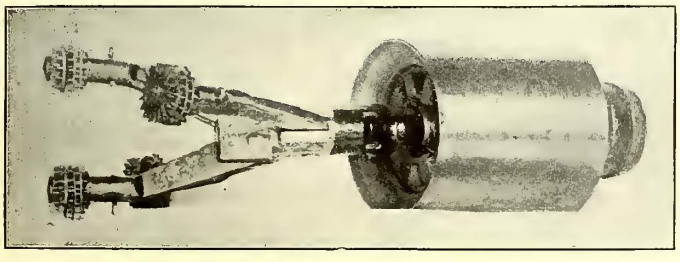
FIG. 3.—ELECTRIC FREIGHT LOCOMOTIVE—SAN ANTONIO, TEX.

The St. Louis Car Company also employs an electric motor of this type, for switching purposes at its works, and finds it not only a great convenience, but a labor saver as well.

Cleaning Water Tube Boilers

Almost every quality of feed water has been found to contain more or less scale-forming ingredients, and where boilers have been allowed to run a year or more without careful cleaning, scale has in many cases accumulated to the thickness of ½ in. or more. Any considerable thickness of scale not only adds very largely to the fuel bill, but it greatly impairs the efficiency of the boiler, reduces its capacity, increases cost of repairs and shortens its life.

The manufacturers of water-tube boilers and others interested in the subject have made numerous experiments with the idea in view of adding to the life of the boilers by removing this scale by mechanical means. One of the latest machines for this work consists of a specially designed turbine attached to the end of a wire-wound hose, and driven by a water pressure of from 90 lbs. to 125 lbs. This pressure causes the turbine to revolve with great force and power, throwing the four heavy cutting arms outward by centrifugal force against the scale with sufficient power to cut and pulverize it into powder, which the flow of water washes away. A series of solid cutting heads and drills is furnished with this cleaner, which is designed to penetrate solid scale, and, at the same time, to save the more delicate parts of the flexible head.



HEAD OF BOILER CLEANING DEVICE

In designing a cleaner which would enter 3-in. tubes and pass around the bends which some of them contain, it was found necessary to condense a large amount of power into a very small compass. It was thought an impulse cleaner does not contain sufficient power to remove heavy scale, and the turbine type of water-wheel was used.

It is this feature which, the manufacturers claim, gives about five times as much power to the turbine as to the impulse cleaner. It is amazing to know the quantity of scale which many of these machines have removed, at a cost of from ten to forty cents per tube. The cleaning of water tubes by this process not only removes the obnoxious and expensive scale, but polishes out the tubes, and, in fact, leaves them in better condition than when new. The cleaner is adapted to any type of boiler, horizontal or upright, with straight or bent tubes, and can be carried by the operator to the top of a boiler, around any obstruction, into the manhole of a steam drum, or wherever he can go. The machine is manufactured and sold by the Chicago Boiler Cleaner Company, Chicago, Ill.

Lubricating Greases

The announcement is made that Dreher journal grease has again been placed upon the market in a somewhat improved form for the use of street railway companies. This grease has been widely used by steam railroads, and is well known to most steam railroad managers. It has been used by the Pennsylvania Railroad Company with excellent results for a number of years. The grease is so compounded as to lubricate only when the car is in motion; as soon as the car stops the grease hardens or "checks," thus avoiding all drip or wasting. The grease in addition to its lubricating qualities is extremely cooling and cleansing, preserving a smooth, clean surface for the journals at all times. It is stated that one application of this compound will suffice to run a car 12,000 miles.

The manufacturers of the Dreher journal grease are also introducing a motor grease which, it is stated, will greatly prolong the life of street railway motor armatures. It is claimed 1 lb. of this grease will carry a car 500 miles, thus making it more economical than lubricating oils, and at the same time giving better results. Particular attention is paid in the manufacture of both these compounds to giving them the necessary body.

The Dreher Grease & Oil Company, of New York, which is now manufacturing these products, is receiving numerous testimonial letters stating that these lubricants are giving excellent satisfaction. One of these recently received from the foreman of the Fifth Avenue depot of the Nassau Electric Railway Company, of Brooklyn, reads as follows:

"I made a test of the grease you sent me as a sample, and can state that the test was very satisfactory in every way. I can recommend it to any one in need of an A1 grease, both for motor and journal bearings.

"The 10-lb. sample of motor grease was used on one of our Westinghouse equipments for forty-two consecutive days with an average of 125 miles a day, making a total mileage of 5,250 miles. No oil was used during this time. The 15-lb. sample of journal grease was used on the same car and ran 11,250 miles with a packing of wool waste. No oil was used at all."

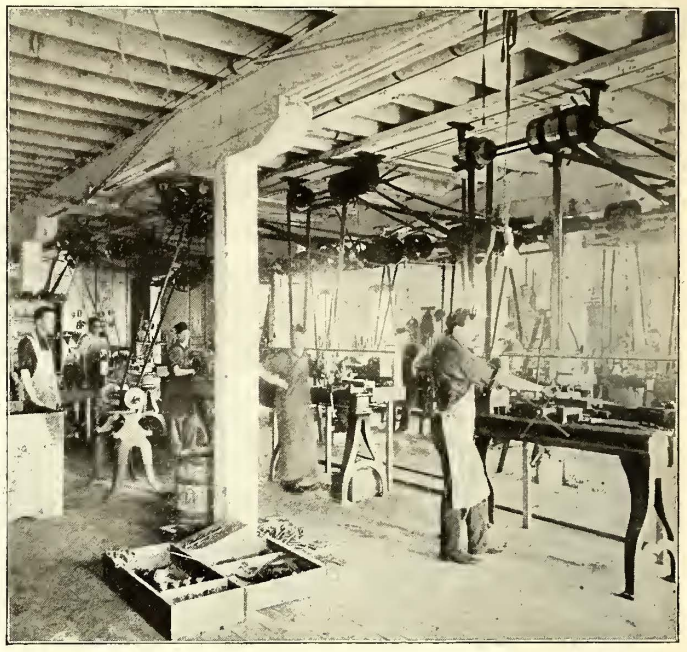
The Manufacture of Electric Railway Supplies

It is always interesting to know where and how particular things are made, and this is especially true of such electrical and mechanical appliances as enter into the overhead construction of city and suburban electric railways. To this end a visit was recently made to the works of the Ohio Brass Company, Mansfield, Ohio, which is one of the largest manufacturers of this class of goods in any country. It will be impossible, however, to name in detail all the various appliances made here, for the illustrated catalogue of the company gives a list of over 400 articles manufactured for the above purposes, and these include not only specialties in overhead material, but also car and motor parts.

The works are located on the outskirts of the city, near the Union depot, and at this season, while running double shift, they employ about 200 hands. The main building is a three-story brick structure 300 ft. x 75 ft., having a wing of the same material 150 ft. x 100 ft. Back of the main building is the brass foundry, a one-story structure 200 ft. x 100 ft., and a japanning building 50 ft. x 60 ft. The business was established in 1888, originally as a jobbing shop, but in 1890 began to manufacture street railway supplies, and the business has steadily increased from year to year, and during the last year turned out 120 per cent more material than the year before, and now shipments are made to all quarters of the globe. The products, however, are not confined entirely to brass, as the name of the company might imply, but embrace products in malleable iron amounting to many hundred tons per year. Much of the malleable iron material is galvanized on the premises by an electrolytic galvanizing process, giving a much more thorough finish than where galvanizing is done by the dipping process. The company also does its own nickel plating and japanning. The departments embrace a brass working shop, in which there is a fine complement of metal working tools, together with testing appliances and trucks and crates for the shifting of the material about the works. The iron working department is similarly equipped, and in both cases the shafting is driven by an electric motor of the Card type. Testing machines are employed for determining the tension strength of materials up to 10,000 lbs. capacity, and there are transformers which give a 10,000-volt current for electrical testing. A large product of the establishment consists of insulating material which the company has named "Dirigo," and which is giving excellent service. In the manufacture of this material a special department is employed in which there are a great number of hydraulic presses and other machines. The company employs a corps of competent engineers and draughtsmen for originating special designs in every department of the work, and also for such new devices as are suggested by particular customers.

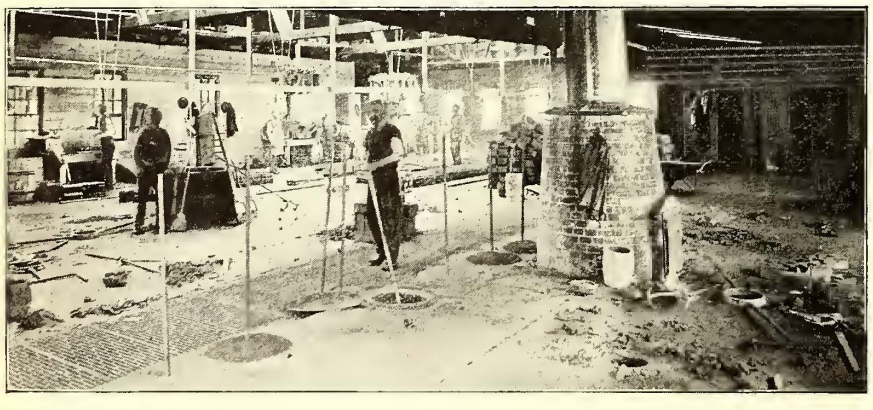
The brass foundry is of ample proportions and has twelve smelting pits, together with the ordinary foundry equipment which includes twelve tumblers for smoothing up the small castings. In connection with the plating department is a large number of emery grinders and buffing machines, all of which are provided with exhaust pipes for removing the dust. The japanning department is equipped with two large baking ovens with suitable racks for drying the material, and joining it is the tinning department, in which are the usual tanks for acid baths and melting kettles. The stock and tool room is especially well designed, there being a large number of shelves, cases and racks for storing in separate receptacles the great variety of products. The shipping room is of ample proportion, and right alongside are tracks from a neighboring steam railway, so that material for shipment is loaded directly into the cars without any trucking. There is also a wood working department, in which the patterns and templates and shipping crates are manufactured, from which it will be seen the works include almost every branch of the mechanical trade. Power is supplied from a 75-h.p. engine, while there are generators for lighting and power. The boiler equipment consists of two 50-h.p. and one 100-h.p. boilers.

The offices of the company are located on the third floor of the main building and occupy rooms with glass partitions on two sides of a reception room of ample dimensions, all being finished in Georgia pine. Adjoining on one side is a sample show-room, in which samples of almost all materials manufactured are placed on shelves and in cases, making a very attractive museum.



VIEW OF MACHINE SHOP

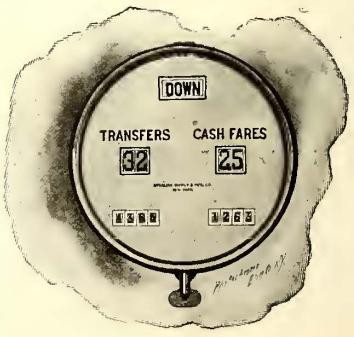
The affairs of the company are operated under the direction of E. T. Cooke, president; B. F. Blymyer, vice-president, and C. K. King, secretary and manager of the railway department; F. P. Black, treasurer, and William Bunting, superintendent. The New York office of the concern is located in the Commercial Cable Building and is under the management of R. A. Byrnes.



VIEW OF BRASS FOUNDRY

Double Registers

The practice on street railways, where one register only is used on each car, differs as to whether it is better to record transfers or not. Arguments can be cited in favor of both plans, but the fact that such a diversity of opinion exists would seem to show that the double fare register, in which a record can be kept of both cash fares and transfers, would satisfy both sides and consequently have wide application. The prevailing tendency of railways is undoubtedly toward the extension of transfer systems, especially in the case of consolidated roads, so that every new device of this kind possesses much interest. A double register can also be used for recording two rates of fares upon long interurban roads.



NEW DOUBLE REGISTER

The accompanying engraving shows a double register recently brought out by the Sterling Supply & Manufacturing Company, and which consists really of two distinct registering mechanisms inclosed in one case. The appearance of the register is very similar to that of the well-known Sterling numeral register, except that there are two sets of dials instead of one, each set being operated by a separate cord or rod. The mechanism is operated through a train of gears and not entirely by springs, and the gear connection between the trip and the totalizing wheels is positive, no cams or dogs being used. The construction is similar to the well-known Sterling standard and every working part of the register is a carefully tested steel casting and all parts are interchangeable. The interior mechanism is compact and simple and the finish of the case is durable and handsome.

Open Cars for a French Railway

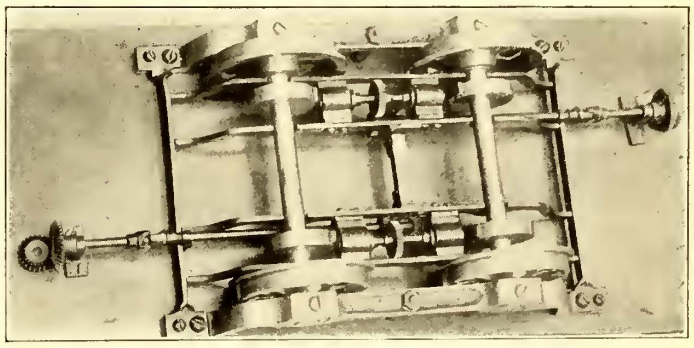
The car shown in the accompanying illustration is of considerable interest, since it seems to be the first open car of purely American type ever sent to Europe. It is from the shops of the Brill Company, and is of the standard twelve-bench type, and is mounted on Eureka maximum traction trucks. The length of the body is 34 ft. It is 43 ft. 8 ins. over the buffers. The limitations of French streets, however, come in, and a breadth of only 5 ft. 10½ ins. is permitted at the sills. This is increased to 6 ft. 5 ins. at the posts, but the extreme width at any part had to be kept down to 7 ft. 8¾ ins. For this reason, although the car has twelve benches, its seating capacity will not exceed forty-eight persons, allowing the American standard of 17 ins. each. The platforms are 4 ft. long, and are separated from the body of the car by bulkheads in the usual manner. On account of the narrowness of the bodies only two sash are placed in these bulkheads. The peculiar form of the grab handles seen on the post is also made necessary by the narrowness of the body and the limiting width over all. The openings between the seats are closed by leather-covered hook chains. The interior finish is of bird's-eye maple for the head lining and ash for the trimming over the openings.

The trucks have 30-in. and 20-in. wheels, with a 4-ft. wheel base, and are furnished with G. E. 1000 motors. The gage is 4 ft. 8½ ins. These cars without motors weigh 15,275 lbs. The weight of one of the trucks was 3000 lbs. The steps are 18 ins. from the ground, with a 15-in. riser. The openings are closed by curtains which come to the floor, the round-corner seat-end panels enabling this to be done easily.

Shipment was effected after the car was entirely completed by taking it apart in sections and packing it closely in boxes. The great length of the car is particularly noticeable, showing that the French street railway people at least are waking up to the advantages of as large a car as can be used on their streets.

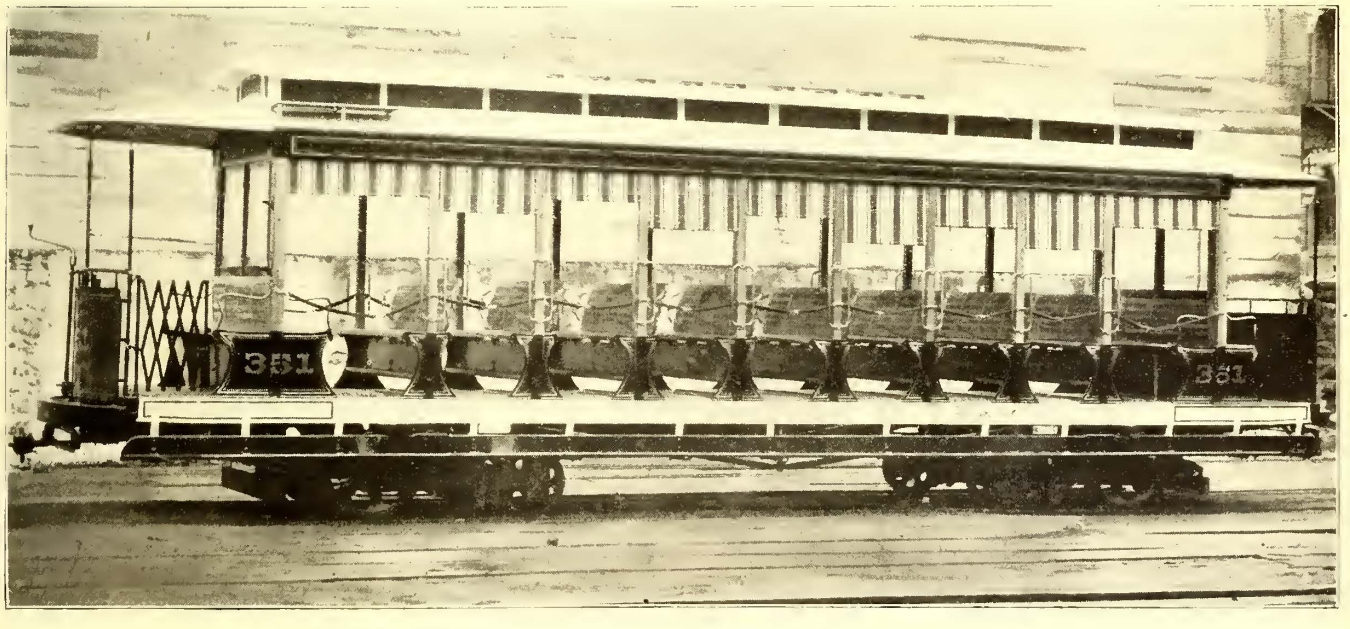
Novel Design of Brake for Street Cars

The accompanying illustration shows a device of the inside brake type. It is quick acting in operation, and, as will be noted from the illustration, the shoes act on chilled drums, attached to the axles, the shoes working between the drums. The shoes are forced against the wheels by means of a shaft, which terminates in right and left screws, that force the shoe heads in opposite direction. This shaft is operated through the medium of spur gears, which, in turn, mesh into the corresponding gears on a shaft that extends under the floor of the car, and which is provided with a universal joint and terminates in a beveled gear, which meshes



NEW BRAKE

into a corresponding gear on the lower end of the brake spindle. An auxiliary shaft, provided with beveled gears, couples the two shoe shafts together, as shown, by which means the brakes of all the wheels may be operated from either end of the car. As the shoes operate on the rim of the inside drum, a very close adjustment can be maintained at all times, so that very little exertion is required on the part of the motorman to bring the shoes into action, while the threading of the shaft provides for the automatic adjustment as fast as the shoes wear. The drums are of the split type, and are keyed and fastened to the axle in the usual manner. This brake was designed by John T. Duff, of Allegheny, Pa., and he claims that it can be adjusted to any type of truck, and so arranged as not to interfere with the mounting or dismounting of the motors. The brake has been worked experimentally and seems to sustain the claims that are made for it.



OPEN CAR FOR A FRENCH RAILWAY

The plant of the Rhode Island Locomotive Works, at Providence, R. I., was formally transferred to the International Air Power Company on Mar. 14. It is reported that the price paid was about $3,600,000. It is also stated that the bond holders of the locomotive works received a mortgage of $225,000 on the property.

Lightning Arresters for Street Railway Circuits

Overhead circuits during storms become highly charged with an induced static electricity—the difference of potential existing in some instances between the line and the earth; in others, between the different sides of the circuit.

Owing to its high oscillatory character, this electricity will not discharge through a coil, but will, in preference, select some path of low inductance, even though of higher resistance. It is due to this fact that when the discharge seeks a path to earth through the coils of a dynamo, motor, or other apparatus, it punctures the electrical insulation of the machine and takes a path to earth generally through the layers of the armature to the core, or over the air space to the pole pieces. The normal current of the line following the lower resistance thus established causes a "ground," or short circuit, and a consequent burn-out. It is the function of a lightning arrester to offer the discharge a better path to the earth. Experience shows that the static discharges will go over the infinitely high ohmic resistance of an air-gap rather than through a few turns of a coil of but a few feet in length.

The Garton-Daniels Electric Company, of Keokuk, Ia., after an experience in manufacturing lightning arresters of six years, has designed an arrester that takes advantage of this peculiar action of static electricity in protecting electric plants and circuits from damage due to lightning discharges. A cross section of the Garton arrester is shown in Fig. 1.

Referring to this illustration, the course of a discharge is as follows: It enters the arrester by the binding post *A*, thence across non-inductive resistance *B*, which is in multiple with the coil *F*, through conductors imbedded in the base of the arrester, to flexible cord *C*, to guide rod *D* and armature *E*, which is normally in contact with and resting upon carbon *H*, thence across the air-gap to the lower carbon *J*, which is held in position by bracket *K*. This bracket also forms the ground connection through which the discharge reaches the earth. It will be noted that the discharge takes its path through the non-inductive resistance in multiple with the coil. The path is, however, of high ohmic resistance, and the normal current is shunted through the coil *F*, which is thereby energized, drawing the iron armature *E* upward instantly. This forms an arc between the lower end of the armature and the carbon *H*.

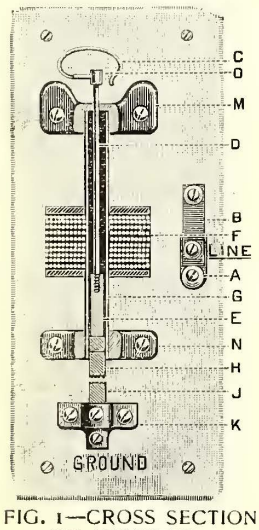


FIG. 1—CROSS SECTION OF ARRESTER

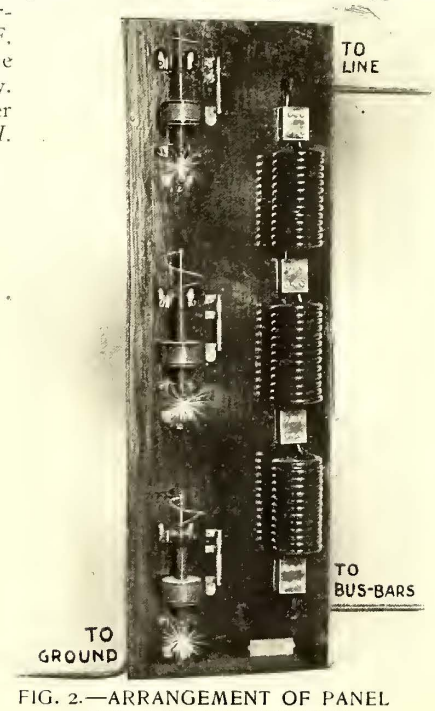


FIG. 2.—ARRANGEMENT OF PANEL FOR RAILWAY CIRCUITS

As this arc is formed inside the tube *G*, which is practically air-tight, the oxygen is consumed, the current ceases, and the coil loses its power, allowing the armature to drop of its own weight to its normal position on the upper carbon. The arrester is again ready for another discharge.

In the railway types a portion of the resistance rod is connected in series with the coil, thereby limiting the flow of current following the discharge. This is necessary, as the normal as well as the static difference of potential is between the line and the ground. This non-inductive resistance is so low that, while limiting the flow of normal current, it does not limit the flow of static electricity, as the potential of the latter is so vastly higher than the normal voltage of a railway circuit.

Arguments have been made against lightning arresters with moving parts, but practice has shown many of these fallacious. The Garton arrester comprises moving parts, but it is so simple and the parts so arranged that all the difficulties anticipated in a device of this character are entirely obviated. The most convincing proof that moving parts are not always objectionable is in the success of the Garton arrester under the most trying conditions.

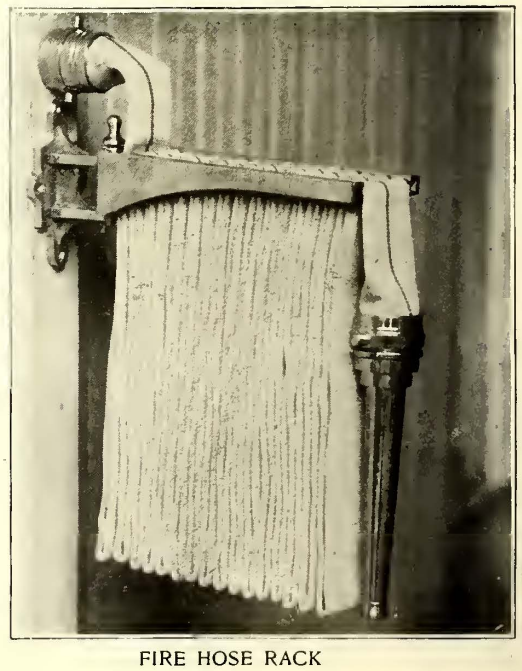
Every operation of this arrester cleans the contacts and discharge points, thereby keeping the conductivity at a maximum and the resistance at a minimum. The arrester is so quick in its action that discharges in rapid succession are taken care of with the greatest ease. After a discharge the Garton arrester increases the resistance in the circuit and chokes and disrupts the current flow. This action is made so quickly that a sensitive plate is incapable of detecting any motion.

The usual arrangement of arresters for the protection of a street railway power station is shown in Fig. 2. Here, it will be noticed, the arresters are used in connection with kicking coils, which consist of a coil of wire so designed as to offer the least ohmic resistance and the highest inductive resistance. One is placed in each circuit, between the apparatus to be protected and the lightning arresters. Acting in the same way as the coils of an armature, which drive the discharge through the insulation to the core, the kicking coil drives the discharge through the lightning arrester before it reaches the machine.

It will be noted that by placing coils and arresters as shown, the discharge passes through the upper arrester; any excess discharge will be taken care of by the second and third, and the three kicking coils offer an inductive resistance that effectively proteets the generator. The Garton-Daniels Electric Company is now mailing its 1899 catalogue, which contains a complete description of its line of aresters for this year.

Fire Hose Racks and Reels

The hose rack and reel illustrated herewith, and which are manufactured by H. J. M. Howard, of Washington, D. C., ought to appeal to station and car house foremen, who desire to have their fire protective apparatus ready at hand and yet out of the way when not in use.



FIRE HOSE RACK

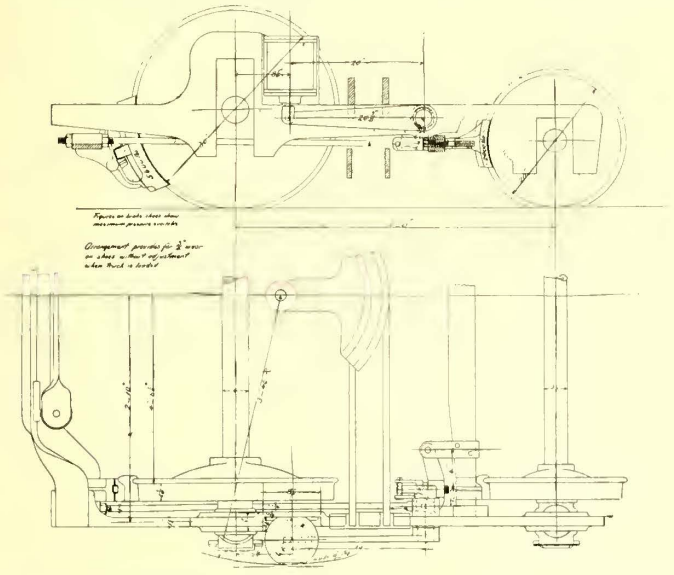
The method of hanging hose on wooden pins, illustrated, avoids all possibility of hose rusting and prevents the sharp bends so objectionable in other styles of racks. The hose being supported in this manner allows the air free circulation through the folds of the hose, keeping it dry at all times. At the same time it is quickly available, as the side arms can be swung out, dropping the hose.

Mr. Howard also manufactures a hose reel mounted on a vertical axis, which, revolving as it does, fills all the offices of a swinging hose reel to those who prefer that type. The automatic draining feature will recommend it to those having hose in places exposed to low temperature.

Although these racks and reels have been on the market but a short time, Mr. Howard states that business is good, that many of the largest street railway plants are being equipped with these devices.

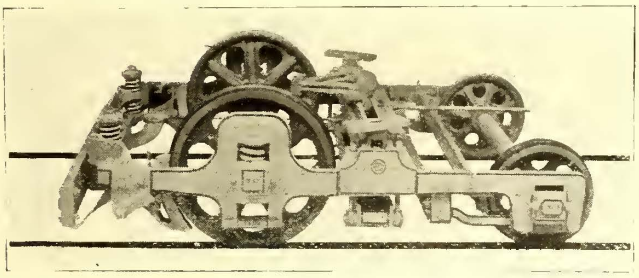
Air Brake with Motor Compressor for New York

During the last month the Third Avenue Railroad Company, of New York, as mentioned elsewhere, awarded contracts to equip the 160 new electric cars, which it will soon put upon its line, with air-brake apparatus of the Standard Air Brake Company. This



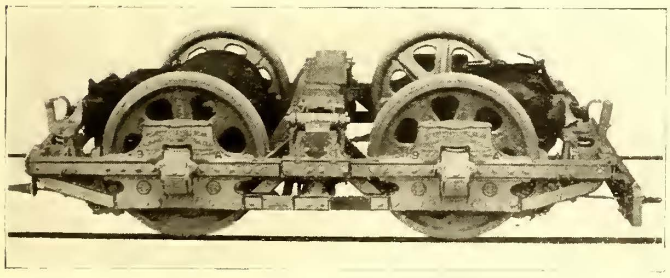
AIR BRAKE CONNECTIONS FOR MAXIMUM TRACTION TRUCKS

constitutes probably the largest order ever given in this country for street railway air brakes and is a striking commentary on the importance which the air brake is being accorded by electric railway managers. The type of air brake adopted is the independent driven compound compressor with automatic current controller and rheostat. The type adopted has only recently been put upon the market by the Standard Air Brake Company and is illustrated in the accompanying engravings.



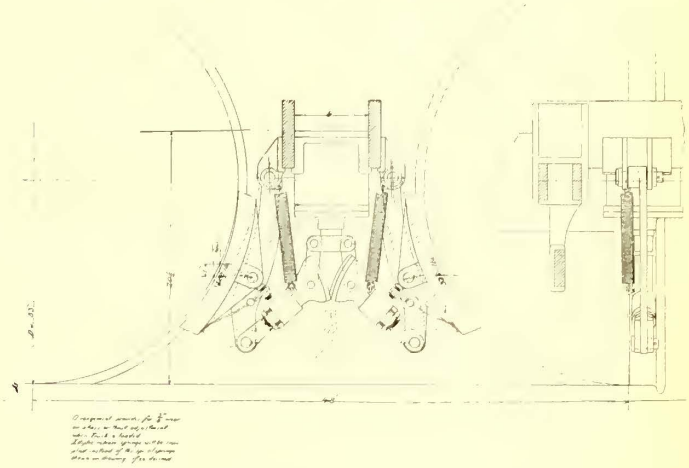
MAXIMUM TRACTION TRUCK FOR THIRD AVENUE RAILROAD

As will be seen, it differs materially from previous equipments of this kind. The motor is of a special construction and designed solely to answer the severe conditions of street railroad air braking. It is series-wound, multipolar, entirely enclosed and securely protected against dust and moisture. At full load the speed is



SHORT WHEEL BASE DOUBLE TRUCK FOR THIRD AVENUE RAILROAD

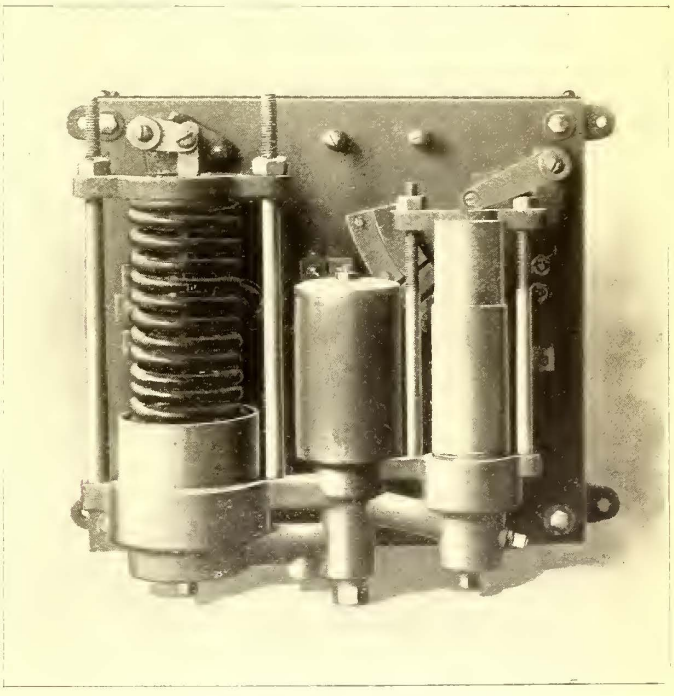
750 r.p.m. The bearings are of ample size and length, self-oiling and self-aligning. The armature is of the type known as iron clad, built up of discs of sheet iron perfectly laminated one from the other, and with grooves punched to receive the windings. The armature core is mounted on a bushing independent of the shaft and keyed to it. This construction allows of expansion and contraction of the armature core without affecting the shaft. The armature coils are of the best cotton covered, soft drawn copper wire, wound on forms, then taped with a special linen tape and laid in mica troughs of the best India mica, in the grooves of armature. The character of the insulation, and the extreme care with which this part of the work is carried out, are sure guards against possible grounding or breaking down of insulation. The pinion, armature and commutator bushing are held in place by keys of the latest design, being a milled half-round key, giving



AIR BRAKE CONNECTIONS FOR DOUBLE TRUCK

the most durability and admitting of the greatest strength of shaft. The brush holders are of good red brass, milled to standard size to receive the brushes. The latter are held in place with adjustable phosphor bronze springs, which are very elastic and can be thrown back to a position where the brush can be removed with perfect ease. The commutator casing is covered with a steel band secured with a self-locking device, and the band is easily removed, giving quick access to brushes, and ample room is provided and unusually large clearances are allowed around the brush holders.

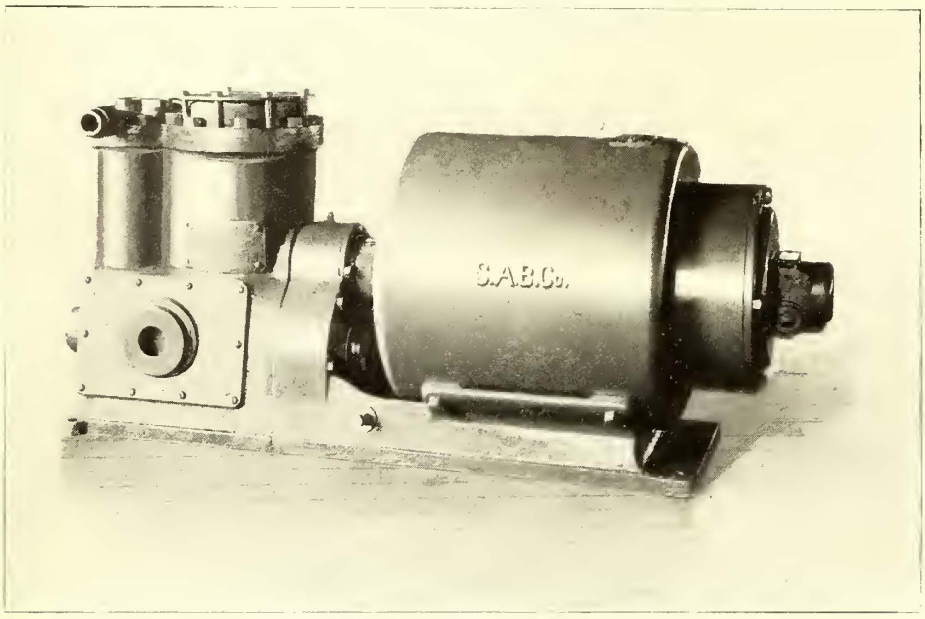
The compressor is of the compound type, and the efficiency shown, working against a pressure of 60 lbs. per sq. in., exceeded



AUTOMATIC CONTROLLER AND RHEOSTAT

85 per cent. It is bolted to the end of the motor, the crank shaft extending at this end to receive a gear wheel, meshing with a pinion on the armature shaft directly above. The cylinders and upper half of housing and gear case are cast in one piece, carrying one-half of the bearings for crank shaft. The lower half of the housing and gear case, together with the base for motor and

the other half of the bearings for crank shaft are also cast in one piece. The crank shafts and connecting rods are of cast steel. The valve seats and valve bonnets are of brass, the intake valve being in the head of low pressure cylinder, while the intermediate and discharge valves are in the head of the high pressure cylinder.



STANDARD MOTOR COMPRESSOR

The gear and pinion are entirely enclosed in a gear casing, forming an oil chamber, and, when steel pinions are used, can be run in a flood of oil. The housing of the crank shafts is so arranged that it forms a chamber, and all cranks and pistons, together with the bearings, operate in oil. The muffler over the top of the intake valve is cast in one piece and enclosed with a wire screen filled with special woven asbestos cloth and iron wire threads, making a perfect guard against dirt and completely muffling the noise of valves.

The new automatic current controller and rheostat is worthy of special mention. The construction is very durable and simple, and its few parts serve as the best guarantee of its effectiveness. All electrical parts, together with the working devices, are mounted on a slate slab to insure perfect insulation. The apparatus automatically maintains a practically uniform pressure in the air storage reservoirs, and the rheostat forming a part of the machine prevents the sudden starting of the motor against full load. By its use, when the air supplied to reservoirs reaches a predetermined limit, the motor compressor is entirely stopped. As long as air pressure in the reservoirs remains within 8 lbs. or 10 lbs. of the required maximum, the motor compressor remains inoperative. Should the pressure, however, be reduced below the limit, the motor compressor is immediately started (slowly at first and gradually increasing as the resistance is automatically removed from circuit) and continues operating until the maximum limit is reached, when it again immediately stops as before. The motor is series-wound, and when starting with empty reservoirs would naturally "run away;" but, under such conditions, the resistance remains in circuit and is only cut out as the pressure increases. The speed of the motor compressor is at all times automatically controlled by the amount of work required. While the motor compressor is in operation, if for any reason the line circuit is interrupted, the resistance is thrown in circuit with the motor compressor simultaneously with the stopping of latter. When the circuit is again restored, the motor compressor resumes operation, gradually increasing in speed in the way above indicated. The resistance wire in the controller is wound on porcelain tubes secured in the base of the controller, under the slate, giving perfect insulation. The back of the controller is lined with asbestos and covered by a sheet of metal. The whole is then entirely enclosed in an iron casing, fitted with a cover and secured by a lock. The resistance is divided into six steps and seven contact points.

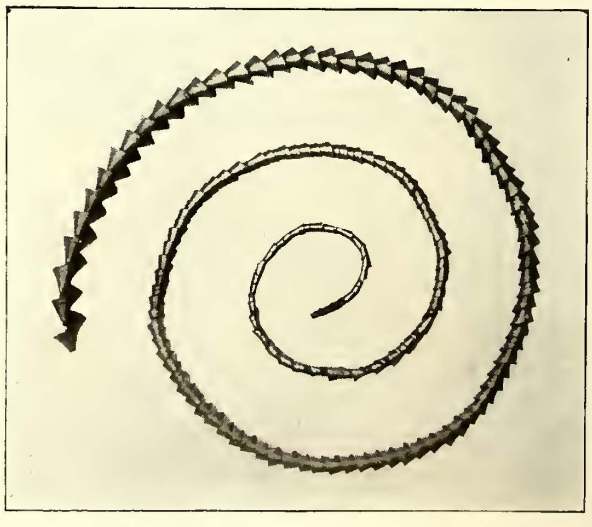
The company will adopt a special method of attaching the brakes to the trucks. Two types of trucks have been adopted for the new equipment, the Peckham 14-B short wheel base truck and the Peckham 14-D maximum traction truck. Of these, 200 of the former and 120 of the latter have been ordered during the past month. The method of connecting the brake to these trucks is quite novel, as will be seen by an examination of the accompanying diagrams. In the case of the short wheel base truck there are two jam cylinders on each truck, and these are connected to a form of toggle joint which brings the shoes in contact with the wheels by an outward pressure. In the case of the maximum traction truck, one jam cylinder is mounted on each truck and connected by a system of levers with the brake shoes. Views of both of these trucks are given herewith. Detail descriptions of them have been published in previous issues.

The independent motor driven compound compressors of the Standard Air Brake Company are built in sizes of 1½ h.p., 2 h.p., 3 h.p., 5 h.p. and 10 h.p. The company also manufactures what is known as its double cylinder, single acting, direct connected, motor driven compressors, and has also four types of axle driven machines. The company's 7½-in. duplex, geared,, axle driven compressor was fully described in the Street Railway Journal for June, 1898. Since that time a number of improvements have been added and a large number of machines have been placed upon the market.

A test was made of this equipment recently at the factory of the Standard Air Brake Company, at Jersey City, in the presence of a number of railway managers, and the results were pronounced most satisfactory. Besides its factory at Jersey City, the company has a second factory at Trenton, N. J. Both are running full time, twenty-four hours a day, to supply the large demand for air brakes. Orders for these appliances have come from all civilized parts of the globe.

A Long Metal Shaving

The accompanying engraving made from a photograph illustrates a metal shaving recently drilled from a steel rail on the Illinois Central Railroad. With the old-fashioned ratchet drill such a boring would be practically an impossibility. The one shown is from a 13-16 in. hole; it was made without a break, in one



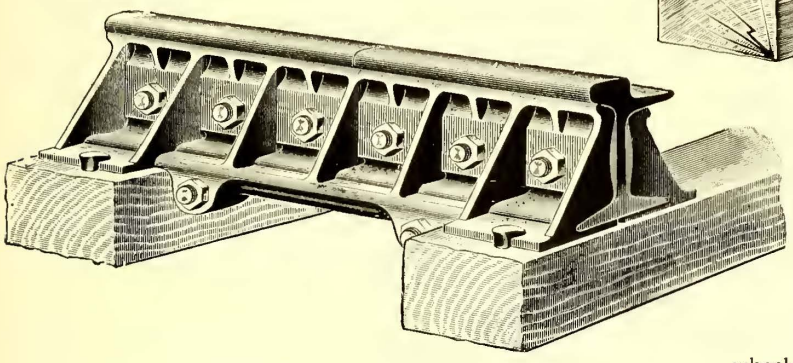
LONG METAL SHAVING

minute and forty-six seconds, and contains all the metal taken from the rail in drilling the hole. It gives proof that the drill which did the work was driven by a continuous feed. The boring was some 40 ins. long and was cut by a Paulus drill manufactured by the Buda Foundry & Manufacturing Company, of Harvey, Ill.

The Argentine-American Commercial Company, of Philadelphia, proposes to establish a warehouse in Buenos Ayres for the exhibition of American goods of all kinds, with a view to increasing the trade relations between the Argentine Republic and the United States. This company will also employ a number of competent salesmen to introduce the American goods.

A New Rail Joint

In the accompanying illustrations is shown the Atlas rail joint, which is manufactured by the Atlas Railway Supply Company, of Chicago. The Atlas joint consists of one or two girders whose depth and design make the connection between the rail ends stronger than a section at any other point. When two girders are used, they slip over the rail from either side in such a way that the lower flange is practically enclosed, and presents a broad bearing surface to the under side of the head. In addition to the usual bolts through the web, there are others through lugs on the under side of the joint and passing under the flange. If the single bar style is used the lower flange of the joint is made wide enough to extend under the entire width of the rail. Over the ties the flanges



RAIL JOINT FOR GIRDER RAILS

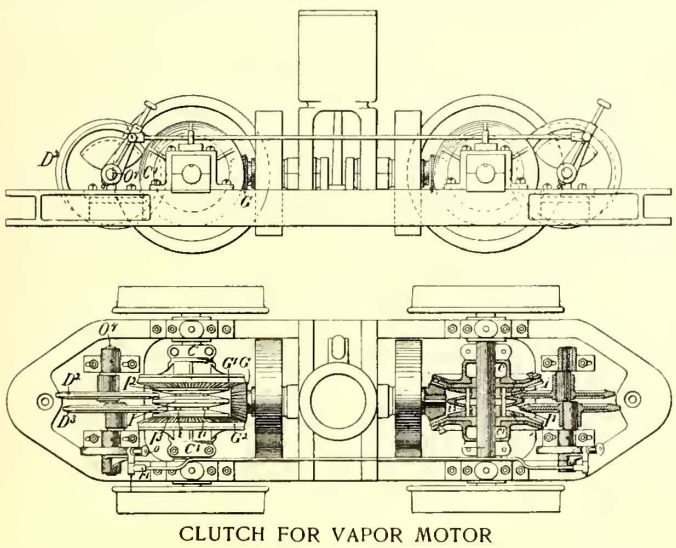
of the joint are extended so that they serve as rail braces, and the lower flanges of the joint act as tie plates.

A special joint is made for track that is laid with chairs, the joint being deep enough to do away with a chair at that point.

New Clutch for Use with Vapor Motors

Since the invention of vapor engines many attempts have been made to apply them to self-propelled vehicles for street railway traction. In systems employing a gasoline or other vapor engine, mounted on the truck or car body and operating continuously at a uniform speed, the main obstacle has, of course, been the difficulty of securing a flexible connection between the engine and the axle for bringing the car to speed from a state of rest, and also for graduating the rate of speed. In 1896 a mechanism was invented by E. Prouty, of Chicago, Ill., that, it is claimed, successfully supplies this demand for a flexible connection.

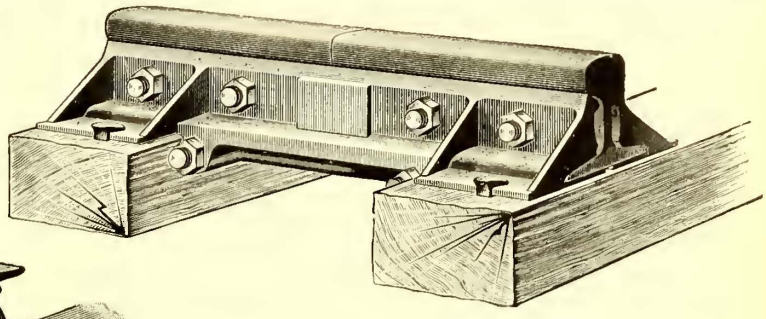
By the use of a single lever the car is started from rest without jerk or jar, and given any desired speed up to the maximum, and



CLUTCH FOR VAPOR MOTOR

by simply pulling the lever over to the opposite position the car is as smoothly reversed and moved in the opposite direction. By placing the lever in a vertical position the car is stopped, while the engine continues to run as before. At the same time the application of the power to the vehicle is graduated in correspondence with the speed.

The accompanying illustration shows the clutch applied to a truck. *F* is the beveled pinion on one end of the engine crank-shaft and G^1 and G^2 are beveled gear running idly in opposite directions when the load is off. *I* is the middle block, fastened rigidly to the axle, and which is beveled ordinarily 3/16 in. to the inch. I^2 and I^3 are beveled discs on one side and smooth, flat surfaces on the other, and while they admit of a lateral movement on the axle they are held by keys or pins, *i* and i^2, forcing them to revolve with the axle. *C* and C^1 are the outside discs, that are rigid on the axle, with a flat face lying against the corresponding



RAIL JOINT FOR T RAILS

flat face on the beveled gear. *D2* and *D3* are impinging wheels on the eccentric rocking shaft *O4*, *D3* being shown in effect, G^2 now carrying the load, while G^1 is playing as an idler. By reversing the lever G^2 is freed and G^1 is put into effect, and by placing the lever in a vertical position both gears are freed and play as idlers. The impinging wheels never slip, but revolve by contact with the discs.

It will be noted that the friction of the discs on both sides of the gear is in the same direction, eliminating all counter friction when applied. Hence, if the clutch is thrown in lightly, it is operative without loss of power to that extent, and will start or move the load gradually. It is stated that in practice the clutch does not heat when run at any degree of slipping pressure. As there is no counter friction there can be no loss by slipping friction, and, it is claimed, as the faces of the clutch do not disintegrate, but wear as an ordinary journal, the force of the power or engine is conveyed to the load without any more waste than would be on the wrist pins and cross head of an ordinary locomotive.

Signal System for Single Track Roads

Williamson & Company, of Allegheny, Pa., manufacturers of the Ramsey signal system, report that this device is giving entire satisfaction wherever it is used, and that it has proven itself entirely efficient in actual operation, covering a period of several years. The large number of high speed single track surburban roads now being built has largely increased the demand for an adequate signal system to prevent collisions and to enable the conductors of cars on different parts of the system to communicate with each other and with the central office. The Ramsey signal system appears to fulfill all these conditions. The latest modification of this device was fully described in the STREET RAILWAY JOURNAL for September, 1898.

Massachusetts Institute of Technology

The Massachusetts Institute of Technology has recently made a number of important additions to its laboratories, thus greatly enlarging the facilities for making tests of various kinds. One of the principle improvements is the erection of a new building and the addition of a new tandem compound engine in the engineering department, by which twice the amount of work can be done. Where thirty men formerly worked on one engine and its pumps, fifteen men now work on each engine, giving the men a great deal more experimental work. Various tests are now being carried out on the effect of moisture on timber, elasticity of wood, etc.

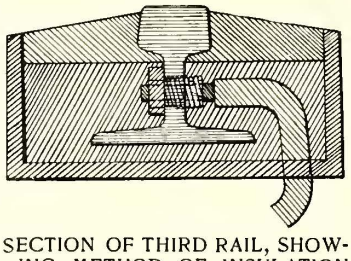
American Institute of Electrical Engineers

The 133d meeting of the institute was held at the Institute Building in New York on the evening of March 22, 1899, President Kennedy in the chair. A paper was presented by M. L. Pupin, of Columbia University, on the propagation of long electrical waves. An interesting discussion followed the reading of this paper. The council decided to hold the next general meeting at Boston during the last half of June, the exact date to be fixed by the executive committee.

Safety Third Rail Railway at Coney Island

During the last month a third-rail electric railway, installed by the Safety Third-Rail Company, of New York, to demonstrate the advantages of its system, was put in operation at Manhattan Beach, Coney Island. The road equipped is the Marine Railway, connecting Brighton Beach and Manhattan Beach, and it is 1951 ft. in length. The track is of standard railroad construction, with 56-lb., 4⅛-in. T rails and stone ballast, and differs from a trolley track only in the absence of the overhead system and in the use of a third rail which is laid on the ties in the center of the track. A standard 500-volt current, taken from a special dynamo located in the lighting station of the Manhattan Beach Hotel, is used.

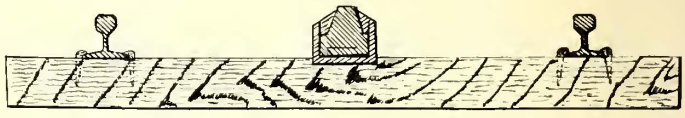
The third rail, which is of standard T section, is of steel, and is laid in alternate live and dead sections insulated from each other. The live sections are 15 ft. in length and are supported at either end by granitoid bases, as shown in the section and side elevation of the third rail construction herewith. The entire rail circuit, including the granitoid pieces, is then enclosed in a creosoted wooden trough, which is then filled with a special form of insulation which is poured in hot. The granitoid insulating blocks also act as section insulators between the live and dead sections, presenting a surface of 1 ft. between the two. The line has seventy-two live sections and seventy-three dead sections, the latter are 10 ft. in length. The height of the top of the third rail above the ties is 5 in. The track rails are bonded in the usual way for return.



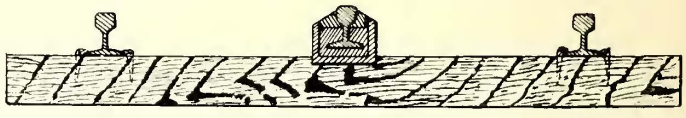
SECTION OF THIRD RAIL, SHOWING METHOD OF INSULATION AND CONNECTION TO FEEDER.

The system of connections used is shown diagramatically on page 261. Each live sectional rail is connected to a solenoidal switch which has two windings, one of low resistance wound with coarse wire and another of high resistance wound with fine wire. The former is normally open and the latter is normally closed, connecting its circuit between the sectional third rail and the ground. The car carries a small motor-dynamo of 20-500 volts and a storage battery of ten cells connected as shown in the diagram. When ready to start, the motor-dynamo is driven by the 20-volt battery current, generating at its other end, an e.m.f. of 500 volts. The method of operation is then as follows:

Suppose the car to be over a rail and ready to start. The switch being open there is no connection between the feeder and the car, which therefore can receive no current. The motorman operates the controller and thereby connects the motor-dynamo to the third rail and to the ground and current passes through the fine wire of the switch and causes it to operate. In response to this current



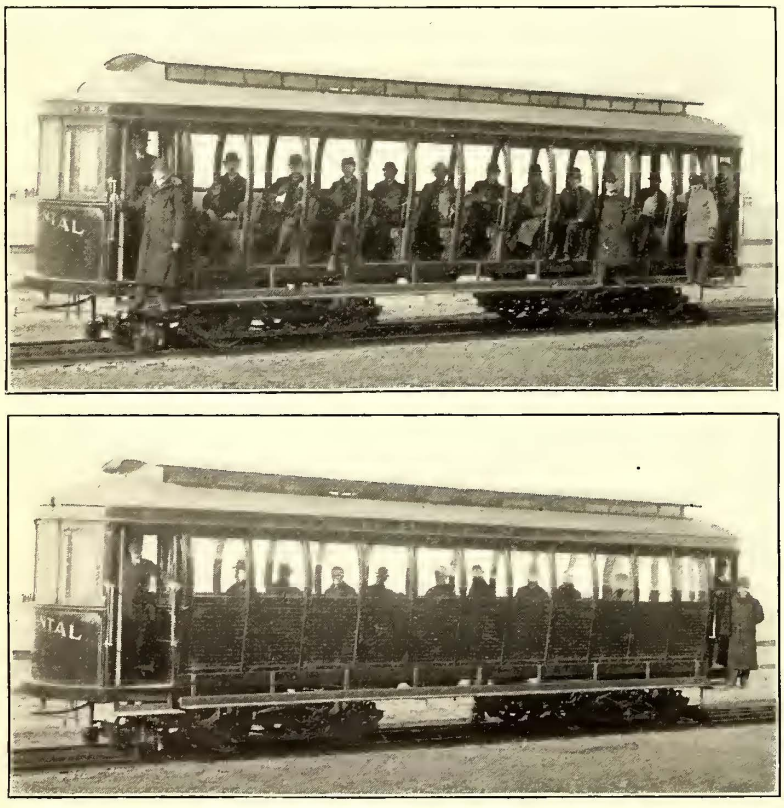
CROSS SECTION OF TRACK THROUGH INSULATING BLOCK



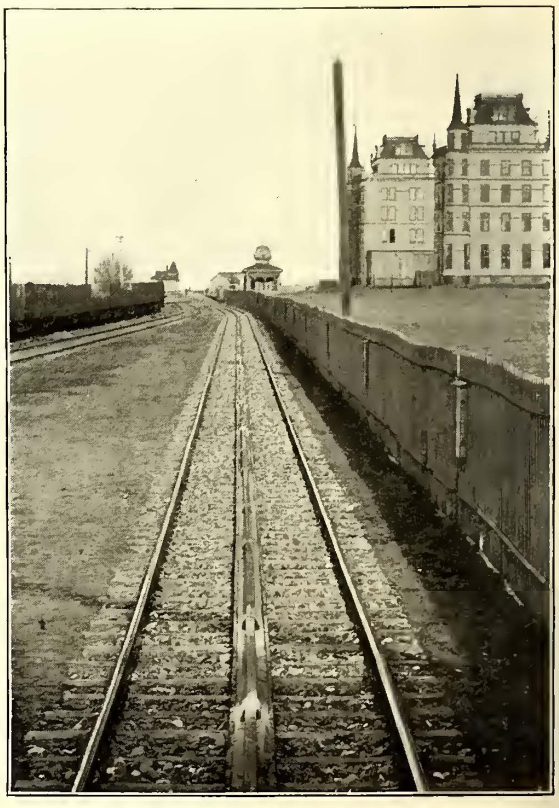
CROSS SECTION OF TRACK THROUGH LIVE OR DEAD SECTION

SIDE ELEVATION OF INSULATING BLOCK

the plunger rises and first makes contact between the main feeder and the rail and then breaks the current of the fine wire winding. The controller is now open and current comes from the feeder through the coarse wire winding of the switch to the third rail and from thence through the car motor to ground, causing the motor to revolve and the car to move. The switch is held shut because of this current in the coarse wire winding. In this closed condition the switch will remain as long as the car is taking current from the section to which the switch is connected. When the car leaves the section, there is no longer any current passing through the switch feeding it and it falls open, first breaking the circuit between the feeder and the sectional rail and second, restoring the circuit from the sectional rail through the fine wire to earth. The switch is then ready for the next car. The car being thus started, the motor-dynamo is no longer needed to operate the switches because the car is provided with two sets of shoes which are con-



DUPLEX CAR, OPEN AND CLOSED



VIEW OF TRACK

nected together and placed sufficiently far apart to span the distance from section to section. The forward shoe as it impinges on a section, subjects it to the full line potential, drawing its source of current from the rail preceding, for the main feeder has already been connected thereto in the manner just described. Once started, therefore, the car becomes independent of the motor-dynamo, for it uses the power house current to operate the switches.

It will be noted that the switch remains closed until the car ceases to take current from the section it controls. It will then fall open from lack of current to hold it up and there is then no

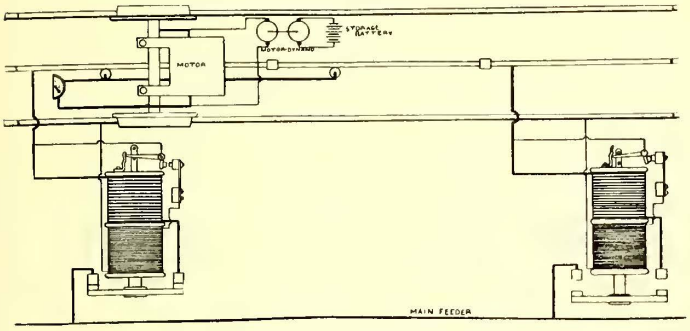


DIAGRAM OF CONNECTIONS

current to break, and hence no arc at the switch jaws, and it is therefore a non-arcing switch.

One side of the motor-dynamo is connected across the motor terminals and ordinarily receives current therefrom, acting as a motor and driving the low potential side as a dynamo charging the ten small storage cells. If, however, the line current should fail, the sides of the motor-dynamo will exchange functions and the high potential side, now a dynamo, will supply current to operate

END VIEW OF CAR AND SWITCH

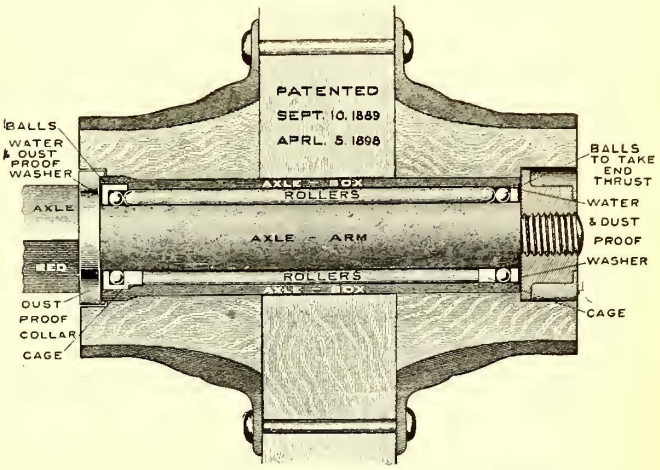
the switches and light the car. This is the operation also at starting.

The car is of the Duplex type, manufactured by the Duplex Car Company, of New York, and has attracted much favorable comment by its tasteful appearance when open and closed. The engravings on page 260 show it in both conditions. The car is mounted on two Peckham 14-A trucks, equipped with G. E. 1000 motors with standard controller, with the exception that one contact is changed. The car carries ten cells of storage batteries and the rotary transformer required by this system. Both of these are located underneath the car so as to take up no space available for passengers.

To demonstrate the reliability of the system under adverse conditions, the road has been subjected to very severe tests. One of these tests was that of covering the road for a distance of 25 ft. with closely packed and wet snow heaped to a height of several inches above the track, entirely hiding the three rails from view. This condition did not interfere with the operation of the system in the slightest degree and the car glided through the snow without difficulty and was started on the section covered with snow without trouble. Another test consisted of covering the track with dirt, entirely hiding the three rails, after which buckets of water were poured on the track, making a combination of mud and water. This did not in the slightest degree interfere with the operation of the car. The test was carried on under the supervision of Capt. J. McL. Murphy, the inventor of the system, and was witnessed by a number of well-known railway men who spoke in the highest terms of the results secured.

Roller Bearings

A new form of roller bearings for street railway service, heavy road wagons, etc., is shown in the accompanying cut. The device consists of a series of from nine to fifteen rollers, the number varying according to the size of the axle, about ⅜ ins. in diameter.



SECTION OF ROLLER BEARING

These rollers are readily interposed between the axle and the axle box, coming into immediate contact with both. In addition to this, there are balls at the end of each of the rollers, thus reducing the friction to a minimum. It will be observed that the weight is not on these balls, and there is, therefore, no danger of their being crushed. The weight comes directly on the rollers and is evenly distributed throughout their length. The device is manufactured by the Standard Roller Bearing Company, of Philadelphia, and the principal claims made for it are simplicity and strength, cheapness, and a great saving in power.

Exhibits at the Convention

Mr. T. C. Penington, secretary of the American Street Railway Association, has issued the following letter to electric railway supply men, in reference to the exhibits at the next convention:

The exhibits and displays of the supply men are so important a part of our conventions, that the executive committee, in making arrangements for the meeting, have been as mindful of our wide-awake allies and as zealous in providing for their convenience and accommodation as for any other feature of the gathering. The Exposition will be held in Tattersalls, the largest exposition hall in the city. We will have an abundance of floor space with all the light, heat and power required. Every applicant is assured that he will get all the space desired, as our resources in this direction are unlimited. The convention will be held on the second floor of the exhibit hall, all stairways leading up from the inside, thus insuring the attention of all delegates and visitors to the exhibits.

The income from the sale of space will go to the American Street Railway Association. The executive committee of the association has fixed the price at ten cents per square foot, and ruled that no space less than one hundred square feet will be assigned, but applicants may have as many multiples of this quantity as they wish, all in one body. Payment for space should be made to Mr. T. C. Penington, secretary and treasurer of the American Street

Railway Association, 2020 State Street, Chicago, Ill. Application for space should be made to Jas. R. Chapman, 444 North Clark Street, Chicago, chairman committee on exhibits. Please state in your application for space the shape desired, number of feet wide and long, and the committee on exhibits will comply with your request if possible. Cars, sweepers and plows will be placed outside of the building on the street.

It is earnestly requested that all exhibits shall be in place and all work finished by Monday evening, Oct. 16, which is the evening prior to the opening of the convention. The local committee has rented the building from Oct. 10 to Oct. 24, so you can ship your goods early and will have ample time to remove them. Watchmen will be in charge of the building so that exhibits will be safe. All goods should be marked to yourselves, Tattersalls, Chicago, care of H. W. Smith, successor to Anderson Transfer Company, 1618 State Street, sending him bill of lading or advice that you have shipped goods in his care, giving particulars in regard to shipment, and it will be delivered to your space in the exhibition hall. Ship all goods early to insure delivery in time and prepay charges. We hope to have you with us with an extensive display. All articles intended for the exhibition shall be delivered at the building by the agent or owner, and at his expense, but the local committee have made arrangements with H. W. Smith (successor to Anderson Transfer Company) to haul and deliver all shipments to and from the building at low rates if directed in his care. Articles will be placed on your space in the hall if you mark the number of space on your boxes. The number of your space will be mailed you in ample time for shipment. All electrical connections for power and extra lights must be made at the expense of the exhibitor.

We expect a large exhibit, and perhaps it would be in the interest of the exhibitors to make arrangements to have the building open in the evening, as it is well lighted, and the electrical companies expect to make a large display. Space must be applied for by Sept. 1. Assignments will be made as promptly as possible after that date and exhibitors notified of their location. Exhibits of like character will be grouped together and space will be assigned in the order of application. The committee on exhibits will make contracts with carpenters, electrical workers and laborers at regular prices, so the exhibitors will not be overcharged for lumber, labor, etc.

Friday, the 20th, has been set apart by the executive committee for the examination of exhibits. No session of the association will be held on that day and no entertainments of any kind will be given by the local committee, so all delegates will have ample time to call upon you and see what you have to show them.

The headquarters of the association will be at the Auditorium Annex. All our hotels are within a radius of one-half mile and within ten minutes' ride of the hall. They include Auditorium, Victoria, Leland, Great Northern, Wellington, Grand Pacific, Tremont and Sherman. The executive committee advises all who desire room to apply at once, as they will be assigned in the order in which applications are received. The executive committee found our Chicago friends so enthusiastic as to the coming meeting, and so hospitable in their greeting, that success is assured, the location being central and accessible; and the inquiries and information already received being so encouraging an unusually large attendance seems guaranteed. The annual dinner will be held at the Auditorium, Friday, Oct. 20, at seven o'clock, P. M. Tickets will be sold at the actual cost to the association.

The railroads will sell tickets on the certificate plan. Be sure and leave your certificate with the clerk the first day of the convention, when you register; it will be signed, vised and ready for you on Thursday, Oct. 19, 1899.

Please make your arrangements and applications as above noted as promptly as possible.

(Signed) T. C. PENINGTON,
Secretary and Treasurer.

Large Orders for Well Known Engines

The Willans engine, as manufactured by Willans & Robinson, of Rugby, Eng., are being introduced very extensively into tramway power plants. Among the larger orders for engines for this class of service received during the past year may be mentioned the following: Eight engines of 1200 h.p., besides several smaller engines, for the Liverpool Corporation; four of 700 h.p. for Bradford, Eng.; two of 500 h.p. and 250 h.p., respectively, for the City & South London Railway; two of 800 h.p. each for the Brighton Corporation, England, and two of 1200 h.p. each for the Glasgow Corporation.

The manufacturers of this engine report that the orders received during 1898 exceed those of any previous year, and the sales thus far in 1899 continue to show an increasing demand. This concern is now building larger engines than ever before, the standard size for central station work having until recently been about 280 h.p., but within the last few months the size has been increased considerably, until now, 700, 800, and even 1000 and 1200 h.p. engines are not uncommon. To meet the demands of the business, the manufacturers are arranging to greatly enlarge the capacity of their works.

Personal

MR. E. L. SIMONTON, formerly electrician of the Lincoln Electric Street Railway, has resigned.

MR. H. R. McLEOD has left the Portland & Cape Elizabeth Railway Company, of Portland, Maine.

COL. G. W. PARKER has been elected president of the Springfield Traction Company, of Springfield, Mo.

MR. WILLIAM P. GANNON has been elected president of the Syracuse Rapid Transit Railway Company, of Syracuse, N. Y.

MR. JOHN M. BLATT has resigned from the superintendency of the Milwaukee, Racine & Kenosha Electric Railway Company.

MR. EDWIN WARNER has been appointed secretary and treasurer of the Birmingham Electric Railway Company, of Birmingham, Ala.

MR. FREDERICK SARGENT, of Sargent & Lundy, Chicago, has been appointed consulting steam engineer for the Boston Elevated Railway.

MR. EDWARD W. DECKER has left the Portland & Yarmouth Electric Railway Company, of Portland, Maine, of which he was formerly superintendent.

MR. L. C. WEIR has been elected president and general manager of the Weir Frog Company, of Cincinnati, Ohio, in place of F. C. Weir, who died on March 1, 1899.

MR. JOHN CLIFFORD has been appointed superintendent of the Wilkesbarre & Wyoming Valley Traction Company, of Wilkesbarre, Pa., in place of John Meixwell, resigned.

MR. CHARLES F. FRANKLIN, superintendent of the Newburgh Electric Railway Company, has resigned his position to accept a situation as superintendent of the Ohio Southern Railroad.

PROF. A. B. W. KENNEDY, of London, is visiting America with a view to examining American electric railway practice and to render a report to the London County Council upon the results of his investigations.

MR. MAURICE HOOPES, electrical engineer of the Lynn & Boston Railway Company, has resigned that position to take charge of the building of a new railway between Albany and Hudson, N. Y. His place at Lynn will be taken by Mr. William Pestell.

MR. S. W. JAMISON, general manager of the Roanoke Street Railway Company, of Roanoke, Va., has resigned that position, and will be succeeded by George C. McCahan, who has been made superintendent of both the street railway and electric light companies.

MR. F. E. DRAKE, director of machinery and electricity of the American commission to the Paris Exposition of 1900, sailed for Europe on the "Lucania," on March 11. He will spend most of his time in Paris negotiating for several engineering concerns, and in going over the field of the exposition work preliminary to taking up the detail of the final allotment of space.

MR. E. K. STONE, JR., of Quincy, Ill., writes that through the similarity of names, his father's death, which occurred Nov. 28, 1898, has been quite generally misunderstood to be his own. Mr. Stone states that he has sold out his interests in the local road at Quincy, but expects to continue in the same line of business.

AMONG THE MANUFACTURERS

THE E. W. BLISS COMPANY, of Brooklyn, N. Y., is sending out a folder describing the new pattern Bliss inclinable power presses for the manufacture of sheet metal goods.

BRYAN & HUMPHREY, consulting mechanical and electrical engineers, of St. Louis, announce their removal from their old offices to rooms 706-708 Lincoln Trust Building.

FREDERICK J. GRAF, of New York city, states that he has received the highest award for fenders at the American Institute exhibition, held at Madison Square Garden, New York.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, has placed its New England office, which is located at 170 Summer Street, Boston, in charge of F. B. Smith.

THE JOSEPH DIXON CRUCIBLE COMPANY, of Jersey City, N. J., is sending out another one of its extremely unique and ingeniously gotten up brochures describing Dixon's pencils for all kinds of use.

THE FALK COMPANY, of Milwaukee, Wis., has secured the plant and business of the Western Gear Company, of Milwaukee, and will continue the manufacture of the gears and pinions formerly made by that company.

THE ELECTRICAL INSTALLATION COMPANY, of Chicago, has secured a contract for all the overhead work for the northeast division of the Brooklyn Avenue Railway, at Kansas City, Mo., which includes 4 miles of double track. The work will be of span wire construction with iron poles.

COMPAGNIE HEILMANN, of Paris, France, manufacturer of electrical locomotives, announces that it has been decided to change the title of the company to the Société Anonyme de Locomotion Electrique. No other change will be made in the status of the company. The Paris office is at 2 Rue Pasquier.

CHARLES A. BROWN and GEORGE L. CRAGG, of Chicago, have recently formed a partnership under the firm name of Charles A. Brown & Cragg for the practice of law, giving special attention to patent, trade-mark and copyright litigation and to the soliciting of United States and foreign patents. With the firm will be connected A. L. Lawrence.

THE DUPLEX CAR COMPANY, of New York, has in operation one of its new cars on the experimental line of the Safety Third Rail Company at Manhattan Beach. The Duplex Car Company, whose offices are in the Postal Telegraph Building, is daily receiving inquiries from street railway companies regarding its new form of car and is also receiving flattering testimonials.

PRESTON, COHEN & CO., of Philadelphia, Pa., have made arrangements for handling the goods of some of the leading manufacturers of electrical and street railway supplies at their Philadelphia office, 1004 Real Estate Trust Building. The members of the new firm have had considerable experience in this line of work, and with their present facilities will undoubtedly make a complete success of their new venture.

THE LOMBARD WATER-WHEEL GOVERNOR COMPANY, of Boston, has received an order for three additional type "B" governors for the plant of St. Anthony Falls Water Power Company, of Minneapolis. These governors are for the three additional units of the four Victor turbines each, which are to be installed. This will make in all ten Lombard governors in the above named plant, regulating forty water wheels.

IT IS ANNOUNCED that the partnership heretofore existing between J. R. McCardell, C. H. West and M. J. McDonald, under the firm name of McCardell, West & Co., was dissolved by mutual consent on March 20, 1899, Mr. West withdrawing from the firm. J. R. McCardell and M. J. McDonald have purchased the entire interest in the business, patents, etc., and will continue the business under the firm name of McCardell & Co., at Trenton, N. J.

FRANK H. MONKS, who is well known as the former master mechanic of the West End Railway Company, of Boston, now the Boston Elevated Railway Company, is doing a large business as expert on street railway properties in all parts of the country. Mr. Monks, by experience, is well fitted for determining the value of street railway properties and making suggestions for their improvement, and numbers among his clients the properties of many prominent lines, as well as general investors.

EUGENE MUNSELL & CO., of Chicago, will open a large mica factory at Ottawa, Can. Extensive buildings on Wellington Street have been leased and it is the intention to forward the mica direct from the mines to the factory, where it will be carefully examined and prepared for shipment to New York. Eugene Munsell & Co. now have establishments in New York, Chicago, St. Louis, Cincinnati, San Francisco, and London, Eng., and the opening of these new works is a good indication of the company's prosperity.

THE GARTON-DANIELS ELECTRIC COMPANY, of Keokuk, Ia., reports that orders for its lightning arresters are coming in almost faster than they can be cared for. During the winter this company had prepared twice as large a stock of arresters as last year, but the spring demand has required it to double its force to keep up with orders. Additional help will be secured, however, and all orders will be shipped with promptness. This company's new catalogue, No. 22, is having a large demand and it may be necessary to issue a second edition.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., is sending out its catalogue No. 96, for 1899, and also a little eight-page leaflet devoted to the subject of mechanical draft. Catalogue No. 96 describes and illustrates the Sturtevant steel plate fans for all kinds of service, and will be of great value to any one needing appliances of this kind. The leaflet on mechanical draft contains among other views, an illustration showing the relative size of a fan and chimney required for the same boiler capacity with mechanical draft and natural draft respectively.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, of Newark, N. J., is sending out its complete catalogue for 1899, of the Weston standard electrical instruments. These instruments are built in an almost unlimited number of sizes, styles and shapes, and for every class of service required. They are made under the most careful supervision and all parts are turned out and fitted by experts in this line. In addition to this, each instrument is thoroughly tested and checked before it leaves the factory, so that the name of "Weston" on an electrical instrument is a guarantee of no mean value.

THE ARCHITECTS AND ENGINEERS Electrical Bulletin for February, which is published by the Sprague Electric Company, is just out in a new cover. This bulletin has been published for some time and contains facts and figures of interest to architects and engineers that cannot be secured in any other publication. The issue for February includes, among other articles, the following: "Automobiles," "Electric Heating, and Surface Contact Electric Railways," by E. H. Johnson; a description of the Sprague multiple system, by C. R. McKay; "Electric Wiring Practice," by Fred. Bathurst.

EDWARD ROBINSON, proprietor of the Wells light, will be one of the passengers on the "Lucania," April 8. Mr. Robinson goes to England and the continent on a combined business and pleasure trip and expects to be absent about six weeks. The Wells light is regarded as the most simple and practical lighting device for use in night construction, for shop work, heating heavy metal, etc., and, owing to the unusual activity in the electric and steam railway fields, the company's business for the season has been the largest in its history. The Klondike has opened up a new field for this device, the company having already shipped twenty outfits there for melting the ground.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., has published a new catalogue on transformer design and operation which is very complete. Among the recent pamphlets and printed matter issued from the printing department of this company are the following: Bulletin No. 4164, devoted to series enclosed arc lighting with alternating current; bulletin 4163, on alternating current induction motors, type I. S., for single phase, 60 cycle, 115-volt circuits, and bulletin 4165, on small direct coupled generating sets. In addition to the above, folders have been issued describing porcelain clamp insulators, T. H. lamp sockets and receptacles, single pole primary switch and fuse boxes.

ELMER P. MORRIS, 15 Cortlandt Street, New York, has secured the contract for 45,000 ties, 140,000 lbs. copper, 17 miles of this being an improved figure-8 design of wire, 650 flexible brackets, all of the overhead material, 2000 tons girder and T rails, 900 wooden poles, and all of the bonds for the Elmira and Seneca Lake Electric Railway, Elmira, N. Y. Mr. Morris has also closed large orders for iron poles from the Brooklyn Heights Railroad Company, Brooklyn; Union Railway Company, New York; the Columbia Railway and the City & Suburban Railway Company, Washington, D. C.; the New Jersey Electric Railway, Newark; 1100 poles for Plainfield, N. J., and iron poles and copper wire for Phœnixville, Pa.

THE TAYLOR ELECTRIC TRUCK COMPANY, of Troy, N. Y., manufacturer of high grade trucks for electric service, has published a new catalogue describing the various types of trucks which it makes. This company claims to fully supply the demand for trucks that are simple in construction, economical in management and easy riding in service. The wheels, axles and all wearing parts are made interchangeable in both the single and double types and contain only the best materials and workmanship. The catalogue contains an interesting illustration of one method of testing the side frames used in the construction of these trucks. In this test the journal boxes are supported solidly and a pressure of 2160 lbs. was placed on each end of the frame, which endured the weight without the least deflection.

THE VOSE SPRING COMPANY, of New York, reports an increasing demand for its various products. Among the specialties that this company is now producing are rubber center yoke springs for journal boxes of electric cars, the Vose patent rubber and iron core springs, coil and elliptical springs for all standard types of electric trucks, trolley springs and brush holder springs, rubber springs, washers and cushions, rubber blocks for elliptical springs, etc. Gustave Suckow, the genial general manager of the company, is probably one of the best known men in the street railway supply trade. He commenced work with this company when but thirteen years old, and has been with it for over twenty-two years and is largely responsible for the satisfactory business it is now enjoying.

THE SIEGRIST LUBRICATOR COMPANY, of St. Louis, Mo., is receiving numerous orders for its well known automatic oiling system. The Southern Electric Railroad Company, of St. Louis, has installed this system on all the engines in its large power station, and the Metropolitan Elevated Railway Company, of Chicago, has also ordered this device for use on two new Allis engines now being installed. The Metropolitan Elevated Railway Company has used the Siegrist system for both cylinder and engine oil for over four years. The Siegrist automatic oiling system has also been specified by Armour & Company for use on a new ice machine and two new Corliss engines now being installed at South Omaha, Neb. This order is given after eight months' use of the system on the other machinery in the Armour plants.

HEDDEN & WHEELER, of Newark, N. J., manufacturers of varnishes, iron paints, etc., report that the growth of their business in iron paint during the past year has been very satisfactory. This paint meets the approval of everyone using it, and letters of commendation are being constantly received. The paint is well adapted to use on all exposed metal work such as electric railway poles, bridges, etc., and a number of street railway companies are using it in large quantities. Among the latter are the Consolidated Traction Company, of Jersey City, N. J.; Buffalo Railway Company, of Buffalo, N. Y.; Camden & Suburban Railway Company, Camden, N. J.; Portland Railroad Company, Portland, Maine; Middletown-Goshen Traction Company, Middletown, N. Y.; Plainfield Street Railway Company, Plainfield, N. J., and many others.

ARTHUR W. FIELD, of Boston, sole New England agent of the Peckham Truck Company and the American Car Company, has just sold the Boston Elevated Railway Company seventy Peckham Excelsior trucks to be used under the nine bench cars of the American Car Company's make, which he sold last January to the same company, and thirty pairs of Peckham maximum traction trucks to be used under the twelve-bench open cars of the American Car Company's make, which he sold to the Boston Elevated Railway Company in connection with the above. He also reports the sale of eight cars to the Western Construction Company, of New Haven, Conn., to be used on the line of the Ohio Central Traction Company, which owns a 12-mile road extending from Galion to Bucyrus, Ohio. Four of these cars are 26-ft. double truck closed cars, two of which have baggage compartments. The other four are ten-bench open cars. Mr. Field reports over $125,000 worth of business since Jan. 1.

L. E. MYERS, Monadnock Building, Chicago, has just secured the contract for building an 8-mile extension of the lines of the Chicago Electric Traction Company, from Blue Island to Harvey, Ill. Under the successful management of E. R. Gilbert, this road is giving excellent promises. Mr. Myers has also secured the contract for building and equipping the Peoria & Pekin Terminal Railway, 12 miles long at Peoria, Ill. The contract includes a power house with steam and electric equipment of 1000 h.p., car barns, round house, machine shops, office buildings and three passenger stations. A 1200-ft. steel bridge with a 380-ft. draw span will be built across the Illinois River. The contract for this has already been let to the Schultz Bridge & Iron Works. Another steel bridge 150 ft. long will be built across the Kickapoo River. The line will be equipped with both steam and electricity, the steam equipment being used for handling freight, and including fifty coal cars and three 70-ton locomotives. Seventy-pound, 60-ft. T rail and 000 figure-8 trolley wire will be employed.

W. R. GARTON COMPANY, of Chicago, has just been appointed exclusive representative of the Electrical Railway Equipment Company, of Cincinnati, Ohio, for its entire line of specialties in the Middle Western States, Chicago being the headquarters for this territory. The Garton Company will carry a very complete stock of everything necessary for the equipment of electric railways, including motor supply and repair parts. Among other concerns which this company represents are the following: Massachusetts Chemical Company and C. S. Knowles, of Boston, Keystone Electrical Instrument Company, of Philadelphia; Pittsburgh Steel Hollow Ware Company, of Allegheny, Pa.; Empire Lamp Works, Graphite Lubricating Company, of Bound Brook, N. J.; Garton-Daniels Electric Company, of Keokuk, Ia.; Partridge Carbon Company, of Sandusky, Ohio; Billings & Spencer Company, of Hartford, Conn., and it is prepared to make prompt shipments of all the products manufactured by these establishments. The Garton Company is also exclusive agent for the celebrated American incandescent lamp, which is made for all voltages and in all types. The company reports that its volume of business is extremely gratifying and it looks for a still greater increase during the coming season.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., reports the following recent sales of Cochrane heaters: Minnesota Iron & Steel Company, 350 h.p.; Dayton & Western Traction Company, West Alexandria, Ohio, 300 h.p.; Chase & Company, Boston, 150 h.p.; Sears, Roebuck & Company, Chicago, 100 h.p., special; Douglas & Company, Minneapolis, Minn., 200 h.p.; McGinn & Lewis, Pittsburgh, 350 h.p., special; Avondale Mine, Plymouth, Pa., 850 h.p.; Parke & Lacy Company, San Francisco, Cal., 50 h.p.; Imperial Ice Company, Philadelphia, 100 h.p.; Bland, Bullen & Gund Company, Chicago, 350 h.p.; Liberty Mills, San Antonio, Tex., 200 h.p.; Republic Marble Company, Luttrell, Tenn., 150 h.p.; Pana (Ill.) Modern Electric Light, Power & Street Railway Company, 500 h.p.; Alabama Ship Building & Dry Dock Company, Birmingham, Ala., 3000 h.p.; Pabst Brewing Company, Milwaukee, Wis., 500 h.p., and many others. The company also reports the following sales of Cochrane separators: Pejepscot Paper Company, Pejepscot Mills, Maine, 10-in. horz.; J. D. McRae & Bro., Chicago, 4-in. horz.; Empire State Dairy Company, Brooklyn, N. Y., 4-in. horz.; Nutter & Seabury, Boston, 8-in. horz.; Estey Organ Company, Brattleboro, Vt., 8-in. horz.; Warner Bros., Chicago, 4-in. horz.; La Compagnie Generale Glace Hygienique, Paris, France, 6-in. horz.; Atlas Cement Company, Northampton, Pa., 4-in. horz.; United Shirt & Collar Company, Troy, N. Y., 6-in. horz.; Monessen (Pa.) Steel Company, two 5-in. vert., one 6-in. vert., and one 8-in. vert., also 6-in. horz.; Dover Iron Company, of New Jersey, 8-in. horz.; Dill & Collins, Philadelphia, 6-in. horz.; Fergus Falls (Minn.) State Hospital, 4-in. vert.; P. Cogan & Son, Stoneham, Mass., 4-in. horz.; Walworth Construction & Supply Company, Boston, 5-in. horz., and many others.

New Publications

Fourteenth Annual Report of the Board of Gas and Electric Light Commissioners of the Commonwealth of Massachusetts. Paper. 210 pages, with appendix of 158 pages. Published by Wright & Potter Printing Company, State Printers, Boston, Mass.

This very complete report contains full financial and other information pertaining to the 158 companies, and the gas and electric light plants in fourteen towns and two cities which are under the supervision of the Board of Gas and Electric Light Commissioners.

Trade Catalogues

Various Catalogues. Published by the General Electric Company, of Schenectady, N. Y.

Trucks. Published by the Taylor Electric Truck Company, of Troy, N. Y. 39 pages. Illustrated.

Steel Plate Fans. Published by the B. F. Sturtevant Company, of Boston, Mass. 131 pages. Illustrated.

Attractions for Pleasure Resorts. Published by J. W. Gorman, Boston, Mass. 32 pages. Illustrated.

Mechanical Draft. Published by the B. F. Sturtevant Company, of Boston, Mass. 8 pages. Illustrated.

Biddle's Bulletin for February, 1899; Volume 1, No. 9. Edited by James G. Biddle, of Philadelphia. 8 pages.

Electrical Instruments. Published by the Weston Electrical Instrument Company, of Newark, N. J. 60 pages. Illustrated.

Architects and Engineers Electrical Bulletin for February, 1899. Published by the Sprague Electric Company, of New York. 50 pages. Illustrated.

...SUPPLEMENT...

TO THE

Street Railway Journal

Expert Opinion of the New Rapid Transit Proposition in New York

[The following letter, written by President Stuyvesant Fish, of the Illinois Central Railroad Company, to Chairman Orr, of the New York Rapid Transit Commission, has just come into our possession, and is so full of valuable suggestions, based on the writer's experience with the extremely interesting transportation problems in Chicago, that we have decided not to postpone its publication until next month, but to give it at once to our readers.—Editors Street Railway Journal.]

ILLINOIS CENTRAL RAILROAD COMPANY, 214 Broadway.
NEW YORK, March 29, 1899.

MY DEAR SIR:

Permit me to add my congratulations to the hundreds which you must be receiving over the success of the Rapid Transit Commission in securing so fair a proposition as appears to have been made on behalf of those controlling the Metropolitan Traction Company, and to submit some considerations, based on a long experience, in respect to rapid transit in Chicago.

Bear in mind that I am in no way interested in any present or prospective line of communication on Manhattan Island, nor have I ever been so interested in any, and that the Illinois Central Railroad Company has now been running suburban trains in Chicago for over forty years.

I.

A hurried reading of the proposition before you, as given in the newspapers, has not enabled me to see that the vital point of speed of ordinary trains is guaranteed.

The title and the reason for the being of your commission require you to exact rapid transit and that of the rapidest kind consistent with safety and comfort. The utter inefficiency of existing means and the failure, in the past, of such means to even keep abreast of the times, much less to meet a growing demand, require that such guarantees of speed should be most strict, and broad enough to cover the needs of the future.

As no such guarantees can be fulfilled if the carrier is hereafter to be burdened with the payment of an excessive per cent of its profits as taxes, or restricted too much in respect to maximum charges, a liberal, broad-minded, live-and-let-live policy should be adopted and adhered to in this respect.

The Manhattan Elevated Railway, which, after all, affords our nearest approach to rapid transit, advertises, in the "Official Railway Guide," the following schedules on Manhattan Island for its express trains:

Second Avenue,
South Ferry to 129th Street:

Miles	8.81
Minutes	40
Miles per hour	13.21

Third Avenue,
South Ferry to 129th Street:

Miles	8.48
Minutes	40
Miles per hour	12.72

Sixth Avenue,
South Ferry to 155th Street:

Miles	10.76
Minutes	49
Miles per hour	13.17

Ninth Avenue,
South Ferry to 155th Street:

Miles	10.07
Minutes	42
Miles per hour	14.39

Including the initial and terminal points, there are advertised as being on the

Second Avenue	27 Stations in	8.81 miles.
Third Avenue	38 Stations in	8.48 miles.
Sixth Avenue	31 Stations in	10.76 miles.
Ninth Avenue	29 Stations in	10.07 miles.

But the express trains stop at comparatively few of these stations.

The number of stops made by their express trains is unknown to me, but, of course, accessible to you.

The speed of the Manhattan Company's other, local, trains is much less.

Now the ordinary or local trains of the new "Tunnel Company" will meet with no competition as to speed of a higher order than that which is or may be afforded by the trains of the Manhattan Company.

It would, therefore, seem necessary that you now require of the tunnel company a guarantee of such minimum speed on its ordinary trains as it can perform and you may deem satisfactory.

The only thing which I have found in the tunnel company's proposition in respect to speed applies solely to express trains, and is as follows:

"No train to be deemed an express train except one which is scheduled to run, and, barring accidents, does customarily run, over its entire route below Ninety-sixth Street at the rate of 20 miles an hour, and for at least 2 miles below Forty-second Street at the rate of 30 miles an hour."

It is not stated that intermediate stops are to be made below Forty-second Street, and from the different speeds offered above and below that street, it is to be inferred none will be made by express trains.

The distance from Forty-second Street to the southern terminus will, if the latter be placed at South Ferry, amount to about 4 miles. Time, eight minutes.

The distance from Ninety-sixth Street to South Ferry will be about 6.75 miles. Time, a trifle over twenty minutes.

While I would deprecate a discussion of details, and do

not advocate trying to bind the tunnel company too strictly, I beg to submit from the printed schedules of the Illinois Central Railroad Company what is being done in Chicago.

The plant comprises, in addition to side tracks, the exclusive use of two main, or running, tracks, from the initial station, Randolph Street (in the business center) to the next station, Van Buren Street (64-100 of a mile), four running tracks thence to Sixty-seventh Street (8.21 miles from Randolph Street), and two running tracks thence out of town.

There is a local service stopping at every station (seventeen stations in 8.21 miles, from Randolph Street to Sixty-seventh Street, inclusive), and also an express service. Both start on the same tracks from Randolph Street Station, each stops at Van Buren, and the express trains run thence to Hyde Park (6.38 miles from Randolph Street) without stopping, and thereafter make various stops.

ILLINOIS CENTRAL R. R.

Local Suburban Trains.

Randolph Street to Douglas Station:	
Miles	4.01
Stops at all stations	8
Minutes	13
Miles per hour	18.51
Randolph Street to South Park:	
Miles	6.88
Stops at all stations	14
Minutes	22
Miles per hour	18.76

ILLINOIS CENTRAL R. R.

Express Suburban Trains.

Randolph Street to South Park:	
Miles	6.88
Stops	4
Minutes	13
Miles per hour	31.75
Van Buren Street to Hyde Park:	
Miles	5.74
Stops	2
Minutes	9
Miles per hour	38.27

I have, throughout this letter, included the initial and the terminal stations; the express trains make no intermediate stop between Van Buren Street and Hyde Park

The motive power used by the Illinois Central consists of steam locomotive engines, most of which were built many years ago. If the tunnel company is to be tied down to electricity as a power, it cannot, in the present state of the science, be required to make the speed of our trains. We believe, however, that before long it may become possible to move trains by electricity on our schedules, and we have been carefully watching developments in that direction for many years.

On the other hand, the use of electricity as a motive power, in an underground tunnel, will admit of thoroughly heating the stations and platforms, and of using, throughout the year, side-loading cars. We found, during the World's Fair, that the use of such cars effected a great saving of time at stations.

Without professing to know, I should guess that the tunnel company could safely covenant to put in stations averaging about half a mile apart (those of the Manhattan Company averaging a little less than one third of a mile apart), and to run their local trains at a minimum speed of 15 miles per hour, including stops at each, from Forty-second Street south, and also to guarantee a minimum speed of 17 miles per hour, including a stop at each station for the whole distance from Ninety-sixth Street to the southern terminus.

This would give from Forty-second Street to South Ferry a local schedule of sixteen minutes, and from Ninety-sixth Street to South Ferry one of twenty-seven minutes, with corresponding time from intermediate points.

Unless from and to all stations something faster than the so-called express service of the Manhattan is guaranteed and furnished, the tunnel company will neither furnish rapid transit nor be able to survive in competition with the Manhattan.

A guarantee of such speed will prevent an amalgamation with the Manhattan far more effectual than any statutory prohibition, which, after all, is subject to repeal. It will also stimulate the Manhattan to do better, and in my judgment to fare better thereby.

II.

The right to charge an extra fare up to not exceeding ten cents on express trains should be granted, (*a*) in order to prevent those trains being overcrowded by passengers wishing to ride only from one station to the next and incommoding those performing a longer journey, while saving but a fraction of their own time; (*b*) in order to induce the carrier at all times hereafter to keep up that service to the highest standards of safety, efficiency and speed, and thereby make life livable in the upper part of Manhattan Island and the annexed district; (*c*) because the length of the journey, 6.75 miles now, and potentially much more, justifies the charge, especially in view of the tremendous verdicts now so often awarded in personal injury cases, and the expense to which carriers are put through the wiles of shyster lawyers and perjured witnesses in such cases.

Disregarding persons of ample means, to whom the extra five cents each way *per diem* or $36.50 a year is of no consequence, there are occasions in the life of all, except the absolutely penniless—festivals and funerals, times of illness and complete exhaustion, the necessity to catch a train or meet an appointment—in which they would gladly pay five cents for extra comfort and speed in transit. That our civilization and methods of life have advanced to this point is shown by the universal use of sleeping, dining and drawing-room cars on railroads, of providing staterooms as well as mere sleeping berths on all our river and sound steamers.

That the public will gladly pay an extra fare for higher speed was demonstrated in Chicago in 1893, although as a people we were all then economizing severely.

This is made clear by the following extracts from published reports.

Annual report of the Illinois Central Railroad Company for the year ending June 30, 1894, page 1:

"During the six months, from May 1 to Oct. 31, 1893, there were carried, at a uniform fare of ten cents for a journey of over 9 miles, 8,780,616 passengers on the special World's Fair trains, without serious injury to any of them. In the regular suburban trains there were carried during that period 9,358,695 passengers, and the travel in the other passenger trains was also unusually large. The universal satisfaction with the facilities afforded, as expressed by the public through the press and by the directors of the World's Columbian Exposition in formal resolutions, redounds highly to the credit of the service and of the officers and employees engaged therein. The fact that the fare charged by the company was double that of its principal competitor, the elevated railway, demon-

strates that the public are willing to pay reasonable rates for adequate service, when performed with promptness, safety and comfort to the passenger."

Mr. H. N. Higinbotham, president of the World's Columbian Exposition in his report to the board of directors of that corporation, dated Jan. 1, 1898, states, at page 306, that the Illinois Central Railroad Company estimated the number of passengers carried upon its trains between the city and the fair as follows:

Express or special World's Fair trains	8,779,393
Local suburban trains	9,559,791
Other trains	1,003,600
Total by I. C. R. R.	19,342,784

And on the next page (307) he gives the number landed in the fair grounds by the elevated railroad as 4,352,409

Dividing the number carried by the Illinois Central by two, so as to get at the actual number of passengers brought to the fair, we have.. 9,671,392

From which we must infer that at that time and place two-thirds of those who traveled by rail preferred to pay ten cents for a quicker, instead of five cents for a slower, service.

The initial stations of the Illinois Central Railroad, and of the elevated railway referred to, were within about a quarter of a mile of each other, and the latter had the more central location. The elevated also enjoyed the advantage of picking up passengers at many intermediate stations, which the Illinois Central could not do on its special World's Fair trains, but only on its regular suburban trains, and to a very limited extent, if at all, on its other trains, referred to by Mr. Higinbotham.

III.

At the risk of getting into details, let me also suggest that the tunnel company be required to find a seat for each passenger. This can be done. It was done, with few and rare exceptions, all throughout the summer of 1893 in our World's Fair trains. It is done daily on the London underground railways, indeed on all English railways with rare exceptions. The use of side-loading cars makes this possible, and it was largely from my experience while traveling abroad that I insisted on the use of that form of car for that special service. It also has the merit of economy of space by giving a much greater seating capacity in proportion to length of train, and consequently of platform. The latter will prove a vital consideration to the tunnel company.

IV.

You have doubtless gone too far to now take up one more suggestion which has been "borne in" on me.

As yet electricity has not been applied in such a way as to give a service equal in speed to that furnished by the Illinois Central in Chicago by using steam. After the most careful, painstaking and patient investigation, we have been forced to adhere to the use of steam, although anxious on many accounts to substitute electricity.

In a tunnel, steam would be intolerable, witness the London underground steam railways.

While I believe electricity can be hereafter so used as to develop schedules about equal to those which we now have in use in Chicago, there is as yet nothing to show that better can ever be done through the use of electricity. Our investigations teach us that with each added unit of speed the cost increases more rapidly where electricity is used than where steam is used.

When your commission began its labors, and even when it formulated and promulgated its plans, the success of the underground trolley had not been demonstrated here in New York. You therefore turned to an underground railway as the only solution.

If not too late, might I suggest at least the consideration of the following plan:

The city has been for many years widening West Street, and has the similar improvement of South Street in view. Why not build on each of these streets (widened) a four-track elevated railroad on which express and local trains can be run as fast as are those of any railroad, and with the same indefinite possibilities as to speed in the future?

In order to avoid the long bend of the East River, which culminates in Corlears Hook, the line on that side of town might leave South Street in the neighborhood of Pike, run through private property to the southern terminus of Essex Street, along that street (widened) until Avenue A is reached, and thence up that avenue.

The other line on the west side might take up the general course of Eleventh Avenue, or possibly Twelfth.

Roughly speaking, the distance between Avenue A and Twelfth is a trifle over 2 miles.

Given two such railroads as are herein suggested, with an express service on each at the rate of at least 40 miles an hour, and local service at at least 20, and trolley lines across town on suitable streets, making 6 miles an hour—as the distance from the Battery to Harlem Bridge is less than 9 miles—one could go from any central point down-town to his home on Manhattan Island below 130th Street in twenty-three and one-half minutes, as follows:

Battery to Harlem,

Express 9 miles at 40 miles per hour.... 13½ minutes.

Across town,

Trolley 1 mile at 6 miles per hour..... 10 minutes.

Total ..... 23½ minutes

This would be something worth having.

The New York Central & Hudson River Railroad might accept the use, during the night, of two tracks on the west side line, from its depot in St. John's Park, to, say, Thirtieth Street, and give up its tracks in Eleventh Avenue and other streets south of, say, Thirtieth Street.

The use of the remainder of two tracks for freight purposes during the night would prove a great source of revenue, relieve our congested streets, make property along both lines valuable for storage purposes and equip this city, as it never can in any other way be equipped, to handle freight cheaply and promptly in competition with other ports and cities.

The magnitude of the interests involved and the possibilities now in sight must excuse so long a letter.

With renewed congratualtions and best wishes for an ultimate, complete and final success, believe me,

Very respectfully yours, Stuyvesant Fish.

To the Hon. Alexander E. Orr,
Chairman of the Rapid Transit Commission.