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RECENT INTERURBAN ELECTRIC RAILWAYS.

E.J.

The possibilities of the profitable competition of electric systems with steam lines for interurban service promises to be given a thorough trial during the coming year in several sections of the country. It is interesting to note that practically all enterprises of this character which have been put into operation in this country have been built by purely electric railway companies, the steam railroad companies which had occupied the field showing no disposition to change from steam to electric power. So far as indications go, the electric railways have been successful in securing a fair amount of traffic, a considerable part of which has usually been taken from their steam railroad rivals. The general tendency is to an increase in the number of such lines, largely following steam railroad models in roadbed and car construction, and toward their use to a considerable extent of highways, thus securing not a little local traffic. This, however, will prevent the maintenance of a very high rate of speed. It is the purpose of the following article to describe some of the most recent lines of this character, including an account of the method of caring for freight on one urban railway with a long interurban branch.

A number of interurban lines have been recently completed in the northern part of Ohio, most of them having the city of Cleveland as a terminus. As the map of Cleveland and vicinity, published on the following page, will show, these lines extend in nearly every direction from that city, and are operated in direct competition with steam railroads with which that district is well supplied.

The entrance into Cleveland of those railways which have one terminus in that city is effected over the lines of the present urban system, so that passengers can take cars from any point within the city reached by the city lines with which these railways connect. The right of the city companies under their franchises to allow cars of outside companies to use their tracks has been questioned by the city authorities, but as the cars change crews at the city line and within the city are operated by the employes of the city company, and as all fares are collected by and for the latter, they become for operating purposes the property of the city company, and hence have as much right to use the streets as any other cars. At least this is the ground taken by the street railway companies.

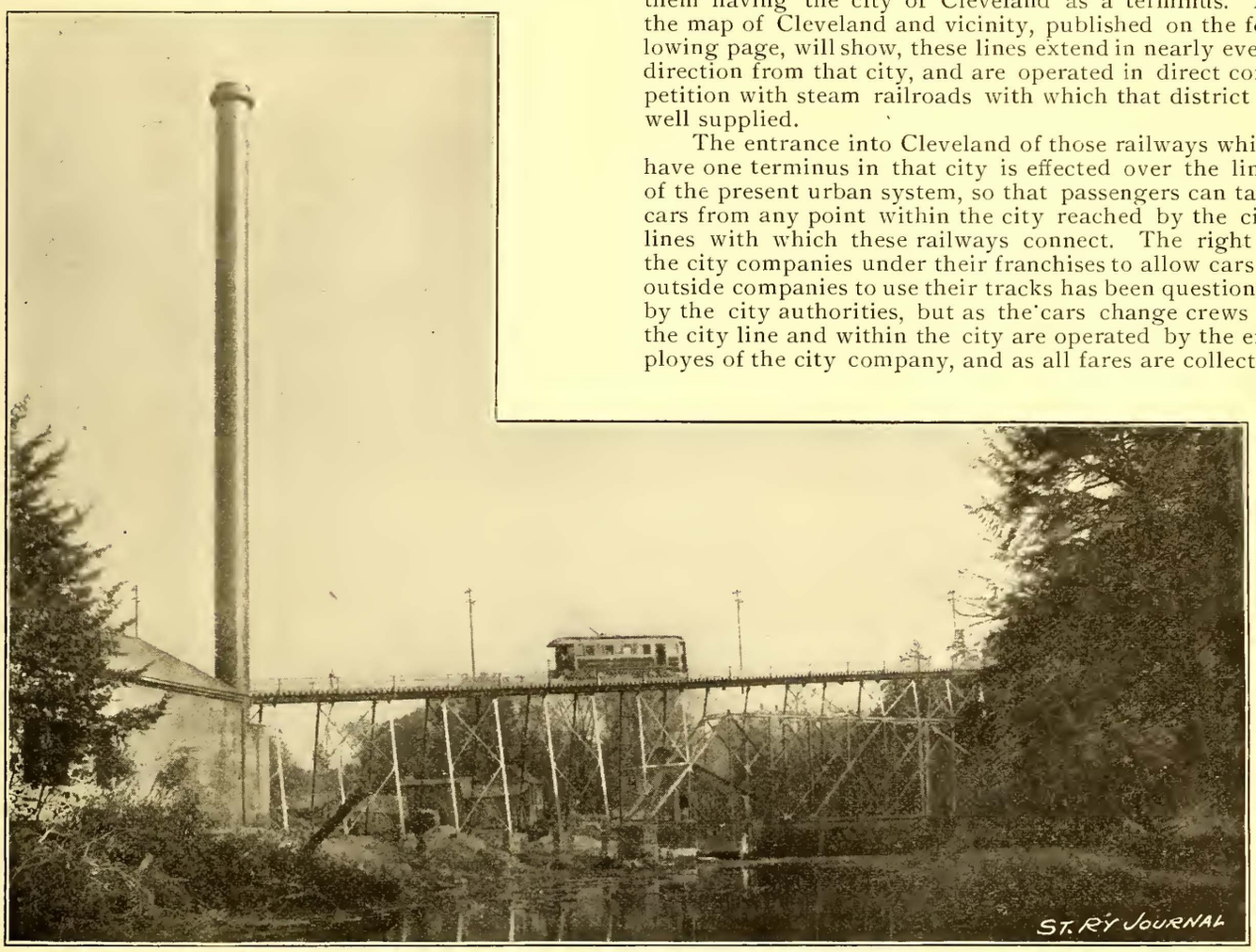


FIG. 1.—POWER STATION AND TRUSS BRIDGE—AKRON, BEDFORD & CLEVELAND ELECTRIC RAILWAY.

The running time from terminus to terminus of the interurban lines is, in most cases, somewhat greater than that required by the steam trains, but the ability to board and leave cars at more convenient points, coupled with the considerably lower fares charged by the electric lines, will, it is thought, bring to the latter a great deal of traffic now carried by their steam rivals, and in addition will

create a great deal of travel. In fact, along the line of the railways built from Cleveland, the value of the real estate has increased rapidly, and in some cases has risen as much as 100 per cent above the price at which it was formerly held. It has been found that, as a result, many of those who were most strongly opposed to the building of these lines are now among their best friends.

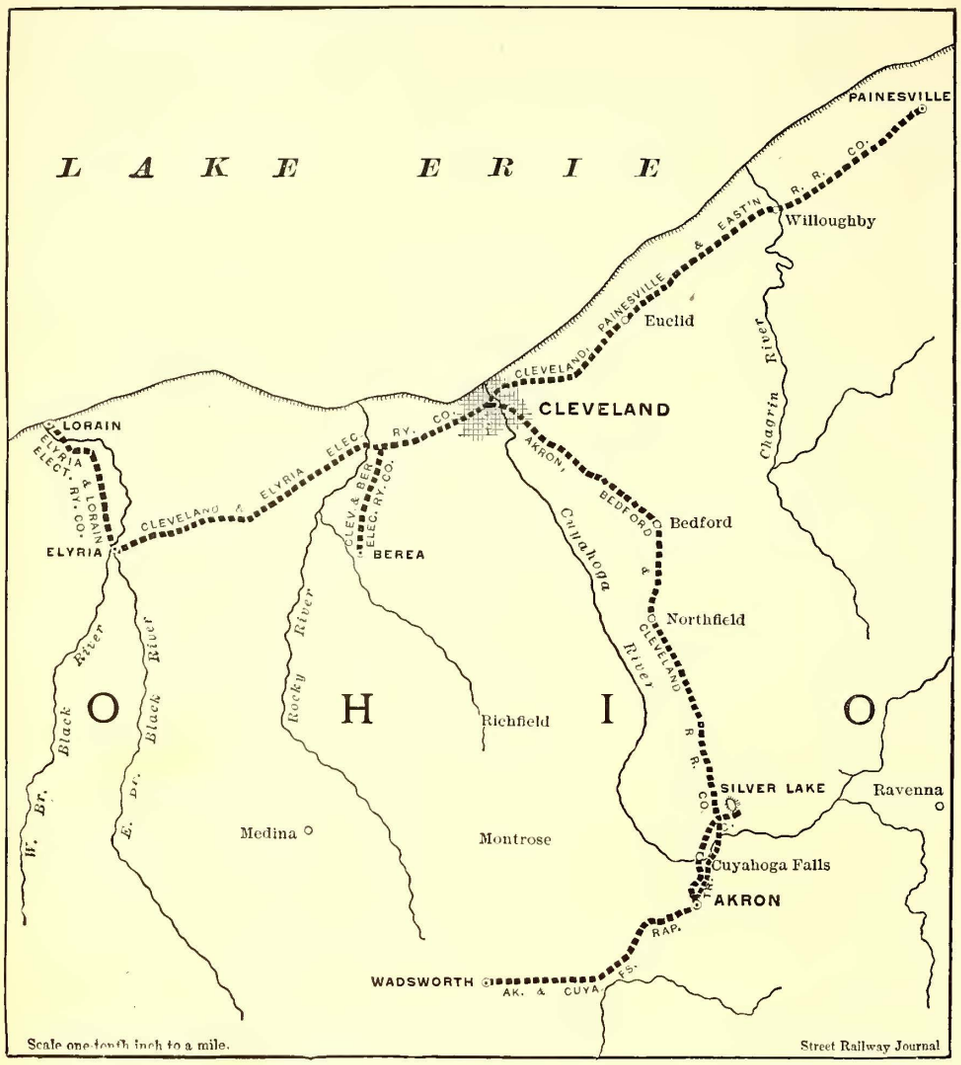


FIG 2.—MAP SHOWING INTERURBAN ELECTRIC RAILWAYS ABOUT CLEVELAND.

THE AKRON, BEDFORD & CLEVELAND RAILWAY.

This railway, known as the A. B. C., or alphabet line, has a length of thirty miles, mostly single track, and extends from Akron through Bedford to the city limits of Cleveland, where the cars enter the city over the tracks of the Cleveland Electric Railway Company. In Akron the tracks of the Akron Street Railway Company are used. The length of route from the business center of Akron to that of Cleveland is thirty-four and one-half miles. The company is organized under the regular steam railroad law of Ohio.

The fares charged are, single trip 60 cents, round trip $1.00. For this amount a person can go from any point on the street railway lines in Akron to any point on the lines of the Cleveland Electric Railway Company, or *vice versa*. Excursion tickets for theatre parties are sold at a reduced rate. The steam railroad fare is now $1.05 one way, and $1.90 for the round trip. The electric cars run every half hour and make the trip in one hour and fifty minutes. Between the city limits of Cleveland and Akron the running time exceeds twenty-five miles per hour, including stops. The road was put in operation about December 10, 1895.

A serious accident occurred on January 9, on the line of the railway at Bedford where the railway crosses Tinker's Creek. The bridge here is 164 ft. long with a center span of 140 ft., the height at the middle of the bridge being 65 ft. The center span was a truss with a trestle approach. Owing to the fact that the summit of the south bank of the creek is considerably higher than that of the north bank, there was a grade of about six per cent. on the bridge. A view of the bridge is given in Figs. 1 and 8.

The accident occurred as a coal train, consisting of a motor and platform coal car, passed over the bridge, the center span giving way, precipitating the train into the river with a loss of two lives. The cause of the disaster is now being investigated by the proper authorities.

Regular steam railroad construction is used throughout. The rails are of fifty-six pound Tee section, and the track is ballasted with slag and gravel. The company is using 0000 copper bonds, all of which are annealed, it having been found that the ordinary bond had a tendency to break.

With the exception of a distance of about ten miles, the road runs at the side of the highway connecting the cities of Akron and Cleveland. The width of the right of way for the distance over which the tracks of the company extend over its own property is on the average fifty feet, and the track is inclosed by wire fencing. The crossings are protected with ordinary cattle fences and guards. Side poles with iron pipe brackets are used throughout. The poles are of wood with seven-inch tops, and about thirty feet in length. They are spaced ninety feet apart. The feed wire is of 300000 c. m. capacity, and trolley wire is B. & S. 0000. The overhead material is of the Ohio Brass Company's make.

There are two power houses, one at Bedford on Tinker's Creek, six miles from Cleveland, the second at Cuyahoga Falls, on the Cuyahoga River. The former supplies current for six miles to the north and nine miles to the south; the second, nine miles north and five and one-half miles south to Akron. The steam equipment is similar in each station. There are two Stirling boilers of 250 h. p. each, with 350 h. p. Allis Corliss engines, which are belted to Westinghouse generators of 250 k. w. The pumps which

FIG. 3.—CAR—AKRON, BEDFORD & CLEVELAND ELECTRIC RAILWAY.

supply the reservoir are operated by two seven and one-half horse power motors.

The generators at both stations are of novel construction. The armatures are wound for both alternating and direct currents, and have both commutators and alternating current collecting rings, the latter being outside the former. The voltage of the alternating side is 380 when that of the direct current side is 500, the alternations being 3800 per minute. The output of the machines, if the alternating side should be used alone would about equal its direct current capacity when used alone.

The object of the use of machines of this character is two-fold. The company intends to use the generators at present for supplying both direct current for its line and alternating current for lighting purposes. Later, should it be considered desirable to operate the Cuyahoga Falls station by water power, and transmit power to Bedford by the three-phase system for operating the station at that point, the machines can be used as rotary transformers.

The power station, motor shop, car house and offices at Cuyahoga Falls are of brick with iron roof.

The cars of the company resemble in general appearance those in use on steam railways, and are forty feet in length. Eleven motor cars and two trail cars are in use at present. About one-half of the motor cars are built with baggage compartment, the passenger compartment seating thirty-two persons. The rest of the cars and the trail cars are full-seated with a capacity for forty-two passengers. The cars have cross reversible seats, upholstered in plush, with center aisle, are provided with toilet, and ice water tanks, and are lighted with twenty electric lights. There are electric push buttons

FIG. 4.—CAR HOUSE—AKRON, BEDFORD & CLEVELAND RAILWAY.

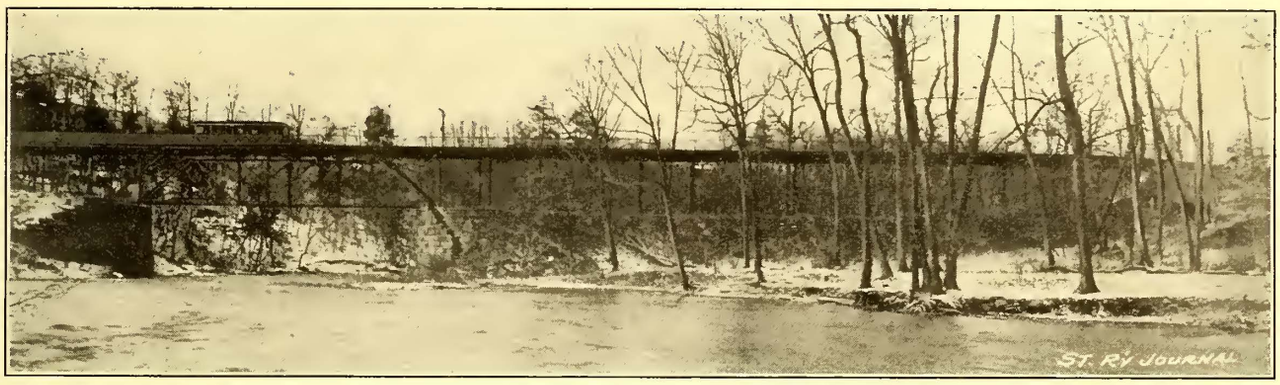


FIG. 5.—BRIDGE ACROSS CUYAHOGA RIVER—AKRON, BEDFORD & CLEVELAND RAILWAY.

The company controls the electric lighting system at Bedford, and expects to also light two other towns from the railway power station. The arc lighting will be done from the direct current railway circuit, and the incandescent from the alternating current side of the same generators by the use of transformers.

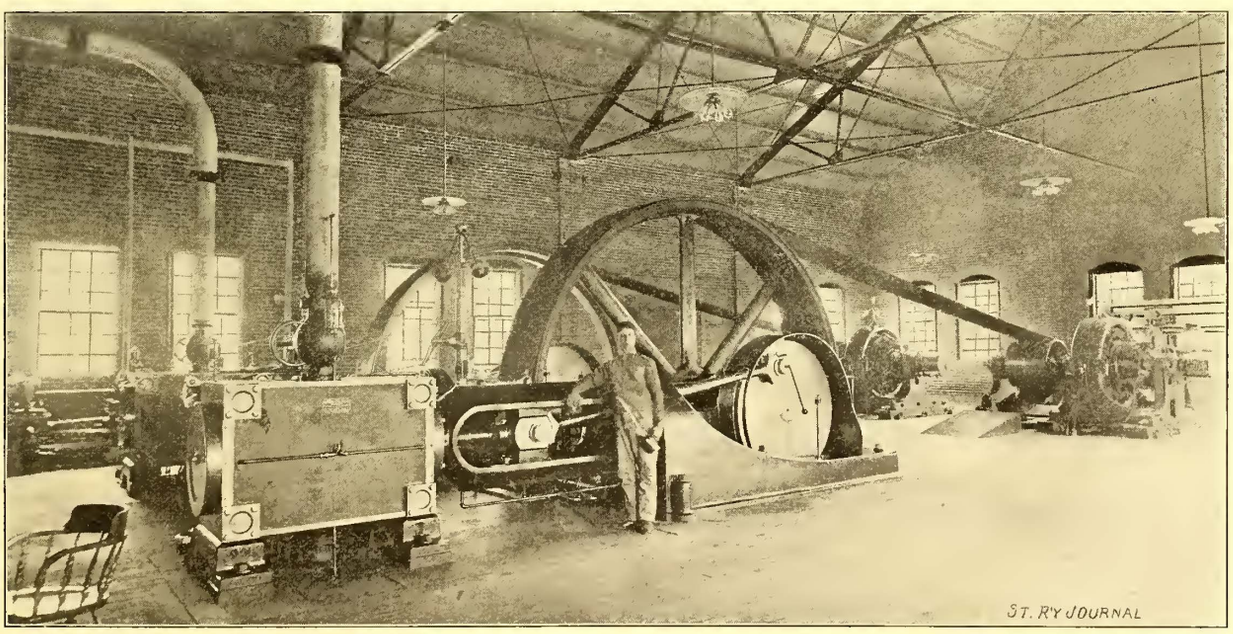


FIG. 6.—POWER STATION AND ALTERNATING AND DIRECT CURRENT GENERATORS—AKRON, BEDFORD & CLEVELAND RAILWAY.

in front of every seat. The bodies are very handsomely painted, the color being a dark maroon with cream trimmings and gold lettering. The inside finish is natural cherry. The motor cars were supplied by the Jackson &

FIG. 7.—BRIDGE ACROSS TINKER'S CREEK AFTER THE DISASTER.

Sharp Company, and the trail cars, which will be equipped as regular motor cars, by the Barney & Smith Car Company.

Electric heaters are used, one heater being carried in the motorman's compartment. The cars are equipped with two 50 h. p. motors, both on the rear truck. A Hunt air-brake pump and eccentric is fitted on the front trucks of part of the present equipment and a Standard geared air brake equipment will be installed on one of the new cars of the company.

For caring for snow the company uses snow scrapers on every car, and has in addition two heavy nose plows. A twenty-five ton steam locomotive which was used in construction, has also been equipped for snow work, and during the storms which have already occurred this season no trouble has been experienced with snow blockades, although there are several cuts on grades.

The company now carries on its cars light express matter, and, as shown by the number of cars arranged with freight compartments, anticipates that quite a good deal of business can be secured in this direction, from the fact that the city and urban population at the Akron end of the line exceeds 50000, and that there are from 15000 to 20000 inhabitants between this and the Cleveland terminal. The express privileges are leased to the American Express Company.

The operation of such an extensive line involves new problems of dispatching and operation. To accomplish the best results the company decided upon the establishment of a special telephone exchange at its Cuyahoga Falls office, and the operation of the cars by regular train dispatchers. All of the offices and residences of the operating officials are connected with the exchange by direct wires and a portable telephone outfit is carried on each car. This outfit can be put in connection with the dispatcher's line at any of the sidings and every half mile along the line. It will require no signal bell, as the act of cutting into the line will do the signaling. The telephone wires will be strung on the company's own poles, and to overcome the induction of the railway current, a metallic circuit will be used consisting of a three or four conductor cable with wires intertwisted to overcome the inductive influence.

The pleasure traffic of the company promises to be considerable. The line passes Tinker's Creek Gorge at Bedford, six miles from Cleveland; Boston Ledges, fifteen miles from Cleveland; Turtle Lake, three miles from Cuyahoga Falls; Silver Lake, Gaylord's Grove, High Bridge Glens, Old Maid's Kitchen, and the Cuyahoga River Cañon. Several of these properties are owned by the company, and all are locally well known resorts noted for their wild and picturesque scenery.

The road was constructed under the direct supervision of Will Christy and James Christy, Jr., of the Cleveland Construction Company, and its officers are: President, H. A. Everett; vice-president, J. Christy, Jr.; Secretary, F. S. Borton; treasurer, E. W. Moore; general manager, W. Christy; superintendent, F. J. Sloat.

CLEVELAND & ELYRIA ELECTRIC RAILWAY.

This line extends from the Cleveland city limits to Elyria, a distance of seventeen miles, connecting at Cleveland with the Cleveland City Railway. The line passes through a comparatively level and beautiful country, and the fare for the round trip is seventy-five cents. In general construction, the line is similar in many respects to the Akron, Bedford & Cleveland line, and it was built by the same contractors. About three and one-half miles from the Cleveland line the road passes over a magnificent steel cantilever highway bridge 1220 ft. in length and 138 ft. in height.

FIG. 8.—BRIDGE ACROSS TINKER'S CREEK BEFORE THE DISASTER.

There are two power stations, and their equipment is similar to that of the Akron, Bedford & Cleveland Railway, except that the generators are single direct current. One station is on the Rocky River close to the long bridge already mentioned, and one of 300 h. p. is at Elyria.

The rolling stock consists of motor cars, similar to those on the Akron, Bedford & Cleveland line, the outside color, however, being dark olive with gold lettering and ornamentation.

The company is now furnishing power to the Cleveland & Berea Electric Railway Company for the operation of its line between Cleveland and Berea, a distance of ten miles. The cars and track construction of the Cleveland & Berea Railway Company are similar to those of the Cleveland & Elyria Electric Railway Company, and the management is the same.

The officers of the Cleveland & Elyria Electric Railway Company are: president, A. H. Pomeroy, Berea; vice-president, L. M. Coe, Berea; secretary, A. E. Akins, Cleveland; treasurer and general manager, F. T. Pomeroy, Cleveland.

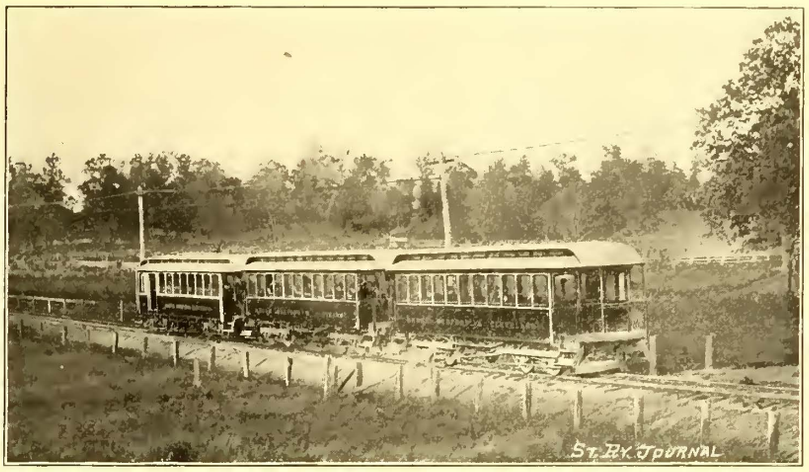


FIG. 9.—TRAIN—AKRON, BEDFORD & CLEVELAND RAILWAY.

CLEVELAND, PAINESVILLE AND EASTERN RAILROAD COMPANY.

This railway will extend east from Cleveland to Painesville, a distance of thirty miles, ten miles of which will be over the lines of the Cleveland Electric Railway Company. During the past season track has been laid to Wickliffe, and it will be extended to Painesville early in the spring.

The track of this company extends through a clay district, and in order to take care of the drainage, great pains were used in its construction. The ties, which are of white oak, 5 in. × 8 in. × 7 ft. are laid 2 ft. centers, and rest on six inches of broken stone, and are ballasted with cinders. At the ditch side of the track a six-inch tile was laid the entire length of the track. The ditch above the tile was then filled in with cinders. The tile is designed to carry off the water that might fall on the track. The rail used is a sixty-eight pound Wharton girder with six-hole 26-in. fishplates. The joints are bonded by a copper horseshoe, which is applied to the joint underneath the fishplate.

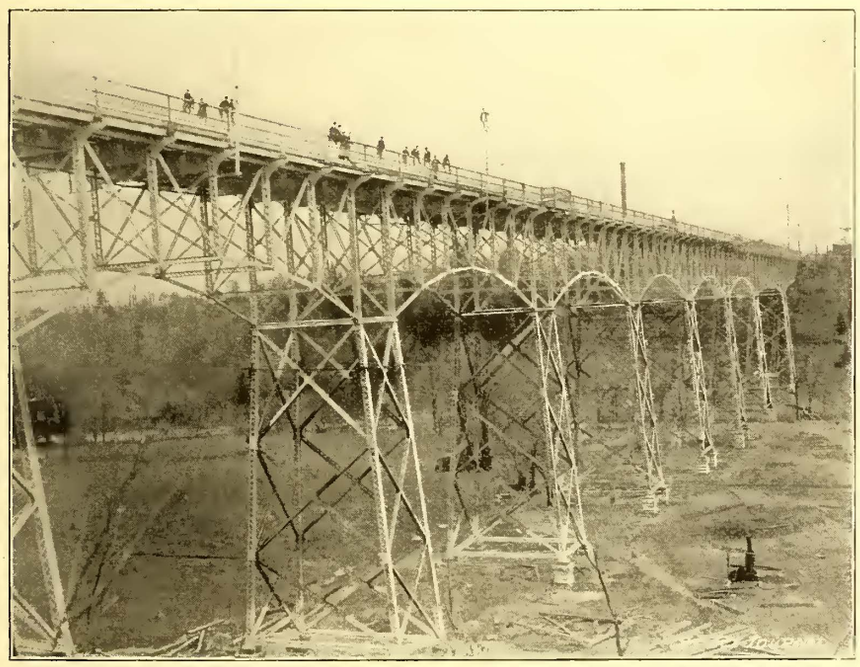


FIG. 10.—BRIDGE OVER ROCKY RIVER—CLEVELAND & ELYRIA RAILWAY.

Double wooden pole construction is used with 00 trolley wire. For a considerable part of the distance two trolley wires will be employed, thus doing away with overhead switches, which might prove troublesome in high speed work. The company is now taking power from the Cleveland Electric Railway, but a station will be built at Willoughby. The engine equipment will consist of compound condensing Cooper engines of 250 h. p., direct connected to General Electric generators.

The cars are thirty-five feet in length, with double trucks, electric heaters, etc. The motors are of the G. E. 1200 type, two on each car. The general manager of the company is C. W. Wason, of Cleveland.

OTHER ROADS.

Some other electric roads which do not have a terminus in Cleveland, but which act as feeders to other lines which do, are the Lorain & Elyria Electric Railway and the line of the Cuyahoga Falls Rapid Transit Company.

The former runs past the works of the Johnson Company at Lorain, and is owned by Mr. Johnson. The cars are single truck and make sometimes as high a speed as thirty-seven miles per hour. The line extends for the greater part of its length through its own right of way.

The Akron & Cuyahoga Falls Rapid Transit Railway has a length of twenty-seven miles and twenty-eight motor cars in operation. The track is laid with fifty and eighty lb. Tee and girder rail. T. F. Walsh is president and general manager of the company. The extension of this line to Cleveland by way of Melrose and Richfield has been proposed.

THE NEWBURGH (N. Y.) ELECTRIC RAILWAY COMPANY.

The Newburgh Electric Railway Company is carrying on an interurban traffic of considerable importance especially in the transportation of express and light freight, which it has found to be a profitable department of its business. The city of Newburgh with a population of about 25000 inhabitants is connected with New York City by both the West Shore and Erie Railroads and by steamboat, and with the New York Central Railroad at Fishkill by ferry. Some ten miles back of the city over a ridge of hills lies the fertile Wallkill Valley famous for its fruit, especially grapes. It contains a number of manufactories, and is a great shipping point for milk to New York City. The transportation facilities for this valley have been furnished until recently by the Wallkill Valley Railroad, a steam line extending from Kingston on the West Shore Railroad on the north and connecting with the Ontario & Western and Erie Railroads on the south.

During the spring of 1895, the Newburgh Electric Railway was built to connect that city with Walden, one

of the principal towns in the Wallkill Valley which has a population of about 2500. The distance from terminus to terminus is about fourteen miles. The company commenced the transportation of freight and express about the first of June, 1895. The results from both this and

FIG. 11.—VIEW IN WALLKILL VALLEY—NEWBURGH ELECTRIC RAILWAY.

passenger service have been most satisfactory. At Newburgh the line runs alongside the steamboat dock and close to the freight houses and tracks of the railroads, and freight is billed through to or from New York or other points. At present the company is operating two electric freight cars a day each way between Newburgh and Walden, besides a special milk freight service of one car each morning. In addition there is an express service by combination cars for the transportation of light freight, every hour.

A good idea of the traffic which has been built up in this way is shown by the fact that in September the company transported 192 tons of grapes alone, and from 500 to 600 tons of hay. These were delivered to the cars at Walden, and were then sent to New York by boat from Newburgh. The milk traffic has amounted, during the last seven months, to 40,000 cans, equal to 2,000,000 qts. The cans are delivered to the railway company at Walden from the creamery, and the car used is similar to that employed in freight service and illustrated in Fig. 14. It is capable of transporting from 235 to 250 cans.

The merchandise mentioned so far has been only that carried in one direction, but an equal amount is carried the other way, including practically all the raw material for two large cutlery works, dry goods and other merchandise to the Walden merchants.

The charge for transporting freight depends, as in steam railroad service, upon the material carried, there being a regular schedule and five different classes of freight; that for fruit, for example, is $2.60 a ton. To deliver freight in Walden the company employs a team.

The express service is leased to the National Express Company, which furnishes an expressman on each car to care for the packages and delivery facilities at the further end. Regular daily returns are made by the express company to the railway company on the amount of express matter carried, and settlement is made monthly upon the basis of $4 per ton.

So far a description has been given only of the method of caring for the freight business, but the passenger traffic is an important part of the company's traffic, not only on the Walden line but also about Newburgh and to several parks including Glenwood park and Orange Lake. The latter is an all the year resort, being in winter the racing grounds of the ice yachts, and was last winter the place where the National skating races were held. The interurban fares are collected by selling regular tickets at ticket offices, of which there are three or four at Newburgh and one at Walden, and tickets are also sold by the conductors. The fares vary from five to twenty-five cents. The tickets are sold in coupons, that is, a twenty-five cent ticket from Walden to Newburgh would be five five-cent coupons. One coupon is then collected at the end of each section, of which there are five on that particular branch, and each coupon is registered in the usual way, the register being turned back at the beginning of each section.

The track is laid with 90 lb. girder rail in the city paved streets, and 60 lb. Tee in macadam and interurban sections. The rails are laid with broken joints and on ties 7 in. × 6 in. × 7 ft., laid two feet centers. On the interurban divisions where the track is laid, for the most part, over the company's own right of way, the roadbed is stone ballasted to a depth of six inches under the ties. The special work is of manganese steel and Johnston bonds with return feeders are employed.

The feed wire is of 500000 c. m., and the poles are of iron in the city and chestnut with iron brackets in the suburban section. On Broadway, Newburgh, center poles are used, the tracks being twelve feet apart. There

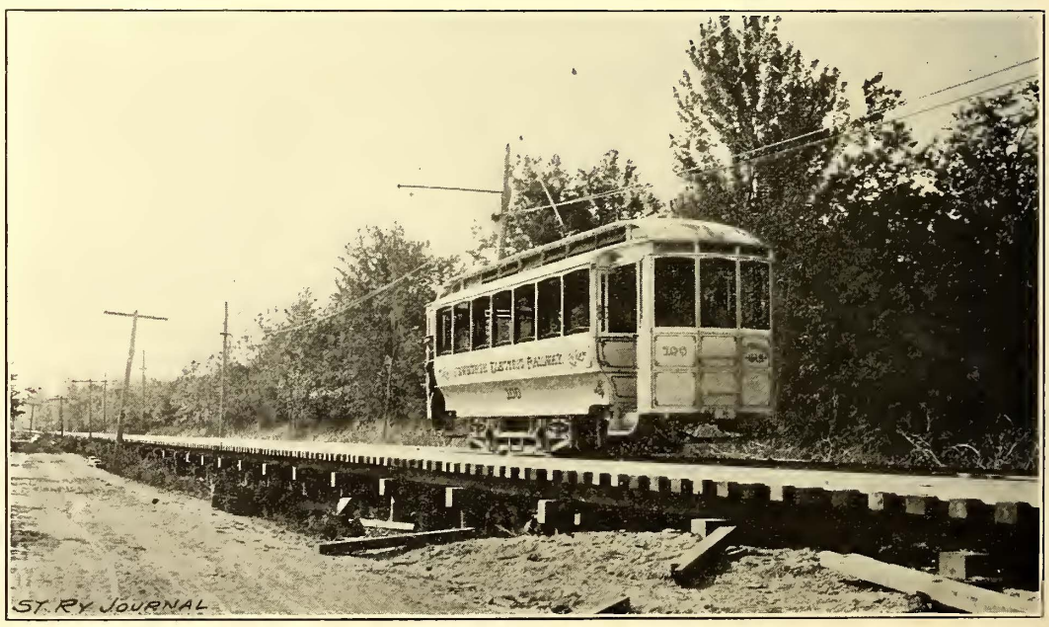


FIG. 12.—LONG TRESTLE NEAR ORANGE LAKE—NEWBURGH ELECTRIC RAILWAY.

are a number of steep grades, the maximum being twelve per cent, but no trouble has been experienced in holding cars on these grades, sand and salt being used liberally.

The running and dispatching of cars is controlled from Newburgh by a special telephone wire, with telephone box at each turnout. The cars run on regular schedule, and if detained for any reason the conductor

is obliged to telephone at the first turnout to the dispatcher's office at Newburgh and receive his directions as to proceeding, the dispatcher being able to signal any car at any turnout by a code of signals.

The power station is at Newburgh, and is shown in Fig. 14. It occupies a building formerly employed by the horse railway company, predecessors to the present company, and has a handsome stack, square in section and 100 ft. in height. The engine room contains three Dickson Corliss engines, of 300 h. p. each, belted each to a Westinghouse generator. The boilers are of the return tubular type. Buckwheat coal, costing $2.20 a ton, is burned, and about four tons are required daily. Five tons is the maximum ever used during any day, and 22000 passengers have been carried with this amount of fuel. The station is provided with feed water by a 148 ft. well operated by a Blake pump. The car house is at West Newburgh, and measures 67 × 160 ft., and has a capacity for twenty-eight cars. The repair shop is in the power station and has pit room for four cars. No special devices are used for maintaining the voltage at the further end of the line.

There are twenty-five motor cars, of which four are box freight cars, and two combination. The baggage compartment of the latter is eight feet in length. The cars are mostly of the Brill and Jackson & Sharp makes. The company has in addition passenger trail cars and four gondola cars, capable of carrying each from eight to nine tons of freight. The cars are mounted on Peckham trucks and are equipped with Westinghouse No. 13 and 12A motors. All the cars are vestibuled. Nuttall trolleys, New Haven and Meaker registers and Consolidated Car Company's heaters are used. The company has under construction at the Brill works a novel type of car, divided into three cross compartments with side doors like a European railroad coach, and designed for baggage, smokers and ladies' compartments respectively.

FIG. 13.—CAR HOUSE AT ORANGE LAKE—NEWBURGH ELECTRIC RAILWAY.

The average number of car miles per day is 1200, and per car day 135, for fifteen hours operation.

The freight cars are so arranged that they can be equipped with snow plows and the track outside of the city is cleared of snow in this way. In the city a Fowler electric sweeper is used. The president and manager is Benjamin Norton, who owns or controls practically all the capital stock of the system. He originated the scheme and carried it through and built all the lines in the system.

FIG 14.—POWER STATION, EXPRESS AND FREIGHT CARS—NEWBURGH ELECTRIC RAILWAY.

The company reports an excellent business. The gross receipts for the six months ending November 30, 1895, were $62,967 with operating expenses less than 48 per cent of receipts.

INTERURBAN ROADS NEAR LOS ANGELES, CAL.

The construction of long electric lines for interurban traffic is being carried on on the Pacific slope as well as in other parts of the country. In Southern California the construction of such lines receives an especial stimulus from the fact that the climate is mild during every month in the year, making a trip by electric cars particularly agreeable, and from the fact that the population comprises a large proportion of wealthy persons who have been attracted to the region on account of its climate and who would be apt to liberally patronize any line catering to pleasure travel. Los Angeles, as is well known, is the largest city in Southern California and it has become an important center of electric railway development. To the northeast of the city, about twelve miles distant, lies Pasadena connected with Los Angeles by the Pasadena & Los Angeles Electric Railway through the charming valley of the Arroyo Seco. North of Pasadena is Echo Mountain and Mount Lowe reached by electric railway and inclined plane. From Los Angeles to the west another line about twenty miles in length has been built by the same capitalists that are interested in the Pasadena lines through a beautiful region to Santa Monica on the Pacific Ocean and the seashore resort of Los Angeles. These two lines comprise an interurban system which is perhaps not equalled in extent by any electric line west of the Mississippi River.

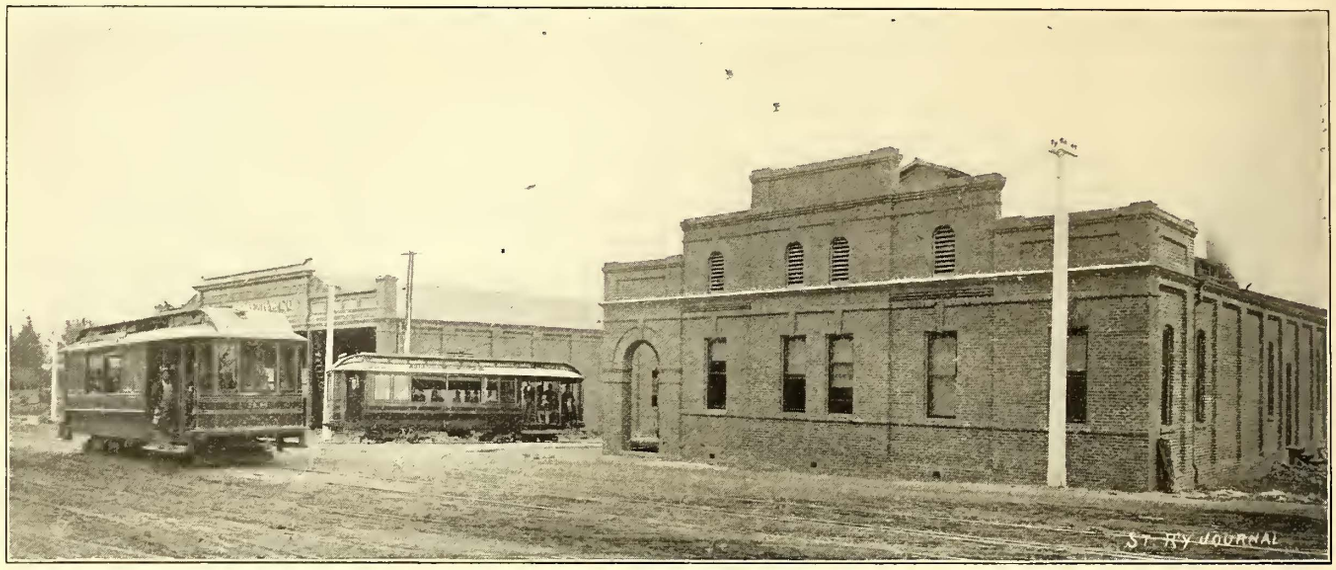


FIG. 15.—POWER STATION AND CAR HOUSE—PASADENA & PACIFIC ELECTRIC RAILWAY.

The Pasadena & Los Angeles Electric Railway which comprises all the lines in Pasadena with the exception of the Pasadena & Mount Wilson Electric Railway was begun in 1894 and opened for traffic, May 1, 1895. The construction was single track, but the first week's operation of the road proved its inadequateness in carrying capacity, and the work of doubletracking the entire line has just been completed. There are three long bridges, one of 300 ft. over the Arroyo Seco in Los Angeles; one 900 ft. long and 45 ft. high over the Arroyo at the town of Garvanza; and one of 700 ft. across the Terminal Railway in South Pasadena. The roadbed is substantially laid on a heavy subgrade of gravel, and the track is of 40 lb. and 50 lb. Tee rails spiked to 6 × 8 in. redwood ties. The gauge is 3 ft. 6 ins. The power station consists of two brick structures 100 × 175 ft. and 60 × 175 ft., with iron roof. There are installed three 250 h. p. Stirling boilers of the latest type, two Ball & Wood compound condensing engines, of 250 and 450 h. p. respectively, two 300 h. p. General Electric generators and one 200 h. p. Westinghouse generator. The car house, 100 × 175 ft., will accommodate thirty-two long cars, with room for paint and repair shops. All the buildings are of brick with thirty inch concrete foundations. A sufficient water supply is furnished by the company's well. A complete machine shop is fitted with all the latest and best machines necessary to a railway plant.

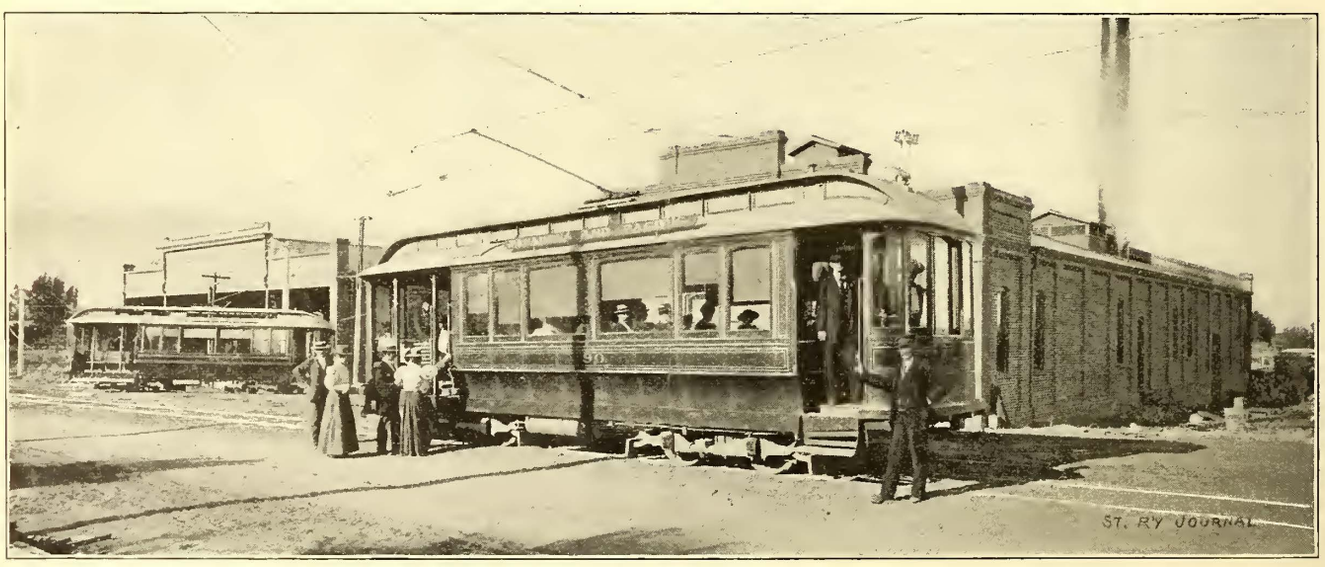


FIG. 16.—COMBINATION OPEN AND CLOSED CAR—PASADENA & PACIFIC ELECTRIC RAILWAY.

A view of the cars employed is shown in Fig 16. They are of the combination type, partly open and partly closed, a style which has proved exceedingly popular in Californian service. The length is thirty-five feet and the cars are finely upholstered and finished in mahogany with plate glass windows. They were built by the American Car Company and the J. G. Brill Company and are equipped with Westinghouse forty horse power motors of latest design, making eighty horse power to the car. The cars are equipped with Standard air-brakes, a necessity, since the grades range from 3 to 7.6 per cent.

The line of the Pasadena & Pacific Railway Company to Santa Monica will be double track throughout and will be laid with forty to fifty pound Tee rail, with about the same construction as that of the Pasadena & Los Angeles Electric Railway. The steam equipment and cars will also be of the same type and make. The general manager is a believer in double truck cars especially for this class of service, and a high speed will be reached on this line. The road will comprise about forty-five miles of track.

This line to the sea will come into competition with the heavy excursion traffic of the two steam lines of the Southern Pacific Railroad and the Santa Fé Railroad. As the road to Pasadena is in competition with three steam lines, and has been successful in securing traffic, it is expected the new seaside electric service will become equally popular and profitable. The electric line to Pasadena has already proven what is now becoming a well known fact, that steam railways cannot in any measure successfully cater to the needs of suburban traffic. One steam road alone has reduced its train service by half, and would reduce still further if its franchise permitted, and still its trains often carry more employes than passengers.

Electric Traction in Rome.

A new electric road was put in operation in Rome, Italy, during the fêtes of September 20, 1895, and the results already secured are such as to prove that the road more than fulfils the expectations of the promoters. The line extends from the railroad station to the Place de San Silvestro, establishing thus communication between the new part of Rome and the center of the city. The maximum grade is about seven per cent for a distance of 1600 ft., the rest of the line being practically level. The minimum curves are of sixty foot radius.

The rolling stock consists of ten cars, of which eight are in regular service and two in reserve. These cars operate on a headway of from four to five minutes. The maximum speed attained is about eleven miles per hour but the average speed is very much lower, not usually exceeding six miles per hour. In spite of this fact the road seems to enjoy a fairly good traffic. The cars are all of the same type with longitudinal seats and room for forty passengers. The equipment of each car is two G. E. 800 motors with type K 2 controller. Each car is equipped with an electric headlight. About the only novel feature of the road is the method of furnishing the motive power. This is supplied by the historic falls at Tivoli, some fifteen miles distant from the city, the power being transmitted by alternating current, changed in the city to a direct current by Ganz rotary transformers. In order to equalize the fluctuations in load, there is located at the transformer station at Porta Pia, a battery of Tudor accumulators capable of furnishing a maximum current of 400 amperes. The entire transmission system is operated by the local electric illuminating company of Rome which sells the direct current to the railway company. The line is operated by the Rome Tramways and Omnibus Company and all the electrical apparatus was supplied by the General Electric Company. The cars are of Italian make.

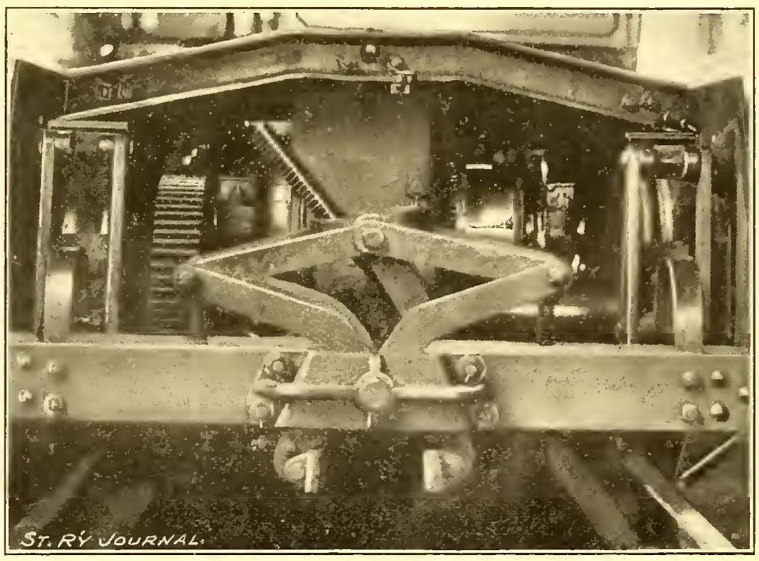
The results of operation of the railway are shown by the following figures: The average daily number of passengers carried is 8000. These at a fare of three cents equal daily receipts of $240. The power required is from 400 to 500 h. p. This is presumably water power.

Our information is taken from the Railway and Public Works Review, published at Florence.

The Mt. Snaefel Railway, Isle of Man.

In our November issue, some particulars were given of the Snaefel Mountain Electric Railway, recently put in operation in the Isle of Man. Through the courtesy of G. Noble Fell, the engineer of the railway, the accompanying additional illustrations, which have never before been published, are presented on this and the following page.

The line is about 4¾ miles in length, rising 1820 ft.



SPECIAL THIRD RAIL GRIP BRAKE—MT. SNAEFEL RAILWAY.

by an almost uniform grade of eight per cent. The gauge is 3 ft. 6 ins. The motor cars measure 35 ft. in length by 7 ft. 3 ins. in width, and can seat forty-eight passengers. They are mounted on two bogie trucks and are equipped with four 25 h. p. Mather & Platt motors. The current is taken from the overhead wire by inverted U-shaped collectors, making sliding contact.

An interesting feature of the line is the third rail, introduced for safety purposes, on account of the steep grades, and designed by Mr. Fell. The top of this rail, which is double headed and weighs sixty-five pounds to the yard, is somewhat higher than the level of the outer rails, and is carried on wrought steel chairs, to which it is bolted and which are fastened to the ties. Two pairs of flanged wheels bear against this rail, preventing any danger of derailment.

For emergency brake purposes the device shown in Fig. 1 is employed. This is a pair of steel blocks which by the action of a screw can be made to grip the center rail as in a vise.

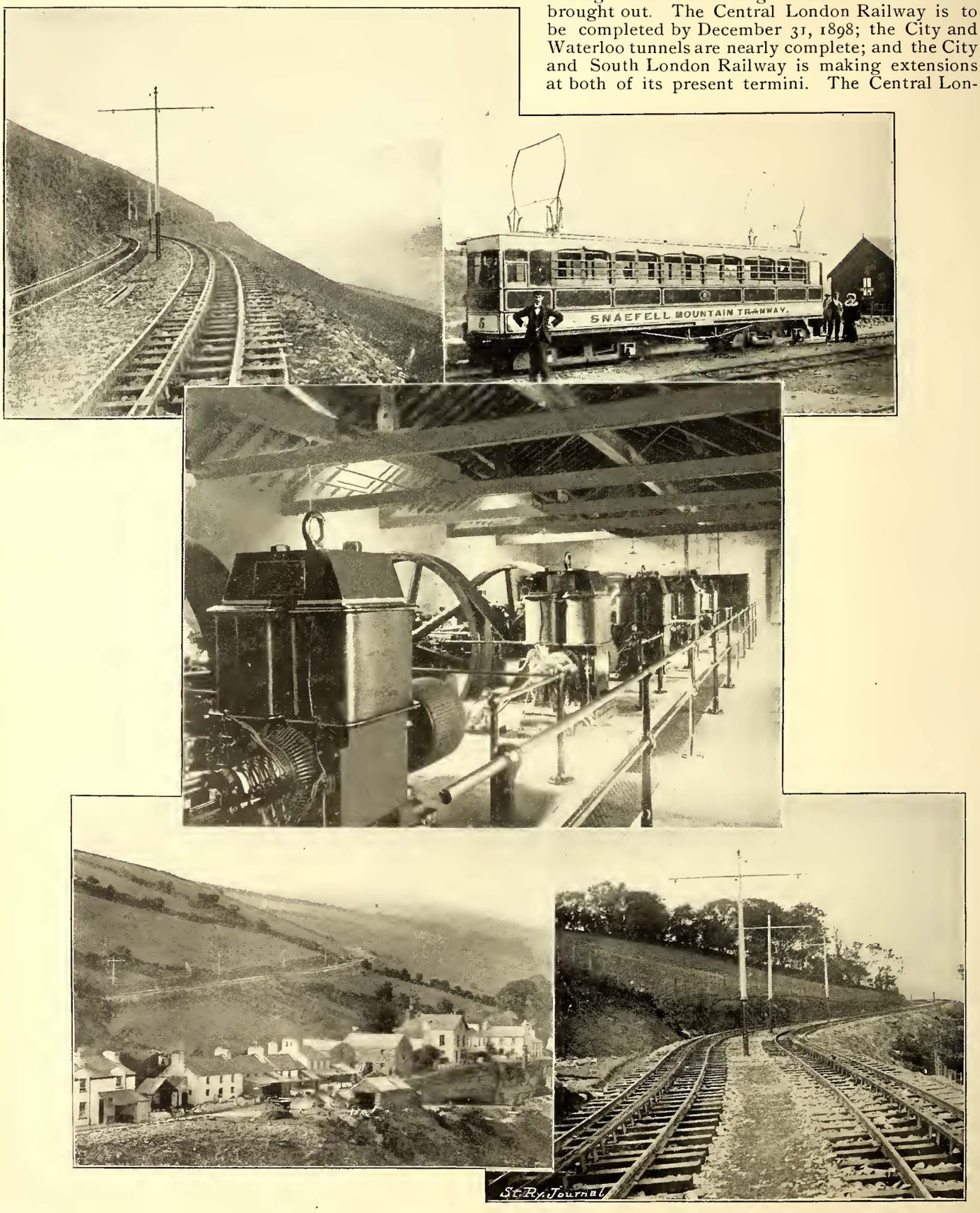
The power station is situated close to the line and about two and three-quarters miles from the Laxey terminus. Steam is raised by four Lancashire boilers, each 26 ft. × 6 ft. 6 ins. diameter, working at 120 lbs. pressure, and capable of giving steam sufficient in all for about 700 h. p. There are five compound horizontal engines of over 100 h. p. each, the cylinders being 12 and 20 × 16 ins. stroke. Five Mather & Platt dynamos, each of 55 k. w. capacity, are driven from the engines by belting, the armature speed being put at 800 revolutions per minute.

A special feature of the installation is a large accumulator station located at Laxey for equalizing the load on the generating stations. The Snaefel railway accu-

mulator station contains 246 cells of a patent chloride type. The accumulators are charged by the spare current from the dynamo when the load is light, and automatically distribute their energy to the line whenever the load rises above a certain point.

The railway was open for public traffic in the end of August.

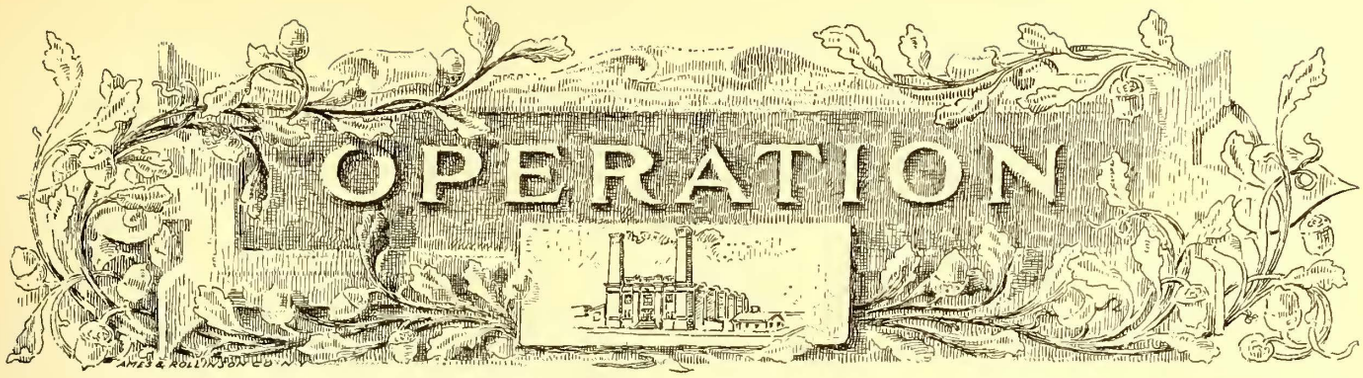
The views on this page will give the reader an excellent idea of the picturesque scenery which can be enjoyed in a trip over this line.



VIEWS ON THE LINE OF THE MT. SNAEFEL RAILWAY, ISLE OF MAN.

London Underground Systems.

In a just published article in *Lightning* the following facts concerning London's traffic were brought out. The Central London Railway is to be completed by December 31, 1898; the City and Waterloo tunnels are nearly complete; and the City and South London Railway is making extensions at both of its present termini. The Central London Railway will have stations about half a mile apart, will give a 2½ minute service, and will run (by electricity) at a schedule speed of about fourteen miles per hour over a route which is estimated to have a daily traffic between 8 A. M. and 8 P. M. of over 225000 persons. The City and Waterloo Railway will carry according to present estimates about 40000 passengers per week day.



Street Railway Repair Shops.

BY HENRY P. MERRIAM.

Eighth Paper.—Repair Shops and Methods of Maintenance of the West End Street Railway Company of Boston.

The West End Street Railway Company, of Boston, presents an interesting study as regards the system of operation and maintenance. The methods here used are the happy combination of the conservatism of successful horse car operation joined with the enterprise and enthusiasm characteristic of the present electric railway epoch.

FIG. 1.—EXTERIOR OF CENTRAL REPAIR SHOP—WEST END STREET RAILWAY.

The West End road, as the pioneer in the present system of traction, has necessarily obtained much of its experience at great expense, but no company has been more liberal or contributed from its funds more ungrudgingly to the end of improving its own condition and in no small degree shaping the course of all railway engineering. It is chiefly, however, with regard to maintenance of equipment that this article is concerned.

The distinctive feature of the system of repairs and maintenance of this road is the segregation of its system among numerous depots as opposed to concentration, which is the characteristic method of most large railway systems. Cars are not housed in a few large depots but are kept in numerous small stations, and in these stations all repairing and overhauling is attended to by workmen who are thus personally cognizant of the condition and peculiarities of every car under their charge.

This road operates about 1750 cars, including both open and closed. The motor equipment consists of 1758 General Electric motors, of which 1638 are of the "W. P. 50" type and 120 of the "G. E. 800" type, and 500 Westinghouse motors, of which 420 are of the "No. 12" type and 80 of the "No. 12 A" type. The General Electric "Type K" controller is used in all cases where rheostats are not used.

The above number of cars is divided among thirty-three car houses, of which twenty-two have pits for repair work. Five additional car houses are now in process of construction. These houses are located in and around Boston, the number of cars to each station varying from 30 to 200. In the assignment of cars to the various stations it is sought to group similar equipments as far as possible, to the end that the workmen may become more expert in their maintenance, the necessity for multiplying spare parts may be diminished and less cause may exist for motormen to object to the peculiarity of a car. The fire risk is also lessened and as the cars are generally housed somewhere along their particular route of travel, needless wear is avoided.

After a car is equipped and sent to a particular car house, all repairs incident to the operation of that car must be done by the car house pit foreman and his workmen. Armatures that burn out are replaced with others repaired at the central shop and kept in reserve, flat or worn wheels are changed, and each month the motors are dropped from the truck and taken apart for inspection and cleaning.

Night work is avoided as far as possible and aside from the workmen required to fill grease cups and examine brushes none is done. The system of operation is such that nights and mornings all cars are in service, while during the middle of the day a considerable part of the cars are in the house. In this way every third or fourth day each car is in the house to be carefully inspected by the day man.

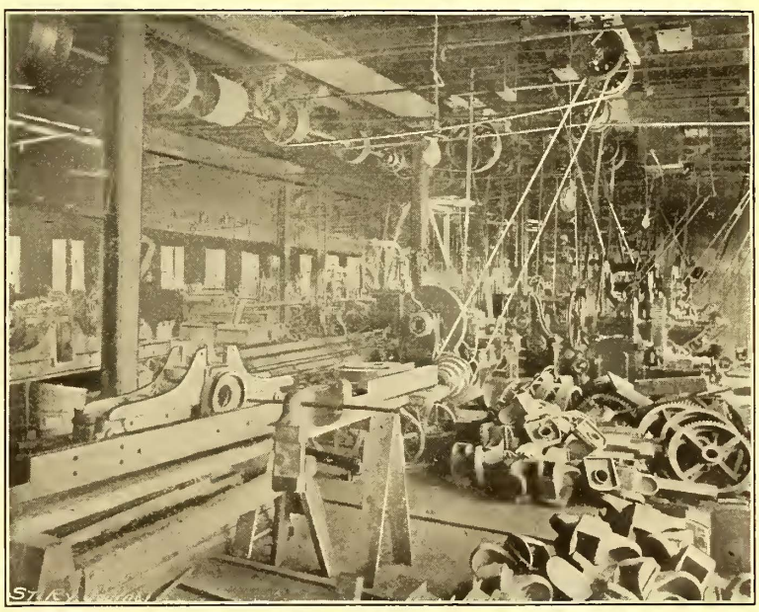


FIG. 2.—VIEW IN MACHINE AND BLACKSMITH SHOP—WEST END STREET RAILWAY.

Workmen are apportioned to the various car houses in the ratio of one pit man to every four long double track cars or every six short cars. At each car house there is a forge and bench drill with the necessary tools for small repairs. The operation of the cars is in charge

of the several division superintendents, there being eight operating divisions in the entire system.

The division superintendents are responsible for the condition of the cars jointly with the superintendent of repairs whose jurisdiction extends to all the car houses and who makes personal inspection at regular and frequent intervals.

Any damage to a car resulting from carelessness on the part of motorman or conductor is chargeable to the party responsible, who reimburses the company for the expense of repair.

The employment bureau, a special department of this road, is extremely critical in its inquiry about applicants for position of conductors or motormen and one of the results of thus securing good men is the greater care to avoid scratching and damage of cars along the narrow, crowded streets.

When a car gets in such a condition that revarnishing, repainting or other extensive repairs are required it is sent to the maintenance shop at Bartlett Street, and afterwards returned to its own station. Cars are taken into the shop for revarnishing every twelve to fourteen months and are thus kept in good condition. In the matter of painting no uniform color prevails, but certain general routes are indicated by the general color of the car, the particular destination being shown by the lettered signs at the side and front. With so many different routes interlacing, this system has much to recommend it, and in spite of the obvious advantages to the company of uniform coloring it is probable that a number of colors are necessary in Boston.

It is the practice with this road to divide its motor equipment during the summer months between open and closed cars. The long double truck cars are allowed to remain with two motors, but the short cars are relieved of one motor each, which is put under an open car. In this way all open and closed cars are in a condition to run. This is undoubtedly imposing severe work on the single motors, but it is the only way an equipment can be temporarily extended, and as a matter of fact, while the repairs per motor are increased, the repairs per car are less than when double motors are used as is the case in winter. When single motors are used with the "Type K" controller a slight change is made in the terminal connection at the resistance box, and the controller used on the "Series" notches.

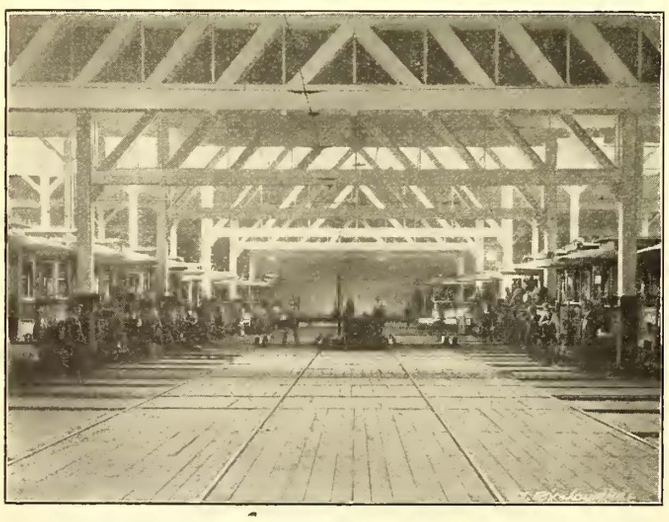


FIG. 4.—VIEW IN PAINT SHOP—WEST END STREET RAILWAY.

The various items of repair expense including labor and material are grouped in several general divisions such as "Armatures and Fields," "Trolleys," "Gears and Pinions," "Wheels and Axles," etc., and accounts of these are kept for each car house. Mileage is not kept from the performance of each car.

Each week supplies are distributed to each of the various car houses upon foreman's requisition covering the probable requirement for the coming week. The supply cars, of which there are three, are sixteen foot box cars fitted with motors, and flat cars in tow are used when required. Spare armatures, wheels and axles, etc., are also sent out with the supply car and it is only in exceptional cases that a second trip through the week is needed. All machine work of whatever character is done at the central repair shop, and sent to the car houses as such is needed.

CENTRAL REPAIR SHOP.

The central repair and equipment shop is on Albany Street adjoining the principal power station. The build-

FIG. 3.—NEW MAIL CAR BUILT IN SHOPS OF WEST END STREET RAILWAY.

ing was originally the locomotive shop of the Hinckley Locomotive Works, and the arrangement of pits, transfer and turntables is such as was used by that company, and many of the machine tools formed a part of the original plant. The accompanying cut (Fig. 1) shows a part of the exterior and the arrangement of tracks, etc.

The building is of brick, three stories in height. The first story has eight tracks, and the one story extension at the right in the picture is the brass foundry. These tracks extend across the building from side to side and accommodate two cars, each with room at center and ends for passageways. This arrangement is an admirable one, as it permits an abundance of light from both sides, cars are conveniently located for the workmen and any car can be taken out by shifting at most one car. Light traveling cranes, with two hoists each, span each track and run on tracks suspended from the ceiling. The hoisting of cars is thus effected without the use of jacks and blocking. The remainder of the floor is taken up by machine tools for the heavier work, among the tools being two wheel borers, two hydraulic wheel presses and several axle lathes. Workmen are engaged on this floor in repairing and refilling rheostats, although the "Type K" controller is gradually supplanting these. The rheostat filling used is made here.

The second floor is for the most part used as a storeroom for all motor and electrical supplies, and it is from here that supplies are sent to numerous sub-stations. A well equipped pattern shop occupies a portion of this story, and the armature room is also on this floor. Here is done for the entire system all rewinding and repairing of armatures, renewing of commutators and pinions and rewinding of field coils. The mica collars, segments for refilling commutators and the armature slot insulation are also made in this department.

The third floor is occupied as a machine and blacksmith shop for the manufacture of repair parts, trucks, etc. A view in this room is shown (Fig. 2), taken from a position at one end only; it does not, however, give a fair idea as to the full depth of the room.

The work done at this shop embraces generally the equipment of cars, the manufacture of the various supply and repair parts of the electrical machinery, all armature work and all fitting of wheels and axles, and to some extent the manufacturing of trucks. Cars and trucks

that are fitted out at this shop do not return here, except for rewiring or re-equipment or unusual work not in the line of maintenance. Such machine work as is required for power station repairs, and in some cases construction work, is also done here.

MAINTENANCE SHOP.

When a car or truck is in need of repair, repainting or overhauling, beyond that which can be done at the

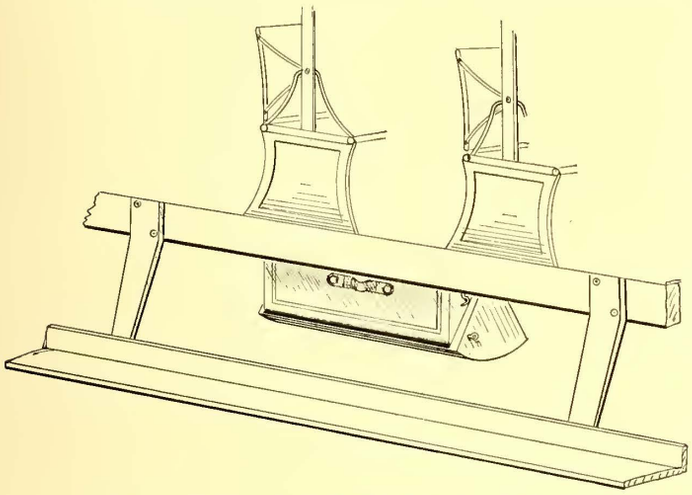


FIG. 5.—SWINGING COVER FOR FUSE BOX.

car house, it is sent to the shop at Washington and Bartlett Streets. This shop was the repair shop of the Metropolitan Street Railway before the West End Company was formed. The building is 360 × 90 ft., three stories high, and 257 workmen are employed here.

On the first floor, beside the portion used for the storage of lumber and supplies, there is a mill room where the various parts of the wood structure of a car are gotten out, and machines suited for this purpose are used. In the adjoining blacksmith shop there are twelve forges, one steam and one power hammer. A small machine shop on this floor renders this shop independent of the central repair shop for such machine work as is here required.

The second story of this building is where repairs are made to the car bodies, also where new cars are erected. Three railway mail cars of a new design have recently been finished here. The cut (Fig. 3) shows the external appearance of these cars. The interior fittings are arranged in a convenient manner to meet the requirements of this service.

The work carried on on the third floor comprises the cleaning and varnishing of doors, sashes and blinds, and the painting of signs. The amount of this latter work is considerable.

The paint shop is in an adjoining building and comprises two floors, each with track room for fifty-eight

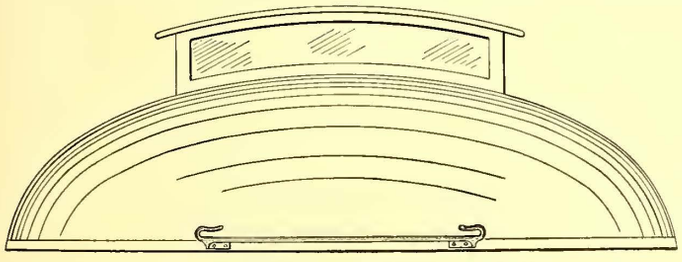


FIG. 6.—GUARD FOR TROLLEY ROPE.

cars. On the first floor the cars requiring minor repairs are put in condition for the painters. Seventy-three painters are employed at present.

The top floor where the painting is done is well adapted for this purpose, being high posted, with a monitor roof affording abundance of light and air. A view of this room is shown in Fig. 4. Cars are hoisted by an electrically operated elevator and transferred to any of the fourteen tracks by an electric transfer table.

NOTES AND DETAILS OF PRACTICE.

There are observable numerous ingenious devices and arrangements about the cars and shops, due to the co-operative efforts of the engineers and workmen of this company. In the matter of headlights this company is fitting all its cars with electric headlights in the dash. The reflector is about ten inches in diameter and the frame of the light projects forward through the dash about four inches. Lamps are wired to switches which light one end or the other as required. To provide light in case the current should go off the line, each car is furnished with a candle lantern carried under the seat.

Fuse boxes on open cars are covered with an asbestos lined box similar to the accompanying sketch (Fig. 5). This device was rendered necessary by the frightening of passengers when a fuse was blown. The device is practical enough to be used in other places, particularly where water is liable to wet the box.

For holding the coupling link a box or pocket is made at one end of the car near the step, one side being formed by the outside platform timber.

The trolley rope is prevented from being blown around to the side of the car by a guard and chafing piece shown in Fig. 6.

It has been found by experiment that the life of the "W. P." motor brushes can be greatly increased by shifting the line of commutation and using a brush five-eighths of an inch thick. The change made consists in raising the brush yoke on the axle side five-eighths of an inch and lowering the opposite one a corresponding amount.

FIG. 7.—VIEW IN EQUIPMENT ROOM—WEST END RAILWAY.

Guards for excluding water and snow from the motors are made by suspending a canvas curtain from three-eighths of an inch iron frame made U-shaped, the ends being secured under the head of the case bolts.

Gear cases are used on all motors. With "W. P. 50" motors the gear case is held free from the axle and pinion supports by iron brackets which attach to the gear case bolts and to the bolts uniting the two halves of the motor case. Cut cast steel gears are used exclusively. With the lubrication and protection from dust that the gear cases afford, their life is yet to be determined; many have now been in service three years.

The main axle bearings are lubricated with a mixture of grease, graphite and oil in boxes fitted with a felt wick. With this arrangement boxes will run six to nine months with one filling.

Many of the car houses are so arranged that it is impossible to fill all tracks from curves leading into the building, and transfer tables are rendered necessary. In most cases, the transfer tables are equipped with electric motors and all shifting readily done by one man. The usual arrangement is that shown in the view of the paint shop (Fig. 4) where the motor is boxed in.

It is a noticeable fact that the equipment of the West End road is universally in excellent condition and

while later forms of motors have been put out, the "W. P. 50" motors are still kept in working order. The cost of repairs to motors has satisfactorily decreased during the past few years and this is the best evidence that an equipment is receiving proper attention.

Conduit Electric Railways.

By A. N. Connett.

Notes on the Operation of the Ninth Street Line of the Metropolitan Railroad Company, Washington, D. C.

In the August number of the Journal the writer described at some length the construction of the Ninth Street line. A promise was then made to give data later on its operation.

The first public trip was made on July 29. From that date the horse cars were gradually withdrawn until August 15, when they were all displaced by the electric trains. The equipment consists of an open motor car, hauling in summer an open, and in winter a closed trailer. The weight of the summer train is 21250 lbs., and the winter train 20400 lbs. The number of trains in daily service has varied from twenty-two to twenty-six, the latter being the present number. The interruptions in service have been insignificant considering all of the conditions. Most of the delays have been from causes other than electrical, such as running into open switches, or derailment at the north terminus. The first serious delay was occasioned by a car of an intersecting cable road stopping too close to the crossing while an electric car was passing. The rope caught the plow, jamming the shank plates tightly into the crossing slot. This accident has not since occurred. A short circuited plow stopped the line for some time one evening. The addition of fuses in the plow leads, and of a rheostat in the station, has since reduced the danger of delays from this cause to a minimum.

The most serious stoppage was from the burning out of a special insulator at a cable crossing. In designing the road it had been found impossible to place the regular insulators in complicated pieces of special work without impairing the strength of the track construction somewhat. A special insulator bolted to the bottom flange of the slot rail was designed for such places. It had an opening between the head of the bolt which holds the conductor rail, and the bottom of the slot rail, and this opening was filled with insulating material. A joint opened in this insulation allowing water to reach the bolt head. The leak created enough heat to burn away the insulation and to melt the bolt. In consequence, the short piece of conductor rail at the crossing dropped at one end, allowing a plow to ride on top of the conductor rail, and bend the bolts of about six regular insulators. These had to be replaced at once. These special insulators will soon all be replaced by recently designed ones similar in construction to the regular insulators, and from which no such trouble can possibly be anticipated.

These three delays are the only ones of any moment which have occurred in the first five months of operation. But few new cable, and even trolley roads, can show a much better record. If the appreciation of the public is a reliable guide, the line is certainly giving a most excellent service. All forms of weather have been successfully encountered, except hard snow storms. Up to the date of this writing there has been only one light snow storm. It is idle to predict the effect of a hard snow on the operation of the line. It is no specially easy matter to contend with snow storms on either cable or trolley roads. It takes hard work and good appliances to keep any line open under the worst conditions of weather, and the management feels that the same will be true of the Ninth Street line. But that the line can be kept open it feels confident. The heaviest kind of rainfalls have entirely lost their terror. It has been demonstrated that operation does not have to be suspended by the complete flooding of the tubes in comparatively long stretches. The leak if large can be taken care of by adding another generator, or by reducing the voltage, by passing the current of the flooded circuit through a water rheostat at the station. With a properly designed switchboard, and a water rheostat, almost all of the troubles of the conduit can be remedied at once without affecting the operation of the road.

Banks of lamps connected to each side of the circuit and to ground give a fair idea of the insulation of the line and equipment at all times. A fault in insulation on one side of a plow can be detected very readily with these lamps, by making an opening in the conductor rails and reversing their polarity on each side of the opening. The bright lamps will become black and vice versa when the defective plow passes the opening. If the lamps are in the car barn and the opening in front of it, the faulty plow can be detected and changed at once.

On the Ninth Street line each side of each circuit is tested to ground every night by the engineer. If any abnormal leak is shown, it is almost invariably disposed of by putting a current on the circuit through the water rheostat. A positive short circuit while the line is in operation is handled in the same way.

From both a structural and economic standpoint a conduit is limited in size. The clearances, therefore, between the conductors and the walls of the tube must be small. This idea was prominent in the design of the Ninth Street line. Stiff conductor bars were used, and adjusted to a perfect line during construction; but when so adjusted they were fixed and capable of no movement, except the slight longitudinal amount necessary for expansion and contraction. Large insulators were used for mechanical rather than electrical reasons. Experience has shown that if any error in these insulators was made it was on the side of excessive rather than deficient strength. The principle of a sliding contact on the vertical faces of the steel conductor rails has proven highly successful. There is no appreciable wear yet on the conductor rails from the soft cast iron shoes pressed against their faces by the very light springs. That the company is satisfied can be inferred from the fact that they are now building the thirteen and one-half miles of their more important East and West line with the same construction.

The maintenance of sufficient insulation has always been regarded as the primary difficulty of an open slotted electric conduit; therefore, the writer feels that any facts bearing on this question will be of interest. It was soon found that the insulation of the positive side of the circuit was much higher than that of the negative side. Each of the four circuits showed the same fact. To demonstrate conclusively whether this result was due to local faults, a section of the line of about two thousand feet long from the station was disconnected at a cable crossing, and each insulator inspected. This section was then tested and showed the same result as before. Besides, this section showed an insulation resistance on each side of about twenty times that of the entire line of forty thousand feet. This seemed conclusively to prove that the loss was surface leakage, distributed uniformly over the line. It was feared that the insulation of the negative side would continue to depreciate. But this does not seem to be so. The relative difference of insulation resistance between the positive and negative sides still continues, but their absolute values are fairly uniform for like conditions of the weather, and with no local faults.

Some tables are given showing values of insulation at different times. Each of the four circuits has approximately four miles of exposed conductors in the tubes, supported by fifteen hundred insulators.

INSULATION RESISTANCE IN OHMS.

Circuit Number.	October 17.		November 15.		December 6.	
	Positive.	Negative.	Positive.	Negative.	Positive.	Negative.
1	19,500	770	8,300	400	36,800	1,250
2	16,500	280	5,200	14	25,800	700
3	18,100	670	8,000	480	29,100	830
4	10,900	770	5,200	330	27,600	910

Oct. 17 was a dry day; on Nov. 15 it rained hard all day; and Dec. 6 was dry and cold and there had been no rain for seven days.

There was a local fault on circuit No. 2 on Nov. 15 found in a rubber covered cable connecting the conductor bars at a cross-over. Its test is therefore of no comparative value. Immediately after making the tests of Dec. 6, the polarity of the leads on circuit No. 4 was reversed. The object of this was to see the effect on the insulation resistance. This circuit was changed back to its original condition on Dec. 24 after taking the test. The table will show the result of this experiment.

TESTS ON CIRCUIT NO. 4.

Date.	Resistance. East Conductor.	Polarity.	Resistance. West Conductor.	Polarity.	Remarks.
Dec. 6..	27,600 ohms.	+	910 ohms.	—	Reversed after test.
Dec. 24.	280 "	—	2,500 "	+	" " "
Jan. 9..	5,000 "	+	780 "	—	

It should be stated that the low resistances were measured by readings on a special ammeter, and the high resistances by readings on a Weston voltmeter, up to, and including the tests of Dec. 6. After that, the voltmeter was injured, consequently the ammeter was used entirely. If the insulation resistance of *both* sides of the circuit should fall to 250 ohms, the daily leak would amount to twenty kilowatt hours, which would take ten cents worth of coal to produce. As a matter of fact, the writer does not believe that the line leak on the Ninth Street road averages in cost one cent per diem.

The following table gives some idea of power and coal consumption. The figures for August and September are omitted, because the records were not systematically kept in the confusion of starting a new road:

Month.	Motor car miles.	Trail car miles.	Total car miles.	Average daily kilowatt hours.	Average lbs. of coal used daily.	Coal per kilowatt hour.	Coal per car mile.	Watt hours per car mile.
October	91,541	91,164	182,705	3,092	13,343	4.31	2.26	524
November. .	86,444	83,638	170,082	3,028	12,720	4.20	2.24	534
December. .	95,303	95,303	190,606	3,377	13,616	4.03	2.21	549
December 1 to 18.....	.....	.....	.....	3,262	12,477	3.83	.....	.....

The figures from Dec. 1 to 18 are given, because the station economy was affected by having to run a second engine and generator a part of the time after the latter date, on account of the heavy holiday travel. This affected the monthly average, as the figures show.

The poor economy from an underloaded engine is well known. The following table shows it in a most striking way, and may be of interest:

Date—Dec.	Day of week.	Hours of No. 1 engine.	Hours of No. 2 engine.	Total engine hours.	Kilowatt hours.	Kilowatt hours per engine hour.	Coal used.	Coal per kilowatt hour.
14	Saturday...	20.5	.....	20.5	3,605	176.	13,500	3.73
15	Sunday.....	19.75	.....	19.75	2,585	131.	11,400	4.41
16	Monday....	20.5	.....	20.5	3,405	166.	12,600	3.70
17	Tuesday....	20.5	.....	20.5	3,555	173.	13,200	3.71
18	Wednesday.	20.5	9.	29.5	3,590	122.	15,600	4.35
19	Thursday ..	20.5	16.5	37.	3,590	97.	16,800	4.68
20	Friday	20.5	14.17	34.67	3,340	96.	18,000	5.39
21	Saturday...	14.67	18.17	32.84	3,685	112.	17,100	4.64
22	Sunday....	19.75	.....	19.75	2,700	136.	12,000	4.44

The following table gives the operating expenses for November. This month is chosen because repairs of equipments had not reached any fair amount until then. The December figures would have been given also if they had been ready:

Officials and clerical help	$ 705.16
Car service, switchmen, car cleaners, etc.	4,499.37
Car, equipment and plow repairs, etc.	1,198.12
Motive power	919.53
Maintenance of way, including all track and conduit expense	155.93
Light service	74.53
Repairs to buildings	25.65
Sundry expense	89.17
Total operating expenses	$7,667.46
Operating expense per car mile	4.5 cts.
" " " motor car mile	8.87 "

The trail car mileage was not quite equal to the motor car mileage in November, therefore the expense per train mile cannot be given absolutely. The cost per motor car mile is sufficiently close to the train mile expense for all practical purposes. It will be seen that the operating expenses are exclusive of taxes, accidents and insurance. Figures for these items are not available.

The cost of motive power per motor car mile is 1.06 cts. The cost of producing a kilowatt hour is 1.01 cts.

These figures demonstrate that so far the Ninth Street line is commercially successful.

Power Distribution for Electric Railroads.

By Louis Bell, Ph. D.

I.—Fundamental Principles.

The distribution of electrical energy for use in propelling railway cars is, by nature, a special problem. It deals with magnitudes and distances greater than are usual in other branches of electrical engineering, and, in addition, with the difficulties of a load that constantly shifts in amount and position. Consequently, the design of a distributing system is of singular difficulty.

In computing the area of conductors, one ordinarily assumes the load to be the only independent variable, but in this case the distance of transmission must be so considered, and both quantities are of the most erratic character.

The general equations can therefore only be solved within limits, except in special cases, and even then only

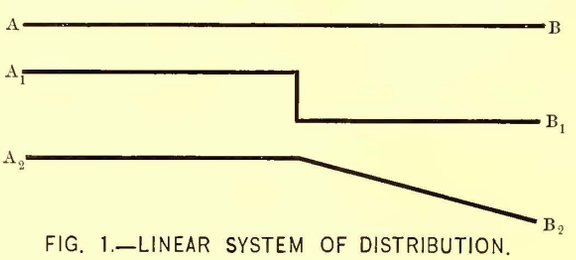


FIG. 1.—LINEAR SYSTEM OF DISTRIBUTION.

by very judicious assumptions. It is therefore worth while to investigate these limits, their extent and the causes which impose them.

The conducting system of an electric railway, large or small, consists of three somewhat distinct parts—the working conductor, the return circuit and the feeders. By the first is meant that part of the total circuit from which the moving contact, carried by the car, immediately derives its current. Physically it is a wire or bar, uninsulated, as respects the moving contact, and supported in any position—overhead, on the ground or under the ground—that circumstances may require.

The return circuit is, in a large proportion of cases, that which receives current from the wheels of the car, and is composed, partly or wholly, of the rails. In certain cases, conduit roads, double trolley roads and telpher systems, the working and return circuits are alike and of equal resistance. They may therefore be treated as part of the working circuit. The ordinary return circuit calls for special investigation, because it is a heterogeneous conductor, unequal in resistance to the working conductor, and involving unusual complications.

The feeding system in railway work serves the double

purpose of reinforcing the conductivity of the working conductor and equalizing the voltage at various parts of the system. It therefore must be deferred as a practical matter until the working system, which it supplements, has been considered.

Three types of working system are common, making the classification according to the nature of the distribution.

The first class is illustrated by the linear system, shown in Fig. 1. Ideally it is a straight line, A B, near some point at which the power station is generally situated. It may be modified by bends or curves, as in A_1 B_1, A_2 B_2, A_3 B_3, but whether it be a small tramway line along a single street, or a long interurban road, it retains as its main characteristic a single working line, not generally re-curved on itself, and subject throughout its length to fairly uniform conditions of traffic.

The second class is illustrated by the branched type, represented in Fig. 2. As shown, it consists of a main line, A B, into which run two branches, C D and E F. The branched distribution is the one most commonly met with in electric street railways of moderate size, and may assume an infinite variety of forms. It is the legitimate result of growth from the linear type, and through all its modifications is noteworthy in consisting of several lines which are neither interlinked, although often overlapping, nor subject to the same traffic conditions. Its conducting system is therefore essentially complex.

Finally, we have the meshed system, Fig. 3. Ideally, it is, as shown, a simple network composed of parallel lines crossing each other at right angles and at nearly equal intervals, and with fairly uniform conditions.

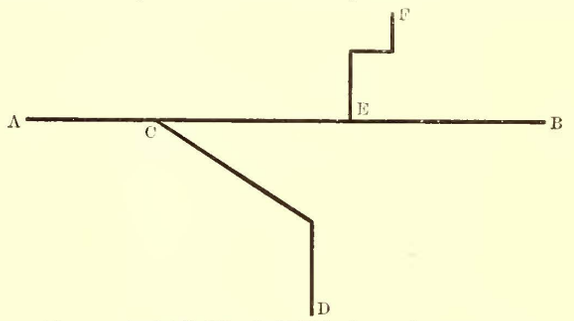


FIG. 2.—BRANCHED SYSTEM OF DISTRIBUTION.

Practically, the various lines composing the network cross at all sorts of angles and intervals, and are subject to all sorts of conditions of traffic. All networks, however, have this property, that they are composed of interconnected lines, so that the conducting system of any line can reinforce, and can be reinforced by other systems. Fig. 4 shows that portion of the Boston network which lies within a mile radius from the Post Office as a center. It conveys an idea, better than any words, of the sort of network that occurs in practice. It differs totally from networks usually met in electric lighting, in that it is without any pretense of symmetry, either in configuration or load.

In all large installations one is likely to find all three types of distribution, usually a network in the center, and branched and linear distribution in the outlying districts. In laying out the system as a whole, each type must conform, as far as practicable, to its own conditions of economy, while the general feeding system must consider them all.

The starting point in any discussion of a conducting system for any purpose is Ohm's law in its simplest form

$$C = \frac{E}{R}.$$

In problems of distribution such as we are considering, the term involving R is usually the quantity sought, since the current and loss of potential are generally known or assumed. It is therefore desirable to transform this simple equation into some form which allows the ready substitution of the known quantities to determine the unknown. The resistance of any conductor may be written $R = K\frac{L}{A}$. In which A is the cross section, L the length and K a constant depending on the material considered and the units in which L and A are measured. If L is in feet and A in square inches the constant is obviously different from what it would be if L were taken in miles. The constant is, in practice, so taken that R will be in ohms when L and A are in convenient units. In English-speaking countries it is usual to take L in feet and A in circular mils, *i. e.*, circles $\frac{1}{1000}$ of an inch in diameter. The constant connecting L in feet

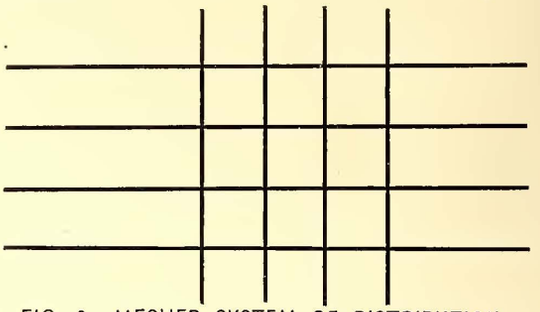


FIG. 3.—MESHED SYSTEM OF DISTRIBUTION.

and A in circular mils with the resistance in ohms, for copper wire of ordinary quality at ordinary temperatures, is 11. This is approximately the resistance in ohms of a commercial copper wire one foot long and $\frac{1}{1000}$ of an inch in diameter. The exact figure is a trifle less, but the ordinary contingencies of temperature, joints, etc., make it desirable to take 11.

Substituting now this value of R in Ohm's law it becomes, designating the area in circular mils,

$$C = \frac{E}{11\frac{L}{c.\,m.}} \text{ or, transposing,}$$

$$(1)\quad c.\,m. = \frac{11\,C\,L}{E}.$$

This is the fundamental equation of electrical distribution. It is like the original form of Ohm's law, strictly a linear equation, so that all the quantities are connected by simple proportions. Doubling E, for example, halves *c. m.*, while doubling L doubles *c. m.* A convenient transposed form is

$$(2)\quad C = \frac{c.\,m.\,E}{11\,L}$$

which determines the current which a particular line will carry without exceeding a given loss, and another,

$$(3)\quad E = \frac{11\,C\,L}{c.\,m.}$$

is convenient in figuring the actual fall of voltage. Throughout these equations E represents the fall in volts through the conductor under consideration, and L is always the total length of the wire, *i. e.*, double the length of the circuit, with a uniform return wire. For grounded circuits the equations give correct results for so much of the circuit as is exclusively copper—the grounded portion involves a different constant and must be taken up as a separate problem.

FIG. 4.—NETWORK OF LINES IN BOSTON.

It is often convenient to have some simple expression connecting the area of a wire with its weight, so that the latter may be readily taken into account. By a fortunate chance, a copper wire 1,000 *c. m.* in section weighs almost exactly three pounds per 1,000 ft. So if, in equation (1), we multiply the constant by three, and reckon L in thousands of feet, we obtain directly the weight of conductor per 1,000 ft. Putting L_m for the length, to distinguish it from the former L reckoned in feet, we have

$$(4)\quad W_m = \frac{33\,C\,L_m}{E}.$$

Thus, if we wish to transmit 100 amperes through 7,000 ft. of conductor at a loss of 50 volts, the conductor must weigh $\frac{3300 \times 7}{50} = 462$ lbs. per 1,000 ft. The total weight of conductor is evidently $W_m L_m$, and since a simple way of getting the total weight, without reference to wire tables, is often desirable, we may re-write (4), as follows:

$$(5)\quad W = \frac{33\ C\ L^2_{in}}{E}$$

which gives the total weight directly. These weight formulæ are very easy to remember and apply, and are accurate to about 1 per cent.

The diagrams of Plate I. put equations (1), (3), (4) in graphic form for ready reference. Four different values of E are assumed, and the unit of power is taken as 100 amperes. The chart is therefore independent of the initial pressure, and serves for transmission at any ordinary voltage. Distances on the horizontal axis represent length of circuit, *i. e.*, half the total length of conductor. To find area or weight per 1,000 ft. of conductor required for a certain distance, take an ordinate at the required point on the distance scale and follow it up until it intersects the oblique line representing the assumed loss of voltage. The area of the necessary wire can then be read off on the left hand scale, and the weight per 1,000 ft. on the right. The corresponding sizes of the B. & S. gauge wires are annexed to the former scale. In a similar way the distance for which a given wire will carry 100 amperes at a given loss can be found, while the loss for a given wire and distance can be rapidly approximated by estimating the position of the intersection of the area and the distance co-ordinates with reference to the oblique lines. By noting that the area of conductor varies inversely with E, one can extend the working range of the chart. Halving the area shown for E = 75 gives, for instance, the area for E = 150, and so on.

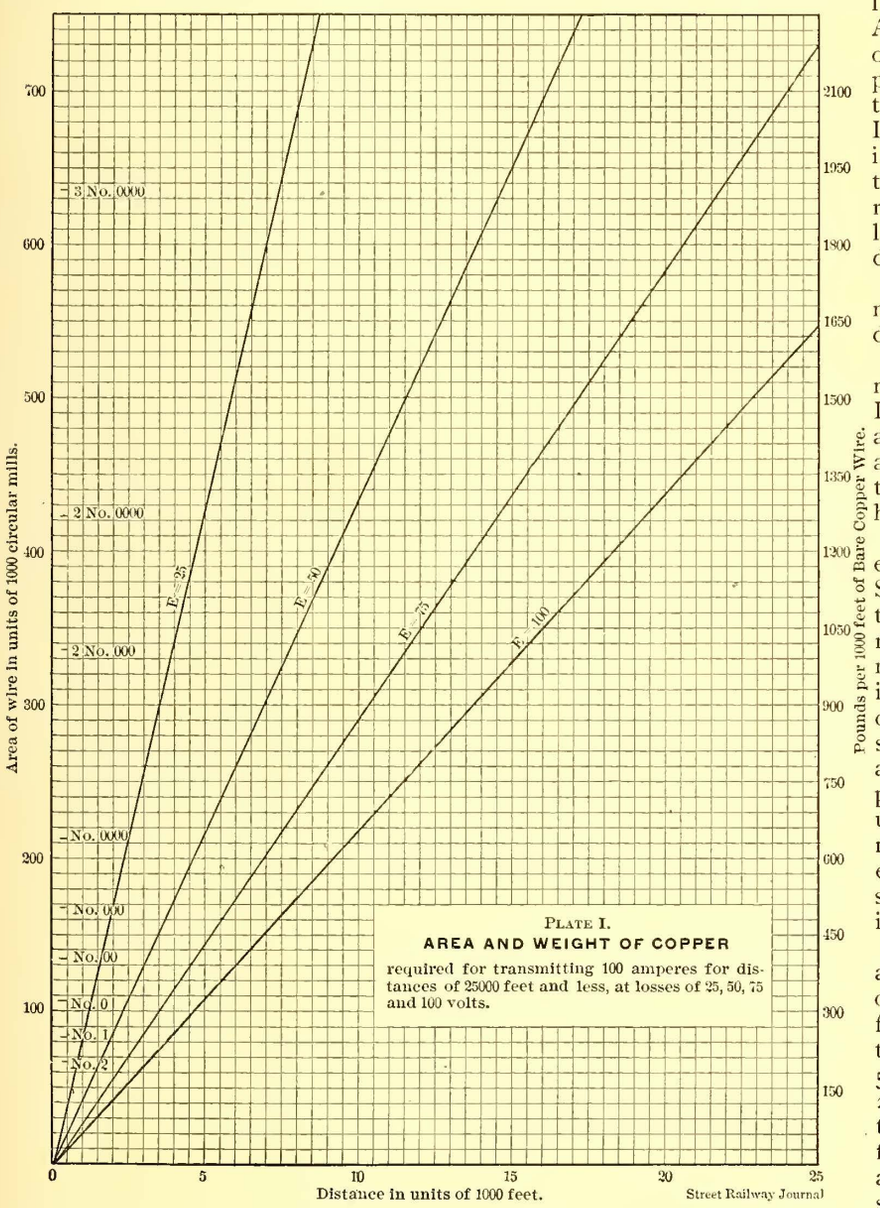


PLATE I.
AREA AND WEIGHT OF COPPER
required for transmitting 100 amperes for distances of 25000 feet and less, at losses of 25, 50, 75 and 100 volts.

Taking up now the case of linear distribution, it has already been shown that the fall in voltage in any conductor is directly proportional to the load and the resistance. If, now, a uniform line, A B, Fig. 5, be loaded at B, the voltage evidently decreases uniformly throughout its length. To make the example more concrete, the length A B is taken as 20,000 ft., and the voltage kept constant at A, *e. g.*, 500. Now, if the drop at B under the given load be 100 volts, a straight line drawn from C to D shows the state of the voltage at every point of the line. An ordinate erected at any point of A B and extended to C D shows the voltage of the line at the point selected, and tha part of the extended ordinate cut off between C D and C F shows the loss in volts. If the load be transferred from B to some intermediate point of the line, an ordinate there erected will show the drop and the residual voltage at the new point. C E similarly shows the conditions for a terminal drop of 200 volts.

The average drop is evidently half the maximum in each case, since the minimum drop is 0, and the voltage varies uniformly.

Now suppose one has to deal with a load moving uniformly back and forth along A B. If the maximum drop be 100 volts, the voltage evidently moves uniformly along C D, and the average voltage is 450, since half the time the voltage is above this, and the other half an exactly equal amount below.

This case corresponds to a line traversed on a uniform schedule by a single car. Such, however, is not the usual condition of things. The normal condition of an electric road of any kind is a plurality of cars. This means that current is taken from the working conductor at a certain limited number of points. In general, these points represent approximately equal loads and, so long as the time table is maintained, are approximately equidistant. In Fig. 6, the uniform straight conductor A B is loaded, not, as in Fig. 5, at one point, but at ten equidistant points, the loads being assumed equal, as they would be quite nearly if each load were a car on a level track.

Here the conditions of fall in voltage are radically different from the conditions of Fig. 5. At the power station, A, the full current for the entire load is supposed to be delivered at a uniform pressure of 500 volts. Assume the total current to be 200 amperes, and the resistance of each of the uniform sections to be 0.05 ohm. The first section carries the whole 200 amperes, and the drop, C R, is 10 volts. The second section carries but 180 amperes, and the loss is 9 volts, and so on, until the tenth section carries 20 amperes, and the loss has diminished to 1 volt.

Mapping these successive falls of potential on Fig. 6, the curved line, C D, is formed, showing the consecutive values of the potential on A B. C E, a prolongation of the drop in the first section, shows the result of concentrating the whole load at B.

In such a uniformly loaded line the drop is found as follows: If C is the total current and there are n sections in the line, then $\frac{C}{n}$ is the current taken off at each section, and $\frac{C}{n} r$ is the drop due to that current, where r is the resistance of each section. The drop in the first section from A is $10\frac{C}{n} r$, in the second section $9\frac{C}{n} r$

and so on, *i. e.*, for the whole n sections the total drop must be

$$(6)\ E = \frac{C}{n}\, r\,(1+2+3\ldots\ldots n.)$$

But the sum of this series of integers is well known, being $\frac{n(n+1)}{2}$. Hence, substituting and reducing, we have

$$(7)\ E = \frac{C\,r}{2}\,(n+1).$$

This gives the total drop produced by n uniform loads uniformly spaced and aggregating C amperes.

It is generally convenient to have working formulæ give the cross section of conductor directly, since that is most frequently the quantity to be determined. Equation (7) can readily be transformed for this purpose as follows:

$$(8)\ R = \frac{11\,L}{c.\,m.}.$$

But since the R here concerned is the total resistance, and not the resistance per section r, as in (7), we may write,

$$r = \frac{11\,L}{(c.\,m.)\,n}.$$

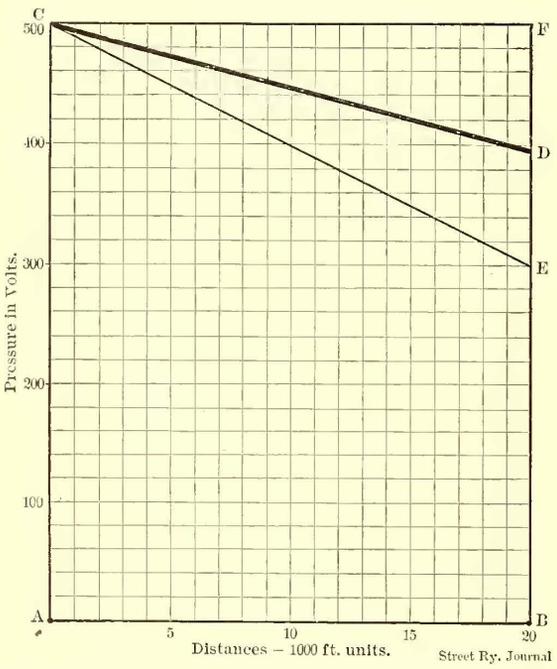


FIG. 5.—DIAGRAM OF LOSSES IN CONDUCTOR WITH LOAD AT ONE END.

Then substituting this value of r in (7) and reducing, we have

$$(9)\ c.\,m. = \frac{11\,C\,L}{2\,E}\left(\frac{n+1}{n}\right)$$

This equation gives the area of conductor required for C amperes supplying a line of known length equally loaded at n points at any required terminal drop.

For a large number of sections $\left(\frac{n+1}{n}\right)$ approaches unity, so that, for a given current in amperes and a given terminal drop, the copper necessary for a uniformly distributed load is one-half that required for the same load concentrated at the end of the line. As the number of sections increases, too, the likelihood of obtaining a disarrangement of load sufficient to disturb the terminal voltage much, decreases. The effect of a uniform motion of all the loads on the terminal voltage is small. So long as the schedule is uniform and is adhered to, the worst that can happen is a transformation of the system into half the original number of sections. Suppose in Fig. 6 all the load points of odd number to be moving to the right, and all those of even number to the left, at uniform speed. Then after each point had moved half a section, there would be five sections each loaded with a pair of coincident loads. Applying (7) to the data of Fig. 6, E = 60, assuming the sections uniform. As, however, the first section would be but three-fourths the length of the others, the real loss would be 55 as before. Another equal movement and the ten sections appear in their original relation. Another and we have the five sections, but with an initial section one-fourth the length of the others and total loss of 45 volts. Next would come a ten-section arrangement, but with the first load at A, and E = 45, and so on. The upshot is that while the terminal voltage oscillates through a range equal to the drop in the first section, the final effect on the average drop of uniformly moving the loads is the same as loading each section at the middle point or increasing n indefinitely. Hence, in a line with uniformly spaced and uniformly moving loads, we may assume $\left(\frac{n+1}{n}\right) = 1$ in (9) and write

$$(10)\ c.\,m. = \frac{11\,C\,L}{2\,E}$$

or, transposing,

$$c.\,m. = \frac{L}{2}\cdot\frac{11\,C}{E}.$$

That is, the area of the line can be calculated for average terminal drop just as if the load were concentrated at its middle point. Hence, for all practical purposes, by

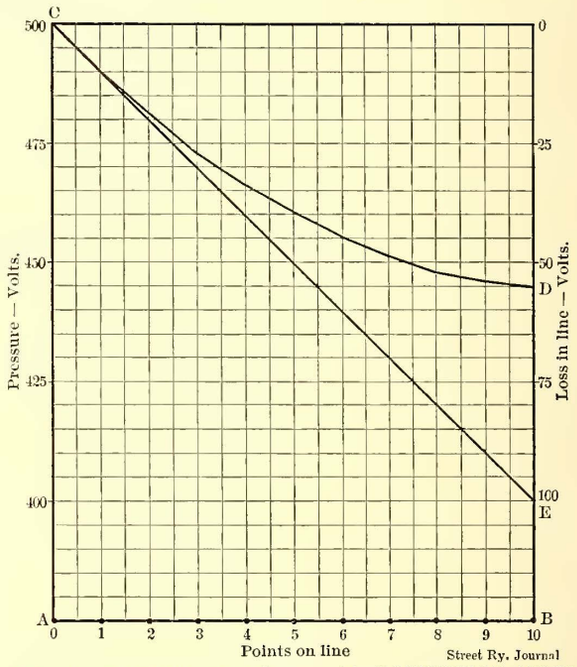


FIG. 6.—DIAGRAM OF LOSSES IN CONDUCTOR WITH LOADS UNIFORMLY SPACED.

making this assumption, equations (1), (4), (5) can be used in calculating the line.

To keep the voltage approximately uniform over a linear system of distribution is comparatively easy. In the most favorable case, a number of uniform loads moving uniformly, the drop is half that met in the most unfavorable distortion of the load, *i. e.*, bunching at the end of the line. This latter condition brings the worst possible load upon the station, barring short circuits. Although long stretches of uniform conductor often occur in railway practice it is usual to reinforce the working conductor by feeders variously arranged, as will be shown later. Such feeders were very necessary in the early days when trolley wire as small as No. 4 was used, but now, when No. 00 is very commonly employed, elaborate feeding systems are less necessary for linear working. The most important linear distributions are likely to come in long interurban roads, which often demand special methods of feeding. Whatever these may be, the uniform working conductor is of sufficient importance in every system to warrant this discussion of its general properties.

As a corollary to this general investigation, it is evident that in dealing with any linear system such as A B, Fig. 6, the best point for the power station is at the middle point of the line, since under the conditions of uniform load supposed, this point would give the small-

est average drop. Since L in such case is one-half its value when the whole line is fed from A, the total copper per equation (5) is reduced to one-fourth the amount for the same loss.

Considering, now, the branched type of distribution, shown in Fig. 2, it is best to take it up in the simplest available form. This, Fig. 7, shows a main line, A B D, with a branch, B C, which is straightened and made parallel to the main in order to more clearly show their relations. Unless the branch is of such magnitude and position as to require special feeders, it is supplied with current from the main linear system. In a few cases the service on a branch is from B to C and back. More gen-

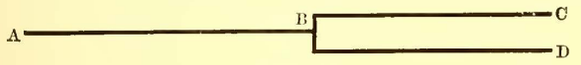


FIG. 7.

erally it is from C to A and back, a part of the cars being devoted to a through branch route. On the section A B, the load is the sum of those due to each line of cars. Beyond B there are two independent linear systems.

If there are m cars on the route A D, and n cars on the route A C, then the load on A B, due to both lines, will be

$$m\frac{\overline{A\,B}}{\overline{A\,D}}+n\frac{\overline{A\,B}}{\overline{A\,C}}$$

and the loads on B C and B D respectively will be

$$n\frac{\overline{B\,C}}{\overline{A\,C}} \text{ and } m\frac{\overline{B\,D}}{\overline{A\,D}}.$$

Consequently, if the section A B is computed for this load according to (10) we shall get the proper conductor for the assumed loss E. The lines B C and B D can then be computed for losses E_1 and E_2. The values of E, E_1, E_2 are usually taken with the condition imposed that $E+E_1$, $E+E_2$ shall be less than a certain specified maximum. A more general method is that of Fig. 8. Here there is a line, A B, with branches running to C, D, E, F. The loads are l, m, n, o, p, amperes respectively. A B, A C, A D, A E, A F, are now considered as separate, each subject to its own conditions. Taking now a drop for each line, according to the dictates of economy or convenience, and figuring the conductors from (10) with the respective currents, an area is found for that belonging to each line. Then the cross section of copper required from A to the first branch is $[c\,m]_l+[c\,m]_m+\ldots\ldots$ That from the first to the second branch is $[c\,m]_m+[c\,m]_n+\ldots\ldots$ and so on. In practice the conductors would be installed of the nearest convenient size, neglecting small variations of E from the calculated amount at the termini of the various lines.

The same procedure applies to all sorts of independent lines radiating and fed from a common center, whether or not these lines have any sections in common.

We have thus far assumed all lines to be uniformly loaded all along their lengths. It often happens, however, that for some cause a line is loaded unequally. In

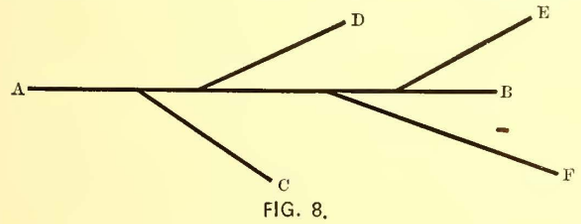


FIG. 8.

the long run, grades partially compensate themselves, since as many cars run down by gravity as go up by the expenditure of extra power, so that their effect shows more in the variations of power required than in the total amount. Not infrequently, however, from the effect of grades, curves or local cars in an extended system, there is a regular demand for extra power at some point of the line. This is shown in Fig. 9. Here the line A B is divided into ten sections, each equally loaded, except that at 8 the load is three times the normal. Now it has just been shown that a uniform distributed load is the same in effect as if it were concentrated at the middle point of the loaded line; that is, the electrical loads, like mechanical ones, act as if concentrated at their center of gravity. Hence we may represent the above case by $A^1\,B^1$, Fig. 9. If c be the normal load of each section, then a load of $10\,c$ will be concentrated at C while a load of $2\,c$ is at D. Hence, following out the principle of center of gravity, the system requires for a fixed value of terminal drop the same extra area of copper as if the whole load, $12\,c$, were concentrated at E, a point chosen so that $2\,c\,l'=10\,c\,l$. The same result is reached in many cases more simply by figuring the normal uniform load as if concentrated at C, and then treating the load $2\,c$ at

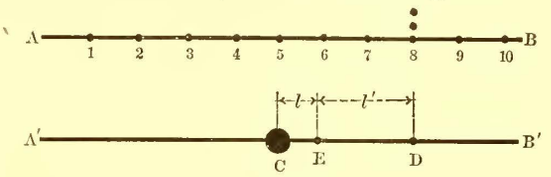


FIG. 9.

D as if it were on a separate line, as in computing branches. This is the best procedure when grades and other extra loads are superimposed on normal and regular traffic.

But the principle of center of gravity has another and a broader application.

In any case of scattered load the center of gravity of the system is the proper point from which to distribute the power, at least in so far as this point gives the minimum weight of copper for a given loss. For instance, in the line of Fig. 9, E is the point from which the power should be supplied, whether direct from a generator or from a feeder, if $A^1\,B^1$ is but a single part of a large system. The center of gravity of two points in a line is found by the ordinary balancing principle, as in Fig. 9. The center of gravity of any number of points in a plane is found by an extension of exactly the same method, as shown in Fig. 10. Let there be, for example, five load points in value respectively 1, 2, 3, 4, 5; required the center of gravity of the system.

Take any two points, as 2 and 3, and find their mutual center of gravity, just as in Fig. 9. This will be approximately at a point at which the whole value, (5), of the 2-3 system may be assumed to be concentrated. Now find the center of gravity of this point and 5; this will be at a point at which the weight will be (10). Then taking 1 and 4, the resultant weight will be (5). Finally, balance these resultants and the center of gravity of the entire system is found at (15). The order in which the combinations are made is of no consequence, since a given system can have but one center of gravity. Now, suppose the points 1, 2, 3, 4, 5, are supplied from a common source O through lines l_1, l_2, l_3, l_4, l_5. Referring to equation (5) the total weight of copper in any line as l_1 may be written $W=K\,c\,l^2$, where K depends on the uniform drop assumed. For any number of load points thus connected to a center O $\Sigma W=K\,\Sigma\,c\,l^2$. But this is directly proportional to

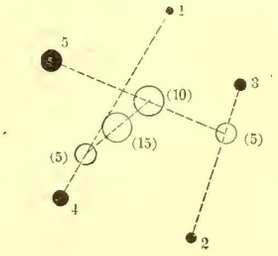


FIG. 10.

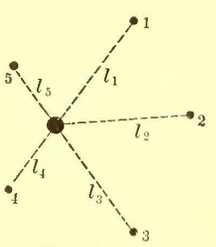


FIG. 11.

the moment of inertia, $\Sigma\,m\,l^2$, of the loads considered as weights, about O as an axis. Now the moment of inertia of any body about any axis is composed of the sum of two terms, viz., first, the moment of inertia of the parts of the body around its center of inertia, and, second, the moment of inertia of the whole mass concentrated at its center of inertia, about the axis chosen. Therefore, the minimum moment of inertia for a given set of loads is obtained when the axis coincides with the center of inertia, thereby causing the second term to disappear. Hence the total weight of copper required for supplying,

at a given loss, any system of loads is a minimum when the system is fed from its center of gravity. And the penalty for disregarding this law is severe, as will presently be shown.

Truck and Motor Repairs.

In the following tables will be found the various items in truck repairs as made at one of the leading shops of a large street railway corporation in the vicinity of New York. The individual items are separated as much as it was possible to do in the vouchers open to inspection. It would have been desirable to carry this separation to a greater extent, but the want of detailed itemizing has not yet been felt, and consequently many general managers are allowing items to be grouped which no doubt will be ultimately separated.

The first table given shows the total number of repairs made upon the motor trucks from March 17 to June 18, 1895. The total number is 568. The second column shows the distribution by percentages.

The first item to attract notice by its size is that of wheels, seventy-five pairs having been put on, or 13 per cent of the total. The number is the more surprising because the road is comparatively level. There are no long or steep hills on the line, the service being no harder than that of ordinarily busy roads on an undulating profile.

During the time covered by the table there were some seventy-five pairs of wheels replaced. The cost as shown by the table includes some wheels and pinions, but even with these additions the total amounts to only 25 per cent of the whole cost of truck repairs.

The repairs upon motors, armatures, commutators, and other portions of the electric apparatus of the car were much smaller than might have been anticipated. They are shown as a whole to be less than 8 per cent; the largest single item being 5.7 for armature repairs. To have the smallest items take their proper places it would be necessary to extend the investigations over a whole year. Some of them are represented by much larger fractions than is fair, while others have no place at all.

Item.	Number of Repairs.	Percentage of total.
"Touched up"	21	3.7
Brakes	16	2.8
Pairs of wheels put in	75	13.2
Gears furnished, old and new	164	28.9
Pinions	156	27.4
General repair	3	.5
Trucks painted and cleaned	16	2.8
Shifting truck	4	.7
Armature repairs, "burn outs" etc	46	8.1
Commutator and bearings	5	.9
Elliptic springs	15	2.6
Motor bolt	1	.2
Fenders applied	33	5.8
Axles, sprung, etc	4	.7
Bent channel bars	1	.2
Armature, bent shaft, etc	3	.5
Motor frame repairs	5	.9
	568	100.0

The actual cost of brake repairs shows very well and the cost percentage is practically the same as that obtained by comparing the number of repairs of each kind.

The items of gears and pinions are so large as to at once attract attention. These two items form more than 55 per cent of all the repairs made. Some of the gears placed in service were partly worn, but all were counted alike. The great number of repairs in the given time is accounted for by the fact that an entire new equipment was put on the road at one time, when the change was made from horses to electricity. The table covers the period at which a large number of repairs became necessary, owing to the fact that the whole of the new rolling stock went into service at nearly the same date. It, of course, would need renewal and attention at about the same time. Later on the repairs will distribute themselves more equally. The proportions which the different repairs bear to each other, and to the total, will be the same, however, whether they extend over a long period or are compressed into a short one.

Item.	Total Cost.	Percentage of total.
Brakes, including some general repairing	$ 90.	1.5
Pairs of wheels, including some gears and pinions.	1490.	24.5
Trucks "touched up"	51.	.8
New gears, pinions, including some old gears and pinions replaced	3601.	59.2
General repairs	56.	.9
Trucks painted and cleaned	38.	.6
Trucks shifted, charged at 40 cents each	3.	.1
Armatures burnt out and other armature repairs.	346.	5.7
Commutators, bearings and other electrical repairs	81.	1.3
Motor bolt	3.	.1
Bent channel bar	1.	.0
Fenders, new ones put in place	274.	4.5
Broken motor frame and frame repairs	52.	.9
Total cost of repairs of these items, March 18, 1895, to June 17, 1895, inclusive	$6086.	100.0

Fenders, as shown in the table, do not properly come under the head of repairs, because, at the period named, all cars were being equipped with new fenders, and these were applied whenever a car came into the shop.

The second table gives the cost of making the different repairs. The figures include both labor and material. The sum total on the items named was a trifle over $6000, and the startling feature of the table is that 60 per cent of this amount is charged to gears and pinions. These items alone are more than double that of the wheels. While not separated from other repairs as carefully as could be wished, its great importance as compared with all other repairs of rolling stock is not to be doubted.

Novel Method of Emptying a Car House in Case of Fire.

The need of some method of quickly running the cars stored in a car house from the house in case of fire, is important, and has led to the adoption of various expedients, of which perhaps the best known is that of having the tracks pitched at a slight grade, so that the cars in case of need can be quickly run out. This involves keeping the brakes continually set, and in certain respects is somewhat inconvenient to construct and use. A new method has recently been patented by one of the employes of the Detroit Railway, of Detroit, Mich., and is certainly ingenious in conception. The tracks are level, but the trolley wire running over each track is furnished with a cut-out switch, located near the exterior of the building. When the cars are left for the night this switch is opened, leaving the trolley line dead, and each controller is put on the first point. In case of fire an employe has simply to turn the switch operating the trolley line over the track, and the cars immediately file out at a slow rate of speed. In case the motors on one car are disabled, it is pushed by the one immediately in the rear. When these cars are safely out, the switch controlling the trolley line over another track is thrown in, and the cars on that track are safely removed from danger.

Street Railway Rolling Stock.

By W. E. PARTRIDGE.

V.—Car Corners.

One of the weakest portions of the ordinary closed or box street car is to be found in the corners. Where wood meets wood at right angles there is always a great difficulty in making a secure and strong joint. The wood is liable to split, and if the work is exposed to the weather there are additional influences tending to destroy the solidity.

The peculiar curved forms necessary for the sides of a closed car make the strengthening of the corner a very difficult matter. The engravings which we present herewith illustrate the corner finish used by the Brill Company upon its standard cars. It also shows the method of strengthening the corner so that it becomes practically as firm and durable as any other portion of the structure.

FIG 1.—SIDE AND CORNER OF CAR "IN THE WHITE."

Fig. 1 shows the corner and end of the car "in the white," as it is termed. All the portions of wood are here in place, but the corner is unfinished, none of the defending iron work being in place. The principal member of the corner is, of course, the large solid piece of timber called the corner post, cut to fit all the required curves. Upon this the two curved panels are fastened by screws, and on it the window panel, the window rail and the guard rail, with the other outside panels, all find a secure fastening. From the sill to the guard rail the curved panel has by reason of its form a joint upon the corner post which is peculiarly difficult to secure, and as this corner from the window down is liable to blows of all kinds from the vehicles in the street, it is necessary to make the construction as perfect as possible.

The convex panel does not reach the extreme corner of the car. A quarter round moulding worked on the post itself butts against the two panels. The point where workmanship of a solid character is most needed is at the end of the guard rail. In the photograph the three pieces of wood which constitute the corner at this point are shown in position before they are finished. A tenon is made upon the end of the guard rail and what may be called its prolongation around the end of the car is fitted over it and screwed fast, the joints being carefully made with thick white lead paste. The guard rail is at an angle and the corner of the post is left projecting and square, so that the three pieces of wood have a firm bearing upon each other. At this point with ordinary methods of construction great difficulty is always experienced from the shrinkage of the wood, the burring up of the ends of the wood, the entrance of water and a general disintegration of the joint.

By reference to Fig. 2, it will be seen that the wood is finished by rounding the end of the guard rail and carrying its upper surface around the corner upon a curve, at the same time cutting away the square corner of the corner post, so as to make a smooth finish. To defend this corner, which presents the end wood of two different sticks to the weather, a flaring curved corner plate is used which comes down and meets the guard rail strap. This strap is made by the Brill Company in a single piece from door post to door post, no joints being tolerated.

The concave corner, instead of being covered by two distinct strips of metal, as is a common practice, has a peculiarly formed angle iron piece fitted into place, and this is screwed fast in the post, so as to hold both the end and concave panel perfectly secure. Considerable work is necessary in this fitting, but when it is well done a strong and durable joint is obtained and there is no danger of the fastenings splitting or pulling from the ends. From the belt or guard rail to the window rail two iron mouldings are used, one covering the joint of the end panel and the other covering the end of the joint of the convex panel with the post. These are also set in white lead. At the window a belt cap is put on to the corner having a recess to take the window rail strap. This, like the belt rail strap, runs continuously from door to door without splice or joint. The advantages of this piece are, first, the protection which it gives to the joints between the three pieces of wood, and, second, the very neat and strong finish which it makes. The entrance of water on the corner is particularly disastrous because with the constant working of the car and the tendency of the wood to spring and open, water finds its way into these joints with extreme facility and when it once gains entrance its work is very rapid. It softens the wood and allows the bolts and screws to lose their hold and at the same time it promotes decay, and, when the latter sets in, extensive repairs are imperative if the destruction has not gone so far as to make them useless.

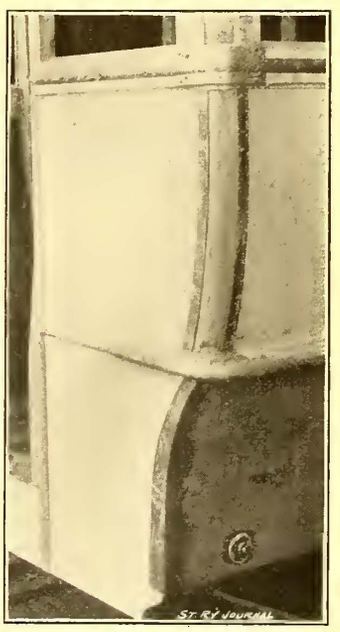


FIG. 2.—CORNER PLATES FOR DEFENDING JOINTS.

In Fig. 1, at the upper corner of the car, it will be noticed that the window panel or letter board, the end panel and the water table are all joined to the head of the post. Within (not shown in the engraving), the plate of the car has to take a bearing upon the post. As this post is the most important one in the car, and the whole momentum of the roof is practically resisted by it, the necessity for great strength and stiffness is apparent.

In cars where the posts are too light, and, consequently, the motion of the roof is great under the swaying of the car in service, the joints between the posts and the letter board usually open, and when the screws are not sheared off they are pulled loose or split out of the panels. To make this corner perfectly secure, and at the same time to obtain a neat finish, the corner plate shown in Fig. 3 was designed by the Brill Company and made in wrought iron. It was a very difficult form to produce, and is turned out at the present time by what is known as a drawing press. The dies for this piece of work, although apparently quite simple in form, required a great deal of skill in their formation and adjustment before they could produce a piece of metal of this shape from the flat without wrinkles or puckers. The two slotted holes seen in Fig. 3 are intended to take the brackets holding the inner ends of the hoods. This iron, like the others, is laid in white lead and is screwed to the posts, rails and plates by some fifteen large screws. In case of accident this iron, like that in the lower parts of the car corner, performs the very important function of preventing the wood from being battered or bruised, distributing the blow in such a way as to prevent local injury. Thus secured, the joint has little opportunity to work, and is perfectly protected against moisture and hard usage.

Upon the corner of the raised deck, as will be seen in Fig. 3, a piece of wrought iron is used to secure this somewhat weak joint against the entrance of moisture and from opening under stress. As usually built the raised roof is much exposed to the weather and to racking strains, and the joints frequently open and decay begins in the framing. The projection of the raised roof some distance beyond the end window is an important advantage. In the ordinary construction, where the roof stops at the end of the monitor or raised deck, much annoyance is often experienced by rain beating in at the end window and dropping down on the seats. Indeed, so great a nuisance has this become that it has been proposed to make the two end sashes in the raised roof stationary, so that when running into head winds the rain driving around the corner should find no opening.

The defence of the car corner by these straps and corner irons is exceedingly complete and can hardly be improved with the present form of structure. Both wood and iron are used so as to take advantage of their best qualities respectively.

Theory is, however, of small interest unless accompanied by an object lesson. One new car is just as fine in appearance as another and promises to wear just as long. The worn out car tells a tale which compels conviction, and in Fig. 4 we have an illustration which emphasizes all that has been said in regard to the car corner.

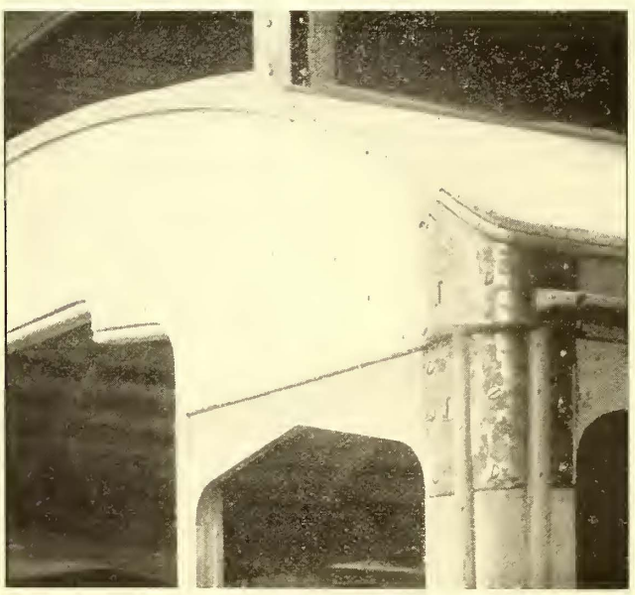


FIG. 3.—CORNER PLATE DEFENDING JOINT BETWEEN POSTS AND LETTER BOARD.

The car represented in this engraving was built for a horse car and probably ran as such for some years. The road changed its motive power to electricity and placed motor trucks under the car and a trolley stand upon the roof.

From bad construction, as well as hard service, the car soon went to pieces. Water entered at the roof corner and kept the corner post wet. The upper corner went to pieces and a piece of heavy tin was nailed in place to protect the wood and hold the parts together. This, however, kept out no moisture. The post decayed, not only at the top but at the window rail as well, and finally from decay gave way at that point. The heavy iron strap going down the post was for the purpose of giving strength to the corner. It extends from a point ten or twelve inches above the window rail to the bottom of the sill.

The window rail has rotted off from the corner post and the lower curved panel is free from the wood of the frame. It should be mentioned that the panels only extend from one window post to another. While loose in most cases many of them are mere decayed posts and rails. Probably the tenon on the corner post has rotted off, but this could not be known without destroying the car.

In this car it was easy to trace the decay along the lines where the water entered and was held in contact with the wood. Even the sinking of the roof seemed to be the result of decay induced by bad workmanship rather than by bad design.

It is safe to conclude that where vital points are neglected and workmanship slighted neither good material nor perfect design is sufficient for the production of a durable car for street railway service.

Notes on Car Construction and Repairs.

With the ordinary style of platform, shortening the inboard end of the platform timbers one-half increases the strain on the end sill of the car by fifty per cent. This does not seem possible but it is a simple question of leverage. The long timbers pay in the end.

Care should be taken to have the wood at the ends of the guard rail on a car body always protected by paint and varnish. The car corner is a weak portion of a car body and the junction with the guard rail the weakest part of the corner. A few minutes work now and then inkeeping this part in good order is well spent.

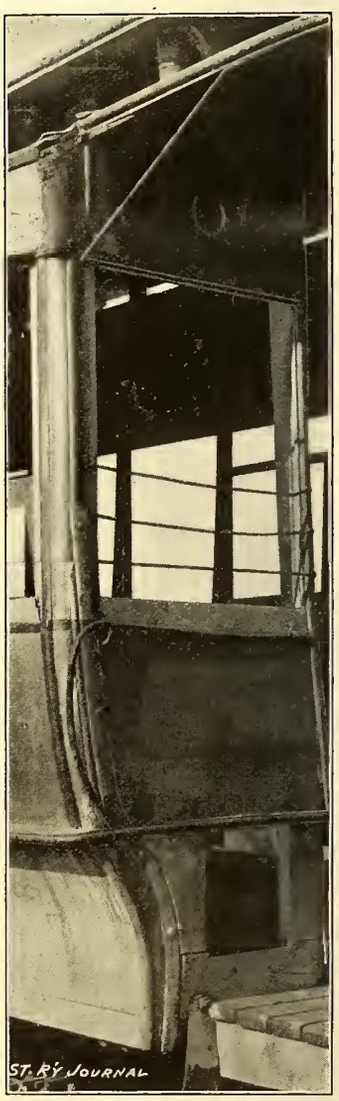


FIG. 4.—"READY FOR SPLITTING UP."

It does not pay to spoil a $1200 car body to save a $200 truck. This is a self-evident proposition yet it is disregarded by men who appear in other things to be perfectly clear-headed. When a truck begins to go to pieces and shows by its weakness that it is depending on the car body instead of giving it support, it is time to choose between the least of two evils and sacrifice the truck rather than the car.

A cable road of some importance contributes the following figures in regard to the cost of keeping up its cars and grips. There are no trail cars in use. The total cost of repairing cars and grips for one year was $19600. The cost of repairing the grips was $7300. As this road reported a short time since that it had 160 cars it will be seen that the repairs to each must be very light. It should be added that the road reports its grip repairs as twenty-eight per cent. of its total car repairs and the body repairs as seventy-two per cent.

The following memorandum of costs is taken from the note book of a Western street railway manager:

	Labor.	Material.	Total.
Cost of repainting a 16 ft. closed car	$40.70	$16.23	$56.93
Cost of repainting a 26 ft. open car	37.40	14.61	52.01
Cost of repainting a grip car	25.52	13.51	39.03
Cost of touching up and varnishing a 16 ft. closed car	10.12	3.12	13.24
Cost of touching up and varnishing a 26 ft. open car	11.00	7.38	18.38
Cost of touching up and varnishing a grip car	11.00	6.68	17.68
Cost of recanvasing and painting car roofs 16 ft. closed cars	3.35	11.51	14.86
Cost of recanvasing and painting car roofs 26 ft. cars	3.95	12.36	16.31
Cost of recanvasing and painting car roofs grip cars	3.25	9.70	12.95

LETTERS AND HINTS FROM PRACTICAL MEN.

Distance Between Tracks.

EDITORS STREET RAILWAY JOURNAL:

We start the new year by asking you some questions which you will confer a great favor by answering.

In double track work what is the least distance between tracks—center to center—that you know of, or in other words, what is the least clearance between cars?

What is the customary distance of clearance?

Is this distance increased or shouldn't it be increased when center poles are used?

What is the narrowest roadway between curves that you know of, when center poles are used?

What would you advise, side poles or center poles for narrow streets with lines of shade trees on each side?

J. F. F.

[It is always advisable to leave as much clearance as possible in order to avoid danger to persons who may be caught between cars. The width of cars varies so much between belt rails that there is nothing which may be called "standard practice." A good average distance between gauge lines of inside rails is 5½ ft. where no center pole is used, and 6 ft. should be allowed with center poles. This is the distance used on Niagara Street in Buffalo, which has center poles. On the Broadway line in New York (cable system) the distance has been reduced to 5 ft. An attempt was made in Newark to use center poles with inside rails only 4½ ft. apart, but there was danger of passengers hitting heads and elbows against the poles and they were abolished. In Pittsburgh particularly narrow cars are used and we believe that the distance between inside rails is, in a few instances, as low as 3 ft., but this is, of course, a decidedly unwise extreme. It is, of course, true that much more distance should be provided on curves than on a straight track.

The general practice is toward the use of span wire construction wherever possible. Where there are many shade trees in a street, span wire construction is sometimes undesirable both to the public and to the company, the latter sometimes having difficulty in preventing leakages of feeders through trees to ground in wet weather.—EDS.]

Hartford & West Hartford Railroad Company.

HARTFORD, Conn., January 1, 1896.

EDITORS STREET RAILWAY JOURNAL:

I do not think that the question of providing strips for water conductors on the roofs of open cars has had due consideration, and that the same provisions that are made on steam cars are not carried out on electrical equipment. It would require but a small strip on the edge of the roof under the canvas to turn the water off at the ends, thus avoiding having the water blown into the car to the great annoyance of the passengers. To a tidy, neatly dressed conductor it is simply torture to collect fares with the dirty water from a car roof running down his back. I think the idea entirely practical and hope that the car builders will provide something suitable for the open cars which are built for use next season.

R. L. RAND, Superintendent.

The Effect of Improper Wheel Flanges on Rails.

NEW YORK, January 15, 1896.

EDITORS STREET RAILWAY JOURNAL:

A day of reckoning is coming to many street railway companies which will be a surprise and a sorrow. Street car wheels have for many years been bought in a more reckless manner than any one article purchased. It is not the purpose of this letter to consider the question of whether these wheels will last in a way to justify the money expended. It is not always the wheel which suffers the most. Poor wheels inflict their own retribution upon the purchaser. Until recently there may have been some excuse for the purchase of the cheapest possible wheel, because it was difficult to know whether the wheel was good or poor. Mileage records were imperfect and few managers were aware of the extreme differences in value between the poorest and the best wheels. But it is beyond any understanding how a rational man with sound mechanical ideas can buy wheels whose sections are entirely unfit to run upon the rails used upon his road. The enormities committed in this line by those who, in much of their mechanical work, are above unfavorable criticism is something past belief. There are numerous instances where roads having rails with grooves scarcely an inch in width have purchased wheels with flanges which entirely filled the grooves. It is a matter of common knowledge among wheel makers everywhere, that managers are constantly buying wheels which, by reason of their shape, cannot run upon the rails of the roads without binding. Perhaps the first cause for complaint against street railway companies is to be found in the track itself. This is, for the most part, put down as though it were never intended for a wheel with a flange to pass over it. For reasons which in sixty years of railroading have been proved valid, all wheels are made with a small amount of cone for the tread. The flanges, on account of the necessities of manufacture, must have a certain thickness to obtain strength and wearing qualities.

In laying track none of these things are considered. The rail head is placed dead level instead of being set at an angle to conform with the cone of the wheel; consequently, new wheels and new rails have a bearing surface consisting of little more than a point, possibly a line barely a quarter of an inch long. Under such conditions it is about a year, under ordinary traffic, before the wheel and the rail have worn themselves to conform sufficiently to obtain a rational amount of bearing surface. While this wearing process is destroying the comparatively cheap wheel, it is also cutting away the head of the rail in a very rapid manner. Before the wheel and rail reach a full bearing the rail has lost an appreciable fraction of all the metal which it can lose before it goes into the scrap heap. This is not useful wear because it must take place so rapidly, and because it is destroying wheels by reason of local uneven wear which might be spread over the whole tread.

Another injurious feature of the rail is the sharp corner of the head. Wheel flanges are also made of such shape that they sharpen this rail head until it forms an angle like the knife edges of a pair of scales. When this form is reached, the rail in turn quickly gives the wheel a sharp flange and then the mutual grinding reaches its maximum severity.

Special work is put down without regard to the fact that cars with long or short wheel bases must run over it. Wheels are run over this special work through the grooves, and are constantly grinding the rails in the most vicious manner. The whole roadbed is suffering because of the unsuitable form of the wheels, and in many cases no form of wheel could be adapted to the rail.

Sharp flanges are a constant terror to the special work, and yet with the rail sections which seem to be favorites, it is impossible to run wheels without making sharp flanges. In passing around curves, there is a useless grinding of the wheels in almost every road of the country. That it is permitted seems unaccountable. That it is entirely unnecessary is a matter of easy demonstration. That it should have taken place when electric roads first began to be laid is no wonder, but that it is allowed to continue and to destroy one of the most expensive parts of a street railway system is unaccountable.

A day of reckoning is coming. This replacement of the track at short intervals will not be tolerated by business men, because it will mean vastly larger repairs than the investment will stand. How fast this cutting of rails is going on can be determined with ease. Comparing

some of the present sections of rails with the standards received from the rolling mills, it will be seen that there are many new roads on which the rail is already half worn out, or perhaps, to be more exact, half the wearable metal in the head of the rail is already gone. The cost of destroying this good steel is considerable, because it has to be done by good cast iron wheels propelled by powerful and costly engines which are burning good coal. It is bad enough to wear out wheels uselessly. Perhaps there is an economy in buying poor wheels which will wear faster than the track. But it is difficult to see where there can be any excuse for such an unthinking and wasteful destruction of property as may be seen at almost any piece of special work in the country.

W. E. P.

Repair Shop Equipment.

The following is an actual estimate made by a prominent Western street railway manager of the cost of equipping a new repair shop for his road, which operates about fifty horse cars, twenty-five electric motor cars, seventy-five cable grip cars and 150 trail cars:

1 15 H. P. engine	$200
1 12 in. × 5 ft. engine lathe	185
1 18 in. × 8 ft. engine lathe	340
1 26 in. × 10 ft. engine lathe	605
1 14 in. × 8 ft. speed lathe	250
1 50 in. upright pulley borer	1,100
1 24 in. drill press	225
1 32 in. drill press	375
1 20 in. swing lever feed drill press	65
1 bolt threader to cut from ⅜ to 1½ ins	276
1 keysetter to cut ¼ to 1 in. with patent keymaking attachment	375
1 32 in. × 32 in. × 8 in. planer	1,200
1 24 in. shaper	480
1 power-shear and punch combined to cut 1 in. × 6 ins.	440
1 wet emery grinder with plunger pump 13 in. × 2½.	110
1 dry emery grinder No. 7 Diamond	75
1 150 ton hydrostatic press	756
1 100 ton hydraulic ram	225
1 forge and blower, No. 2 Sturtevant	50
1 1 ton Weston chain hoist	16
1 2 ton Weston chain hoist	24
1 8 ton Weston chain hoist	208
1 No. 30 Forbes pipe cutter to cut 2¼ in. to 6 in	175
Total	$7,755

WOOD SHOP.

1 No. 4½ mortiser and borer	$370
1 No. 3 tenoner	207
1 16 in. No. 2 buzz planer	130
1 26 in. No. 3 shaper, 2 spindles	150
1 24 in. surface planer	370
1 band saw	125
1 rip saw	55
Total	$1,407

Wheel Notes.

It is hard to believe that there is a better material for street railway wheels than chilled cast iron of the best qualities. From 50000 to 75000 miles have been made with such wheels, a record which is certainly satisfactory and hardly excelled. The best brands of chilled iron are hardly distinguishable from fine tool steel.

The use of a wheel gauge which shows the relative positions of the journals, the root of the flange on each wheel, as well as the gauge, measured at the back of the flange, shows that a surprising number of wheels are badly fitted upon the axles. The adoption of such a gauge has been known to almost put an end to broken flanges on a road.

In the *Milwaukee Street Railway Bulletin* appear the following instructions to motormen: "Sand should never be used unless it is impossible to decrease the speed of the car without it, and then the operator must be sure that his wheels are turning. It may perhaps be added that it is not improper to use sand before a wheel when about to start if the rail be slippery, since it will give friction for a grip upon the rail when its revolution begins, but of all things do not use sand unless the wheels are revolving."

The replacement of wheels is largely a business question. The direct expense is from $1.50 to $5.00, the actual figures depending largely upon the facilities and the number of spare cars. If it takes three or four wheels to make 40000 miles, the cost of replacement becomes greater than that of a new wheel—often very much greater. Moreover, the road loses not a little because of the rolling stock being out of service. The interest on the cost of the car alone is a shilling a day, and the loss of net income is far greater. The replacement clause in a wheel contract needs to be most carefully considered.

There should always be some means for identifying every wheel purchased. Usually this may be done by calling for consecutive numbers on every wheel purchased, and stipulating that there shall be no duplicate numbers. Makers' names and dates are sometimes used for this purpose, but the method is defective. Prick punching dates or numbers is at times resorted to, but the numbers cast on the wheel is easiest and most correct, and has the advantage of being a trade practice long in use and well understood. Some of the best founders in the country have always cast consecutive numbers upon all the wheels they have made.

Mr. P. H. Griffin says in a personal letter, "We have in the past five or six years directed our work specially towards the production of two distinct features in our metal—one, the turning of the chilled surface into the highest possible condition of combined carbon and iron, which is really nothing more nor less than the question of an exceedingly high grade of steel—and the other the production of a condition in the center or unchilled portion of the wheel that would make it especially remarkable on account of its strength. As a result we have increased the hardness and resistance to wear of the chilled surface of our special wheels from six to eight times beyond the best ordinary practice, and the strength of the material in the center we have been able to increase over one hundred per cent."

A wheel manufacturer says, "The competition of wheel makers continually pressing the price per pound lower and lower by fractions makes it absolutely impossible for most manufacturers to supply anything but the most ordinary, if not entirely improper, material in their wheels. There is one fact that stands above everything in the wheel business, not only for electric, but for steam railways, and that is that at the average price paid it is absolutely impossible to procure anything but the most indifferent quality. The result is that railways may in the first instance buy their wheels cheap, but the quantity they have to purchase and the expense of maintaining the service make a total many times greater than they would have if they treated the whole question in a businesslike manner. They do not buy any other material with the expectation of getting a good quality for the lowest possible price, and this theory should not be applied to one of the most important things they have to purchase."

Street railway managers who have not kept wheel mileage records until recently will nevertheless find it highly profitable to make a study of their past experience in wheels in some such ways as indicated in the accompanying table. A great many deductions can be made from the results shown in this table as to general tendencies resulting from the purchase of wheels from year to year from different manufacturers, although it is true, of course, that no accurate results can thus be obtained.

	1891.	1892.	1893.	1894.	1895.
Miles operated					
Cars operated					
Car mileage					
Passengers carried					
Wheels purchased					
Cost of wheels					
Shop expenses—replacing of wheels					
Total expense—purchase and repair items					

LEGAL NOTES AND COMMENTS.*

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

OF THE NEW YORK BAR.

Insurance of Common Carriers of Passengers Against Liability, Arising from Their Negligence.*

The insurance of persons and corporations using machinery of all kinds, which is likely to do damage through the carelessness of servants or agents to life and limb, against the liability of such persons and corporations to the insured or to the relatives of the dead, is a new form of contract. It arose, in this country, out of the provisions in steam boiler insurance policies which, like fire insurance policies, at first provided only for payment to the insured of indemnity for the loss of property but which afterwards, through the rivalry of companies to insert more liberal provisions, contained covenants to indemnify also against liability incurred to third persons—employes and others—by reason of personal injury and death caused by boiler explosion. The next step was a natural one. Companies were incorporated, and existing companies had their powers enlarged and issued policies indemnifying the insured against loss caused in any way to life and limb by the use of machinery or by the negligence of servants or agents, irrespective of the use of machinery or boilers.

To-day, in England and in this country, large sums are paid annually in premiums for this sort of insurance, and the legality of such policies, so far as is known, has not been called in question. The general rule deduced from all the authorities would seem to be that such contracts are valid, although some question might be raised where the act of negligence amounted to a crime, for which the insured himself might be indicted.

To such of our readers, however, as are common carriers of passengers, is presented another question which may be an exception to the general rule asserting the legality of such policies. At the outset it may be noted that, whether such an agreement made with a common carrier of passengers is, or is not, invalid, is a question not likely to arise in the ordinary course of business. Who would raise it? Surely not the railroad company, which is seeking to recover for losses, and certainly not the insurance company, for if it should contest a policy on the ground that it had no right to issue it, the practical result would be that it would be unable to write any more policies of that class. Hence we are not surprised that the question has never been mooted in the courts until recently, although such insurance has been written in the United States for nearly six years. Nor do we find the question treated in any of the text books.

The question has now arisen in the courts, however, by reason of the failure of a large insurance company, among whose creditors are a number of street and steam railroad companies; their claim for a part of the assets being contested by other policy holders who are not common carriers of passengers.

With no precedents in the courts, the only basis of an argument upon this question is an examination of the general principles of the common law and of the adjudicated cases which are analagous although not identical.

The Supreme Court of the United States has held that "the fundamental principle on which the law of common carriers is founded, and the great object of that law, is to secure the utmost care and vigilance in the performance of their important duties—an object essential to the welfare of every civilized community. * * * In regard to passengers, the highest degree of care and diligence is expressly enacted. * * * It is obvious, therefore, that if a carrier stipulates not to be bound to the exercise of care and diligence, but to be at liberty to indulge in the contrary, he seeks to put off the essential duties of his employment, and to assert that he may do so, seems, almost, a contradiction in terms." *Railroad Co.* vs. *Lockwood, 17 Wallace, 357, 377.*

Reasoning from these fundamental principles, the United States Supreme Court has held, and most of the states have followed its reasoning, that, where a passenger contracts with the common carrier that he will hold the common carrier harmless because of any liability which it may incur by reason of his death or injury caused by its negligence, such an agreement is null and void as against public policy; and, notwithstanding such agreement, the injured passenger may sue and recover precisely as if it had never existed. Any other rule, say the courts, would cause a relaxation of that care and diligence which is to be enacted on behalf of the public by the great corporations who have received franchises from the state and municipality.

The question now arises whether the same reasoning will apply to a case where the common carrier does not contract with the passenger for such immunity, but where it contracts with a third party—an insurance company, for example—and an arrangement is made with it by which the company is saved harmless in case of its negligence. The common carrier remains primarily liable to the passenger, but is indemnified by the insurance company. The question is the one which, as I have already stated, has never been passed upon in this country, either by a court of original jurisdiction or last resort. It would seem, at first sight, that the effect of such a contract in causing any relaxation of diligence would be the same as in the case passed upon in the case of the *Railroad Company* vs. *Lockwood.*

There is a reply which might be made, to the effect that it is the interest of the common carrier to pay as low a premium in future years for such insurance as possible, and hence it is reasonable to expect the common carrier to reduce, so far as possible, the number of its accidents for the purpose of reducing the premium.

But it would seem very doubtful as to whether the courts would consider it a foregone conclusion that the insurance was to be renewed in the following year, and even if they did they might hesitate to hold that that was a sufficient incentive in comparison with the incentive which the company would have if no such contract of insurance existed.

Another line of argument, which may be made in defense of the validity of such contracts, is based upon the case of the *Phenix Insurance Company* vs. *Erie Company, 117 U. S., 312.* The Supreme Court had previously held that an agreement made between a common carrier of goods and the consignor thereof, which by it relieved itself of liability for its own negligence, was void as against public policy, and in the Phenix case it held that, notwithstanding that rule and without impinging upon it, *a common carrier of goods* could insure against its own negligence.

Manifestly, if the same reasons, and *only the same reasons*, which support the decisions holding that a common carrier of goods cannot contract against its own negligence, to support the proposition that common carriers of passengers cannot so contract, then the same rule would apply to the validity of contracts of insurance in both classes of common carriers.

But the suggestion comes, at once, to the mind of every reader, that there are other and additional reasons

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

against such contracts on the part of common carriers of passengers. The reason why a common carrier of goods cannot stipulate against its own negligence with the consignor is clearly stated by the courts. They hold that a different rule would tend to increase such stipulations and their stringency and that these stipulations would be forced by the railroad company upon the consignor by the necessity he is under to use the railroad, and thus there would be in the hands of the company an oppressive ability to raise rates and to free itself from all responsibility for its negligence. But in the case of a common carrier of passengers there are other reasons why the railroad company must be held to the strictest accountability. Human life and limb are at stake, public policy demands the most stringent care, and, until the railroad company can indemnify the dead for loss of life or by money restore a limb, it is doubtful whether any court of last resort will hold that a company can insure against its own negligence, where life and limb are involved. The state has an interest in the lives of its citizens, and that interest is one of the reasons why the common carrier of passengers is held to the exercise of the most diligent care. *Bryan* vs. *Missouri R. R., 32 Missouri Appeals, 228, 237.*

Where the common carrier of goods finds that the railroad company has insured itself against loss, he has but little to complain of, even if such insurance has caused the company to be careless, for he will receive from the railroad company full indemnity for the loss of his goods, and no one can be said to be injured. But with the passenger, it may be that the courts will think that a different rule applies, for the injured man is not, even in the eye of the law, fully compensated, for he receives a pecuniary compensation which covers only a part of what he has lost, and in the case of his own death he is not compensated at all, although certain of those dependent upon him will receive a portion of the damage suffered by them, and that portion is generally limited to an arbitrary and specific amount by statute.

Space forbids more than the mention of a number of other considerations which apply to this very interesting question, such as, for example, the fact that in Massachusetts and one or two other states, the negligence of which the railroad is guilty when death results, is criminal and damages are recovered by a criminal procedure beginning with an indictment. Thus, if such insurance contracts are valid in that state, we have the startling proposition that a corporation can insure itself against the penalty which the state imposes as a punishment for crime. Perhaps this is stating the proposition too baldly, especially as the result of the action in Massachusetts is, as everywhere else, payment to relatives of the deceased of the fine imposed. (*Public Statutes of Mass., Chap. 112, Sec. 212.*)

Aside from the legality of such contracts, there are some interesting questions which arise concerning the underwriting principles applicable to them. For, under most policies (e. g., fire, marine, steam boiler and life insurance) a loss during the period covered by the annual premium is an exception, and therefore the principles of average are applicable; while in the case of policies insuring corporations owning large consolidated interests in street railways, where accidents occur daily, the practical principles of average, if applicable at all, are to be considered in reference to the single policy by itself without reference to others; especially, when the accidents are so numerous, over an extended system, as to be practically a fixed quantity year by year. In such a case it is not, as in the case of fire insurance, the putting apart each year of a small sum in combination with a large number of others to meet some great and unexpected loss, but it is a guess between the insurance company and the railroad company as to whether the future operation of the road will result in more or fewer accidents than in the past; and the business question is also involved as to whether the insurance company or the railroad company is best equipped to settle losses at advantageous figures. It is upon a consideration of such questions and not by the ordinary rules applied by actuaries in other lines of insurance that the premium to be paid by a common carrier of passengers is determined.

But we are now, perhaps, outside of the domain of the legal department of a street railway journal, and we will therefore close with the citations of a few additional leading cases which discuss some of the fundamental principles, upon which the arguments for, and against, the legal proposition I have discussed may be found *in extenso.* (*Liverpool Steam Co. vs. Phenix Ins. Co., 129 U. S., 397; Hartford F. Ins. Co. vs. Chi., M. & St. P. R.R., 70 Fed., 201; Maslin vs. R. R., 14 West Va., 180; Kinney vs. Central R. R., 5 Vroom, 513; Roan vs. Midland R. R., 46 L. R. Ir., 157; Penn. R. R. vs. Henderson, 51 Penn., 315; Cleveland R. R. vs. Curran, 19 Ohio State, 1; B. & O. R. R. vs. Brady, 32 Md., 33; Buell v. N. Y. C. R. R., 25 N. Y., 442; Stinson vs. N. Y. C. R. R., 32 N. Y., 333, 337.*) H.

LIABILITY FOR NEGLIGENCE.

New York.—In an action for injuries sustained by being knocked down by a cable car at a street crossing, it is error to charge that the failure of the gripman to warn crossing pedestrians was of itself sufficient to render the company liable.—(Schulman v. Houston &c. R. R., 15 Misc. 30.)

California.—Where plaintiff was standing between street railway tracks, awaiting an approaching car, and, without looking, stepped backward upon the other track, within ten or fifteen feet of a car going in the opposite direction, she was guilty of contributory negligence, as a matter of law.—(Bailey v. Market St. Ry., 42 Pac. Rep. 914.)

Montana.—In an action for injuries by a collision between street cars, a charge that, if plaintiff was not guilty of contributory negligence, the collision cast on defendant the burden of showing absence of negligence, held proper.—(Hamilton v. Great Falls St. Ry. Co., 42 Pac. Rep. 860.)

EXCESSIVE DAMAGES.

California.—Code Civ. Proc., § 377, provides that, in an action for the death of an adult by wrongful act, "such damages may be given as under all the circumstances may be just." Held, that in an action by a husband, personally and as guardian of his two minor children, about twelve years old, against a street car company, for death of his wife, a verdict of $14,000 will not be set aside as excessive where it appears that the expectation of life of the deceased was 31.8, and of the husband 29.62 years, and that the wife was highly educated and competent to instruct the children, and was a devoted mother and wife, and an excellent housekeeper.—(Redfield v. Oakland St. Ry., 42 Pac. Rep. 822.)

Montana.—In an action for injuries to a passenger, there was evidence that she was injured in her back and side, and suffered from nervous prostration, but that such injuries were curable; that she suffered a slight displacement of the womb, but that such injury was much less painful than at first, and was also curable; and that other internal injuries would be relieved after it had been cured. Held, that a verdict of $20,000 was excessive.—(Hamilton v. Great Falls St. Ry., 42 Pac. Rep. 860.)

North Carolina.—In a case where the plaintiff sued to recover damages caused by his team taking fright at a trolley car, the Court say: "The plaintiff voluntarily exposed himself, his buggy, and his mule to the risk of any accident which might be caused by the animal's taking fright at the usual noise incident to running a street car by electricity, there being no testimony tending to show that the motorman wantonly or maliciously made unnecessary noise for the purpose of scaring the animal. Where a horse is being driven or is running uncontrolled along a highway parallel to a railway of any kind, though it give unmistakable evidence by its movements that it is alarmed at an approaching train or car, the engineer or motorman in charge is not negligent in failing to diminish the speed, unless the animal is actually on the track, in his front, or he has reasonable ground to believe that in its excited state it is about to go or may go upon it, so as to cause a collision. People who pay their money in the reasonable expectation of being carried expeditiously are not to be delayed by every person who ventures to test the nerve of a horse or a mule by driving it along the same street on which a company runs its street cars by electricity."—(Doster v. Charlotte St. Ry., 23 S. E. Rep. 449.)

New York.—A verdict for $1500 is not excessive where it appears that plaintiff was under medical treatment for several months, that he suffered from headaches and stomach and liver troubles and that he may permanently feel the effects of his injury.—(Ferguson v. Ehret, 35 N. Y. Supp. 1020.)

New York.—Where the plaintiff had a rib broken, causing a bloody tumor, and pleurisy, incapacitating him for work for a year, with probable permanent ill effects therefrom, and his time is proved to be worth $4 or $5 a day, a verdict for $3200 will not be held excessive.—(Wynne v. Atlantic Ave. Ry., 35 N. Y. Supp. 1034.)

New York.—A verdict for $4000 for injuries sustained, consisting of permanent paralysis of the shoulder muscle, impairing the lifting power of the arm, and permanent spinal curvature, is not excessive.—(Degnan v. Brooklyn City R. R., 35 N. Y. Supp. 1047.)

New York.—Plaintiff's intestate, while standing on the front platform of one of defendant's cars, was hurled over the dashboard by a violent jerk of the car. A passenger testified that he had experienced a jerk as if the driver had put on the brake and let it off, or as if there was a rock on the track. There were unoccupied seats inside the car, the tracks were icy and it was snowing steadily. Held—

that there was no evidence of defendant's negligence and that the decedent was guilty of contributory negligence.—(Bradley v. 2nd Ave. R. R., 35 N. Y. Supp. 918.)

STATUTORY POWERS—CHARTERS—ORDINANCES.

PENNSYLVANIA.—Where the charter of a street car company requires it to keep the street occupied by it in good repair at its expense, the fact that at the time the charter was granted a part of a certain street afterwards occupied by the company was required to be kept in repair by other parties who had privileges thereon does not prevent the duty of keeping in repair becoming incumbent on the company.

The charter of a company provided that it should be "compelled to keep in constant repair that portion of the street which it uses and occupies and be subject to such ordinances of council as relate thereto;" and the city ordinance provided that all street car companies should be at the entire cost and expense of maintaining, paving, and repaving that may be necessary on any street occupied by them. Held, that such company was bound to keep in repair not only the portion of the street occupied by it, but the whole street, from curb to curb.

Where the charter and city ordinances required it to repair and repave streets occupied by it, such duty extends to the replacement of an old pavement by a new one of a different and improved kind, ordered by the city.—(City of Phila. v. 13th & 15th Sts. Ry., 33 At. Rep. 126.)

NEW YORK.—The procurement of a certificate of necessity from the railroad commissioners, as prescribed by §59 of the Railroad Law, is not a prerequisite to an application by a street railway company for municipal consent to use the streets and to the publication of notice of a public hearing in relation to such application.—(McWilliams v. Jewett, 14 Misc. 491.)

MANDAMUS.

NEW YORK.—Where a street car company, because of its inability to get employes to accept its terms, has stopped part of its cars, to the detriment of the public, mandamus lies to compel it to resume full operation of its lines. An application for mandamus to compel a street car company to run its cars may be made by any citizen of the city in which the road is located. The number of cars to be run by a street car company is a matter within the discretion of the directors, subject to the power of the courts to compel them by mandamus to increase the number whenever public convenience may require it.—(Loader v. Brooklyn Heights Ry., 35 N. Y. Supp. 996.)

VALIDITY OF CONTRACT EXEMPTING FROM NEGLIGENCE.

UNITED STATES CIRCUIT COURT. A condition in a lease, by a railway company, of a portion of its right of way, that it shall not be liable to the lessee for any damage to any buildings or personal property thereon, caused by fire set by its locomotives, or by the negligence of its officers or servants is not in violation of public policy and is valid. (Hartford Fire Ins. Co. v. C., M. & St. P. Ry., 70 Fed. Rep. 201.)

Book Reviews.

Electrical Law of the State of New York (with notes), by Wendell V. R. Barnard. Banks & Bros., New York and Albany, 1895.

This monograph is a timely one, and is possessed of considerable, though transitory value, both to the busy practitioner in New York and to the officers of electric street railways. Some three hundred cases are cited by the author, and no less than sixty statutes of New York.

The writer is something more than a compiler, and seems to have a keen appreciation of the difference between leading cases and others of less importance. The cases which he reviews are well selected from the mass of decisions which he cites. The pages of the volume which relate to the electric street railway are comparatively few in number but they contain the main principles of law which have been enunciated thus far by the New York courts, and which form the germ and core of what is to be the law of the electric street railway in this state, and so are of value.

The subject of negligence is touched upon by the author, but so inadequately that the treatment is necessarily uneven. For example, under section ninety-four, there is a discussion of "culpable negligence." Why the negligence there referred to is more "culpable" than other negligence, the author does not state and I cannot guess. Under this section he states a number of exceptions to the general law of contributory negligence. They do not seem to have any connection with the subject he is discussing and they contain some very doubtful propositions, and are given without the citation of any authority to support their very nice distinctions. The absence of any comprehensive discussion of the law of contributory negligence makes this page of the work the more inappropriate and foreign to its principal aim.

The book is to be commended for its conciseness and for the condensation into a few words of great leading principles, but these excellencies have been carried to such an extent as to become almost defects. It may be said to be more luminous than voluminous, and perhaps it would be better for all of us if more of the law treatises recently published merited a similar description.

The typographical excellence of its 172 pages is what can always be expected from the well-known publishers of the work.

Some Decisions in Railway Accounting Methods.

Mr. Henry C. Adams, statistician of the Interstate Commerce Commission, has recently issued a series of "Questions and Answers," which have been passed upon by a committee selected by the National Association of Railway Accountants. These decisions have been approved by the Interstate Commerce Commission. Such of them as have a bearing upon street railway accounting are given herewith.

Q. To what account should be charged wages, board, and expenses of non-employes, witnesses in "Loss and damage" and "Injuries to persons" cases?

A. Wages, board, and expenses of non-employes engaged as witnesses in the settlement of "Loss and damage" and "Injuries to persons" suits are properly chargeable to Conducting Transportation, account No. 35, "Loss and damage," or to account No. 36, "Injuries to persons," as the case may be.

Q. To what account should be charged expenses of litigation growing out of land damage and suits involving title to real estate?

A. All expenses of this nature should be charged to General Expenses, account No. 51, "Law expenses," except where properly chargeable to construction.

Q. Should the salary of Assistant General Counsel, whose time is given exclusively to the business of the company, be charged to account No. 47, "Salaries of general officers"?

A. The salary of Assistant General Counsel or Assistant General Solicitor (whatever the title of the assistant to the head of the legal department may be) is chargeable to General Expenses, account No. 47, "Salaries of general officers."

Q. The A and B railway uses jointly with the C and D railway thirteen miles of track, the former paying for the privilege on basis of valuation. The agents, operators, etc., are joint employes of the two roads, and are paid by the C and D railway, which road renders bill to the A and B railway for its proportion of their salaries. To what accounts should these expenses be charged, and how should the C and D railway credit the amount received from the A and B railway?

A. The payments made by the A and B railway to the C and D railway for use of the thirteen miles of track should be charged to Conducting Transportation, account No. 43, "Rents for tracks, yards and terminals," and the salaries of the joint employes as follows: Agents, to Conducting Transportation, account No. 30, "Station service;" operators, to Conducting Transportation, account No. 29, "Telegraph expenses," and so on according to the character of the service performed.

The C and D railway should credit the whole amount received for the use of the track in question to Miscellaneous Earnings, and report it, as "Rents received from lease of tracks and terminals."

The several accounts charged with the amounts paid by the C and D railway to the agents, operators, etc., who are joint employes of the two companies, should be credited with the proportions payable by the A and B railway.

Q. To what account should be charged repairs to bridges over railroads or to carry them over us?

A. Any repairs or renewals to a bridge built by a railroad company to carry its tracks over any stream, road, street, or other railroad, should be charged to Maintenance of Way and Structures, account No. 4, "Repairs and renewals of bridges and culverts."

A bridge built to carry any highway or track of another railroad over its own roadbed, should be considered as an overhead bridge, and any repairs or renewals to such bridge should be charged to Maintenance of Way and Structures, account No. 5, "Repairs and renewals of fences, road crossings, signs, and cattle guards."

Q. To what account should the wages of passenger car cleaners be charged?

A. The wages of all passenger and freight car cleaners are chargeable to Conducting Transportation, account No. 27, "Train supplies and expenses."

Q. To what account should the wages of employes engaged in oiling cars be charged?

A. Wages of car oilers are properly chargeable to Conducting Transportation, account No. 27, "Train supplies and expenses."

Q. To what account should the rent of general offices be charged?

A. Rent of general offices should be charged to Conducting Transportation, account No. 44, "Rents of buildings and other property," which provides for "payments for rent of buildings and other property" (including offices) when such property is used in connection with the operations of the road.

Q. To what account should the wages of a traveling engineer, whose duties are to instruct engineers in the handling of locomotives, be charged?

A. The wages of a traveling engineer, whose duties are to instruct engineers in the handling of locomotives, should be charged to Conducting Transportation, account No. 21, "Engine and roundhouse men."

Q. Should account No. 34, "Hire of equipment," be construed as requiring all payments made for use of equipment (other than "Car mileage—balance") to be charged to this account, or only the net balance paid?

A. Account No. 34 should represent only the net balance paid for use of equipment, other than that accounted for under Conducting Transportation, account No. 33, the same as if the title of the account read "Hire of equipment—balance."

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IT is time that some one, thoroughly competent to undertake the task, should enter upon a series of calculations and experiments to determine the best chemical composition for street railway rails. The conditions are, of course, entirely different from those of railroad traffic. In the one case we have comparatively light loads traveling at moderate speeds, with great frequency and with many stops within short distances. In the other case, we have heavy loads traveling at much longer intervals, at high and low speeds, with infrequent stops. Examination of some of our street railway track shows in some places not a little "squashing," or "anvil action" at the joints. Does not this mean that a larger percentage of carbon should have been put into these rails to increase their hardness? Or, are the sections of girder rails in most common use such as to make it impossible to use as much carbon as is specified for the thicker and "stockier" railroad tees? What is most certainly true, is, first, that railway managers ought to *know* from careful tests what should be the composition of the iron which they buy in such enormous quantities, and second, that street railway rail consignments should be tested as carefully as is always done with railroad rails.

WHAT are we coming to in this craze for new franchises at any price and under any conditions? There seems to be no limit to the concessions made by street railway promoters and syndicates in contracting with city corporations. This month comes the announcement of the granting of a franchise in one of our large cities, which goes to greater lengths in the direction of concessions to the city than any we have so far seen. The new company is to come into competition with one operating a widely ramified system which is giving an excellent service. Its system is to be about sixty-five miles in extent. What practically amounts to a four cent cash fare is granted, and tickets are to be sold at the rate of three for ten cents with universal transfer rights over the entire new system. It is also provided that the company must be willing to enter into arrangements at any time with the old company, operating about 145 miles of track, for a general transfer arrangement by which these low fares may be divided equally between the two companies, thus making it possible that the future may bring to a resident of this highly favored city the right to ride at the rate of two and a half mills per mile! Cheap transportation, indeed! Marvelous are the accomplishments of electricity! Another of the terms of this remarkable franchise is that only citizens of the United States and actual residents of the particular city in question shall be employed by the company or its contractors in any department of construction, operation and maintenance. What would happen in this city if the company's employes should strike? Is not such a condition in the franchise an actual incentive to strikes on the part of men who know that they have their employers at their mercy? Again, an older street railway franchise in another city contained a provision that after the initial electrical construction period was over, all further supplies and material needed in the construction and operation of the road must be manufactured within the city itself and by residents of the city. Such clauses as these are unreasonable and are sure to make trouble in one way or another, and permanent investors should be very careful about placing their money in channels where contingent losses are so easily possible.

CHICAGO has a "Three Cent Fare Association," which has a so-called "Educational Department" whose function is presumably to furnish statistics and arguments based thereon to the public press. This "Educational Department" has a curious and original way of forming its conclusions and presenting its arguments, as will be seen from its public remarks on the just published operating figures of the three great Chicago companies. These remarks read as follows:

"Taking the accounts as furnished by the combine officers it shows the net earnings are thirty per cent of the gross receipts, or otherwise stated, thirty per cent of every nickel collected is profit. Thus their books show it costs three and one-half cents to carry each passenger, the profit on which is one and one-half cents, or forty-three per cent added to the cost. Conceding the combine should be allowed its alleged three and one-half cents of cost, with seven per cent added for profit, the cost to the people would then be three and three-quarter cents each

ride, or an equivalent of seven rides for twenty-five cents. Should not a general ordinance be passed regulating the rate of street car fares?"

What a commentary this is on the ignorance and utter fallacy which often lie behind these demagogical arguments intended to excite public feeling against street railway corporations. It is almost unbelievable that the responsible head of any public organization of this character should so confound the idea of a "profit," or a margin above operating costs, with "interest upon investment," and yet it is not improbable that some unintelligible or careless public sentiment is manufactured by stuff like this.

HOW should wheels be purchased? What specifications can be laid down to the makers? What are the net results of the recommendations from practical men, which have appeared in our columns during the past twelve months on the subject of street railway wheels? To answer these questions with absolute certainty is impossible, because of the prehistoric times in which we are living in street railway wheel matters. A large number of roads have started systems of record keeping, but their results are not yet available, as time is necessary to produce results. Still, advice can be given on certain questions which have been solved with some definiteness. In the first place, the counsel of the best and most experienced wheel maker known to the purchaser should be consulted as to the character and dimensions of flange and tread suited to the sections of rail in use on his road. It cannot be too strongly insisted upon that the rails, the special work and the wheels should go together—should be suited to each other—so that sharp flanging and undue "tool work" on either wheel or rail should be avoided, and, moreover, it is certain that a wheel maker's experience is almost necessarily more valuable than that of any individual, since the former has studied all street railway questions from the wheel point of view, and has therefore become the most valuable kind of a "crank"—an intelligent crank.

* * * * *

The wheel maker will doubtless say, among other things, that the side of the wheel flange next to the rail should be inclined at an angle of about thirty-five degrees from the vertical, and that the rail head when new should fit the wheel, if sharp flanges are to be avoided. He will also tell you that no amount of fitting of wheels to a half worn and badly worn rail will accomplish good results, nor can such results be obtained unless the track is perfectly gauged and unless wheels are pressed to accurate gauge, not necessarily that of the track, but especially suited to the track. The determination of the weight of wheel should next be made, and from all the experience available, it may be considered certain that the weights should not be less than 325 lbs. for a thirty-three inch wheel designed for ordinary service. Light wheels mean accidents, and a single accident may mean a hundred times the entire annual wheel bill. It may be safely said that results from the use of the best quality of wheels in electric service weighing 325 lbs. to 350 lbs. show that breakage is entirely avoidable.

* * * * *

After deciding, therefore, upon the weight and the proper shape of the flange and tread the remaining problems are those of iron mixture, strength and chill. Specifications of mixtures are worthless. The wheel maker knows what he is about. The purchaser has simply to do with results. He may specify that one wheel in every hundred shall be tested for strength in much the same way that railroad wheels have been tested along the lines of the Master Car Builders' standard, but it should be noted that it has been found in railroad practice easy to make wheels which shall stand these breakage tests but which are not, by any means, good wearing wheels, and few railroad companies, other than the Pennsylvania Company, now test wheels in this way, nearly all having returned to a guarantee and to dependence on the manufacturer from whom they buy wheels. The depth of chill, as shown by the broken portions of the wheel tested, should never be less than three-quarters of an inch, and one inch chills should be required, as the service on electric railroads is much harder upon wheels than with steam roads. Finally, it should be specified that the wheels shall be of uniform circumference within one-quarter of an inch, and of uniform diameter (for unground wheels) within one-sixteenth of an inch, and all wheels should be rejected which do not comply with specifications.

* * * * *

If the simple specifications outlined above are carried out, if a guaranteed life of at least 40000 miles for each and every wheel is demanded of the manufacturer, if flatting of wheels is made an offence leading to prompt suspension of motorman, and if careful wheel records are kept, the standard of street railway car wheels will be immeasurably raised, and the pariahs of the industry —the manufacturers who make a poor and imperfect wheel, from any kind of metal obtainable, at almost the cost of pig iron—will be driven out of the field. One or two of our best manufacturers have recently produced combinations of carbon and iron for street railway wheels which are such that it is exceedingly difficult to determine from microscopic examination or from analysis whether they are iron or steel. In fact, some specimens of chilled iron have been produced which can hardly, upon the closest examination, be detected from Muschet steel, which is one of the highest grades of steel in the world, and is sold at about fifty cents per pound. Is not such work as this worth encouraging in places where the use of good material means the saving to a road of thousands of dollars in avoidance of accidents and loss of car service?

THE extension of city electric railways to suburban towns has been naturally followed by the construction of electric lines for an exclusively interurban business. This enlargement of the field of electric railroading has been so logical and gradual that it is difficult to draw a definite line between what should be regarded as interurban and what city lines, and most roads partake of both characters. Two points are of special interest to notice as regards the construction and traffic of these lines. In the first place, they have all been new enterprises, and have been designed and built as electric railways. There has been, as yet, no transformation of existing steam railways to electric lines, or even their partial equipment for suburban work, as was once freely predicted, though in most cases the towns connected by electric interurban roads were already joined by a steam road. In other words, the development has been an electric extension, not an adaptation of existing methods. The second interesting point is that the electric railways

are occupying a somewhat different field from their steam competitors, and in the case of parallel lines, do not necessarily greatly diminish the steam railway traffic while creating a considerable amount for themselves. They correspond more to the "light railways" of Europe, carrying passengers at low fares and at a moderate rate of speed, largely on highways, though often through a special right of way. Whether steam or electricity is more economical for this service is a question entirely of loads carried and train frequency. In track construction, and also in type of cars used, steam railway practice is being largely followed, except that steeper grades and curves of shorter radius are possible; and so far there has been no departure from the ordinary 500 volt pressure, except a slight increase in some cases to cover long distances. The only novel electrical features introduced beyond mere increase of capacity, strength of apparatus and speed of motors have been, in instances, the avoidance so far as it could be done of overhead switches, by the use of two trolley wires on a single track road with turn-outs, and a special effort to reduce as much as possible at the points of trolley wire suspension any resistance to the smooth running of the trolley wheel.

THE transportation of light freight and express matter promises to comprise an important portion of the traffic of the growing number of electric interurban systems. Those companies which have taken this up to any extent report themselves as more than satisfied with the results, and the possibilities in this line seem to be very large. It is reported that the systems about Cleveland, all of which are under one management, are seeking entrance to that city on their own tracks with the privilege of hauling freight cars, produce, etc., between the hours of 1 A. M. and 5 A. M. If this should be granted it will mean a radical change in the methods of handling freight within a city. There seems no reason why such a request should not be granted, and every reason why permission should be given. The present method of transporting merchandise and freight in city streets by heavy drays driven over rough pavements is wasteful of power, destructive to both pavement and vehicle, and objectionable by reason of the noise inseparable from such service. Transfer this transportation to smooth rails and an economy is effected at the same time that a nuisance is abated. The public will be better pleased because the methods used are quieter, the merchant because they are cheaper, and the taxpayer because the renewal of the pavements need not be so frequent. We believe that it will not be long before a large part, if not the greater part of the intramural freight transportation of many of our cities will be over rails and by the use of electric power.

THE expense of equipping steam and electric grade crossings with safety devices is one which should be borne by the steam railway companies. It is they who have introduced the danger element, and they must be compelled to guard their trains and the public as well with every safeguard which experience has shown to be of value. The effort being made in certain localities to impose this duty on the electric railway companies will not, we believe, be upheld in legal actions arising from accidents at such points. The legal status of the electric street railway is now pretty clearly understood. The transportation which it affords is in harmony with the original purpose to which the highway was dedicated. So long, therefore, as its cars are not run at an extreme rate of speed, or in other ways so as to interfere with the reasonable use of the highway by pedestrians or other vehicles, its cars should have the same rights and privileges as other users, and these include protection against high speed trains crossing the highway.

New York State Street Railway Association.

A special meeting of the Association was held at the office of the Metropolitan Traction Company, of New York, on January 14. The meeting was called for the purpose of acting upon proposed amendments to the Constitution and By-Laws designed to place the Association on a firm financial and sound business basis and to provide an income sufficient to defray legitimate and necessary expenses. The schedule embodied in the proposed amendments was recommended by the Executive Committee, after a careful deliberation, as the most available means and equitable basis for raising the necessary sums, and, upon motion, the amendments to the By-Laws were adopted as follows:

Article II. was amended by the addition of a clause reading

"In the event of a vacancy during the year in the board of elected members of the Executive Committee, the President and Secretary of the Association and the two remaining members of the Executive Committee are hereby authorized to fill such vacancy."

Article VII. was amended by providing that the regular meetings of the Association shall be held on the second Tuesday in September of each year.

Article XV. concerning "Fees" was amended to read as follows:

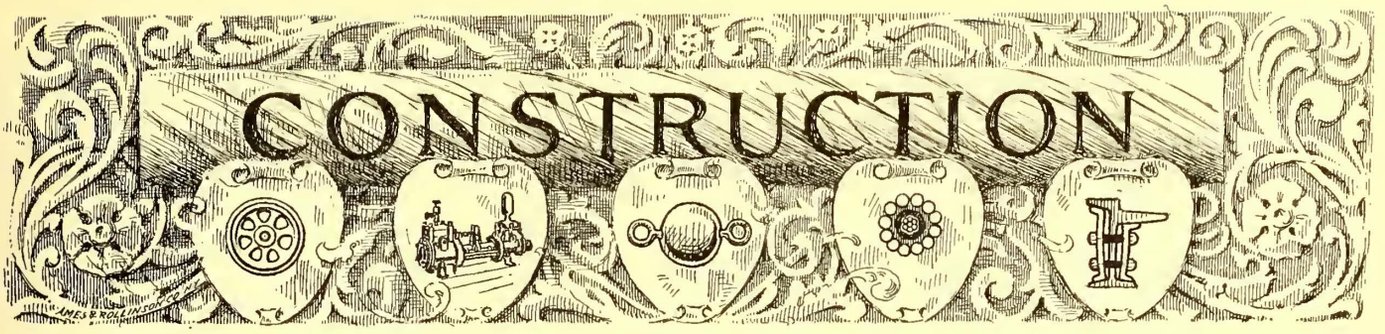
XV. Members whose annual gross receipts from passengers shall be more than $100000 shall pay an admission fee of $25. Members whose annual gross receipts from passengers shall be less than $100000 shall pay an admission fee of $5, and an annual assessment shall be levied on each member of the Association upon the following basis:

Members whose annual gross receipts shall be less than $50,000 shall pay	$10.00
Members whose annual gross receipts shall be over $50,000, or less than $100,000, shall pay	25.00
Members whose annual gross receipts are over $100,000, or less than $300,000, shall pay	150.00
All members whose annual gross receipts are over $300,000, or less than $500,000, shall pay	300.00
All members whose annual gross receipts are over $500,000, or less than $1,000,000, shall pay	400.00
All members whose annual gross receipts are $1,000,000 or over, shall pay	600.00

The assessment levied upon each member to be based upon the report of gross receipts as filed with the State Board of Railroad Commissioners for the preceding fiscal year, ending June 30. This assessment to be in lieu of all annual dues and shall be paid to the Treasurer of the Association on or before the first day of December each year. The Executive Committee shall have no power to expend, for any purpose whatever, an amount exceeding that received.

Results of Reducing Omnibus Fares in London.

As an illustration of the fact that a reduction in fares does not always mean an increase in traffic sufficient to bring net profits to their former level, the case of the great omnibus companies in London may be useful. There has been a sharp warfare of rates which has brought about a general cut in fares. The largest company, the London General Omnibus Company, has, during the past year, operated sixty more buses, run 316,000 more miles, and carried 3,695,000 more passengers, and yet has realized only $4,665 more in gross receipts, its net income being very largely reduced. The other companies have lost proportionately more.



Street Railway Roadbed.

BY MASON D. PRATT.

II.—Modern Girder Rail Sections.

At the beginning of the present decade the six and seven inch sections shown in this and the previous article were the most approved rails in use, and indeed the seven inch sections continue to be largely used on electric roads laid in asphalt or brick pavements, or even in shallow Belgian block pavements where the ties are imbedded in concrete. The latter construction while not common in this country is coming more into vogue. These seven inch sections are also the ones most used on cable and conduit electric roads, where the rail is supported on cast iron yokes and the pavement rests on a concrete base. Fig. 47 shows a seven inch rail lately adopted by the Metropolitan Street Railway Company of New York City for use on its lines, most of which will eventually be cable or conduit electric. It is peculiar

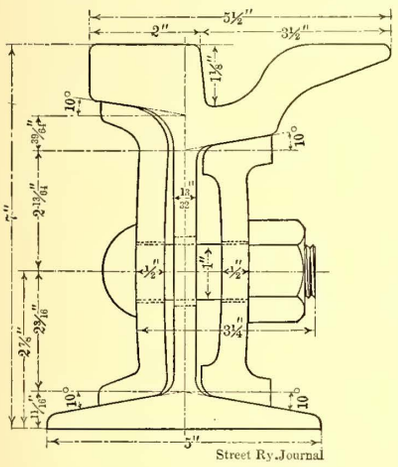


FIG. 47.—NEW YORK RAIL.

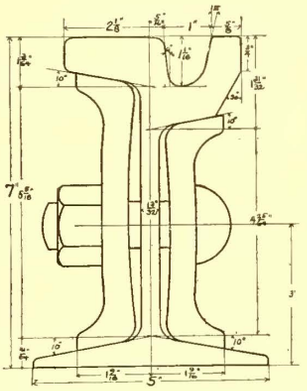
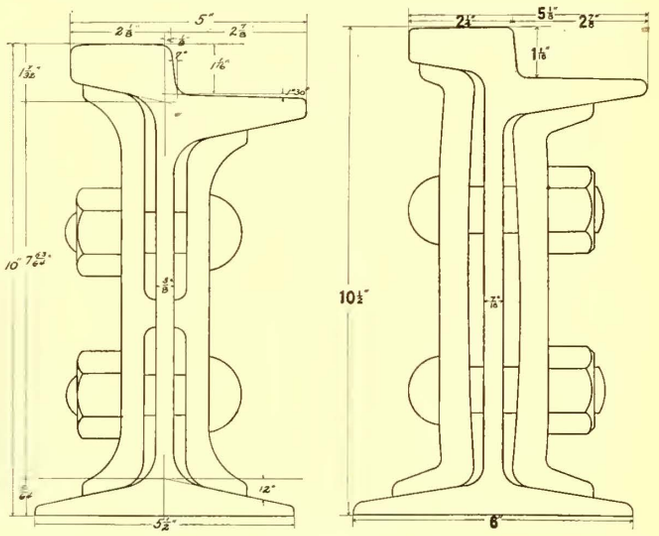


FIG. 48.—WASHINGTON RAIL.



FIGS. 49-50.—10½ IN. RAILS.

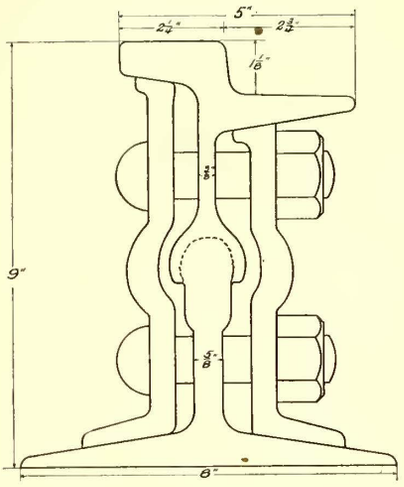
in having an extended lip attached to the guard, the idea of which is that it will carry the street traffic which tracks along the rails to such an extent as to greatly increase the wear on the rail and pavement. But since the rail now in use (Fig. 37, shown in previous article, p. 49) has a difference in elevation between the head and guard, thus *guiding* the street traffic along the rail—a feature which has been eliminated in the new rail by bringing the guard up to the level of the head—it is difficult to see why a tram should be provided for a traffic which will not be able to keep to the track.

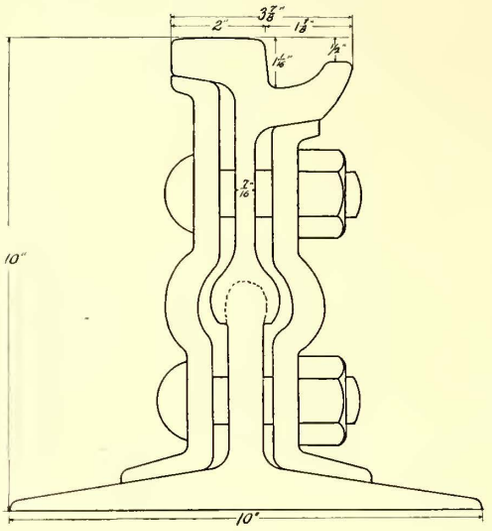
Fig. 48 shows the rail used on the new conduit electric roads in Washington.

There is a very serious objection to these seven inch rails on roads laid in granite block pavement on an ordinary sand base, in that the ties, having little or no sand over them, form a solid bed for the pavement, while that portion between the ties, having a more yielding foundation, sinks and the track soon presents the appearance of a "corduroy" road. To overcome this defect and to meet the conditions where even heavier pavement is laid, still deeper rails were required. Solid rails nine and ten inches high were suggested and called for but it was not until about four years ago that they were produced. Their manufacture presented many difficulties and the rail makers met with many failures in attempting to roll them. Much time, thought and money have been expended in experiments, with the result that to-day these rails are placed on the market at a price but slightly in advance of ordinary T rails. So great seemed to be the difficulties in the way at first that many devices were brought forth to accomplish the purpose without making a solid rail. The most ingenious of these was the so-called "electric rail" which consisted of an ordinary "bulb" section and a ⊥ shaped base rolled separately, the latter being cut into short sections of from four to eight or nine inches and electrically welded to the head portion at intervals suited to the tie spacing. By thus rolling the rail in two separate parts a very broad base could be produced, and a large economy effected in the omission of the entire lower half of the rail between the ties. This rail was fully developed and a quantity of it laid, but the inconveniences of handling and laying it proved to be many and great. During the two years following its introduction a reduction in the price of steel rails of nearly fifty per cent took place and rapid strides were made in the art of rolling solid, deep sections, which, together with the difficulties above mentioned, rendered it a commercial as well as a practical failure.

Many other schemes for the production of a deep construction without resorting to the *solid* rail have been devised. The idea of a combination rail—the head portion to be renewable—has been worked out (on paper) in many different ways. But no such schemes that have been offered may be considered practical in the light of experience. In the first place they are objectionable on account of multiplicity of parts—a condition which should be avoided in track work particularly. In the second place the renewable feature—their fundamental idea—is valueless, from the fact that the permanent parts become so much worn that it is impossible to secure a good fit on renewing the wearing portion. Then again the cost of this renewal amounts to as much as the laying of an entirely new track. For these reasons no other rails than the solid deep sections are seriously considered to-day.

As to the proper form which these deep rails should have, a glance at the illustrations will show that there is a wide variation in ideas. Of course, as explained before, local conditions govern to a considerable extent. Some city governments specify a full, narrow groove; others a broad, flat tram, while those who leave the matter to the railroad companies find rails laid in their streets having all variations between the two. The question as to which is the proper form for the exposed upper surface of the rail is one to be carefully considered in all its relations to motive power, density and character of street traffic, pavement, etc. When these circumstances are considered, no one can say that any one section is the proper one for all cities, or even for all the lines in any one city.





FIGS. 51 AND 52.—RAILS WITH ELECTRICALLY WELDED FEET.

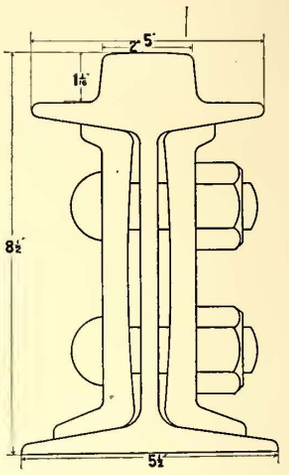
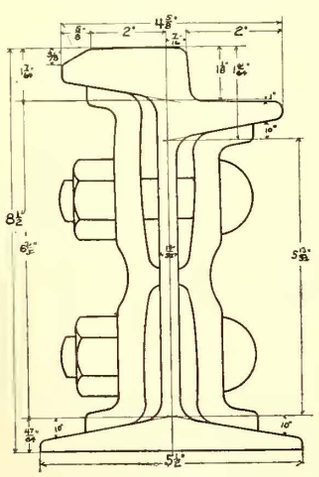


FIG. 53.—CENTER BEARING RAIL.

There is another and all-important factor in determining the form of that portion of the rail which is to be presented to the action of the car wheels, and that is the results of this action itself, the strains resulting from the forces exerted by the weights acting through the wheels at the point of contact, and the wear of the rail produced by both car and street traffic. The points to be considered in connection with these various influences are briefly stated as follows:

Motive Power:—This may be divided into two classes, that which is applied to the axles, as with the trolley electric system, together with gas, compressed air or other similar motors, and that which is applied externally, as in cable or horse traction. With the former it is far more important to have a rail which shall be free from dirt. Particularly is this so with electric roads using the rails for a current conductor, and some form of half groove or tram rail would be selected. A center bearing rail is by far the most desirable, if only the interests of the railroad are considered, but there has been a strong and growing dislike to it on the part of the public, owing to the two grooves formed along each rail, and which render it doubly annoying to carriage traffic. There are but few cities to-day which permit its use. A rail which approaches the center bearing rail in freedom from dirt is shown in Fig. 54, which is the section adopted by the New Orleans Traction Company.



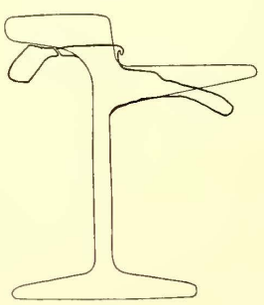
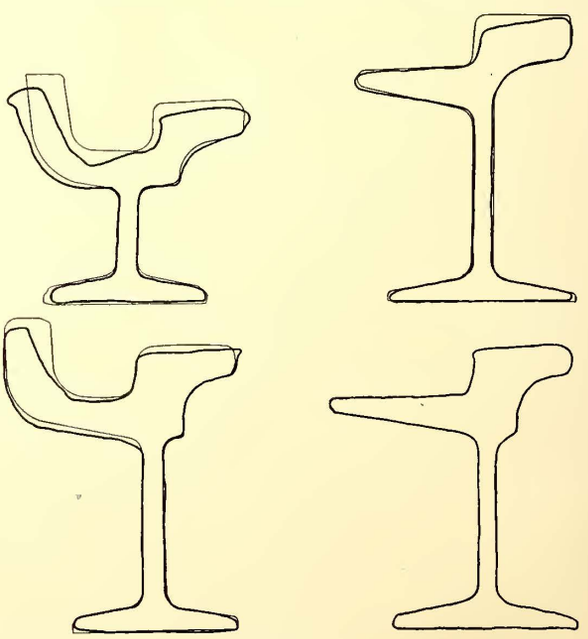


FIG. 54.—NEW ORLEANS RAIL.

With externally applied power, while desirable, it is not so important to have the rail as free from dirt as in the former case, for, under like conditions, the resistances are not so great, and a full groove rail may be used.

Street Traffic:—This can have but little influence in towns where it is light and of a miscellaneous character, but in cities where it is more dense and heavier it must be considered. The ideal condition obtains, as before stated, where the surface of the street presents an unbroken face. This is to be had only with a full grooved rail. With any other section, there is a guiding shoulder for wagon wheels, and they will surely follow the track. The next best section is of the half grooved type, in which this shoulder is a minimum and offers less obstruction to vehicles turning out. The guard or lip should be made substantial to resist bending as well as wear. The full flat tram is very objectionable, from the street traffic point of view, for while it offers a smooth easy track to travel on, it is most severe on a vehicle when turning off.



FIGS. 55 TO 59.—SECTIONS OF WORN RAILS.

Pavement:—With asphalt there seems to be but one section—the full groove. Any other which attracts street vehicles is detrimental, in that this pavement is more yielding to a concentrated traffic than any, and is the most

costly to repair. I have seen broad tram rails laid with this pavement and think them as much out of place as a square peg in a round hole. They practically defeat the purpose for which the fine pavement was laid, namely, a smooth street. The question as to whether a grooved rail should be laid in granite pavements is one to be settled by the probability of the streets being kept clean, as well as by the other considerations mentioned above. In macadamized streets a full grooved rail would be as much out of place as a tram rail in asphalt, but as such streets are found only in the smaller towns both vehicular and railway traffic is apt to be light and when girder rails are used at all the tram rail is the most suitable all around rail.

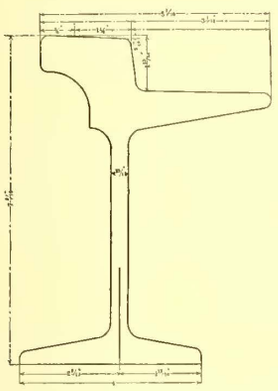
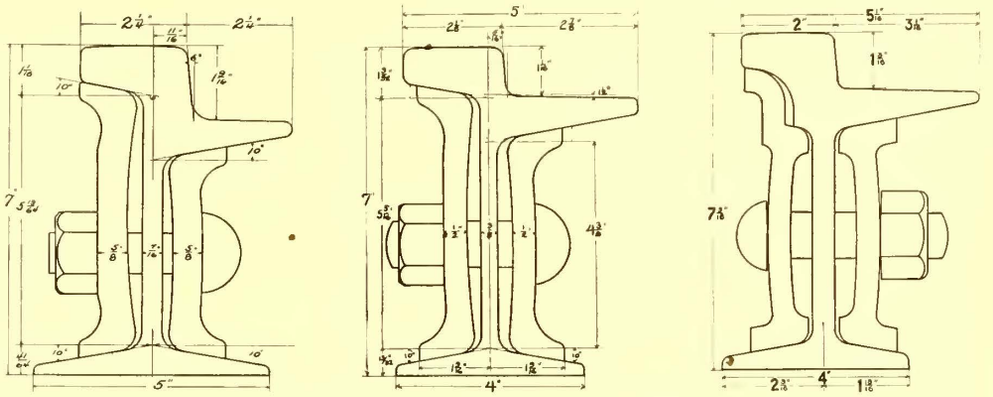


FIG. 60.—CHICAGO CITY RAIL.

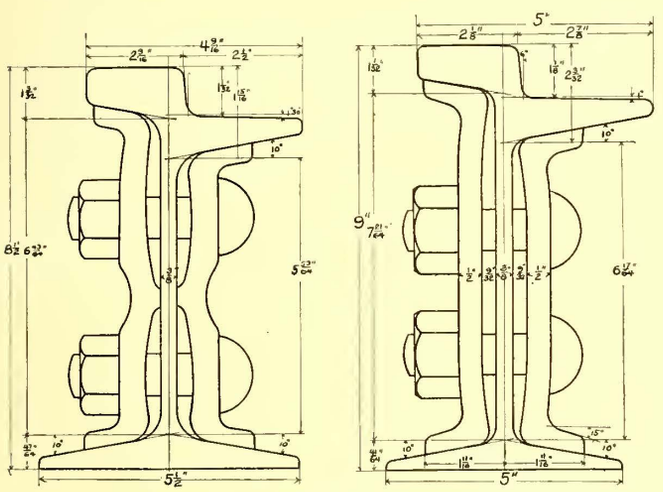


FIGS. 61-63.—MODERN 7 IN. TO 7¼ IN. RAILS.

WEAR:—Now that we have, at last, a rail that will make, when properly laid, a most substantial track, the question of wear becomes of even more importance than formerly. Indeed so substantial may the track now be made in other respects that its life is determined almost entirely by the amount of abrasion the rails will withstand, and with this the *form* of the rail head has something to do as well as the material of which it is made. In this connection I have shown five sections of worn rails, Figs. 55, 56, 57, 58, 59. They were taken twelve or fourteen inches from the ends. In the first four are shown, in the lighter lines, the original section as rolled. The actual amount of metal lost is but a small percentage of the whole section, but there is, in each case, and in one case particularly, a noticeable amount of distortion of the section which must have come from a very heavy vehicular traffic. These rails were removed because of their inability to stand up under this, as well as the car traffic, and the wear shown must not be taken as indicative of the life of heavier and deeper sections now being laid—exception possibly being made to the section, Fig. 57, which is given here to show to what extent rails are sometimes allowed to wear. This rail had about reached the end of its usefulness when removed. Another noticeable feature in four out of five of these worn sections, and one which I have seen in practically all worn street railway rails, is the decided inclination of the top surface of the head from the gauge line up. This, no doubt, comes from the coning of the wheels. The majority of rails heretofore made have either been rolled flat on the head or with an inclination in the opposite direction, which has been given them to facilitate rolling. That it is not impossible to make rails having an inward slope to the head will be seen by a glance at some of the sections shown in connection with this and the previous article. Aside from all questions of better electrical contact, better traction, etc., to be obtained from a full bearing for the wheel tread, the rail head is bound to assume this shape early in its career, but if made so in the first place it is manifest that the life of the rail is increased thereby and any manufacturer who fails to incorporate this feature in his sections will be behind the times, for the observing street railway manager is going to insist upon having it.

Before leaving the subject of proper form for the upper surface of the rail, I wish to call attention to its importance in its relation to the form and size of wheel flange and tread. The variety in design of wheels is as great as in rail sections themselves—a fact which is of great annoyance to the manufacturer of special work, though not of so great importance in connection with straight track, except so far as the depth of the flange is concerned. The difference between the depth of flange and the height of rail head above the tram or bottom of groove represents, theoretically, the amount of wear possible before the rail must come up. Flanges are made from five-eighths of an inch to one inch deep—generally about seven-eighths inch, and since this vertical flange space in the rails varies from one inch to one and one-quarter inches the amount of wear available is from nothing to five-eighths of an inch.

Query—How many passing cars will be necessary to accomplish this amount of wear? The rail shown in Fig.



FIGS. 64-66.—MODERN 8 IN. TO 8½ IN. RAILS.

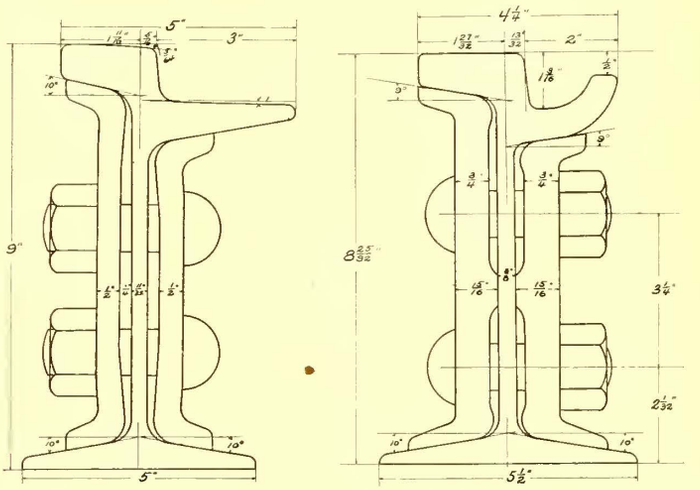


FIG. 67.—BOSTON RAIL.

57 had carried about one million cars on a heavy up grade. The rail on the parallel track, which was down grade and carrying the same amount of traffic, showed but half as much wear.

And now what is the proper shape for the lower portion of our rail—that portion which is not exposed, but which has to withstand all the shocks and strains produced by the traffic over and upon its head? It must be of a form to remain rigid and unyielding under the action of these forces; it must have a broad base to provide ample bearing on the tie. All of which conditions are fully met in the deep sections shown. The web and bottom flanges are as thin as it is practical to roll them and yet are of ample strength. The surfaces against which the flanges of the channel plates find a bearing have a uniform inclination—a necessary condition in manufacture and one equally necessary in securing a proper fit for the jointplates. There is little room for variation in the form of this portion of the rail. The distinctive feature of the early Johnson rails—the shoulder under the head—has disappeared, it being an unsurmountable obstacle in the way of securing a good joint plate fit, and a broad bearing at that point.

The 10 in. and 10½ in. rails shown have been but little used, but the 7 in., 8½ in. and 9 in. rails are all standards. Fig. 67 is the standard of the West End Street Railway Company, of Boston—the form of head being designed by the former Commissioner of Streets, Mr. Carter. The joint shown on this section is peculiar in having a rib extending along the center of the joint plate, in order to provide a bearing and prevent the plate being drawn in against the rail, whereby the fit of the joint is destroyed. This form of joint was designed by the writer over four years ago when deep rails were introduced, and it is now coming into general use. The subject of joints will be taken up later, when this and other approved fastenings will be considered more fully.

Electric Street Railway Tracks.

By R. J. McCarty.

It is, of course, of the utmost importance that the tracks of electric street railways should be of the most substantial construction. It is also very important that this result should be so reached that the current interest on the first cost plus the cost of current maintenance shall be a minimum.

The best street railway track is manifestly that which most nearly conforms to the above requirements.

The importance of constructing a track in a substantial manner is so fully appreciated that some companies are led to extremes, which not only unduly increase the cost of track construction, but also actually increase the cost of maintenance.

One mistake is the unnecessary use of concrete under the tracks. It is not, of course, intended to assert that there may not be instances in which the use of concrete is unavoidable. It is claimed, however, that concrete is often used unnecessarily. This no doubt arises from the extensive use of concrete under street pavements, and from the belief that if it is necessary to place the pavement on concrete outside the tracks, it is also necessary that it should support the pavement between the rails and between the tracks. Some even go so far as to advocate the use of concrete under the ties.

Experience shows that even in the case of large continuous areas of pavement it is possible to construct a perfectly substantial pavement upon sand alone. This requires, however, that the sand should be made perfectly secure from lateral displacement, and that the pavement should be so laid as to prevent the sand from working up through the interstices. In order to accomplish this the solid angles of the blocks should be practically rectangular, the opposite faces parallel and reasonably smooth. The blocks should be laid with great care and the interstices should be well filled. There is one case on record in which a pavement laid in this way upon eighteen inches of sand stood up well under heavy traffic for more than fifteen years. In fact, there never was any trouble with the foundation.

There are, of course, many objections to the general use of such a plan, the principal ones being the great care and skill required in preparing the bed and selecting and laying the blocks, and the certain failure of the pavement in case of unskilful construction. These objections may be obviated to some extent by the use of broken stone. Broken stone alone, however, is objectionable because, the interstices being open, there is nothing to prevent the stone from being forced down into the earth; nor is there anything to prevent the filling, or top base, from sifting down. It is much better to use broken stone in connection with the sand, but not sufficiently so

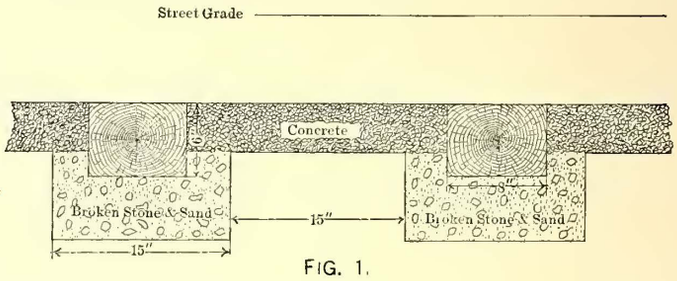


FIG. 1.

to warrant the general use of such a foundation under large continuous areas.

In large continuous areas of pavement, the use of concrete greatly facilitates the construction of a firm bed of uniform surface, at precisely the proper grade and slope. It thus diminishes the labor of laying the pavement to a proper and uniform surface; it distributes the bearing of the paving blocks, and prevents their cocking under traffic, even when carelessly laid; and if the concrete is sufficiently thick it will often prevent depressions in the pavement where the ground may be soft. It also facilitates repairs and renewals.

There is, however, a great difference between the outside pavement and the pavement between the rails and tracks of a street railway. Here, instead of long distances between solid headers there are either one or three narrow spaces, with the rail, a most substantial header, on each side. This makes it entirely practicable to lay the blocks within such spaces, in such a way as to prevent the possibility of lateral displacement or of cocking, even when the base is not a rigid mass. The only requirement is that the base should not yield to vertical pressure. For this reason a pavement laid properly on a base of broken stone, with the interstices well filled with sand, the whole being properly tamped and joined well up to the concrete outside, will stand between the rails

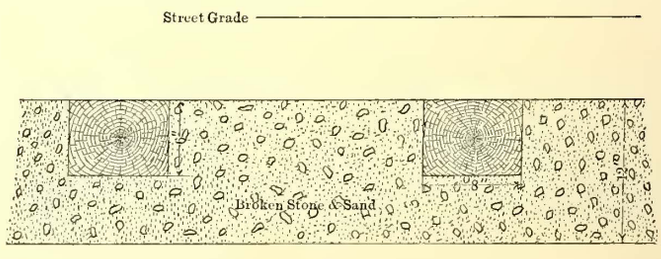


FIG. 2.

just as well as a pavement laid on concrete. Such a base is very much cheaper than concrete and greatly facilitates the work of lining and surfacing the track. That it is, therefore, superior must be obvious to every practical man who is willing to concede the premises.

While the superiority of broken stone and sand over concrete in the construction of electric railways is conceded by many, there seems to be some difference of opinion as to what constitutes the best form of construction. Some advocate the construction shown in Fig. 2. Here there is an excavation of the whole space occupied by the tracks to a uniform depth of six or eight inches below the bottom of the ties. Broken stone, thoroughly mixed with sand, is placed within this excavation to a level with

the bottom of the ties, the whole being brought to a uniform surface and thoroughly compacted by a steam roller. The ties are then placed in position, the rails being spiked down and lined. The remaining space is then filled with broken stone and sand, topped off, and the pavement placed in position.

This certainly makes a good track, but it is open to the objection that it involves a great deal of unnecessary expense.

Nothing is gained by the use of the steam roller, because the bed can be made sufficiently firm without it.

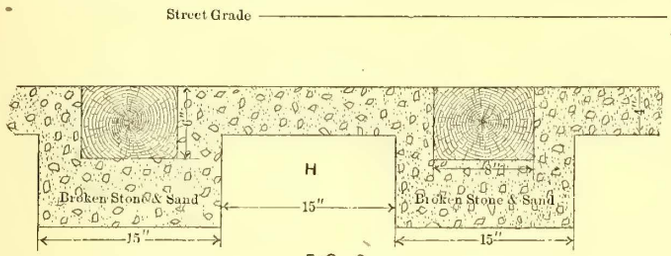


FIG. 3.

In addition to this, the plan involves unnecessary excavation and back filling.

By far the better plan (see Fig. 3) is to excavate to a uniform depth of six inches below the bottom of the paving blocks; then excavate pockets for the ties about six inches wider and six or eight inches deeper than the tie; fill these pockets to a depth of six or eight inches, as the case may be, with broken stone and sand; place the ties in position, fasten the rails, tamp and surface; then bring the bed up to two inches below the bottom of the paving blocks, put on two inches of sand, and pave.

The advantages of the plan shown by Fig. 3 are that it saves excavation and back filling; the pavement between the ties, except in extreme cases, is as well supported as if the body of earth (H, Fig. 3) should be replaced by broken stone and sand; the ties are as well ballasted as is necessary, and the pockets under the ties very greatly facilitate tamping with great compactness.

The only objection to the plan is that of drainage, and this may be removed by connecting the pockets to a small trench, if it should be thought necessary or advisable.

The following may be of interest as showing the relative cost of constructing one mile of single track under the different plans mentioned:

Cost of roadbed below top of ties, with minimum amount of concrete, as shown by Fig. 1:

Excavation	1,044 cu. yds. at	$ .55	$ 574.20
Concrete	400 " "	4.00	1,600.00
Broken stone	461 " "	1.00	461.00
Sand	230 " "	.70	161.00
			$2,796.20

With minimum amount of broken stone and sand, as per Fig. 2:

Excavation	1,564 cu. yds. at	$ .50	$ 782.00
Broken stone	1,381 " "	1.00	1,381.00
Sand	690 " "	.70	483.00
			$2,646.00

With minimum amount of broken stone and sand, as per Fig. 3:

Excavation	1,044 cu. yds. at	$ .55	$574.20
Broken stone	861 " "	1.00	861.00
Sand	430 " "	.70	301.00
			$1,736.20

The plan shown by Fig. 1 is objectionable because of the first cost, and because of the necessity of digging out and replacing the concrete when making repairs.

The plan shown by Fig. 2 is objectionable principally on account of the unnecessary first cost.

The plan shown by Fig. 3, if properly executed, results, under any ordinary circumstances, in a roadbed fully as substantial as either of the others, at greatly reduced cost, and of such a character that it can be repaired at a minimum expense. It seems, therefore, to comply with all the requirements first laid down.

The Doom of the Cable in San Francisco.

BY S. L. FOSTER.

In the month of September, 1873, or a little over twenty-two years ago, the first cable street railway in the world was started in San Francisco. This line was on Clay Street, where the grades are from ten to sixteen per cent, and its original object was only to furnish a means of transporting passengers over lines that were not feasible for horse or steam traction, as these were the only systems in use for street cars at that time. The road was a success mechanically and financially from the start, and its fundamental features were quickly copied on other roads in this city and in other cities.

Articles have appeared in Eastern journals from time to time to encourage San Franciscans in the belief that the cable system was really more economical than the electric, except on long suburban lines, but for about a year and a quarter the Market Street Railway Company has owned electric roads of its own, and has been making data for itself. Snow has not bothered the company at all on its cable roads, nor has the frost closed up the slot. The expense for cables has not been abnormal, and the original construction was most substantially done in iron and concrete. In fact the conditions for cable road traction in San Francisco are the equal of any in the world, and the construction and operation of these roads are unsurpassed. The Market Street Company, however, has become convinced that the people prefer to ride on the electric cars, and that the electric cars carry the people more cheaply then does the cable. These results were not obtained from a few electric cars run on level lines and at high rates of speed, but from the operation of upwards of 150 cars at from 1½ to 2½ minute headway at times, and on lines having grades as high as 14½ p. c. Most of these cars are subject to frequent interference from the heavy wagon traffic on the downtown streets, and all of them are governed by the rule ordering a reduction of speed at the crossing of each intersecting street.

The company began cautiously by changing its old horse car lines to electric lines. Later it decided to equip with electricity the route of a franchise designed to be a cable road, and for which $30,000 worth of cable material had already been bought. The routes of all new franchises were then ordered to be equipped as electric roads, and finally it decided to abandon the use of the cable on one line—Ellis Street—and substitute electricity. This last decision is considered by many as very significant and as foreshadowing the changing of not only all cable roads on the level to electric roads, but the changing of all cable roads on grades accessible to electric cars, and not only the cable roads of the Market Street system, but also those of the other cable roads in the city. The Market Street Company maintains at present six cable power houses and each has its two large monthly items of fuel and labor. Every time a cable power house can be dispensed with and the lines operated by electricity, that power house's item "labor" is wiped out, and the item "fuel" is reduced both on account of the less fuel required per car mile for an electric road as against a cable road, and because the cable houses are usually run non-condensing, whereas in the electric power house the engines are run condensing.

When the Ellis Street line was changed from cable to electricity, it was decided that, as the road was paying well, traffic should be suspended for the least time possible. The road is over 9600 ft. long, double track, and most solidly built with wrought iron yokes and solid concrete tube. It was designed to run for part of the distance in conjunction with a parallel street, making 6750 ft. single track and 2900 ft. double track on Ellis Street. The track and wires on the other streets were already completed and the trolley and feed wires were in place on Ellis Street.

The ground was looked over and it was decided that the change could be made in one week. This statement at first seemed incredible.

The cable road had a 3½ ft. gauge, 11½ ft. centers and the 6750 ft. of single track was laid between the two cable tracks without interrupting the cars. When this was done the cars were stopped and the whole force concentrated on the 2750 ft. of double track. As the engraving, fig. 21 shows, the 4 ft. 8½ in. standard gauge straddled the 3½ ft. cable track, one rail of each track being set on one side of one cable yoke and the remaining rail on one end of a tie. The tube of concrete was left untouched and is available for holding return feeders and perhaps trolley feeders. The cable was left in the tube and being connected to the rails will be used to help out the return circuit. The iron in the slot rails, too, will yield up its quota of conductivity for the return current, as the slot rails are connected to the tram rails every 150 ft. To any one familiar with street railway construction in large cities the amount of work done in this week will be appreciated when it is stated that during these seven days over half a mile of double track was built, bonded and paved, two curves of a Y switch were put in from a single track line on Ellis to a double track line on Devisadero, a single curve was fitted in across the slot rails and concrete tube at Hyde and Ellis, a 30 ft. cable car turntable was taken out at Stockton Street, the pit filled up and a cross-over put in on top of it, a double track electric crossing and four double track cable crossings put in—all on operating roads without interfering with their operation.

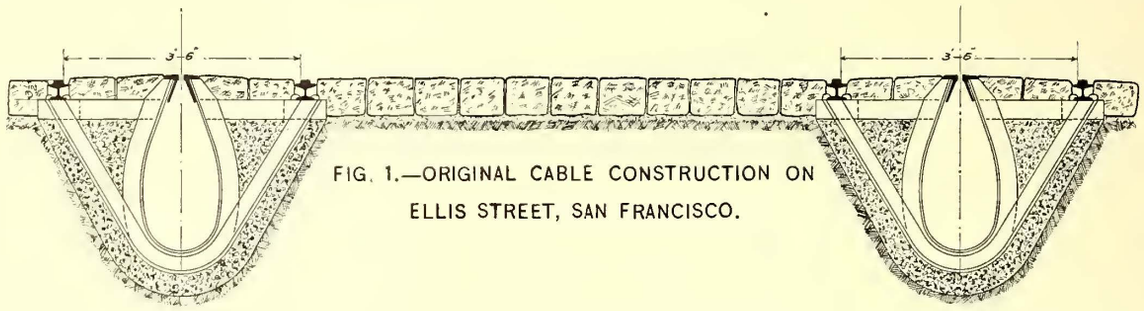


FIG. 1.—ORIGINAL CABLE CONSTRUCTION ON ELLIS STREET, SAN FRANCISCO.

At ten o'clock on the day set for the operation of the new line, the tracks being cleaned and curves greased, an electric car was switched into Ellis from Devisadero and the officials of the company had the pleasurable surprise of riding over the line without a hitch. After making the circuit once the cars began running on schedule time, carrying their heavy Sunday loads of passengers to Golden Gate Park by electricity.

There is a cable line on Oak Street requiring a cable 26,000 ft. long, that is now under reconstruction as an electric road. When this road is changed the large cable power house at Oak and Broderick Streets, from which both Oak and Ellis have been run, will be shut down. The grades on the Howard, the Post, and the McAllister Street lines are all perfectly practicable for electric cars and in case they are changed from cable to electricity two more power houses can be dispensed with.

"Electricity has, perhaps, displaced the cable on the level and on easy grades," some cable men say, "but on heavy grades the cable will always be retained." When we consider the daily spectacle of electric cars unaided climbing 14½ p. c. grades in San Francisco and 15 p. c. grades in Oakland, and by means of a simple auxiliary device ascending a 25 p. c. grade in San Francisco, as described in the October number of the Journal, where no cable grip could be made to hold, the impregnability of any cable proposition is open to question.

Fig. 1 shows the original cable construction and Fig. 2 how the new 4 ft. 8½ in. gauge was imposed over the old 3 ft. 6 in. gauge.

The amount of money saved by this method of construction over that involving removal of the concrete and yokes or even over the partial removal of the concrete for a double set of wooden cross ties was very considerable. The saving in income to the road by shortening the periop of idleness is even larger than the construction saving. Whether the fact that one rail of each track rests on a rigid foundation and the other on a wooden tie will stand up as well as a similar support for each rail remains to be seen.

In this work 70 lb. long lipped steel girder rail, five inches high, was used. These rails were held together by six bolt splice bars of channel section and rested on chairs bolted to 6 in. × 8 in. × 7 ft. split redwood ties set two feet centers. The joints were opposite and supported when on ties.

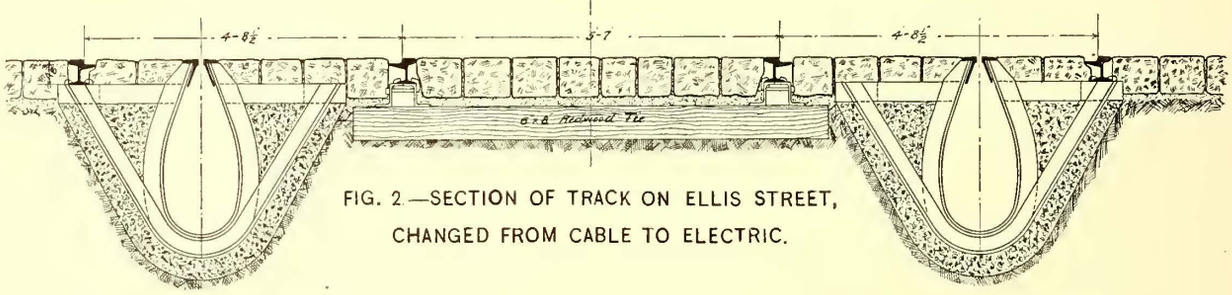


FIG. 2.—SECTION OF TRACK ON ELLIS STREET, CHANGED FROM CABLE TO ELECTRIC.

The bonding consisted of three No. 0 B. & S. Chicago bonds per joint, tram and slot rails being cross bonded every five rails.

To a visitor to the city of Milan one of the interesting sights is the cemetery system of the city. Owing to the hygienic conditions necessary in many parts of Italy, cremation is largely employed in many cities and this has resulted in the establishment of cemeteries which differ in arrangement from those in other places. Very often, as in Milan and Genoa, a considerable tract of land is devoted to this purpose. This is laid out in an artistic manner and contains long corridors or halls with marble memorials to the deceased and vaults in which their ashes are placed.

The main cemetery of Milan has been connected for some time with the center of the city by an electric line, over which many funeral trains are run, and among the recent electrical developments in that city has been the construction of a new line extending from this to a new cemetery recently opened at a considerably greater distance from the city. The funeral train operated is composed of a special funeral car painted entirely in black with the inscription "Service Funèbre." This is followed by other cars occupied by the mourners.

A Lesson in Gearing.

In probably no cable station in the country are the gears put to more severe service than in that of the Chicago City Railway Company at Twenty first Street. The constant increase in the strength of the machinery here shows the hard usage to which it is subjected.

No. 1 and No. 2 engines of the station have cylinders 30 in. diameter and 60 in. stroke, making 60 revolutions per minute. In August, 1887, two spur gears, with 43 teeth, each gear 18 in. face and 6 in. pitch, were placed on the crank shaft, with teeth staggered, forming a gear 36 in. wide.

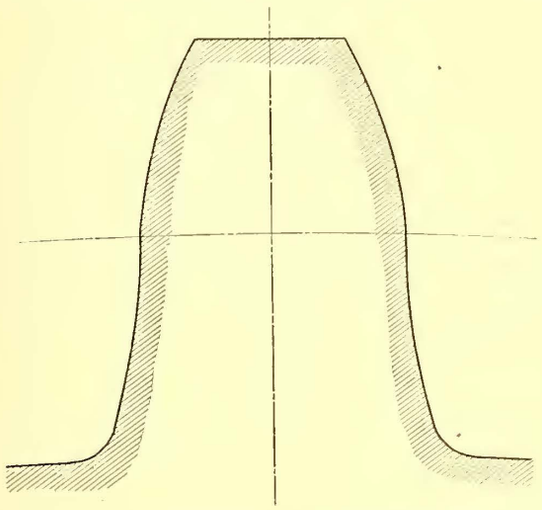


FIG. 1.—FIRST SECTION (HALF SIZE) ADOPTED.

Two spur gears of 61 teeth, each 18 in. face and 6 in. pitch, were placed on the line shaft, with teeth staggered, forming a gear 36 in. wide. They were made of cast iron, with strong oval arms. The two parts forming the pinion and the two parts forming the gear were each bolted together at eight different points of the rim. The form and proportion of the teeth in these gears are shown, half size, in Fig. 1. These gears were calculated to transmit 1,500 H. P. with safety. After running eighteen months, the arms of the large gears broke, compelling their removal, and new cast iron gears, each 20 in. face and 7½ in. pitch, with very heavy arms of high section,

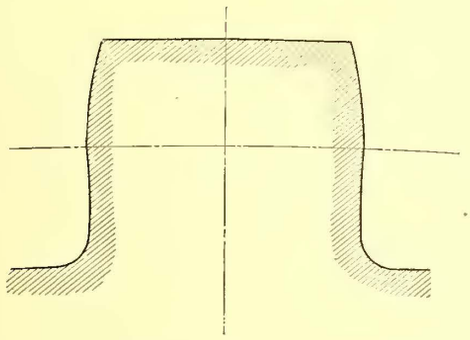


FIG. 3.—THIRD AND LAST SECTION (HALF SIZE).

took their place. They were built similar to the first pair, that is, each gear was of 20 in. face, with teeth staggered, forming a gear 40 in. wide. The two gears, each 20 in. wide on the line shaft, were removed in 1892, and two new gears, same pitch and face, were placed on the line shaft. These ran about eighteen months, when a tooth broke out of one, and the other split through the rim. The form and proportions of teeth in these gears are shown, half size, in Fig. 2.

After this experience it was decided to use steel gears, and a contract was made January 28, 1895, for a set. The pinions have 42 teeth, 20 in. face and 6 in. pitch, with staggered teeth, making a total of 40 in. face. The cast steel gears have 62 teeth, each 20 in. face and 6 in. pitch, with staggered teeth, making 40 in. face. These gears have machined joints, the holes are bored and reamed, all bolts are turned to fit the holes tight, the teeth are carefully cut and the parts are bolted together transversely. The form and proportions of teeth in these gears are shown, half size, in Fig. 3, and were suggested by John Walker, general manager of Fraser & Chalmers, who built the gears, after consultation with J. R. Hill, engineer of the Chicago City Railway Company. The

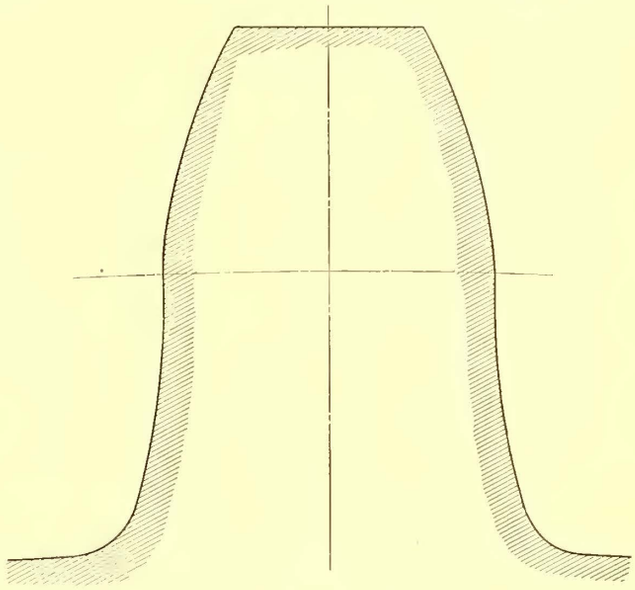


FIG. 2.—SECOND SECTION (HALF SIZE).

Chicago City Railway Company considers these gears safe for 5,000 H. P. On several occasions the maximum load of the engines has been put on these gears, which, under these conditions, ran perfectly noiseless.

To realize the actual difference in size between the three forms of teeth shown the reader should really compare full sized sections, which can be reproduced from the engravings by doubling each linear dimension.

A system of telephone transmission between the cable cars on the New York & Brooklyn Bridge and a central dispatching office has recently been decided upon by the managers of that road. A trolley wire is run under the cars, and connection is made by a novel type of

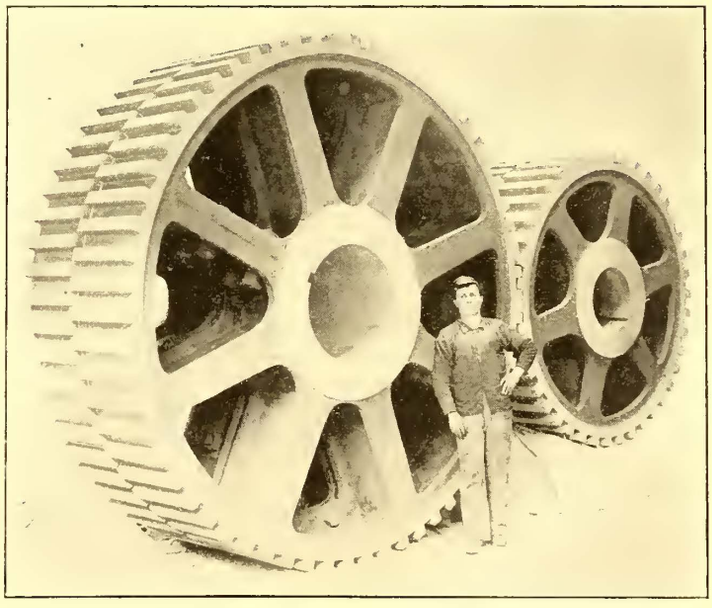


FIG. 4.—TRANSMISSION GEARS. CHICAGO CITY RAILWAY STATION.

brush. A transmitter and receiver will be carried on each car, the former being hung on springs to prevent as far as possible vibration from the jolting of the train.

Club House for Motormen and Conductors.

The Derby Street Railway, of Derby, Conn., has a new institution in the way of a club house for its employes, which is a novelty both in design and results. For a long time the president, H. H. Wood, has had in mind a scheme for bringing the men into closer relationship to the company, providing reading and recreation rooms, a comfortable place in which they could wait when waiting was necessary and a clean and neat place where lunches could be eaten. Usually the men took their lunch pails to the car barn and there in a cold and cheerless corner did what eating was necessary.

For a time a finished room was given the men on the second floor of the car house next the offices. The men did not like it. There was an unusually long flight of steps to reach it and it was too near the office and the men did not use it, preferring the lower floor and such corners as were available.

The president had for some time intended to fit up a building for the use of the men. It was finally decided to take the old brick carpenter shop for the purpose. This is shown on this page(Fig.1). The building consisted of four brick walls and a roof. The second floor was used as a shop and the lower one for storage. The building was well adapted for the purpose, standing as it did next the car house. It measures in plan about 85 ft. × 18 ft., and has, as the engravings show, a good height of ceiling. The plan shows the arrangement. There are three large rooms, each from twenty-three to twenty-four feet in length and the full width of the building. In the front end was placed a hallway with a short flight of steps leading up to the level of the rooms, together with a bath room and a small room for eating.

The finish of the rooms is in hard pine and as will be seen from a glance at the engravings is very attractive.

The large room next the hall serves as a reading room. The next one contains a billiard table which is used both for pool and billiards. The other room is the gymnasium. At present it is supplied with several pairs of boxing gloves and a striking bag. The furniture is very neat and comfortable. It consists of tables, chairs and case for books in the reading room, table and chairs in the eating room and the usual rack for cues, chairs, etc., in the billiard or pool room.

The eating room will have, in addition to its present furniture, a gas stove or a steam table of some kind on which coffee, etc., can be heated and lunches warmed.

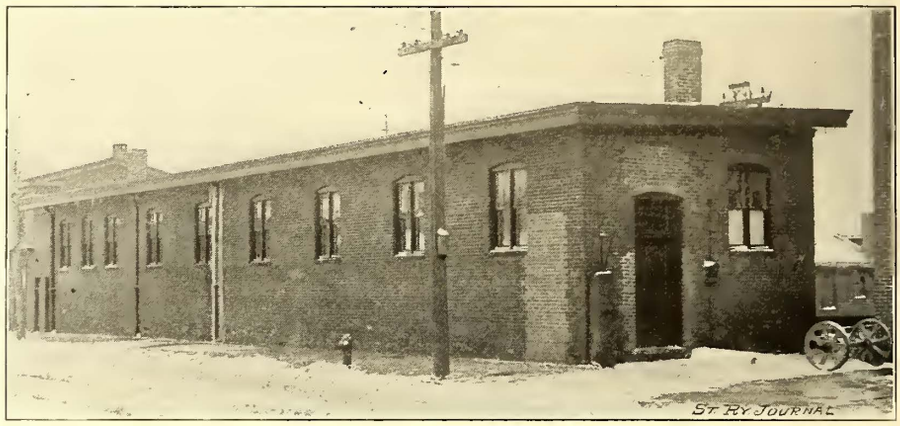


FIG. 1.—EMPLOYES CLUB HOUSE—DERBY.

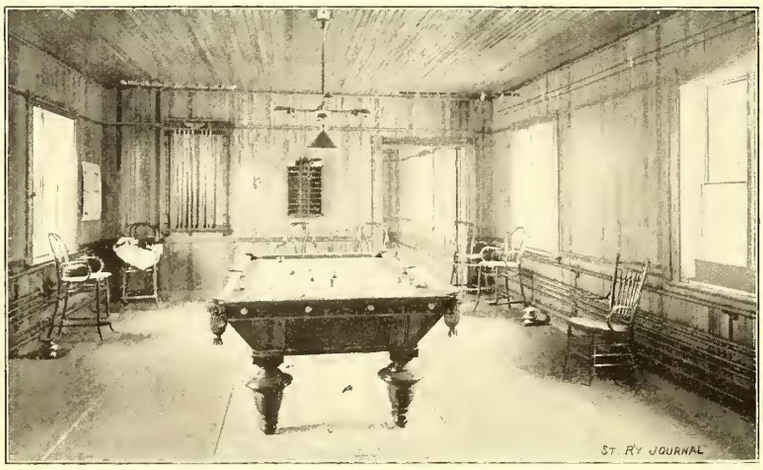


FIG. 2.—BILLIARD ROOM.

In the hallway there is an ample supply of hooks, etc., for clothing, a much needed arrangement in a country where every man wears a bearskin coat when on duty in the winter. The bath room has a bath tub with hot and cold water from a large boiler standing in the corner. There is also a basin and a wash out closet in the room. The building is heated by steam, and a coil of pipe in the boiler furnishes an unlimited supply of hot water for both the tub and the shower bath. The heating and lighting are both furnished by the company's power house.

In the reading room the company furnishes *Harpers*, *Scribner's*, the Street Railway Journal, *Puck*, *Life*, *Cassier*, *McClure's* and several other magazines and papers amounting to a dozen or more.

The whole expense of furnishing, fitting up and running the place has been assumed by the company, and is considered a good investment, its effect upon the men being more than an offset to the expense incurred.

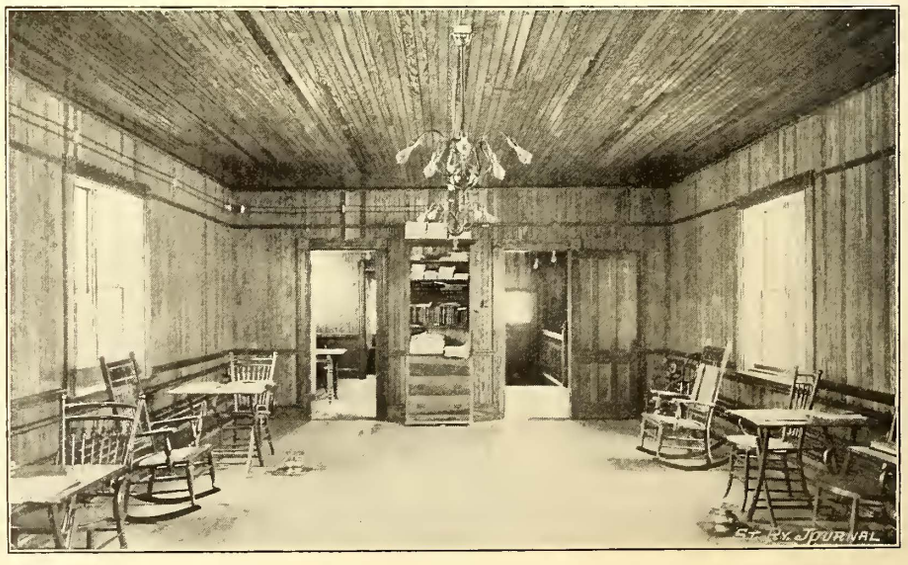


FIG. 3.—READING ROOM.

Another thing looking toward making the men a part of the road has been an annual supper on New Year's eve. This was proposed by the superintendent,

B. W. Porter. The idea of making the men a part of the road and centering their interests upon the success of the company is also forwarded by a system of rewards which is in force.

Having seen the good results coming from much less extensive efforts to benefit motormen and conductors by arranging for their comfort when off duty, there can be little doubt as to the results of this systematic effort.

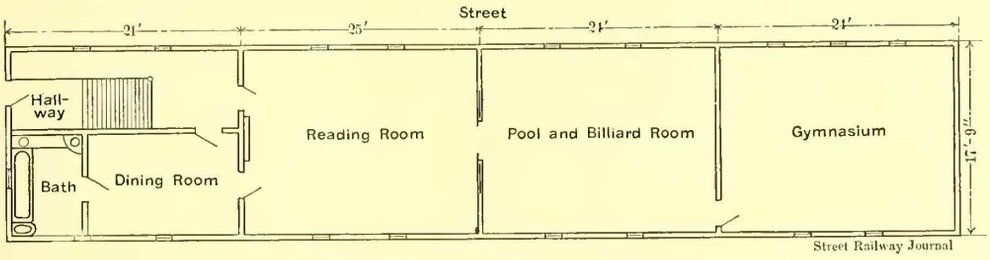


FIG. 4.—PLAN OF CLUB HOUSE—DERBY.

Electric Construction in Chicago.

Although Chicago has the reputation of being one of the most progressive cities in this country, if not in the world, it has been the last of the large American cities to share in the advantages of electric traction. Each of the three larger companies, however, seems to have possessed itself, during the past year or two, with the proverbial Chicago hustle and the work accomplished during the past year materially changes the figures representing respectively horse and electric mileage.

On the Chicago City Railway electricity has been substituted on over forty miles of former horse lines, reducing the mileage of the latter to less than ten miles for the entire system and bringing the total electric mileage up to 118.

On the North Chicago lines the change from horses to electricity has been complete, excepting less than three miles, the electric mileage being now about eighty.

On the West Chicago lines ninety-seven miles of horse car line were reconstructed into electric, and thirteen and a half miles of new electric construction were added to the mileage. This work reduces the horse car mileage to less than fifty and increases the electric mileage to 122.

All of the electric work, thus far, on street railway lines is with overhead construction. The opposition to the overhead trolley system has been remarkably strong in Chicago, and its advocates and promoters have been obliged to encounter and overcome every conceivable obstacle. There still exists a powerful opposition to its extension in the heart of the downtown district, but the Chicago City Railway has finally succeeded in practically entering this district from the south, with its Clark Street line whose northern terminal is at Washington Street, three blocks north of the post office. The Clark Street line was formerly a horse car line, and the passenger traffic over it was very light, but since the change to a trolley line the traffic has increased enormously, although the line has been in operation but a short time. Fortunately the Chicago City Railway Company, in the construction of this line, anticipated an unusually heavy traffic, and the overhead material in its construction is the heaviest ever used on a street railway. A view of the line is shown in the accompanying illustration. As will be observed, it is of center pole construction. The poles were manufactured by Morris & Tasker, from designs furnished by the Chicago City Railway Company. They weigh about nine hundred pounds complete. They average about one hundred and fifteen feet apart and are set six feet in the ground, in cement. The method of flexible suspension has been used. The span or suspension wire is twenty-four inches long and is formed of seven iron wires of No. 10 gauge, twisted into a cable. Each end of the span cable is made fast to a strain insulator, and these are fastened to insulated bolts having soft rubber washers, for the purpose of cushioning the effect of the trolley vibrations. There are, therefore, three insulations between trolley and pole.

The trolley wire used for this line is the new Roebling's figure 8 pattern, the same as used on the Nantasket Beach road. It weighs 1.02 lbs. per foot, being three times as heavy as No. 0. There is a sag of from 10 ins. to 12 ins. between poles. The trolley clips are of malleable iron and 11½ ins. in length. Many have predicted that this wire would flop over, but this has never happened. Brazed connections are not used. Wherever a splice is necessary it is made at a pole with a special connecting device devised by Mr. Knox, the electrician of the company. By this arrangement the splice is as perfect, in all respects, as any part of the line. Sparking at the trolley, on this line, is very rarely seen.

All insulators were especially designed for this line. They are generally of the West End pattern but are fully twice as large as ordinary and the breaking strain is three times as great. All the section insulators, insulated crossovers, connecting ears and other special appliances for the heavy wire, were designed by Mr. Knox and made in the company's own shops.

ELECTRIC CONSTRUCTION ON CLARK STREET, CHICAGO.

Although the Falk cast-welded joint is used on the rails of this line, the joints are also bonded with double 0000 Chicago bonds seven-eighths inch terminals. Two 500,000 c.m. supplemental wires are also used for return, as well as all tracks leading to the power station. The feeder wires are carried overhead from the power station to Clark Street, and are there carried underground in tile ducts. Manholes are placed at an average of 450 ft. apart. Six 350,000 c.m. feeder wires are used. The farthest distance from the power station is 31,020 ft.

As many as forty double motor cars with thirty-five trailers have been handled at one time, on a division of this line 19,800 ft. in length. The line was opened for traffic December 3.

SCIENCE · ENGINEERING · INVENTION ·

General Engineering Notes.

The Montreal Street Railway Company decided at its last annual meeting to build its cars in its own shops, in order to give employment to Montreal mechanics.

A Zurich syndicate has applied to the Swiss local and federal authorities for several electric railway concessions to be constructed in the Cantons of Zurich, Argovie and Zug.

The State Commissioners of Railroads and Telegraphs in Ohio have obtained an opinion from the attorney general to the effect that he is authorized to inspect and pass upon the condition of bridges and trestles used by electric interurban railways in the State. The attorney general holds that such railways cannot properly be classed as street railways, but, transporting passengers, freight and express between different parts of the State, are properly railroads.

Pittsburgh is wrestling with the smoke problem in earnest. The city authorities have passed an anti-smoke ordinance which is to be strictly enforced. Under its provisions the emission of more than 20 per cent. of black or gray smoke from any chimney or stack where bituminous coal is used in connection with boilers for heating or power purposes will be deemed a public nuisance, and any such emission for a continuous period of more than three minutes' duration will be punished by a fine of from $10 to $50.

The *Milwaukee Street Railway Bulletin* says:

"Conductors will please bear in mind that the rear brake should not be set by them unless it be in order to avoid an accident or when the car gets beyond the control of the motorman. The practice of setting up the rear brake at the ends of the route by the conductor is one which should be stopped at once. It is the province of the motorman to attend to the brakes and the controller, and his prerogatives must not be interfered with or his duties assumed except in case of greatest necessity."

The Marseilles Street Railway Company reports that one of its cars has recently run 21935 miles without a single accident to its electric equipment. This record was made between January 24 and September 15, 1895. During this time it was at the repair shop three days owing to an accident to the car body, and one day for the repair of the hand brake. The average distance covered per day was ninety-six miles, the maximum 129 miles; the total number of passengers carried during this time was about 215000. The car is equipped with two 18 h. p. Oerlikon motors, type E. Z. Another car has recently covered more than 10000 miles without any repairs whatever.

The Metropolitan Elevated Road of Chicago is operated, so it is stated, at an expense of 22 cents per train mile, and it is expected to reduce this figure to 20 cents. The Southwest branch or Douglas Park extension of this road will probably be open for business about April 1 next. President Worcester is reported as saying that since the cool weather has set in the traffic has increased from 10,000 to 15,000 passengers per day. With the completion of the elevated loop, work on which is progressing rapidly, the company will be enabled to run its trains into the heart of the down town business district. This is expected to increase the travel between 35,000 and 40,000 passengers per day, which would considerably more than meet the payment of fixed charges.

As an indication of the immensity of street railway construction and operation, the following figures concerning the Milwaukee Street Railway system will be of interest. During the year 1895 there were consumed in the power station about 30,000 tons of coal, which was converted into about 12,000,000 electrical horse power hours for the operation of 165 cars per day (on an average) traveling over 7,000,000 miles—together with electric lights for station, car houses, cars and a general city commercial service. About 28,000,000 passengers were transported during the year and some 6,000,000 transfers were issued. One thousand tons of new steel rail are to be laid and from 25,000 to 30,000 new ties. Seventeen miles of new trolley wire have been erected and fifteen miles of feeder wire. Patrol wagons have responded to 2,150 calls. About $750,000 were paid out in wages.

In a recent issue, the *Pall Mall Gazette* (London) expresses great concern at the present condition of Great Britain as an iron producer and calls attention to the fact that the statistics of iron production show that iron and steel shipments from Great Britain have actually diminished and that imports are increasing in an astonishing manner.

"We share with the United States the honor of being the largest producers, but the trade of the United States, Germany, Belgium, and France is growing steadily, while ours is going quite the other way. The pig-iron production of the leading countries forms a fair basis of comparison as to the relative position of each and all. In 1880 Great Britain turned out 7,749,233 tons, the United States 3,835,191 tons, Germany 2,729,038 tons, and France 1,725,293 tons. In 1890 we produced 7,904,214 tons, the United States 9,202,703 tons, Germany 4,658,450 tons, and France 1,962,196 tons."

The new subway in Boston is making fine progress. By next fall all cars coming from points west of Tremont Street will be taken up to Park Street Church and around the loop at that place without stopping except at the one station nearly opposite the Tremont Theatre. At the same time Boylston Street will be cleared of all tracks between Park Square and Tremont Street and probably widened to the old cemetery fence. A portion of the subway under Tremont Street, seventy feet long, opposite the Park Street Church, has been completed and is now ready for tracks and wires. The work on this section has been pushed more rapidly than elsewhere, partly because of the complicated subterranean pipes, and partly because it may be decided to tunnel the rest of the distance northerly to the Union Station, and this completed section will furnish the entrance to the tunnel. One side of the stone arched tunnel that is to form the subway south of Boylston Street is also constructed.

L'Elettricita of Milan gives the following information of the Malignani process for obtaining a vacuum in incandescent lamps. First, a special compound, the ingredients of which are not mentioned, is introduced into a tube connecting with the bulb. An air pump is then applied, and after a suction of about twenty seconds the current is turned on. After ten or fifteen seconds of illumination during which the pump is kept in operation the connection between the pump and the tube is severed. The gas which is disengaged from the filament during the passage of the current fills the bulb. The pressure is then about one-half millimeter of mercury; this is the practical limit of the vacuum which can be produced by the pump. As soon as the communication with the pump has been severed, the current is again turned on, and with a jet of gas the tube is heated to a point where the chemical composition contained therein is melted. The vapors which disengage themselves from the filament are precipitated in a solid state, and the two produce a perfect vacuum in the bulb. This entire operation occupies about one minute, and it is possible to treat at least forty-five lamps in this way in an hour. The chemical vacuum appears to give excellent results and the light furnished by the lamp diminishes in brightness more slowly than with any other process. One great advantage of the process is the fact that the use of mercury is dispensed with.

The Laconia Car Company.

The works of the Laconia Car Company, at Laconia, N. H., are in many respects among the most interesting of the kind in the country. They are situated upon the Winnepesaukee River, the outlet of the great lake of that name. The works derive from the stream 1000 h. p., which is supplemented by the power of several steam engines in different buildings remote from the water wheels. The works were started under the name of the Ranlett Manufacturing Company in 1844, and for some years they made on a small scale freight cars for steam roads. In 1870 the plant received great additions, and the manufacture of passenger cars was undertaken. In 1881 the Laconia Car Company was started by the purchase of the Ranlett Manufacturing Company, and the plant and manufacturing facilities were greatly increased.

Last fall the company had the misfortune to lose one of its largest shops by fire. This was rebuilt and work was progressing in it in a surprisingly short time. In fact, the company's freight car work for steam roads was scarcely interrupted by the fire. This shop was 220 ft. × 42 ft., with a 75 ft. extension. It was built in a week's time, and men were working in it the thirteenth day after the fire, a fact which illustrates the organization and energy of the company, and it also speaks well for the vim and push of the New England workmen. In this shop during December they were building five coal cars per day. A new store house, 60 ft. × 70 ft., takes the place of one which was burned at the time of the fire, and is arranged for sand storage below, with shed room above.

The lumber department of the establishment is one in which the street railway man is especially interested. From two million to three million feet of lumber is constantly upon the sticks, and the company carries a stock which enables it to build the longest electric cars without splicing sills or rails. The drying house into which the lumber goes after being thoroughly air seasoned has a capacity for forty thousand feet at a time. The treatment of oak is somewhat unusual. It is steamed under a pressure of 100 lbs. per square inch. Steam is allowed to enter very slowly, and after having the sap thoroughly coagulated in this way it is removed to the dry house and after remaining there for a week's time the moisture has been thoroughly removed from it. For street railway work all the lumber is carried through the dry house before being worked up. This is for the purpose of insuring its absolute freedom from moisture before going into the car.

Adjoining these shops, and separated from them by a delivery switch from the railway, are large stock and storage sheds. A little further down the stream is a building, 60 ft. × 120 ft., devoted to the foundry. Here gray iron castings and car wheels are made, the capacity of this department being ten tons per day. The wheel department can make seventy wheels per day, and the capacity of the wheel pits is equal to 350 wheels. The coal and sand for this foundry are delivered to a chute directly alongside of it from the cars by a special track.

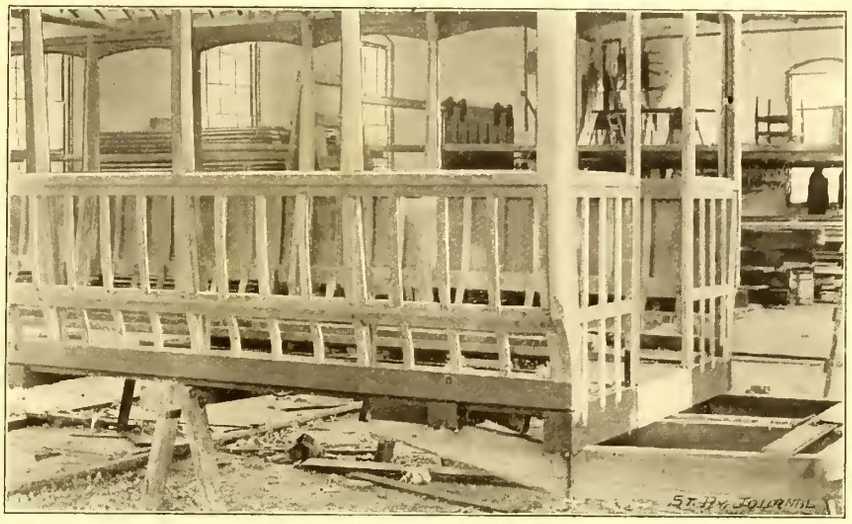


FIG. 2.—FRAME OF TWENTY-FIVE FOOT CAR FOR WEST END RAILWAY.

The cabinet shop, which is a large building two stories high, 200 ft. × 42 ft., is fitted up in the lower story with a complete set of modern wood working machinery for getting out the material for steam, passenger, electric or horse car work. There are also connected with this department carving and routing machines to save hand work. The carving is largely a hand product and the carving machine merely used to save labor in roughing, routing and the general work which requires neither taste nor artistic ability. The upper part of this shop is devoted to the finer portions of the cabinet work and the finishing and putting together of the work which is brought from below by an elevator. From the upper portion of the shop there is a covered bridge to the second floor of the erecting shop.

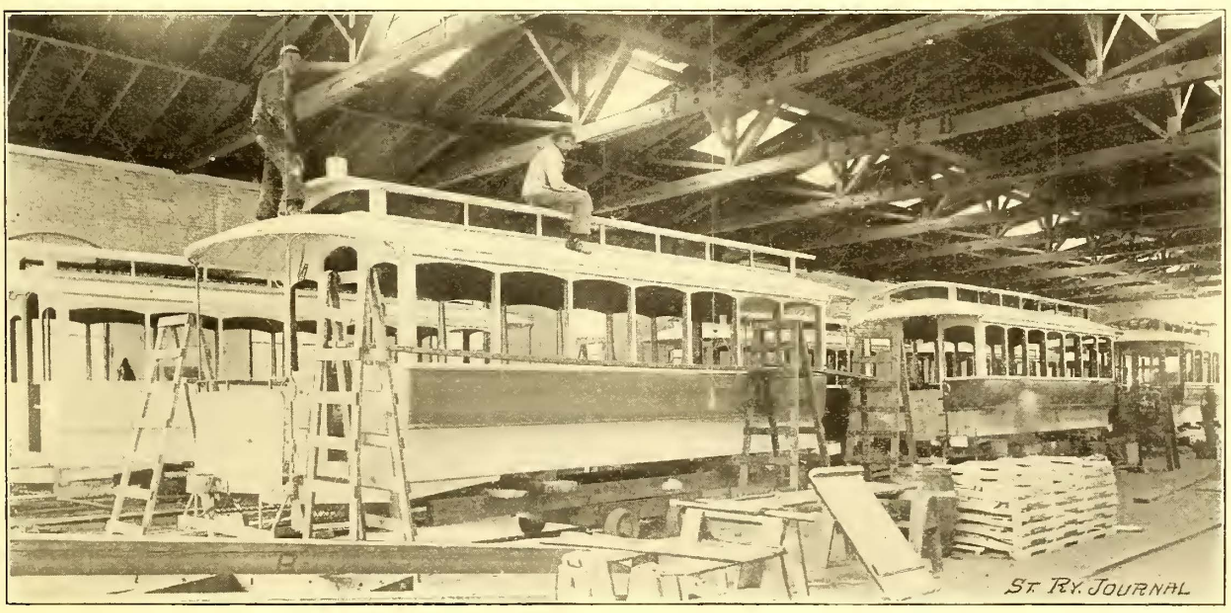


FIG. 1.—INTERIOR OF PAINT SHOP, SHOWING LONG WEST END CARS.

There are two special wood working shops arranged at the end of the erecting works, which take the lumber from the pile or the dry house, and make it ready to go upon the car without the necessity for hand work. Immediately adjoining these shops is a machine shop, 70 ft. × 70 ft., fitted up with tools of the latest pattern, enabling them to complete, conveniently and carefully, all sorts of machine work that may be needed in the forging or blacksmith shop. The latter is 50 ft. × 160 ft. The company makes forgings of all descriptions, bolts, nuts and all the iron work necessary in the establishment, beside turning out a great deal of special work upon orders. The product is about twenty tons of forgings per day.

This erecting shop is 80 ft. × 160 ft. and has upon one side a ninety-foot extension. The arrangement of this shop is exceedingly convenient and the tracks are laid in such a way as to enable the work to be entirely progressive without interrupting the work on any particular car. Across the sixty-foot street is a large paint shop 70 ft. × 140 ft., having four tracks for five twenty-foot car bodies. An interior view of this shop is shown in Fig. 1. Three only of the four tracks are shown in the engraving. At the time the photograph was made, but three cars were in place on each track, but the shop has accommodations for twenty cars. Adjoining this shop at the right and connected to it by several doors is an uphol-

stery and finishing shop 40 ft. × 100 ft. There are also several communicating store rooms. All these rooms are isolated from each other in case of fire by tin covered wooden sliding doors, which close automatically in case of fire. Automatic sprinklers have also been put into the greater portion of the establishment and are being made to cover the entire works. Separate oil and paint rooms of brick also open into the paint shop. There are two 40 ft. × 80 ft. store rooms connected with the paint and upholstery shops.

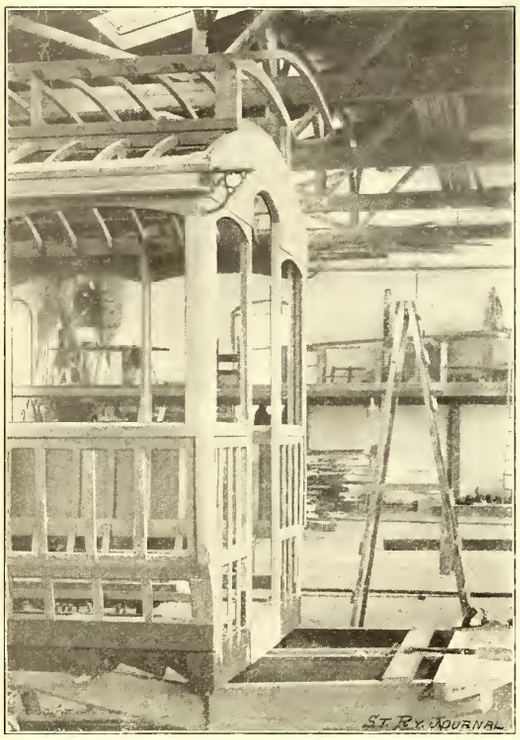


FIG. 3.—END OF LONG CAR FOR WEST END RAILWAY, SHOWING CORNER BRACKET.

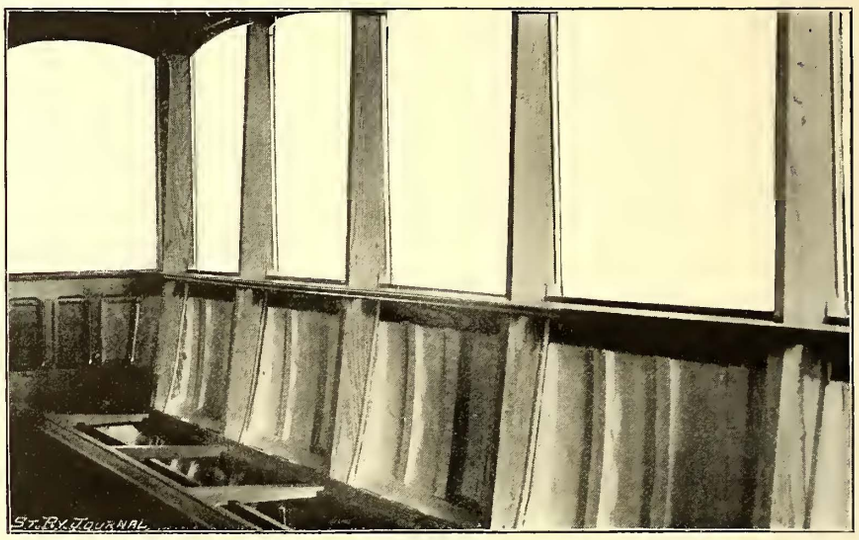


FIG. 4.—INSIDE OF CAR FOR WEST END RAILWAY, SHOWING GUM BLOCKS IN POSITION.

One of the most remarkable features of this establishment is the complete and extensive malleable iron department. This is situated in a four story brick building 50 ft. × 150 ft. It is provided first with a pattern storage department of brick, which is fire proof. There is a pickling room, a mill room for finishing hard castings, and a mill room for small castings, packing and machine rooms. In the third story is an extensive machine shop with special tools for finishing electric work and metal pattern work of all kinds. The fourth story is devoted to finishing electrical work and similar light finishing operations. In this finishing department there are facilities for turning out, in the highest style, brass, bronze and malleable iron work of every kind. The finished work, both plated and simply polished, will compare most favorably with anything made anywhere in the country.

The moulding room and the malleable iron department proper contain two furnaces for melting and five ovens of the largest size for annealing, giving four fires. There are two air furnaces. Taken all together this is a very complete handsome foundry, capable of producing a great variety of work. The building is 225 ft. long × 60 ft. in width. In addition to what is familiarly known as malleable iron castings of all sizes and styles, the company also makes "homogeneous steel" castings up to pieces of about half a ton in weight, as well as small fine steel castings. Some of the samples of this kind of work are exceedingly beautiful and have a closeness and perfection of grain which is quite remarkable.

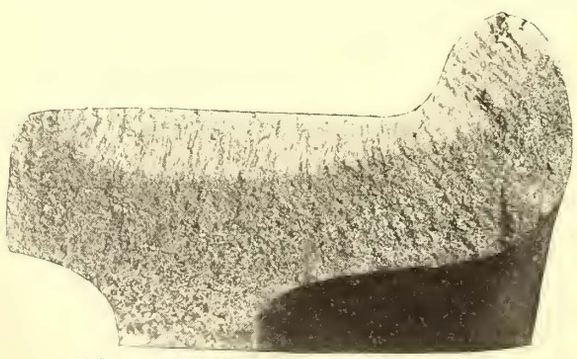


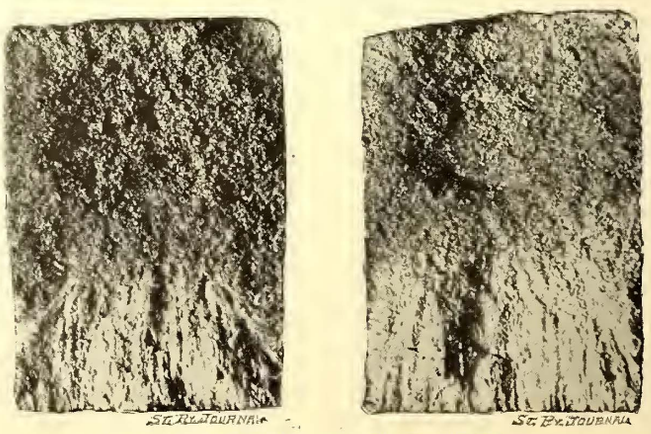
FIG. 5.—SECTION OF WHEEL.

The brass foundry is extensive enough to handle about a ton per day of brass work. In some respects the term brass work is a misnomer, for the president of the company, Mr. Putnam, is thoroughly converted to the belief that good metal is not only about as cheap as common brass but much more easily finished and much better in appearance under wear; consequently bronze has been adopted as the standard metal, and castings are made only of copper and tin. The company makes complete bronze fittings for electric cars besides a great deal of outside work. The smoothness with which such metal runs and the perfect character of the castings, as well as the ease with which they are finished and polished, undoubtedly make them the cheaper metal in the end.

It will be a surprise to many to find a car establishment of this character with so complete a wheel foundry. Figs. 5, 6 and 7 illustrate the character of the iron, showing two samples taken from test pieces, and also a section of a wheel. The quality of the metal is quite well shown in the engravings. For street car work the chill, of course, will be made very much deeper by changing the mixture of the metal. The test pieces show a hard steel-like chill which cuts glass with considerable ease, and a soft, strong gray iron of good quality; this is also very well shown in the car wheel section.

In addition to having numerous switches and trucks for steam cars there is a separate system of narrow gauge tracks running through the works for the transportation of material and car bodies in various directions.

During December just past, the company was building a lot of unusually interesting street cars upon an order from the West End Railway of Boston. The engravings show these cars in various stages of construction. They all have twenty-five foot bodies and are to be carried on double trucks. Many who are familiar with the theory of the car body and the action of the double truck will be surprised to see that instead of the steam road truss construction the street or horse car body has been retained in principle, and the car depends largely for its strength and stiffness upon the panel and frames instead of on a truss. The reason for this in this case, however, is sound. Several gentlemen connected with the West End Company explained very carefully the circumstances which made this form of construction imperative. There are several places in Washington, Tremont and other streets where the space available for the passing of cars is so narrow when trucks are upon the street, that the ordinary straight sided car would not be able to pass. Indeed, with the ordinary concave panel there are many of these places where even projecting nuts and washers are inadmissible and everything has to be flush with the surface. Inside the car the best use is made of the space available and a heavy truss rod is put through under the seats to give as much of a support as possible. Although this truss thus formed cannot be very deep the large size of the rod and sure anchorage at the end render it a powerful aid in holding up



FIGS. 6-7.—SECTIONS OF TEST PIECES.

the car. In Fig. 2 just inside the end sill will be seen the malleable iron casting used to take the end of the truss rod. This casting was specially designed for the place. The facilities of the company for producing anything and everything in the way of malleable iron enable them to introduce very many pieces of special elegance of design without extra cost. This casting is anchored not only to the sill itself but also to the cross timber or needle beam, which takes the inner bearing of the platform timber.

A number of these cars in the white are shown in the view of the paint shop in Fig. 1. They are very handsome and when painted in the standard style, fitted up with the necessary signs, etc., are very neat in appearance. In the construction of the floor frame of these cars are some exceedingly good and ingenious features. The dropping of the end sills below the side sills brings down the platform, while it raises the sills themselves and enables them to be deeper than would otherwise be possible with double trucks. The rails are well secured, and the design of this portion of the car is in general exceedingly good.

In Fig. 4 we have a view of the method of fastening panels and ribs together. It shows the inside of the end of the car, with the last window post next the corner. The panels are first thoroughly steamed and bent to form over hot cauls. The heating of the forms dries out the moisture left by steaming, and the panels go on bent to shape and dry. When they are tacked in place they are hot, and the glue on ribs, rails and post is in its best condition to insure adhesion between the panels and the ribs. Glue blocks are put into the angles very carefully, as shown. This, together with the application of the canvas, is an unusual feature. Fig. 4 shows the inside of one of these cars, with the canvas applied over the blocks. Great care is taken in doing this, and the manufacturers feel that the labor expended in this careful application of canvas to the blocks and panels is well expended. The work appears neat and mechanical, and as far as can be judged, the claim, that it makes an exceedingly good and strong side, is valid.

It will be noticed in this last engraving that the inside belt rail behind the sill is well chamfered to allow dirt and dust which might accumulate to slide off upon the floor. This rail, as will be seen in Fig. 2, is very deep and gives considerable vertical strength to the side. The upper or window rail is deep, and is reinforced on the inside by a deep, strong rail, as shown in Fig. 4, laid horizontally. This binds the posts together and is a part of the framework of the car, instead of the inside finish, as is the usual construction. The end of the car is shown in Fig. 3 on a larger scale. The raised roof has a hood, the bow of which is formed from a single piece of wood bent to the proper shape. The upper rail and the belt are firmly secured to both the post and the end plate, and the joint is covered and protected by specially designed bracket and handle of malleable iron. This bracket also supports the hood. The designer here has intended to make the hood and end of the car as light as possible. The hood itself is built on a "last" or mould, and after the plan frequently employed in fine boat building, which gives a very light but exceedingly strong construction. The form employed is well shown in Fig. 1. In this engraving also is seen the special casting employed for a buffer iron. It is very light, of malleable iron and the outer part reversible, so as to be adjustable for any required height. The one and three-quarters inch platform floor butting, as it does, firmly against the end sill and coming with equal firmness against the platform end timber gives all the strength necessary to resist collisions.

The Chapin-Douglas Electric Company, of New York, N. Y., has been organized to manufacture electrical supplies. President, Chas. E. Chapin; secretary and treasurer, J. S. Douglas, of 136 Liberty Street, New York.

The Manufacture of Iron and Steel Poles for Railway Work.

Among the pioneer manufacturers of wrought iron pipe and boiler tubes in the United States were Morris, Tasker & Company, Incorporated, of Philadelphia. Up to the time when they commenced business, the only wrought iron tubes that had been available for any purpose were gun barrels. These were hand forged upon a mandrel and differed from ordinary modern tubes, not only by being thicker at one end than the other, but in having the weld spiral. They were made from strips of metal wound spirally around a mandrel and welded under the hand hammer during the process. About the earliest use of barrels for tubing of which we have any record in this country is found in the tubular boiler which Colonel Stevens built for his screw propeller at Hoboken, N. J., in 1804.

In 1821, the late Stephen P. Morris, then a very young man, in company with the late Thomas T. Tasker, started in a small way to make grates adapted to the use of anthracite coal. At that time anthracite coal was a new fuel, and no small amount of difficulty was encountered in using it successfully. Indeed, it is on record that in attempting to burn it for the first time in a large way the "black stones" utterly refused to ignite, and a whole forenoon was spent in poking, blowing, fussing and coaxing. When noon came, in desperation the furnace doors were shut and lunch was eaten. At the close of the noon hour the furnace was found white hot, and the discovery was made that anthracite coal must be let alone if it is to burn. There was a considerable call for grates which would burn this new fuel, and as these differed from those previously used, the young firm

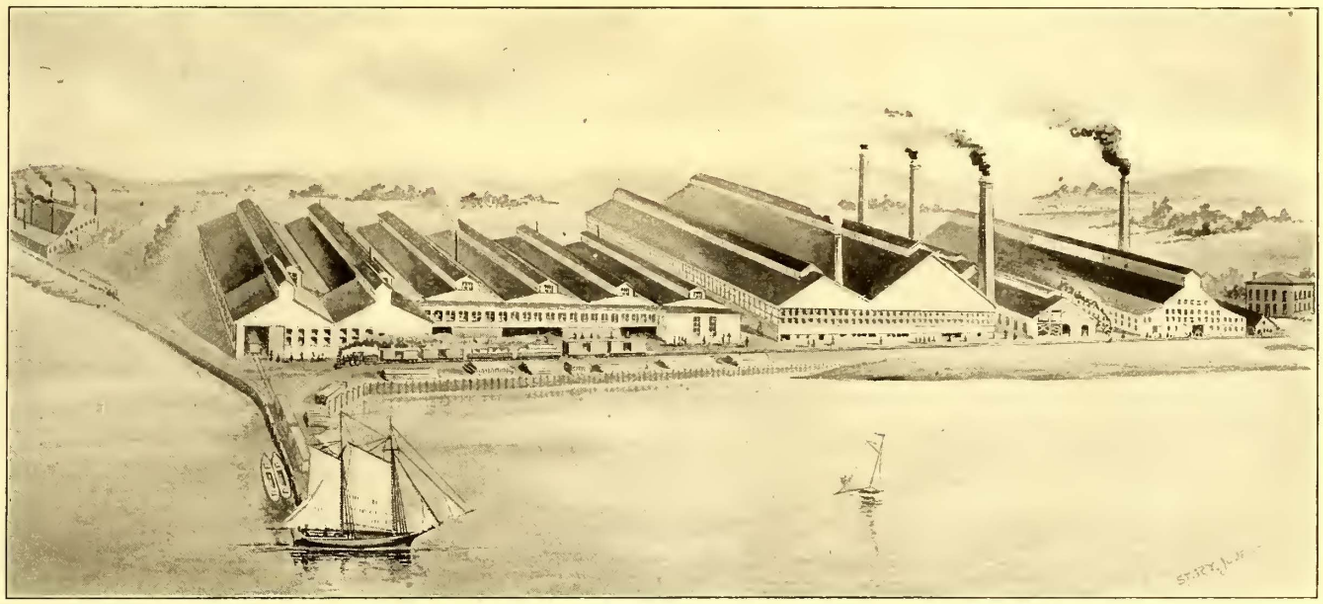


FIG. 1.—WORKS OF MORRIS, TASKER & CO., INCORPORATED.

soon found their business growing, and gradually launched into regular foundry work. Learning that gas was becoming popular in England, and had every indication of being in demand in Philadelphia, they began to look around for a cheap pipe for conveying gas. They began to buy old gun barrels and connect them with screw joints, converting them into pipe, but they soon found that the method was too slow, and also that there were not enough gun barrels to be had in the country to supply the demand. The firm then purchased the sole right to manufacture butt welded pipe in the manner that was then being carried on in a small way in England. The gas industry became very extensive and profitable, and the business of the firm increased so rapidly in consequence, that in 1836 they bought a large tract of land and built what was afterwards known as the Pascal Iron Works. The works covered two Philadelphia squares, 800 × 400 ft. As long ago as 1870 this establishment was employing 2000 men. About this time, and for a few years later, immense improvements in the methods of manufacturing pipe and great increases in the regular sizes took place. Twelve, fourteen, sixteen and in fact (at present) any size up to thirty or thirty-six inch are common, whereas before 1875 a fifteen-inch pipe was something almost unheard of. Under the great stimulus of an increased market the location in Philadelphia was found altogether too small for the enormous business, and a tract of some sixty acres of land was then purchased at New Castle, Del., on the Delaware River below Philadelphia. In 1875 a fine mill was built upon this property, and since that time new buildings have been added from time to time, until at the present time the whole plant has been moved to the New Castle property, and the site of the old works in Philadelphia is now covered with fine dwelling houses.

The engraving, Fig. 1, gives an inadequate idea of the New Castle Works which have a river front of more than 2000 ft. The shops are of great depth connected both with the water front and with the railroad by an extensive system of tracks. The establishment includes the rolling mills at the left, the pipe works, gas producers and the necessary boiler and engine houses. At the ex-

treme right of the engraving is seen the large two story office building, which is now in process of completion.

This New Castle plant or mill is operated under the name of the Delaware Iron Company. It is there making 300 tubular poles per day for electric light and street railway purposes. It also produces a very large tonnage of wrought iron pipe from one-eighth of an inch to sixteen inches in diameter, and boiler tubes from one and one-half inch to sixteen inches of all grades, from the heaviest to the lightest. It also manufactures cast iron pipe fittings, castings, and foundry work in general, as well as special gun metal castings for electric power plants. In addition to electric railway poles, lighting poles and telegraph poles it makes side arms, cross arms, double and single brackets, etc. The products of the company embrace everything in the way of street supports for lamps, lights, overhead irons and all things connected with electrical work. The firm is noted for having had a number of the leading men of the city of Philadelphia connected with it. At no time, however, in its history have there been many interests. Even now as a corporation the stock is almost entirely owned by the officers and the directors.

Both Mr. Morris and Mr. Tasker lived to be very old men, each of them reaching nearly a century of life, and they passed away only a few years ago. Prominent among the different owners were Henry Morris, Thomas T. Tasker, Jr., A. G. Morris, Wistar Morris and Charles Wheeler. For the past ten years the management and control of the business has been in the hands of the following officers: Andrew Wheeler, president, Jonathan Rollins, vice-president, William R. McIlvaine, treasurer, H. Cheston Vansant, secretary. These gentlemen, together with Stephen P. M. Tasker, T. Wistar Brown, and a representation of the Charles Wheeler estate constitute the board of directors and the entire ownership of the corporation.

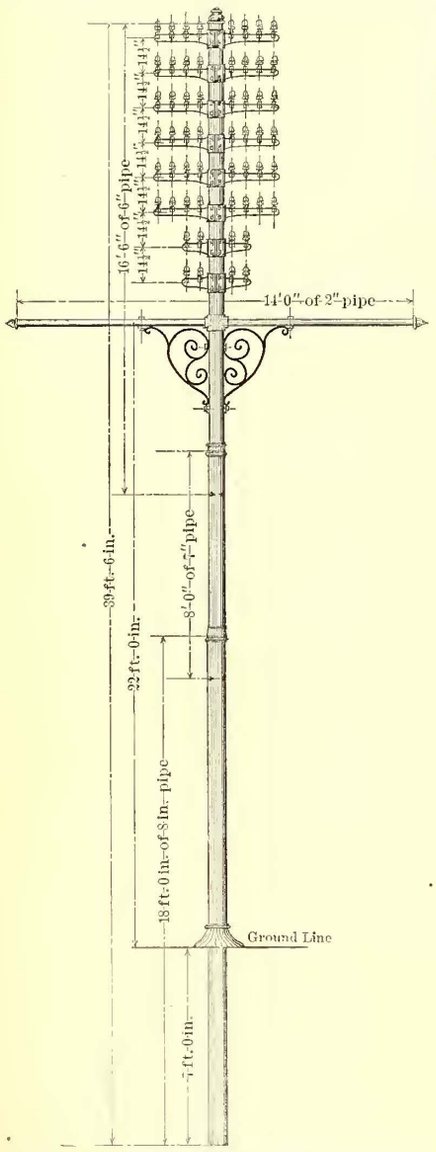


FIG. 2.—COMBINED TELEGRAPH AND RAILWAY POLE.

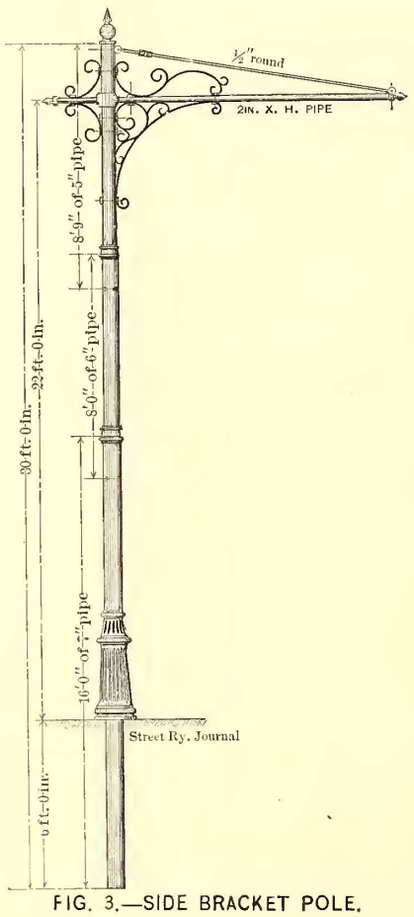


FIG. 3.—SIDE BRACKET POLE.

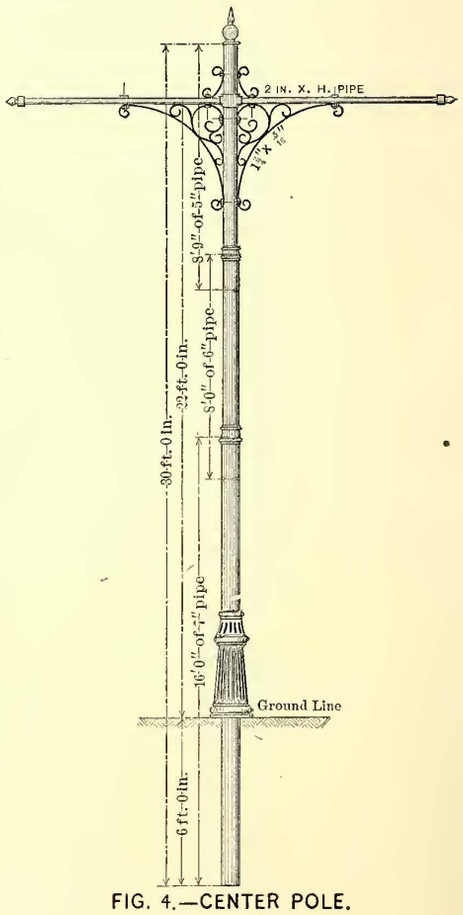


FIG. 4.—CENTER POLE.

In the matter of poles for the support of wires, lamps, feeders and other electric work, the past few years have taught many very important and costly lessons.

Theory indicates that the strongest form in which material can be placed to resist strains from all directions, the point of support being at a distance from the plane in which the forces act, is that of a tapering tube, cylindrical in cross section and having walls gradually diminishing in thickness as the diameter becomes smaller. The manufacturer finds that the cheapest form of iron pole which can be made approximates closely to the theoretical conditions in being the strongest for a given weight of metal.

In practice the street railway pole is made from three or more lengths of pipe of different sizes and thicknesses of metal. Manufacturing conditions change to a slight extent the theoretical sizes and weights of the different portions of the pole. This, however, does not interfere in any appreciable way with the strength relatively to the weight, and the cost is proportionally less.

The modern pole of the most approved form consists of three or more wrought iron tubes of different diameters. The sections are telescoped one within the other far enough to obtain an ample support, and the joint made perfect by swedging. The lower section is not only the largest, but is of thicker metal. The thickness of the metal is, in the lighter poles, decided by the usage to which the pole is subjected in the way of accidents, collisions from vehicles, etc. When it is strong enough for this purpose, it is amply thick for the work put upon it by the strain of wires, etc. The remaining sections are of such thickness as is found most economical in manufacture, the resulting strength being ample. While this form of pole has at last been accepted by all as the best that can be found, the methods of manufacture are as various as can be imagined. Morris, Tasker & Company have adopted a system which produces a strong, durable pole which is quite ideal in its beauty and fitness. In this process the sections used are of such a size that the smaller section telescopes within the larger with a small margin to spare. The larger section is then brought up to a high heat at the point where the joint is to be, the smaller one slipped inside so as to make a lap of some eighteen inches in length, and the hot metal compressed or swedged till the smaller tube is firmly held by the outer tube. This is the solid sunk swedged joint which has given their poles a very enviable reputation. Under the influence of the compression the two parts are very nearly welded. When cooling takes place, shrinking as well as compression of the metal holds the parts together. Shrinking of the different portions, most of our readers know, is considered almost sufficient to hold the parts of a gun in place, and, in the case of poles, is more than ample. Indeed, the poles become stronger at the joints than at any other place.

Pull-off poles have been constructed by this method which are able to safely take a horizontal strain at the top of seven thousand pounds. The solid swedged joint presents a great contrast to the pole made up with shims. It always stands up in place without bending and without showing an angle at the joints between the sections and upon relieving the strain of the wires one joint never drops within another. It is also found that shim joints are not so tight as to keep out water, and rusting is sometimes rapid. These difficulties are all avoided in the swedged joint.

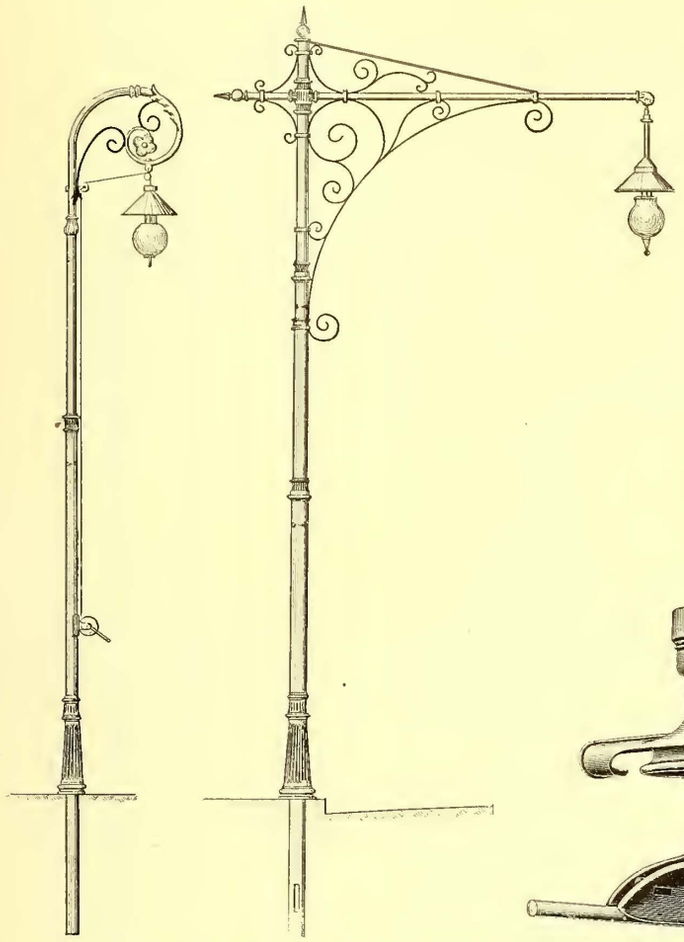
The engravings show several new styles of pole made by the company to meet the demand for something which shall be both ornamental and effective. Fig. 5 is a new design for an electric light pole. It provides ample strength for the purpose while its ornamental character makes it a desirable feature for street use.

Fig. 2 shows a decided novelty in the way of iron poles. It is

a telegraph and trolley pole combined and was designed for Belleville, Pa. The construction is adapted both for side, bracket, or center pole construction. There are insulators for fifty-six wires in all. Eight of these are for feeders and the others for telegraphic purposes. It is a beautiful design and does away with many of the objections usually urged against poles of its class. Its safety is one important point which should not be overlooked. A line of such poles can be furnished of any desired strength, and such wrecks as were reported everywhere in the great snowstorm of a few years ago would not be often experienced with such a construction.

Fig 3. is a twenty-two foot side arm pole decorated at the arm as in the last case and having a fine ornamental base casting. These castings add very much to the appearance of the pole.

Fig. 4 is a twenty-two foot center pole adapted to any method of wire suspension.



FIGS. 5 AND 6.—ELECTRIC LIGHT POLES.

Fig. 6 shows a new side arm electric light pole. It is a great contrast to the so called "poles" which are doing duty for electric light supports in most of our smaller towns as well as some of our cities.

From the experience so far gained it appears probable that the life of an iron pole with swedged joints is nearly unlimited. The outside is easily protected while the interior appears to be so perfectly sealed that rusting does not take place.

What Becomes of the Old Trolley and Magnet Wire?

Very few people outside of a certain line of business know what becomes of the large accumulation of scrap copper wire, discarded throughout the country by electric railways and elecric lighting plants. It would be surprising news to some that there is an industry existing that handles such accumulations of scrap copper wire, brass, etc., and that there are firms engaged in such business whose purchases and sales aggregate from $500,000 to $1,000,000 annually.

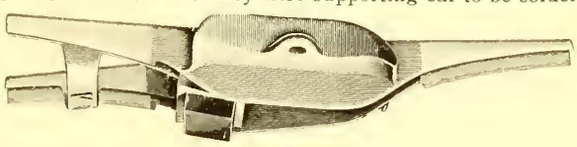
One company, in particular, engaged in this business in Chicago, makes a specialty of catering to the street railway and electrical trade throughout the country, purchasing their accumulation of scrap copper, etc., and supplying them with the very highest grades of Babbitt metal, solder, pig lead, etc., which is manufactured by it. This industry has sprung up only in the last few years and is growing very fast. This company is the Swarts Metal Refining Company, and it reduces the copper wire into ingot shape and disposes of the result to brass foundries and manufacturers requiring copper.

The company at times gets much larger quantities than it can market successfully in this country, and makes large shipments to Germany and other countries.

Type "G" Overhead Material.

To the full line of overhead material known as form "D" the General Electric Company has added as complete a line of another type to which it has given the name of form "G." In this form are embodied improvements and modifications which have suggested themselves as advisable from the experience had with overhead material of previous types. Special attention has been given to strengthening the metal parts at points where the greatest strain is applied. In appearance form "G" is somewhat neater than preceding types and the metal parts are of malleable iron or composition metal as the taste of the purchaser may select.

In the form "G" material, the metal parts enclose an insulated bolt and protect it thoroughly from all moisture and accident; these bolts are interchangeable in all form "G" suspensions, and the use of this bolt enables the trolley wire supporting ear to be soldered to

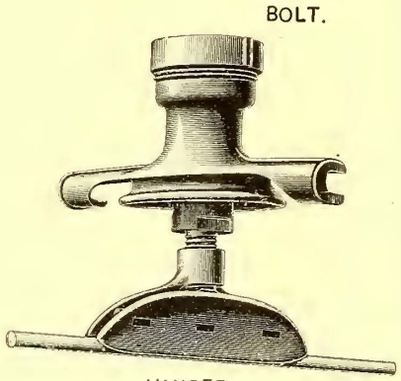


TROLLEY FROG.

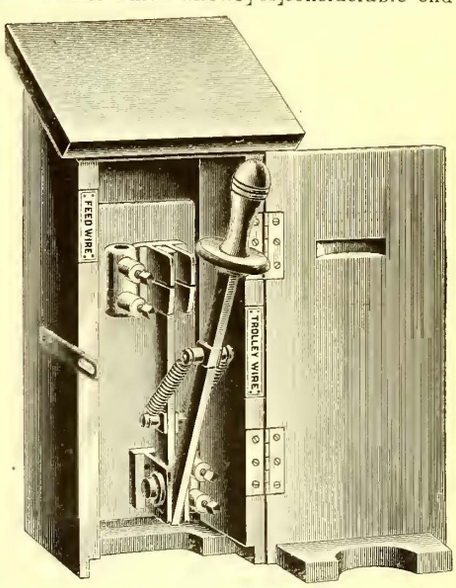
the wire, and the suspension to be assembled afterwards. The form "G" material has already secured the favorable consideration of railway men.

The trolley frog and drawbridge frog have undergone improvements suggested by past experience. These frogs are now so arranged that the trolley wheel does not slip as it passes under them. The drawbridge frog is a special device and has the advantage of giving a firm but flexible contact which allows of considerable end play to the bridge over which the trolley line may pass. It avoids the use of running feeders to the draw span, the frog connecting the trolley wire on the draw to the trolley wire at each end of the shore span.

BOLT.



HANGER.



SECTION SWITCH BOX.

The section switch boxes have been designed to meet all requirements of line service. The movable side of the switch is connected to the trolley line; when the switch is open the cover of the box may be closed and locked to prevent any tampering with the line by unauthorized or incompetent persons.

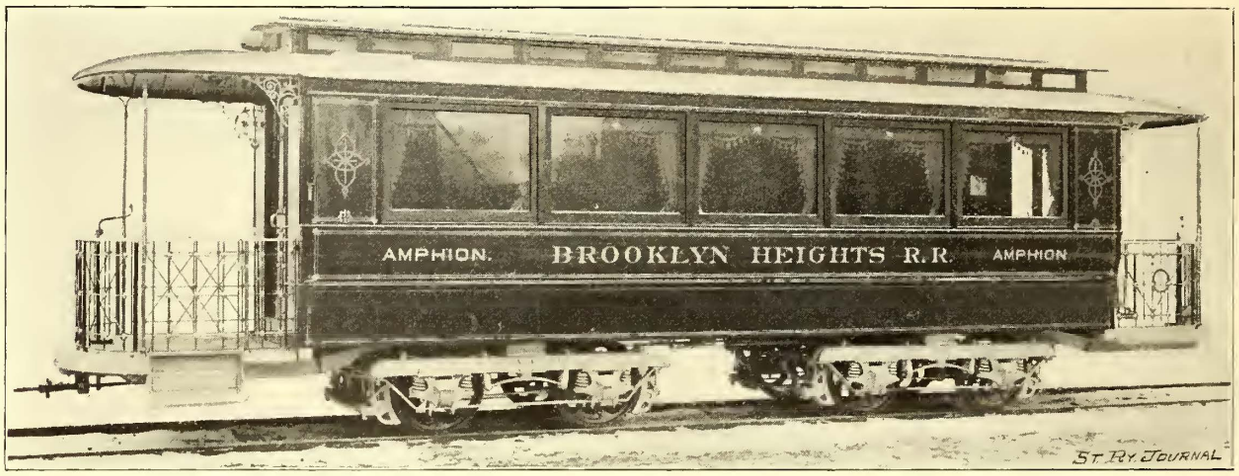
Calendars for the New Year.

The number of tasteful calendars issued for 1896 seems to be greater than that of those published in previous years. Among others which have been received since the January issue went to press and which deserve special mention are that of the Meaker Manufacturing Company, which is the color of its registers and bears a representation of one of the Meaker registers; one issued by J. W. Hoffman & Company, of Philadelphia and New York, one of Hoefgen, Moxham & Company bearing an engraving of the yacht Defender; one of the Shultz Belting Company with a view of its works, and one of P. Pryibil.

The San Diego Cable Railway Company of San Diego, Cal., has issued a pamphlet descriptive of its lines, which will be sold at auction March 11 at the power house of the company in San Diego. The pamphlet describes the route and plant of the company, with views of the station, cars, etc., and a statement of its earnings for different periods. There is also given a report by Frank Van Vleck, M. E., as to the value of the plant and facilities for a conversion to electric service. The pamphlet also gives some particulars of the growth, climate and resources of the city of San Diego.

Brooklyn Heights Parlor Cars.

The car shown has recently been built by the Barney & Smith Car Company for the Brooklyn Heights Railroad Company, is 25 ft. long over the body and 36 ft. long over the platforms. The width over the main panels is 7 ft. 9 ins., the width over the cove panels is 7 ft., and the height from the bottom of the sill to the top of the roof is 8 ft. 6 ins. The cars are framed with a special iron construction, with extended platforms supported by "T" irons. The platforms are enclosed with railings, with bronze trimmings and with solid bronze posts supporting the hoods. The windows of the car are furnished with selected plate glass, the inside finish is of St. Jago mahogany handsomely carved and finished in oil. The windows are



PARLOR CAR FOR THEATRE PARTIES—BROOKLYN.

supplied with Burgess tapestry curtains, with Burrowes automatic fixtures, and furnished with silk velour draperies of the most artistic design. In each of the four corners of the car there is a buffet with lockers above and below, the doors in the upper lockers are furnished with plate glass mirrors beveled.

INTERIOR OF PARLOR CAR.

The doors of the car are of the double automatic pattern at each end. There are three incandescent electric chandeliers in each car, with an incandescent goose neck bracket over each buffet. The headlining in the car is of composite pattern, such as used in steam railroad parlor cars, and are ornamented in the most artistic manner by hand. The hand straps are carried on bronze hand rods supported on solid bronze brackets of the latest design. The seating is of loose wicker chairs, finely upholstered. The floor is covered with the Bigelow Wilton carpet. Each car is also supplied with two tables, which may be attached to the sides of the car at different places.

The cars are painted a Marseilles royal blue, and ornamented in gold leaf, as shown on the elevation.

The cars are mounted on Barney & Smith's standard Class "E" suspension spring motor trucks, and are so arranged that the height of the body is very little different from that of the ordinary four wheel car, the wheels are 30 ins. in diameter.

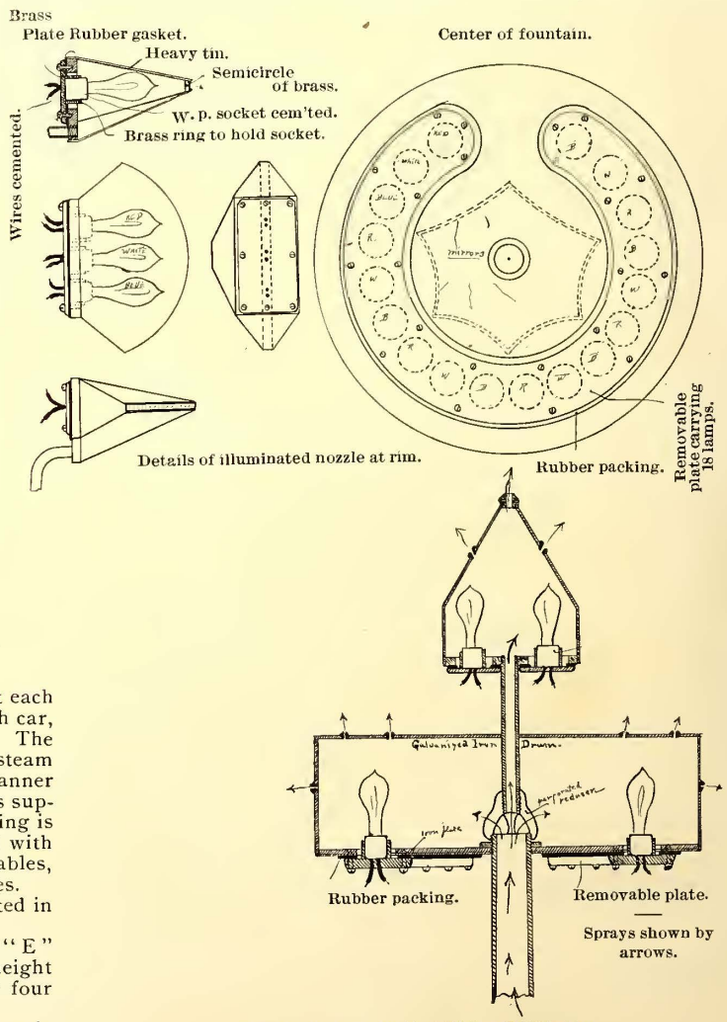
In addition to the seating capacity above mentioned, each car is supplied with twelve camp stools, carried in boxes on each platform, which may be used in case seats are desired on the platform.

The cars have just been received by the railway company, and will be leased for theatre and trolley parties and other excursions.

An Inexpensive Electric Fountain.

The accompanying engravings show an electric fountain recently installed by the Syracuse Street Railway Company, and for which patents have been applied for by Albert Vickers, recently of that company and now of the firm of Rodgers, Baldwin & Vickers. The special feature of this fountain is that it can produce elaborate and beautiful effects, and yet so simple is the design that it can be built cheaply enough to be within the reach of any road that is looking for an attraction of this character.

Incandescent lamps of different candle power and colors are used, and the principle of the fountain is that these lamps are immersed bodily in the nozzles from which the jets are thrown. From the principle of internal reflections, every drop of water leaving a nozzle will be illuminated when the lamps are lighted. The lamps are of several colors, and these can be changed at will, changing the color of the jets. The jets can of course be made in any form, and the amount of water used can be varied to suit any conditions, from



DETAILS OF ELECTRIC FOUNTAIN.

a form of many jets using many gallons of water to one throwing nothing but a fine mist.

The fountain had five rim fan jets, not shown, as well

as two center drum jets. Each rim jet is provided with three colors. The lower central drum has lamps of three colors alternately around the inside of the drum, and the top drum has four colors. By making suitable connections, the three rim colors may be revolved in one direction, the lower central drum colors may be revolved in the opposite direction and the central jet may be changed independently, into any of four or five colors, or the whole fountain may be made any one of the three colors. The alternations are made from a drum switchboard to which the connections are run. With this simplicity of design and flexibility of manipulation it is easy to see that even in the very simple form illustrated, what endless combinations and beautiful effects are possible.

Air Brakes in Street Railway Service.

The increasing speeds of cable and electric cars in our densely crowded city streets, and particularly the speeds which are getting to be common on the highways between cities and towns, in the competition with parallel steam railway lines, are making absolutely necessary the adoption of methods of braking which shall be, in power and quickness of application, at least proportionately as efficient as those which have been developed in steam railroading. From the universal use of air brakes in railroad service the conclusion is natural that compressed air has been found in practice to be peculiarly fitted for this special purpose, and it may readily be supposed that inventors have been busily at work in trying to solve the problems connected with the use of air brakes on street railway cars.

These problems however, present unusual difficulties, if among the problems to be solved is included that of low first cost, and until the last two years no large success had been achieved either in building satisfactory brakes at a reasonable cost or in bringing street railway managers to an understanding of the necessity of replacing hand brakes with the "quick acting" power of compressed air. Some two years ago, however, the air brake problems were grappled with by strong men—men who were capable of taking a large view of the field and who were determined to build up an industry which should have for its main object the more perfect protection of life and property in municipal transportation.

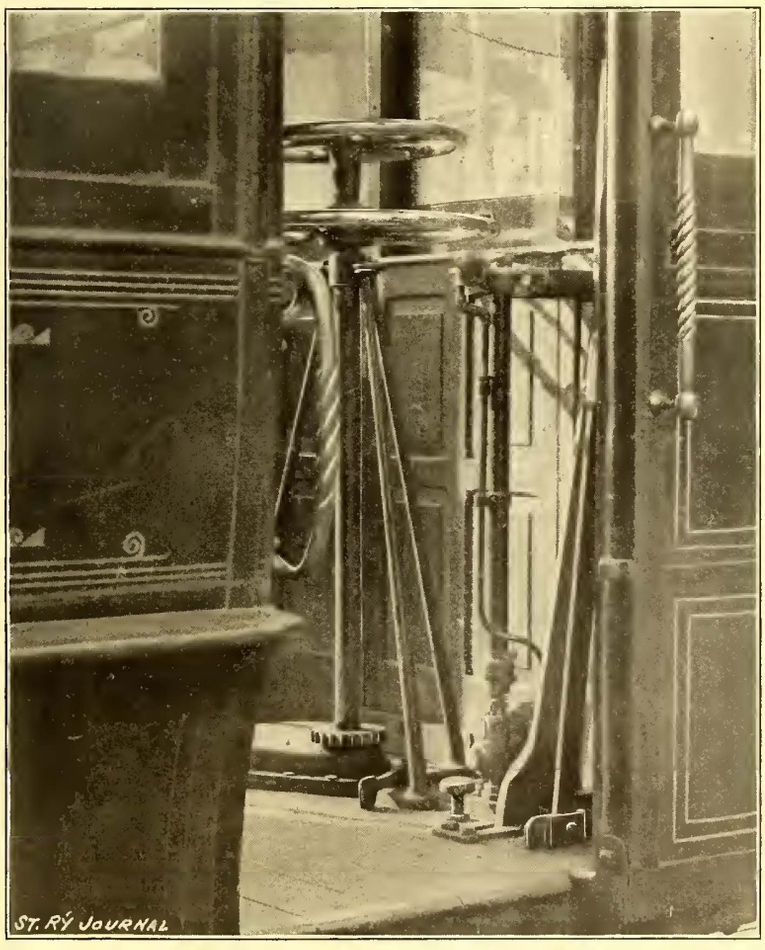


FIG. 2.—AIR BRAKE CONTROLLER.

The Standard Air Brake Company has created a demand for air brakes which it finds it difficult to satisfy to-day, in spite of constantly increasing manufacturing facilities. From England, from Germany, from Australia and from many of the principal cities of the United States are coming orders and contracts which are taxing its facilities to the extreme, and which make promises of deliveries difficult to keep. The company's business department has been successful beyond precedent or expectation in awakening an interest among street railway managers in what can be done by compressed air for the protection of their passengers and property, and in the reduction of their annual damage account. Mr. Wessels' active and persistent campaign in this direction has produced remarkable results of which the company may well be proud.

The company is to-day equipping with its air brakes, cars found in every kind of service—thirty-five foot double truck cars as well as twenty foot single truck cars—cars for heavy grade work as well as for level lines—and its chief engineer, Mr. Merriam, is boldly attacking every special problem presented for the company's consideration. It will be of interest to refer to a few of these problems in order to understand exactly the kind of work which the company is undertaking.

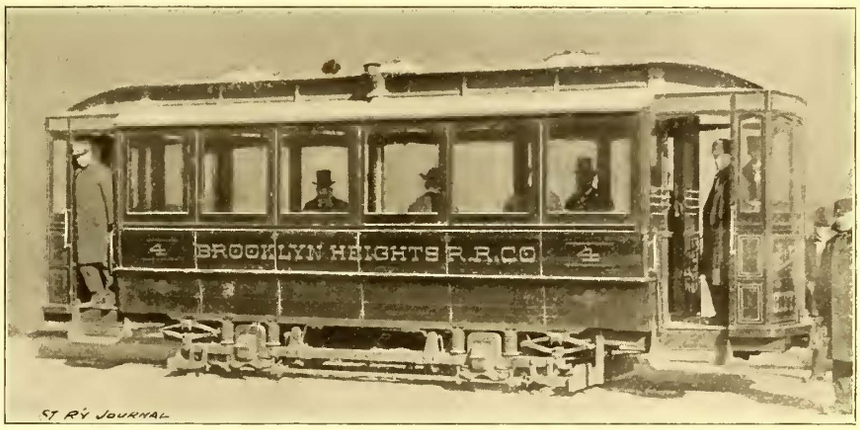


FIG. 1.—CABLE CAR EQUIPPED WITH AIR BRAKE.

The equipment of the eight cable cars used on the Montague Street hill of the Brooklyn Heights Railroad Company, from Wall Street Ferry to City Hall, has just been completed. This division had met with several unfortunate accidents due to lack of proper braking capacity, the last being one in which the car got beyond the control of the gripman and ran down hill, crashing into the bumper at the ferry. President Rossiter, becoming convinced that hand brakes were of insufficient power, decided to equip these cars with air brakes, and the Standard Company has put on its axle driven compressor, which is especially adapted for cars running at moderate speeds. The Brooklyn Heights cars illustrated in Fig. 1. The grades on this line rise to a maximum of ten per cent for nearly one-quarter of its length.

Many interesting conditions were met with in equipping these cars. One was the necessity for compressing air very quickly, so as to provide for frequent stops, the entire road being so short. Special reservoirs were made, together with a quick acting compressor which provides sufficient air for every possible demand. Again, the brake cylinder is mounted on the truck, instead of on the car body, as is usual. The cars have single trucks, with an eight foot wheel base and thirty inch wheels. The speed is about eight miles per hour.

In Fig. 2 is shown the controlling apparatus used on these cars. The upper platform type of valve is used, which provides the least obstruction on the platform and does away with the pipes formerly used. All that is visible is the valve, the controlling staff, next to which is the small gauge pipe, the quadrant containing the gauge, and the removable controlling handle. The air brakes are relied upon for all kinds of stops from the ordinary service to the full emergency application. The car is also equipped with hand brakes, which are not used, however, in regular stoppages.

The company has also equipped with its brakes the five eight wheeled combination postal and passenger cars recently put into service by the Brooklyn Heights Railroad Company, one of which is shown in Fig. 3. These cars weigh over ten tons each, exclusive of passengers and mails. Three are running on the East New York section and two from the Post Office to Greenpoint. They travel over several grades, one of which is long and especially dangerous because of a bad crossing at the foot, where there is also a congestion of wagon traffic. It has always been difficult to brake cars on this grade as wagon drivers run undue risks in attempting to cross tracks when cars are coming down grade. The speed of these postal cars may occasionally rise to such a point as to make the quick and certain application of brakes important, and the fact that the Standard air brakes have been chosen for this service is significant. It is worthy of note, by the way, that with the Standard air brake there is said to be little difficulty in using the sand boxes. In cases of emergency, the motorman throws his handle completely over and sets the brake and can then devote his entire attention to properly sanding the track. The company now offers a special device by which with one turn of the handle sand is run out and the air brake applied.

It is a well earned compliment to the Standard air brakes that

the Brooklyn Heights Railroad Company is equipping its parlor cars Amphion and Montauk with them, and that the third (not yet delivered) will also be so equipped. The weight of these cars is approximately nine tons without passengers. They will be used in different parts of Brooklyn and will therefore have to travel over very bad grades in numerous places. One of these cars is illustrated on page 130.

In Fig. 4 will be seen the long double truck car of the Washington, Alexandria & Mt. Vernon Railway Company, eighteen of which are equipped with the Standard brakes. This road will operate its cars at very high speeds, up to forty-five miles per hour, on account of which, and of the motor and truck arrangement, the Standard Company is using its geared compressor type, an illustration of which was shown in the January issue of the Journal. These compressors are not mounted on the motor axles, but on the small wheel axles of the Brill Maximum Traction Trucks. A high grade of efficiency is said to have been developed by these compressors in recent trials.

These contracts, in addition to others now being filled for similar and even more difficult classes of work, show that the company is making rapid and sure headway. The business management of the company is responsible in a large degree for the very satisfactory results already achieved, since Mr. Wessels is not only able to care for the financial and selling interests of the company, but exercises a direct influence in the engineering and mechanical departments, through his sound common sense and business judgment. The company is also fortunate in its chief engineer, Mr. Henry P. Merriam, whose training as a mechanical and electrical engineer is not superficial, but has been gained through hard experience in electric railroading, and in some of the best machine shops of the country, while a fundamental knowledge of principles was acquired by him in the Massachusetts Institute of Technology, the foremost engineering school in the country. Finally, the financial support given to Mr. Wessels has been generous and unfailing, the company's stockholders being among the best known and most influential international financiers.

FIG. 3.—MAIL CAR EQUIPPED WITH AIR BRAKE—BROOKLYN CITY RAILWAY.

Electric Switching on the Brooklyn Bridge.

The success attending the electric equipment of the Chicago Intramural Railway, the Metropolitan West Side Railway and the Nantasket Beach Railway, has led the trustees of the Brooklyn Bridge to request the General Electric Company to equip one car with their apparatus in order to demonstrate the advantages of electric motive power on the Bridge.

The general plan is to mount four 50 h.p. motors on the axles of one car of each train. These passenger car locomotives will remain with the trains at all times, and will switch the trains from the incoming to the outgoing platform, and to the tilting sheaves, where the trains are attached to the cable. If, while ascending the 3.78 p. c. grade, the grips should slip and a train be in danger of stopping, the electric motors can be employed to assist the train over the summit. During the early morning hours, when the cable is not running, the trains may be operated entirely by electric motors.

By supplying each train with its own facilities for switching, the interference of the locomotives with the incoming and outgoing trains will be avoided and the complexity of the switching reduced one-half. Of course, the common nuisances of a locomotive will be done away with. The noise, steam, ashes and gases will be completely banished.

FIG. 4.—DOUBLE TRUCK CAR EQUIPPED WITH AIR BRAKE—WASHINGTON, ALEXANDRIA & MT. VERNON RAILWAY.

The controlling apparatus is in duplicate and the motors can be operated from either platform.

It is also the desire of the trustees to heat the cars by electricity, and twelve electric heaters will be located in each car. Further details of the interesting installation contemplated will be given in our columns shortly.

With each train equipped with electric light, heat and motive power, and possibly with a telephone connection, the Bridge Railway will fitly illustrate the advance in electric art of this day.

The Eighth Avenue Metropolitan Lease.

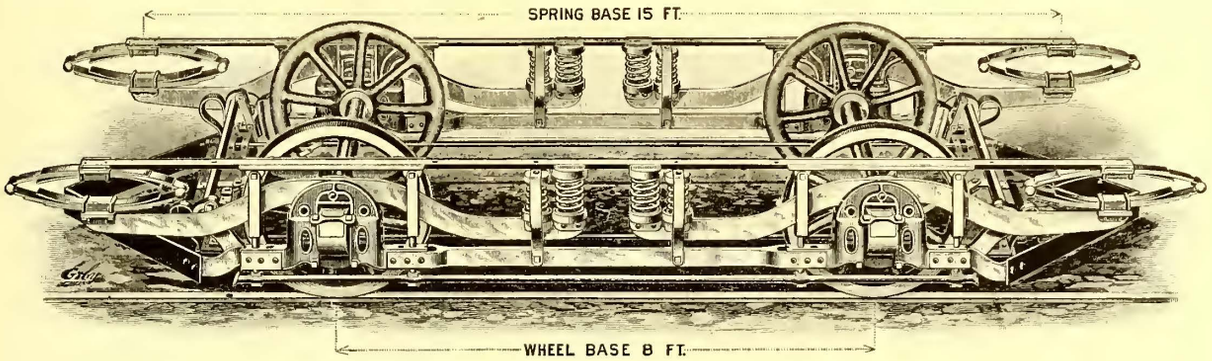
The Metropolitan Street Railway Company, of New York City, has just issued a general order to officers and employes dated January 1, 1896, and referring to its acquisition of the Eighth Avenue Railroad through a lease taking effect on January 1. This property will be operated as the Eighth Avenue division of the Metropolitan Street Railway system, and the authority of the general officers and heads of departments of the Metropolitan Street Railway Company will be extended over the division.

The Winchester, Arlington & Waterford Street Railway Company, of Winchester, Mass., has been organized to build an electric railway in the suburbs of Boston. Capital stock, $150000. Among those interested are: Chas. F. Chandler, John H. Cunningham, of Chelsea, Mass.; James F. Shaw, W. W. Kimball, of Arlington, Mass.; A. B. Coffin, of Winchester; E. C. Benton, of Belmont, Mass.

New Motor Truck.

The accompanying illustration shows a new pattern of motor truck, designed and patented by E. A. Curtis. It is designed especially to overcome the disagreeable and hurtful element of oscillation caused by both high speed and uneven track surfaces. This object is accomplished by the application of an equalizing principle, which enables the car body to retain and travel in a horizontal position under all conditions, instead of responding to every lateral and vertical thrust of the truck frame. By the use of a jaw which fastens to the under side of the top strap of truck and extends down on each side of the rear of pedestal, the springs are rendered absolutely free from all thrust or jar, thus enabling them to act as springs only at all times.

The springs supporting the car body are situated at the extreme ends of the equalizing bars instead of directly on the frame of the truck, and the only point of communication between the truck frame and the spring seats being through the one and one-half inch steel pins that confine the equalizing bars in the saddle at top of pedestal, the car body is relieved of all jar or trembling. The projection of the long equalizing bars beyond the ends of the truck gives a greatly extended spring base, resulting, it is claimed, in a very superior support for the car body.



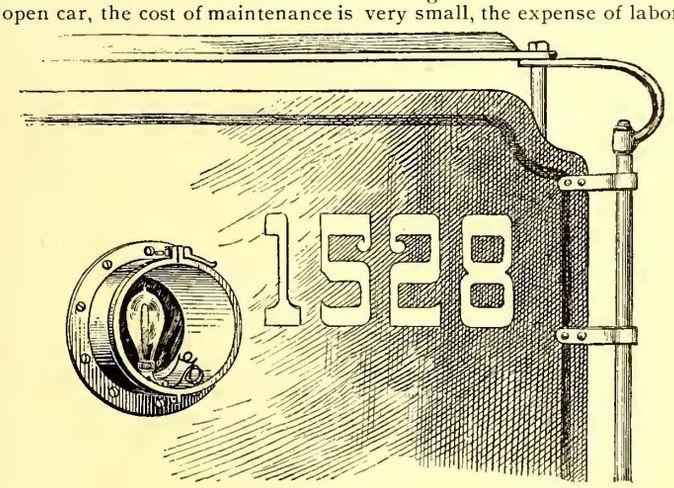
NEW MOTOR TRUCK.

The truck frame rides on eight springs independent of springs carrying the car body, situated inside the pedestals, and therefore rides softly and easily and free from rigidity. The truss for the car body is so constructed and applied that it is absolutely free from contact with the springs or frame of the truck and is practically a part of the car body.

In the effort to produce a truck embodying the very best riding qualities, resulting not only in the comfort of the passenger, but in prolonging the life of both equipment and roadbed, simplicity of construction and maximum strength have been observed at every point.

Electric Headlights.

The accompanying engraving shows an electric headlight of which F. E. Huntress & Company are agents, and which is manufactured by Neal Electric Headlight Company. The advantages of electric headlights are many, among which may be mentioned the fact that there is no smell of oil when sitting on the front seat of an open car, the cost of maintenance is very small, the expense of labor for cleaning and filling lamps is entirely avoided and they abolish kerosene from the car house, reducing liability from fire and lowering insurance rates. All of these facts make the cost of maintenance of the electric over the oil lamp very great.



ELECTRIC HEADLIGHT.

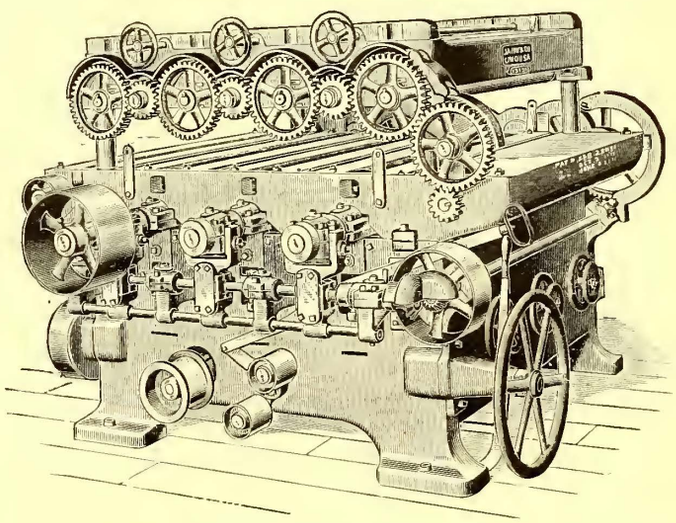
The arrangement of the lamp is such that there is no interference with the lettering on the dashboard. The headlight is painted the same color as the dashboard, making it hardly noticeable during the day. It projects only three inches beyond the dashboard and being made of malleable iron is practically indestructible.

The lamp has been adopted as standard by a large number of companies, including the West End Street Railway Company, of Boston, Mass., and the Brooklyn Heights Railway Company, of Brooklyn, N. Y., both of whom speak in excellent terms of it.

All the rights and titles of this device are owned by F. E. Huntress.

Triple-Drum Eight-Roll Sand-Papering Machine.

The machine shown herewith is designed to sand-paper planed surfaces of material for panels, doors, or any class of work in street car construction requiring a perfect surface either for varnishing or painting. It is heavy and substantial and made to work 30 ins., 36 ins., 42 ins., 48 ins. and 60 ins. wide. The drums are of steel, three in number, and upon them the sand-paper is placed and graded according to the work to be done. The first drum carries a coarse grade of paper, the second a fine grade for smoothing, and the third a finer grade for giving the material the polished surface. Each has an oscillating or vibratory motion laterally across the material to prevent the formation of lines which would result if the revolving motion was direct. They are equipped with a device for placing the sand-paper about them and giving it the proper tension in the shortest possible time. The drum-shafts revolve in heavy bearings, gibbed to the sides, and with adjustments to lift both ends of the drums at once, or either end separately for alignment. By a special device they can be easily adjusted or removed by raising the entire roller and bed frame.



SAND-PAPERING MACHINE.

The feeding rolls are eight in number, four above and four below the platen, driven by a train of heavy expansion gearing, and giving a powerful feed. They are placed so the material will pass between the upper and lower sets and open to receive material eight inches thick. The lower rollers are placed one on each side of each drum, each roller is located in a separate bed-plate, which is adjustable with the roller, and the roller having a separate adjustment from the bed-plate. Each bed-plate can be set to gauge the amount of cut to each drum, or all the bed-plates can be set in line and the drums set to the cut desired above this line. The feed is governed by a double belt-tightener operated by a hand lever. A brush attachment is provided for cleaning the material as it passes finished from the machine. The machine is built by J. A. Fay & Company.

Flexible Pole Brackets.

The accompanying illustrations show the 1896 patterns of the Creaghead pole bracket. The desirability of a flexible support for trolley wires on high speed roads is fully appreciated by those having had experience with rigid bracket supports, the hammering and sudden jars peculiar to stiff forms of brackets being avoided by their use.

As will be seen a number of improvements have been made over the company's former pattern. The bracket for wood poles and for single track construction is made in lengths from seven feet to twelve feet and up

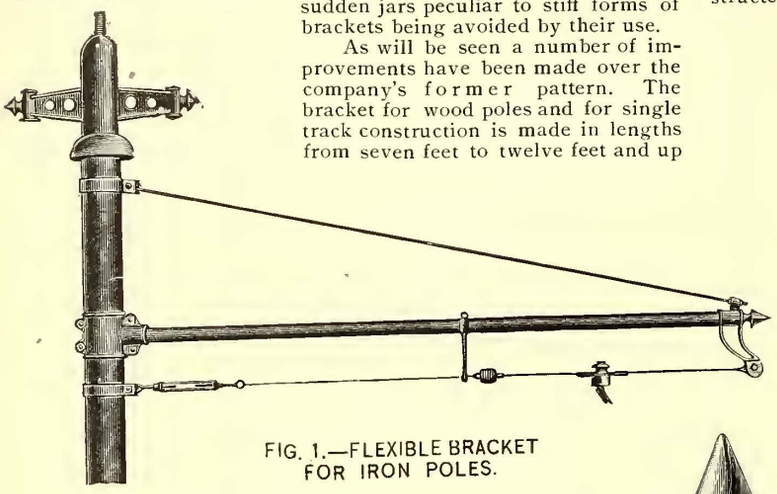


FIG. 1.—FLEXIBLE BRACKET FOR IRON POLES.

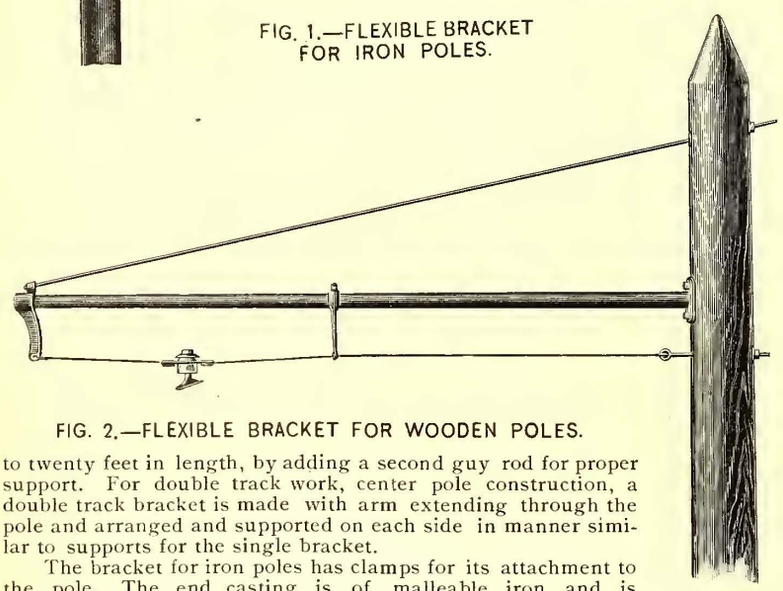


FIG. 2.—FLEXIBLE BRACKET FOR WOODEN POLES.

to twenty feet in length, by adding a second guy rod for proper support. For double track work, center pole construction, a double track bracket is made with arm extending through the pole and arranged and supported on each side in manner similar to supports for the single bracket.

The bracket for iron poles has clamps for its attachment to the pole. The end casting is of malleable iron and is arranged with an insulator in the bottom of the casting to which the span wire is attached. A strain insulator is shown in the span wire near the center casting. The insulator in the casting at one end of bracket and strain insulator in center of the span wire, insulates the span on which trolley insulator is hung from the bracket and iron pole. This arrangement provides double insulation between the trolley wire and the iron pole. This bracket is made in slightly modified form, omitting the insulation for the span wire, leaving only one insulation between the trolley and the bracket and reducing the cost.

Brackets similar to that shown are also furnished for double track center pole construction in lengths to suit the work. This center pole bracket construction with iron poles is very popular in cities with wide streets.

Dials for Wattmeters.

In central stations and railway power stations using Thomson recording wattmeters to measure the total output from each machine, or upon each feeder, the grouping of the dials of all the meters in one place where they could be conveniently read at one time has been frequently urged as advantageous. The General Electric Company has therefore brought out a telltale dial system. This permits the placing of all the dials upon one panel and the installation of the meters out of ordinary reach, as it is no longer necessary to read them each day.

The necessary wiring from the meters to the panel is simple and inexpensive. The panels can be duplicated and the performance of the meters be read either in the dynamo room or in the manager's office, or any other necessary place, and the performance of the station be accurately learned at any time. Each row of dials on the panel represents a single generator or feeder, and the recording indicator is actuated every kilowatt hour by a simple make and break device upon the meter. The dials are several times larger than those on the ordinary meter, and they are all direct reading, all constants being eliminated by modifications of the actuating mechanism. It is only necessary in ordering the telltale dial, to state the constant of each meter and the character of the generator, the panel can then be properly lettered. The introduction of this ingenious telltale system renders the use of a complete system of station output meters possible in many stations hitherto unable to use them on account of the difficulty in installing them, where they can be conveniently read.

The station output meters known as form G are constructed upon the same principle as the recording wattmeter, the construction undergoing modification, however, to adapt the instrument to the conditions imposed by extremely heavy loads. They are constructed upon the series principle, the entire current passing through

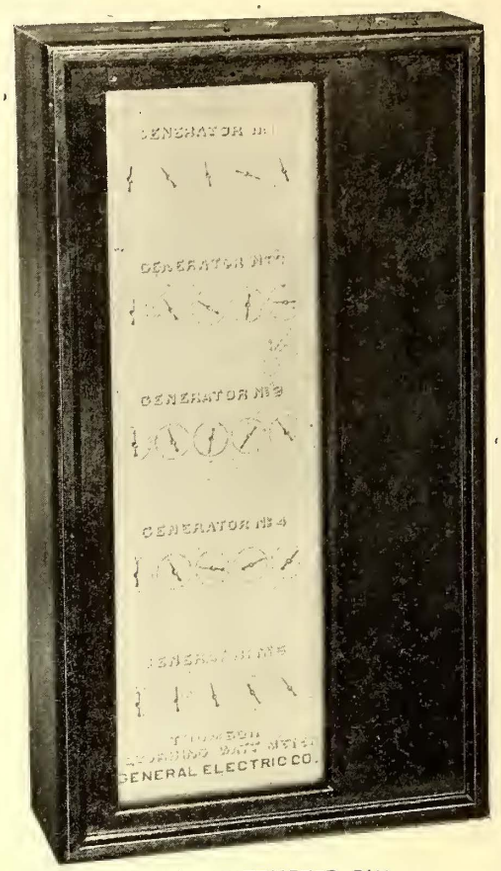


FIG. 1.—WATTMETER DIAL.

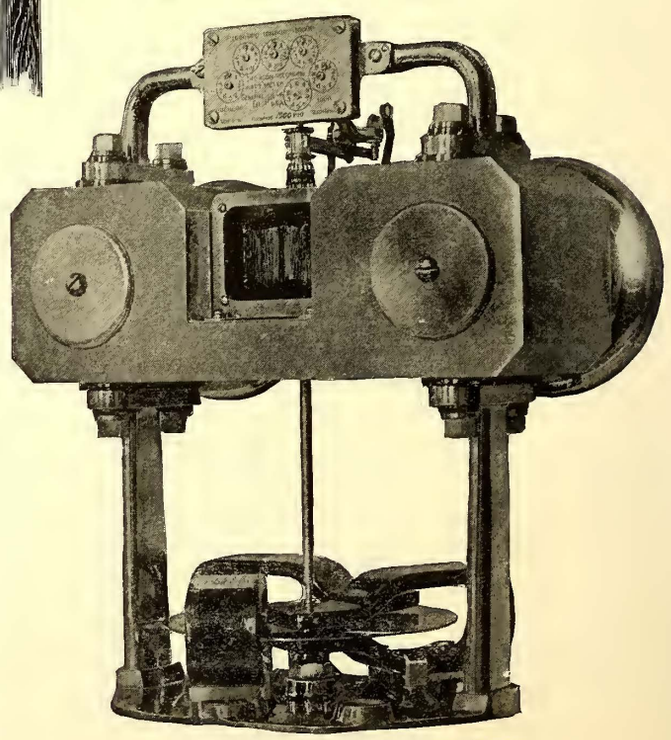


FIG. 2.—MECHANISM OF WATTMETER.

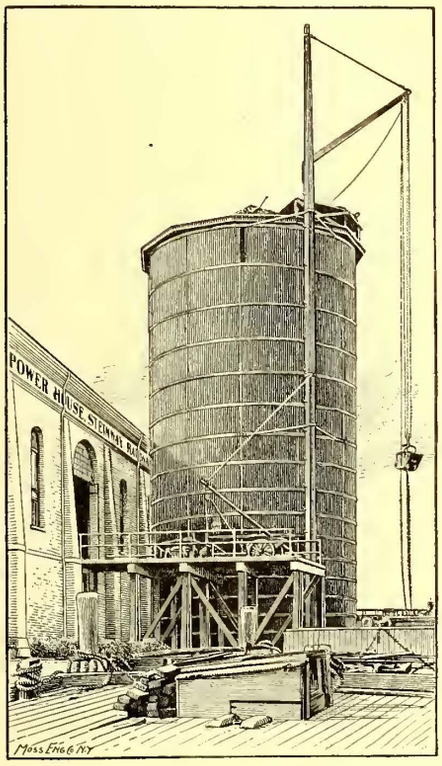
the field, and thus any error and possibility of loss which might result from the use of a high capacity shunt is eliminated.

These meters are adapted for direct application to the switchboard, the studs supporting the meter passing through the board and the bus bars and forming the electrical connection. The conducting parts are of forged copper of high conductivity. The three sizes of these instruments, for either 100 volt or 500 volt circuits, are 2500, 5000 and 8000 amperes.

Coal Pocket at Astoria, N. Y.

The new coal bin or storage pocket, which has recently been erected at Astoria, N. Y., by the Berlin Iron Bridge Company, for the Steinway Railway Company, is attracting much attention. The design is unique and seems to possess many points of merit, since the floor space occupied is exceedingly small for the amount of coal the pocket is capable of storing.

The pocket is cylindrical in form, and is so constructed that the pressure on all sides is equal. The pocket is 28 ft. in diameter, 54 ft. high, and has a capacity of 1000 tons. The coal is unloaded from a barge or car in the ordinary way, and hoisted by a bucket to the top of the pocket by an ordinary hoisting engine. It is taken out of the pocket through an opening in the bottom, and can then be delivered to the boiler by machinery or hand power, as may be required. But its principal recommendation is its large capacity for small floor surface.



COAL POCKET AT ASTORIA, N. Y.

New Combined Electric Locomotive and Passenger Truck.

The accompanying cuts show a new departure in motor rolling stock for elevated and high speed surface roads, in the "L" truck, built for the Lake Street Elevated Railway, Chicago, and the Brooklyn Bridge, by the McGuire Manufacturing Company.

This truck is designed to carry a car both on straight track and on curves with the same easy motion that modern steam passenger cars have, in combination with practically the same points of draught or draught connections between the driving wheels and body or attached train, that a modern steam locomotive has. Equalizing bars, similar to those on a modern passenger coach truck, are mounted on the axle journal boxes in the usual manner, except that cushion springs are interposed between their ends and the top of the journal boxes. These equalizers are double or two to each side of each truck, to permit the truck frame to play between them as hereafter described.

On these equalizers are mounted two cross sills, from which are suspended the electric motors, so that the wheels, axles, equalizers, and motors, all move together, and entirely independent of the truck frame and car body. This forms the electric locomotive, which, it will be noticed, is cushioned on the axle journal boxes, as above described, and on this locomotive frame is mounted the passenger truck, so to speak, in such a manner as to obtain practically the same draught and connections as a locomotive and practically the same riding qualities as a passenger coach, as follows, viz.:

Two equalizer springs are mounted on each pair of equalizers (four per truck) in the usual manner, and from the two cross or motor sills above mentioned are suspended, on inclined swinging links, a spring plank for receiving two elliptic springs on each end (or four per truck). On these four spiral equalizers and four central elliptic springs is mounted the truck frame, consisting of two side pieces having openings formed in each end for embracing the journal boxes between the double equalizer bars, clearance being allowed to permit the wheels to have a lateral motion of 1⅛ ins. in either direction independent of the truck frame.

These side pieces are rigidly attached together by a ten-inch transom bolster, which is fitted at its ends in strong and thoroughly braced pockets formed on the side pieces which embrace this bolster, for sixteen inches at each end, and are thoroughly bolted or riveted thereto.

This construction of the truck frame accomplishes two results besides giving a very easy riding passenger car. One is to hold the truck rigidly in square, and the other is to connect the journal boxes of the driving wheels with their load, directly and in practically the same way as in steam locomotive construction. All the pulling is done directly by the journal boxes of the driving axles upon the pedestal openings of the truck frame, which are directly and rigidly connected to the load without the intervention of any swinging, vertically vibrating bolster. At the same time an equivalent action for easy riding on the truck frame is obtained by the side and vertical movement of the ten-inch equalizer and elliptic springs and swinging links, as above described.

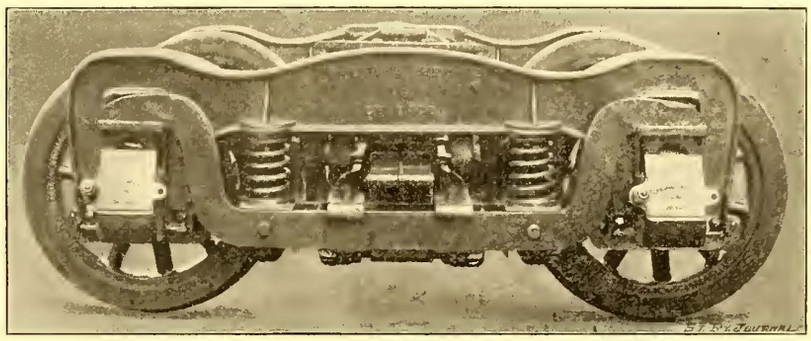


FIG. 1.—SIDE VIEW OF TRUCK.

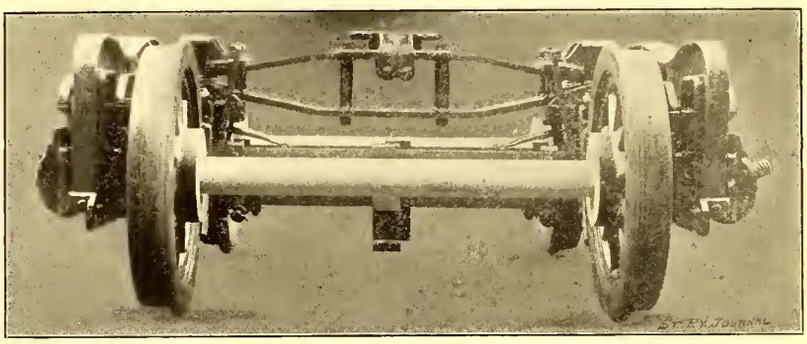


FIG. 2.—END VIEW OF TRUCK.

The brakes are located inside the wheels. This avoids the necessity of extending the truck frame beyond the wheels, making a short, compact truck, occupying the least possible space under the car and making the truck frame less liable to damage in case of accident. These brakes are perfectly equalized, surround the motor without interfering in any way with it, will not lengthen or shorten by the movement of the truck on curves, and are of simple construction.

The brakes are suspended from the truck frame by patent elastic brake hangers, which form shoe backs, brake hangers, equalizing levers, and adjustable release springs all in one, and at the same time take up their own lost motion, preventing all chattering and kicking of the brakes which has hitherto been a common fault of swinging brake hangers.

New Electric Brake.

Some experiments have recently been tried on the Ogden City Street Railway of Ogden, Utah, of an electric brake, a description of which was published in the Journal for April, 1894. The general principle upon which this brake works is that of a solenoid with, however, the addition of a second lever worked by electric power holding the plunger of the solenoid in either a set or free condition, so that no current need be taken continuously from the line to keep the brake in any position. The device, which is very ingenious, was designed by Messrs. Skinner and Dorland, of that railway company.

The brake for a ten ton double truck car weighs complete about 200 lbs. and the leverage between the brake plunger and the shoes is as twenty to one. The current required for setting the brakes is from five to ten amperes.

A Thomson wattmeter was placed in brake circuit in a recent experiment and a counter on the brake to count the applications made. The average power required to operate the brake in 2000 applications was about 4 h.p. for five seconds, equal to .096 h.p. hour. This test was made when the brake was in usual service and the motorman was making stops for passengers. The brake showed excellent results in stopping the car at high speed and has made stops in fifty feet when running at high speed.

STREET RAILWAY NEWS

Notes from England.

(By Our London Correspondent.)

The receipts of the Glasgow Corporation Tramways for the half year ending Dec. 31 last show an increase over the corresponding month of 1894 of £43743, or nearly a quarter of a million dollars. It has to be explained, however, that this enormous increase arises from exceptional causes and cannot be expected to continue in the future. The second half of 1894 represented the first six months' working after the Town Council took over the undertaking from the displaced tramway company, and during nearly the whole period a full service of cars was not run, as both men and animals were only getting familiar with and inured to the work. Glasgow is the greatest specimen we have of tramways being worked by a Town Council, and there have been many prophecies of failure. The accounts which were published last summer of the first year's working were subjected to much criticism, as many tramway men considered that the apparent profit shown was not real, and held that no sufficient allowances had been made for depreciation, etc. It will be impossible to say how the Town Council is now standing till the annual accounts are issued next summer, but I am informed on good authority that the Town Council considers that it is at present making profits at the rate of some £40000 per annum. Whether this is after making any larger percentages of deduction for depreciation and renewals than in the first year I cannot tell. On the capitalization of £565000 the above profit would represent about seven per cent.

An example of the old saying that the worm will turn comes from Huddersfield, where the Town Council has for a few years been working the tramways at a loss. The corporation carries on the work on the plea that it has been unable to get a reasonable offer for the lease of the lines. It is proposed to apply for powers in the coming session of Parliament to work the lines permanently, but this was more than the long suffering Huddersfield ratepayers could stand, and such an agitation arose that the proposal has been abandoned.

London County Council is about to buy up, under the provision of the Tramways Act, 1870, further portions of the lines of the London Street Tramways Company. Doubtless these parts will in the meantime be leased to the present company.

Swansea Town Council will buy the local tramways, lease them to the operating company, and sell to the company electric energy for propelling the cars. The Town Council will from the same generating station light the town electrically. The corporation will equip the line and lend money to the company for the purchase of electric cars. A most amicable arrangement has been come to, and the scheme is a fine comprehensive one. The company agrees to take from the corporation a minimum of 400000 units at two pence per unit. If the quantity rises to 600000, the price will be 1¾ *d.* (that is three and a half cents) per unit, and if 750000 units are supplied, the charge will be only 1½ *d.* per unit. It is expected that the corporation's revenue from the tramway company will largely defray the cost of the street lighting. Accumulators will be used to assist the engines during the period of the overlapping of the day and night loads.

San Francisco Notes.

It appears as if the San Francisco and San Mateo Railway had finally reached the end of its eventful career. On January 3 Judge Seawell of the Superior Court ordered that the road be sold to the highest bidder—that from the proceeds of this sale the expenses incurred by the receiver, including the receiver's certificates, should be paid first, the claims of preferred creditors second, the employes' claims for back wages third, and the bond holders last.

This road was originally built in '91-'92 and had a length of thirteen miles. On the route of the road were two grades of eleven per cent each and 500 ft. long. It has had a checkered history. The line may be purchased by the bondholders. Next to them the Sutter Street Railway is spoken of. The Market Street Company is, of course, frequently suggested as a probable purchaser, but as it has already paralleled all the San Mateo lines on easier grades it would gain little by the move.

Work on Mayor Sutro's electric road is being finished up preparatory to the opening of the road on February 1. This road was built as the result of an ineffectual effort on the part of Mr. Sutro to compel the Market Street Company to reduce the fare to five cents from the ferry landing at the foot of Market Street to the Cliff House. When he actually began work, the fare was reduced by the old company, but as Mr. Sutro had many blocks of land along the route of his new road, the work was prosecuted to a finish. The transfer with the Sutter Street Company practically makes the rate on through business two and a half cents per passenger. To stimulate travel a series of attractions has been arranged by the builder of the road at the Cliff House end of the line. On the site of the old Cliff House, that was burned down a year ago, has been built a fine three-story structure overlooking the seal rocks and giving an unobstructed view down the beach and across the Golden Gate. No expense has been spared to make this complete and modern in every respect. On the beach below Mr. Sutro has erected at great expense magnificent enclosed baths in which water directly from the ocean is used after being warmed by condensing the steam from the railway engines. His private grounds are also open, but these attractions are free only to such visitors as have reached the Cliff House via the Sutro road. Those coming on other lines will be charged admission fees. The work of changing the one and a half miles of Oak Street double track cable roadway of the Market Street Railway Company, between Fillmore and Stanyan, to a single track electric line has been completed. The unfinished track work on Folsom Street from Second to 19th will be taken up next. Work has also been finished on the Bryant Street line and a trial trip was successfully made Dec. 31.

As if there was not enough excitement in attending horse races, a car load of race people on the Ingleside branch of the Market Street Company's Mission Street line, were treated to a still further stimulus to their nervous centers on Christmas day by four highwaymen. These men stopped the car on a lonely part of the return trip, shot one man and escaped with the plunder, about $1200. As yet the perpetrators have not been apprehended.

News Items.

Albany, N. Y.—The Albany, Greenbush & Bath Railway Company and the Albany Railway have asked for the same franchises in the village of Greenbush.

Asbury Park, N. J.—The Board of Aldermen of Long Branch has granted a franchise to the Atlantic Coast Electric Railway Company. C. A. Hammond is general manager of the company.

Baltimore, Md.—J. M. Hood, president of the Western Maryland Railway Company, Baltimore, Md., is thinking of organizing a company to build an electric railway to Fairview.

Barre, Vt.—F. C. Kennedy, A. E. Humphrey, J. J. Flynn and J. C. Pierson, of Burlington, Vt., have signed an agreement with the incorporators of the Barre Electric Company, whereby an electric railway will be built and be in operation by July, 1897, in Barre and East Barre Centre, three miles distant.

Basic City, Va.—Plans for the construction of the Basic City, Bridgewater & Piedmont Electric Railway Company are being discussed. E. P. Wilson is general manager of the company.

Brooklyn, N. Y.—The electrical engineers of the surface railways of Brooklyn have been invited to furnish the executive committee of the new East River Bridge Commission with information necessary to determine the system under which electric cars shall be run on the new bridge when built.

Charleston, S. C.—Julian Fishburne and others have asked for a franchise to construct an electric railway in Charleston.

Charlevoix, Mich.—A franchise for an electric railway has been granted to the Charlevoix Electric Light Company. Charles Gabriel is manager of the company.

Chicago, Ill.—The Arnold Electric Power Station Company has been incorporated to construct and equip electric plants and electric railways. Incorporators: Arthur F. McArthur, Bion J. Arnold and Henry W. Magee.

Chickasawba, Ark.—John B. Driver, L. W. Gosnell and others, have formed the Chickasawba, Luxora & Gilmore Railway Company to build an electric railway about twelve miles long.

Cohoes, N. Y.—The Cohoes City Railway Company may extend its line to Crescent. Urban Weldon is president of the company.

Cleveland, O.—A franchise for an electric railway from Barberton to Hametown has been granted to T. F. Walsh, representing the Akron & Cuyahoga Falls Rapid Transit Company.

V. A. TAYLOR and F. H. Eggers, Cuyahoga Building, Cleveland, can give further information about the construction of the Cleveland & Chagrin Railroad Company, recently incorporated.

Cohoes, N. Y.—The Cohoes City Railway Company has made all arrangements for the extension of its line to West Troy. Urban Welden is president.

Detroit, Mich.—The Detroit Railway Company has asked for permission to build forty-five miles of new track. W. E. Davis is purchasing agent for the company.

Elizabeth, N. J.—The motive power of the Elizabeth Street Railway Company will soon be changed from horse to electricity. J. C. Husbands is superintendent of the company.

Elyria, O.—Another franchise for an electric railway has been granted to James L. Mauldin, of Cleveland, O.

Hamilton, Ont.—The International Radial Railway Company will receive information about steam, electric, gas, or any other motive power which can be used on 350 miles of railway to be built in and around Hamilton. The officers are: President, A. Burns; vice-president, A. McKay; secretary, J. D. Andrews; treasurer, W. G. Lumsden; attorney, P. D. Crerar; chief engineer, Joseph Powell.

Hoquiam, Wash.—H. C. Heermans has been granted a franchise to build an electric railway in Hoquiam.

Kingston, N. Y.—A franchise has been granted to the Rondout & Eddyville Electric Railway Company.

New York, N. Y.—The Board of Aldermen has granted several franchises for extensions to the Metropolitan Street Railway Company. A. C. Tully, 106 51st Street, New York, is purchasing agent for the company.

Norwich, Conn.—The route for the electric railway between Norwich and New London has been surveyed, and it is expected to have the line completed by May 20. E. P. Shaw, Jr., of Norwich, is interested.

Orange, N. J.—It is probable that a franchise for an extension to its line will be granted to the South Orange & Maplewood Street Railway Company on January 16. Frank Brewer is president of the company.

Patchogue, N. Y.—J. B. Swezey, of Patchogue, is secretary of a company that will build an electric railway from Port Jefferson to Patchogue at once.

Plattsburgh, N. Y.—The Plattsburgh Traction Company has been organized to build an electric railway in Plattsburgh. Among those interested are S. M. Weed, H. M. Pierson, H. G. Runke, D. F. Dobie and H. E. Barnard.

Portsmouth, Va.—The Prentis Place Land Company is thinking of building an electric railway to Pinner's Point, a distance of three miles.

Providence, R. I.—Work will be commenced on the electric railway from Watch Hill to Narragansett Pier in February. Wm. C. Clark, of Wakefield, R. I., is interested in the enterprise.

San Diego, Cal.—The Bailey Triple Ledge Gold Mining Company has been incorporated to construct highways, railroads, electric, steam, or other motive power and chutes to and from mines. Capital stock, $100,000. Incorporators: L. H. Bailey, of Banner, Cal., A. C. Nason and O. C. Dranga, of San Diego, E. A. Stanley, of Julian, Cal., and Jas. A. Jasper, of Ramona, Cal.

Stockton, Cal.—Robert Doble, president of the Stockton Water Company, Mr. Hatch, of the Hatch-Armstrong Company, and Mr. Langford, of the Langford Colony, all of Stockton, are talking of building an electric railway from Stockton to the mines in the vicinity.

Syracuse, N. Y.—A franchise has been granted to the Syracuse & Oneida Lake Electric Railway Company.

Urbana, O.—A franchise has been granted to the Urbana & Mechanicsburg Electric Railway Company to build an electric railway twelve miles long. George M. Eichelberger, and E. Hunter Moore are interested.

Waterloo, Ia.—The Waterloo & Cedar Falls Rapid Transit Company will let contracts for the construction of its line, fifteen miles long. L. S. Cass, of Sumner, Ia., is president of the company; C. J. Casselman, of Waverly, Ia., is interested.

Wyandotte, Mich.—An electric railway will be built in Wyandotte by H. C. Burke, C. W. O'Brien and Alex. E. Riopelle, of Ecorse, Mich., who have received a franchise.

Mountain Railway in California.

A few miles from San Francisco there rises from a low mountain chain a high volcanic peak, known as Mt. Tamalpais, from which a very fine view can be obtained. Access to this peak has heretofore been only by rough trail or a still rougher road, but a new company has been formed for the purpose of constructing an electric railway to the top. The line, which has already been surveyed, will have an average grade of five and a half per cent, and at no place will it be steeper than seven and a half per cent. The distance to be traversed will be a little more than seven miles, which will be made by the cars in the ascent in about three-quarters of an hour. Among the leading incorporators are Sidney E. Cushing, A. E. Kent, Alfred Borel and Louis Janes. It is estimated that the road can be built for $125000, and it is hoped that cars will be in operation by the end of July, 1896.

Important Electric Plant in Washington.

O. T. Crosby and Charles A. Lieb, who have, for some time, controlled the stock of the Georgetown & Tenalleytown Railway Company, of Washington, have just purchased the Potomac Light & Power Company and the Washington Electric Company, and are combining these interests and establishing an entirely new plant for the economical production of electricity for light, heat and power. They have acquired the buildings of the Dent Iron Works, together with 110000 sq. ft. of land lying between the Chesapeake & Ohio Canal and the Potomac River. At this point the canal is about forty feet higher than the river, and it is thus possible to obtain a head of water for condensing purposes sufficient to make air pumps unnecessary. Coal, water and all supplies will be brought directly to the station by the canal or river, and the coal can be delivered by gravity to the boiler room from the canal, thus avoiding the necessity for any accessory appliances. A steel stack will be constructed, 9 ft. in diameter inside and 215 ft. high, the Philadelphia Engineering Company being the contractors.

The first installation of machinery will consist of two 800 h. p. engines direct connected to two 500 k. w. General Electric generators, the steam plant complete being furnished by the Cramp-Hoadley Company. This original plant will furnish power to a number of the suburban electric railways in the vicinity, including the Georgetown & Tenalleytown Railway. Within a short time, however, a large two phase alternating installation will be made, in 800 k. w. units, for distribution of electricity for all purposes to an area within a radius of thirty miles. The station is being laid out for a total capacity of 10000 h. p., and there is, of course, large additional land on which further plants can be put up as required.

A New Industry in the Street Railway Field.

In Worcester a firm has been incorporated with an ample capital under the title of the American Car Sprinkling Company. The company owns and controls all the patents of the United Tramway Sprinkler Company, whose street car sprinkler was one of the earliest in the field and which has been adopted in a number of cities. The new company proposes to introduce its sprinklers into every important city in this country.

The sprinkler for electric railways consists of a large tank, over which is built a plain car. The whole is mounted upon almost any kind of a truck. Two men are needed to operate the car, one to manage the motor and one the sprinkler. Any rate of speed can be maintained, up to fifteen miles an hour. The car is filled from hydrants placed flush with the pavement, between the tracks if on a double track road, and close beside the track on single. From one to two minutes is required to fill the tank, according to the pressure used. The stream is under perfect control.

A tank fully loaded will sprinkle from five-eighths to one mile of street according to the width of street. This company will either lease its sprinkler or contract to do the entire sprinkling for any city, or it will form local companies to do the business.

Possibilities of Telegraphy.

According to a report from Philadelphia, a new method of practically doubling the capacity of a telegraph line for the receipt and transmission of messages has been perfected. The principle depends upon the illuminating effects produced in a vacuum by alternations of comparatively low intensity but of high frequency. In the exhibition rooms in Philadelphia, an operator telegraphs over a long wire on the usual Morse instrument, and a second operator sends and receives at the same time over the same wire messages with the aid of the subtle light developed in the vacuum device, without interfering with the other system. In another room telegraphing between moving trains and stations without any metallic connections is practically illustrated. A third phase of the exhibition, that of communicating between vessels at sea and the land, would have been of great value to the pride of our ship-building industry, the St. Paul, if it could have been utilized for her benefit before the calamity which befell her last month. The method adopted is similar in these two cases to that of the duplex telegraph already described.

New Publications.

The Educational Value of Engineering Studies, by Thomas Messinger Drown, LL.D., President of Lehigh University. Published by the University. 30 pages.

This is a thoughtful discourse on a subject of great interest to all students.

American Street Railway Association. Verbatim Report of the Fourteenth Annual Meeting at Montreal. Published by the Association.

The new President and Secretary of the Association are to be

commended for the energetic manner in which they have pushed forward the early publication of this report, which has made it possible to place copies in the hands of members long before the time customary in recent years. An excellent steel engraving of ex-President Joel Hurt forms the frontispiece. The report is well arranged and well printed.

The Anatomy of a Railroad Report, by Thomas F. Woodlock. Published by the United States Book Company, New York. 72 pages. Price, 50 cents.

This little manual is written with the object of enabling investors in railroad securities to analyze and thoroughly comprehend railroad reports so as to form an idea as to whether their securities are increasing or decreasing in value. The author describes by chapters the functions of the "Income or Revenue Account," "The Balance Sheet" and "Physical Statistics," and finally suggests a system of analysis applicable to railroad reports.

Timber. An Elementary Discussion of the Characteristics and Properties of Wood, by Filibert Roth, Special Agent in charge of Timber Physics, United States Department of Agriculture. Published by the Department. 88 pages.

This is a pamphlet which is aimed to be of service to engineers, architects, carpenters, lumbermen and all wood workers. Much of the information exists in the experience of practical wood workers and in books in other languages, but has never before been published in the English in systematic and accessible form and with special application to American timbers. The pamphlet is most fully illustrated in such a way as to make it possible to thoroughly understand the characteristic features of different kinds of timber.

Motive Powers and Their Practical Selection, by Reginald Bolton, Past President of the Civil Mechanical Engineers Society. Published by Longmans, Green & Company, New York and London. 257 pages. Price, $2.50.

In this valuable little book the author has given a condensed presentation of the relative advantages of the engineering features of different forms of motive power, and has attempted to define the field in which each may be made most useful. He has brought together a large amount of technical data and information from many sources in order to throw light upon the various problems arising when a motive power is to be chosen. After discussing fundamental principles, the author proceeds to deal with manual power, animal power, power of wind, power of water, power of steam (engines and boilers), the power of expanding gases, the storage of power by electricity, and the transmission of power by shafts and belting. The book is so written as to be readily understood by the student, and even to some extent by non-technical readers, while engineers will find a great many valuable and important tables for direct and constant use in their work.

Personal.

Mr. P. A. B. Widener, of Philadelphia, expects to take a trip around the world. In a recent interview, Mr. Widener said that he intended to withdraw from all street railway enterprises with which he had been connected, except those in New York City.

Mr. J. J. Walklate, of England, is visiting this country on his way to Brisbane, Australia, where he will have charge of the electrical equipment of the lines of that city. Mr. Walklate has been associated with Mr. Alfred Dickinson, of Birmingham, England, in a number of electric railway enterprises, and will visit a number of Eastern cities before his departure for the Pacific slope.

Mr. Henry C. Payne, who is traveling abroad for rest and improvement in health, writes from Nuremberg to personal friends that he is feeling much stronger and better. His physicians have ordered him South to a warmer climate, and he will pass the winter in Italy. It is earnestly hoped by Mr. Payne's many friends that he will return to this country entirely rested and refreshed, and that he will not again find it necessary to take up the severe and exhausting labors which have been imposed on him in times past by his large financial interests.

Mr. Charles Yerkes Flanders, of Messrs. Morris, Tasker & Company, Incorporated, and whose portrait is presented herewith, was born in Philadelphia in 1863, and was named after the father of Mr. Charles T. Yerkes, of Chicago. He entered the employ of Morris, Tasker & Company, as office boy. He was rapidly promoted, working in all departments and before giving up the office for the road was doing no small portion of the book-keeping work. He commenced traveling eight or nine years ago, first going South and then West, and confining himself exclusively to the pipe and electric light pole business. When the development of street railways in electrical lines began, Mr. Flanders saw the advantages of tubular poles for this work and secured a large order from the Consolidated Traction Company of Jersey City. He is a man of unusual originality and a most pleasant companion. His fertility of resources and action have had an important bearing in enabling the firm to anticipate the wants of its customers in a variety of ways.

Mr. H. Cheston Vansant, secretary of Messrs. Morris, Tasker & Company, Incorporated, has been connected with that company for a long time, beginning in a position of little responsibility and achieving his present place through ability and assiduous devotion to his work. He has charge, not only of those duties which are usual to the office of secretary, but also the buying of all the large supplies for the extensive Morris, Tasker Works, such as iron, coal and other heavy materials. He also directs and attends to much of the selling. Mr. Vansant has given much attention to the subject of the manufacture of poles for electrical service, and is probably as well posted upon this subject as any person in the country. He has always advocated a tubular pole with swedged joints, and it has

C. Y. FLANDERS.

H. C. VANSANT.

been largely through his efforts that this pole has received such general adoption. He is of an old Holland family, the name being originally spelled Vanzandt, and is a member of a number of clubs and social organizations in Philadelphia.

Mr. B. W. Porter, superintendent of the Derby Street Railway Company, of Derby, Conn., is a native of Freeport, Ill., where he was born in 1865. His first railroad experience was with a preliminary surveying party for one of the Western roads. He then entered the office of a large manufacturing establishment until the winter of 1888, when he went to Derby to enter the employ of the Derby Horse Railroad Company, the predecessor of the Derby Street Railway Company. In the following year he was appointed superintendent and in 1894 secretary of the company. The Derby Street Railway is a historical road, having been equipped in 1888 with the Van Depœle system. The company has been through all the vicissitudes of railway motor work, from the Van Depœle apparatus, employing sprocket chains, to the G. E. 800 and 1200, which are in use at the present time. During this time the company has built two power stations. It has about seven miles of track, is operating a park in connection with the road, and is running from ten to twenty-five cars. One of the interesting features of the line is the motormen's and conductors' club house, illustrated upon another page.

B. W. PORTER.

A Strong Philadelphia Combination.

Within the past month the extensive business in street railway supplies heretofore carried on in Philadelphia by Charles J. Mayer has been reorganized, and A. H. Englund, of the International Register Company, has joined him in partnership under the firm name of Mayer & Englund. Both gentlemen are very popular and successful in their respective territories.

Mr. Mayer has established an enviable record for himself in Philadelphia as an energetic and successful supply man. Before locating in that city he had acquired a valuable experience through his connection, extending over a period of four years, with the R. D. Nuttall Company, with whom he became associated early in its career as a manufacturer of electric railway material. This company was among the first in the country to start as independent manufacturers of motor gears, trolleys, etc., and here Mr. Mayer found an opportunity to demonstrate his ability as a salesman. Much of that company's early success was due to his efforts and push. At the commencement of electrical construction on the street railway systems in Philadelphia early in 1894, Mr. Mayer returned East and established the Middle States office for the Nuttall Company.

His abilities were here soon recognized and at once led to increased business for the company, as shown by the adoption of its

trolley as standard by all the railway companies in Philadelphia, upward of 2000 being sold in that city. Having established the company's business in this territory, Mr. Mayer enlarged the scope of his business by adding other lines, principally that of overhead line material, of which he has furnished over 300 miles in the city of Philadelphia alone. During a period of less than two years he has succeeded in establishing an extensive business in general railway supplies that has necessitated increased facilities, and this has led to the union with Mr. Englund.

Mr. Englund's association with Mr. Mayer does not mean any material change in the International Register Company, of which Mr. Englund still remains secretary and a director. One of his first objects in view is to push the International register more directly in the East than has yet been done. Mr. Englund brings with him a long experience, in both the manufacture and sale of electric railway material. He was first connected with the old Sprague Electric Railway & Motor Company in 1889. From this company he resigned in 1890 to organize, with his associates, the Electric Merchandise Company, of which he became secretary and treasurer. After two years of successful business with this concern he resigned to take the active

C. J. MAYER.

A. H. ENGLUND.

management of the International Register Company, which he had organized independently in the fall of 1891. The fare registers manufactured by this company have been adopted by many of the most important street railway systems in the United States. The International portable register, which was the first machine placed on the market by the company, has met with equal popularity.

The factory and general office of the International Register Company will remain in Chicago under the management of A. H. Woodward, treasurer of the company, while Messrs. Mayer and Englund will take entire charge of the eastern territory.

The new firm will succeed to the business of Charles J. Mayer, acting as Middle States Representatives of the R. D. Nuttall Company, the Partridge Carbon Company, and the International Register Company, and will also continue the business of overhead line material on a greatly enlarged scale. In addition to this they have been appointed district representatives of the Westinghouse Glass Factory, manufacturers of a complete line of electrical globes, shades, etc. The aim of this factory is to produce artistic glassware of the most select quality, and the excellence of their product attests their success.

The bringing together of this Eastern and Western ability must of necessity bespeak a brilliant future for the firm of Mayer & Englund.

Obituary.

ALFRED E. BEACH, one of the members of the firm of Munn & Company, and editor of the *Scientific American*, died last month. Mr. Beach was born in Springfield, Mass., in 1826, and was a son of Moses Y. Beach, the founder of the *New York Sun*. In 1846, in company with O. D. Munn, he purchased the *Scientific American*, which had been started in 1845, and about the same time engaged in the business of patent solicitation, which his firm has conducted so extensively since. Mr. Beach was an active inventor himself, as well as editor and patent lawyer. He invented in 1853 the first typewriter, for which he was awarded a gold medal at the Crystal Palace Exposition. Among his other inventions are cable traction and other railway inventions, pneumatic tubes for delivery of mail matter, and the famous Beach hydraulic shield for tunneling in earth and under river beds.

EQUIPMENT NOTES.

The Delaware Iron Works, of New Castle, Del., have just completed an order for 600 trolley poles for Cairo, Egypt. It is said that there is a kind of ant in Egypt which destroys wooden poles, making iron poles necessary.

The General Electric Company, of Schenectady, N. Y., published as souvenirs of the Cotton States and International Exposition held recently at Atlanta, several very handsome catalogues descriptive of some of the products of its factories. Several of these were composed entirely of illustrations, and all were very high examples of taste in trade catalogue publication.

The Wason Car Manufacturing Company, of Springfield, Mass., besides having a large amount of steam car repair work, is building on its standard patterns of street cars at the rate of one per day. The company is building cars for the Hartford, Manchester & Rockville Tramway, the Blackstone Valley Railway, of Worcester, the Bristol & Plainville Tramway and a Springfield company. The company has also an order for cars from the Woronoco road, of Westfield.

The J. H. McEwen Manufacturing Company, of Ridgway, Pa., manufacturers of the well-known engine bearing that name, and of the Thompson-Ryan generator, which was described in our last issue, advise us that the efficiency of this new generator, within the range of ordinary service in the sizes which would be naturally used in railway work, is 95 p. c. This high efficiency is due largely to the peculiar design of the generator, by which the least possible amount of energy is wasted. Other important features of the machine were described in our last issue.

The John Stephenson Company, Limited, of New York, is enjoying its usual large share of business and the company's works are at present busy. Among other orders the company is turning out fifty closed cars of the Broadway type for the Metropolitan Street Railway Company of New York, and 100 open cars for the Citizens Street Railway Company of Detroit. Among other foreign orders the company is at work upon some electric cars for Rio Janeiro, Brazil, and some horse cars for Kimberley, South Africa.

J. P. Sjoberg & Company, of New York, have recently moved from 155-57 Eleventh Avenue to 98-100 Eleventh Avenue. Here they will have about twice as much room as in the old works and better facilities for turning out their work. The change has been rendered necessary by the steady increase of the business of the firm. Mr. Sjoberg reports that the business done by him during the past year has been very satisfactory and has shown a remarkable increase over that of previous years. His new springs, which have been illustrated in these columns, are selling very well.

R. A. Humphrys, of Philadelphia, reports an excellent business in cotton ducks for cars, as well as in car curtains. These are supplied with stripes in all colors and widths. Mr. Humphrys' factories are in Philadelphia. He claims to have such excellent facilities that he can supply the best quality of goods at lower prices than can any other manufacturer. He also manufactures car covers, which are used to cover new cars when they are being shipped, and does a large business in waterproof oil duck, which is used by many companies for covering motors.

A. O. Schoonmaker, of New York, is doing an excellent business in all kinds of mica for electrical purposes, especially washers and rings and commutator segments. These are all stamped out of solid sheet mica, and the commutator segments are carried in stock for every type of motor in use, from the Sprague No. 6 and the T. H. F. 20's and 30's up to the latest types of all companies. The mica in which Mr. Schoonmaker deals comes direct from the original sources in India, and is selected stock of guaranteed purity. It is claimed to be entirely free from iron, thus giving it non-conducting properties of the highest order.

The J. G. Brill Company, of Philadelphia, has recently been awarded the contract for building twenty new cars for the Milwaukee Street Railway. The style of car selected shows the tendency of railway companies at the present time to adopt some of the best things of steam road practice which are applicable upon street railways. The new cars are to have double trucks; the bodies will be twenty-six feet long, with five foot platforms. These will have removable vestibules. The seats will be placed across the car after the steam road practice, and each will be furnished with a push button for signaling the conductor, a convenience much needed on all cars where great crowds are carried.

George Kissam, of New York, successor of Carleton & Kissam, has recently formed a new partnership, associating with him in the street car advertising business, Chas. A. Fish, of New Orleans, La. Mr. Fish is an old New Yorker, who moved to the Crescent City some sixteen years ago, where he was engaged in the commission fruit business, and was also the owner of a line of freight and passenger steamers to Central America. He possesses executive ability of the rarest order, and will be a great acquisition to Mr. Kissam in the conduct of street car advertising business, insuring for the firm the same continuous regard and esteem in which Mr. Kissam has always been held by the railroad corporations.

Eugene Munsell & Company, of New York, with agencies in the principal cities, reports an increased demand for solid sheet India and Amber mica, of which they make a specialty for electrical insulation. The firm imports direct from the mines, and at all times carries probably the largest stock of mica to be found in this country. The firm recently installed several new power presses, which give increased facilities for furnishing stamped solid sheet mica segments for all types of railway motors, and mica to any shape or pattern. Franklin Brooks, the junior member of the firm, is now making a tour around the world, and, at the present, is spending considerable time at the mines in India, where the firm is largely interested.

The Berlin Iron Bridge Company, of East Berlin, Conn., has just completed for the town of Houlton, Me., a new iron bridge 300 ft. long and 18 ft. wide, with a sidewalk 5 ft. wide. The bridge company furnished the entire bridge, sub-structure and super-

structure complete. The company has also just completed for the H. W. Johns Manufacturing Company, at Brooklyn, N. Y., a new dryer house, which is built entirely of steel. It has also just completed for the Windsor Company, of North Adams, Mass., a new fireproof store house, 70 ft. × 125 ft. The construction is composite iron and brick and fireproof, no woodwork being used. The floors are of terra cotta.

The E. Horton & Son Company, of Windsor Locks, Conn., has published a new catalogue descriptive of the Horton lathe chucks and drill chucks. The catalogue contains much new matter including engravings and descriptions of a number of new styles of chucks which have been added to the company's list since the publication of its last catalogue. The catalogue is well illustrated by views which show both the exterior appearance and construction of the chucks. The Horton chucks have been on the market for some forty years or more, and the manufacturers have achieved during that period a very high reputation for excellence of construction and design. The company also makes all kinds of iron castings.

The Business of the Standard Air-Brake Company has increased so rapidly that it has become necessary to secure larger office space and better facilities. In considering the different buildings adapted to its use, the company decided that the American Surety Company's mammoth new structure at 100 Broadway would be the most desirable headquarters. A suite has been rented on the tenth floor, giving an abundance of light and air. The view from the offices is fine and takes in the harbor and river. The removal occurred on the 21st ult., since which date the company's headquarters are in the American Surety Company's building. Mr. Wessels says the latch string will hang out, and that he will be glad to welcome old and new friends in the new offices.

The Kelsey Electric Railway Specialty Company, of New Haven, Conn., is meeting with excellent results in the placing of its trolley stand. Since July the company has received orders for thirty roads, and in every case, except two, after a short trial, the company has received at least one more order. An example of the reason why this stand has gained so much popularity is shown by its record on the line of the Middletown-Goshen Traction Company, where, according to the testimony of the officers of that company, the stand causes the trolley wheels to have three times the life of any other stand. Each car on this line ran 195 miles per day, passing twenty-two times under two railroad bridges giving only three inches of clearance over the top of the stand. Ordinarily the wheel is nineteen feet above the rail. In spite of this hard service, the company has never had to replace any springs in the stand. The E. S. Greeley & Company write that after testing the trolley stand that they are satisfied it is equal to any on the market and in some respects superior.

Messrs. Clarence Whitman & Company, of New York, the well known wholesale dry goods house, have recently put upon the market a new type of duck curtain for open cars, which is thoroughly waterproof. It is of two thicknesses of duck, sheeted together with Pantasote, the waterproof material which the firm has introduced with such successful results for railroad curtains, and in other industries. There is no rubber used in this adhesive compound, and it will not dry up and deteriorate like rubber. Temperature does not affect it and it will resist the action of the sun and dampness, making it especially desirable for curtains for open cars. Pantasote duck has also great tensile strength, and has been in use for four years without showing any signs of splitting apart. This is probably the first time that the principle of a mackintosh cloth has ever been applied to a car curtain or awning, for which purpose it is equally desirable. Pantasote has been used very successfully on linen for inside car curtains, and the New York Central Railroad Company has 500 cars so equipped.

The Craven Supply Company, of New York, is the title of a new company of which Frank T. and N. J. Craven are the proprietors. They are making a specialty as manufacturers' agents for the sale of rails, tees, poles, wire, line material, steam power plants, etc., for electric railway work. They have their offices at 26 Cortlandt Street and are energetic and hustling. Since starting, their ability, combined with their especially good connections, have secured for them an extensive and satisfactory business. Several large orders recently booked by them seem to point to and assure them of continued success. Frank T. Craven, the young and active manager of the firm, by his open and genial manner towards those with whom he has business relations, has made him very many warm personal friends in this and other cities. He has been connected with electric railway work for the past eight years. Part of this time was spent on the Buffalo Railway Company's work under the supervision of his brother, J. B. Craven. While there he had especial charge of a large amount of line track and underground construction. His experience there and at other places where he has been engaged on electrical work has especially fitted him for recognizing and supplying the wants and requirements of electrical railway companies.

Edwin Harrington Son & Company, Incorporated, of Philadelphia, have recently brought out a new catalogue descriptive of the hoists and traveling cranes which they manufacture. This firm has achieved a very high reputation for appliances of this description and with the improved equipment being introduced for repair shop work by electric railway companies the Harrington hoists are meeting with a great demand. They are manufactured in all sizes and for operation by both hand and electricity. Among the particularly interesting features of the catalogue might be mentioned the spur gear hoist, the improved Harrington screw hoist, the new combination hoist and a new combination electric motor and hoist. This is something which has recently been brought out and appeals particularly to electric railway managers. The hoist has a capacity for raising 10000 lbs. at a maximum speed of five and one-half feet per minute, and can lower the same weight at the rate of ten feet per minute. Smaller loads can be raised faster. By means of a controller the operator raises and lowers at any speed within these limits. The motor is multipolar, iron clad and not affected by surrounding machinery, and is as well entirely enclosed, making it dust proof, fire proof and moisture proof. Among the other apparatus described and illustrated of particular interest to street railway managers are the safety traveling crane, especially adapted for power stations which will hold the load at any point, and a 2000 lb. hand swing crane with supplemental jib arranged to rotate about an independent axis, and very convenient in repair shop work. In fact, this company has a complete line of articles which are essential in the equipment of an electric railway.

The Sterling Supply & Manufacturing Company, of New York, reports a continued demand for its Millen brake. The increase in the size and weight of the cars and equipment which has occurred during the last few years, together with the increase of speeds, has developed the necessity of having efficient and reliable safety brakes. The amount of power necessary to be applied to the brakes, in stopping the car within a given distance, depends upon the condition of the brakes, the weight and speed of the car and the condition of the track. Another and very material point in connection with this subject is that the braking power should be thoroughly reliable, the best material should be used in all its different parts, as well as good workmanship in its mechanical construction. In no other class of service is there more necessity for reliable, non-failing and positive braking power than in street railway service, where cars are run up and down steep inclines or heavy grades and through crowded thoroughfares, where quick short stops have to be made very often to avoid accidents and loss of life. The Sterling Company's brake is the result of a great deal of thought devoted to that particular subject, and for it the company makes the following claims: Safety, due to double chain connections. Increased power, owing to ratio or gearing from brake post to sprocket wheel. Instantaneous operation, regardless of direction in which handle may be turned. Reduction of lost motion, by having chain and connections the precise length required, so that brake shoe may be carried close to wheel. Less liability to breaking of chains, owing to positive and equal bearing for each link of the chain in sprocket wheel, thereby lengthening the life of the same; does not subject it to undue strains, as is the case where the chain is wound around the ordinary brake shaft, in a cramped position, in which case it is more or less liable to fracture. Maximum power, obtained with one-half turn of wheel or handle.

The Whittingham Electric Car Heating Company, of Baltimore, reports among recent sales of the Whittingham electric car heaters orders from the following roads: City & Suburban Railway Company, Baltimore, Md., twenty-one heaters; Baltimore (Md.) Traction Company, five heaters; Second Avenue Traction Company, Pittsburgh, Pa., twelve heaters; Ithaca (N. Y.) Street Railway Company, five heaters; Cortland (N. Y.) & Homer Traction Company, two heaters. Heaters have also been shipped to the following roads: Montreal Street Railway, Belle City Railway Company, Racine, Wis.; Terre Haute Electric Railway Company, Consumers' Electric Light & Street Railway, Tampa, Fla.; North Chicago Street Railway Company, Winnipeg Electric Street Railway, Bloomington (Ill.) Street Railway Company. The following is an extract from a letter recently received from the Ithaca Street Railway, Ithaca, N. Y.: "We are pleased to note that, so far, we have had so much satisfaction with the use of them (the heaters) that we have no hesitation whatever in saying that they are the best thing in the market, of which we have any knowledge, and it is the writer's opinion that you should in some way make them more extensively known, and their adoption would surely be more universal. You should particularly impress upon any one using car heaters, the fact that your heaters are clean and sightly, and that the heat is not intense at any one point, but is evenly distributed throughout the entire length of the car. In almost every other heater that is on the market, the exact reverse of this is the case. Then again, with the old style open resistance coil heater, the heat is so intense in some of them, as to not only scorch the seat rugs of the car, but sometimes the passenger's clothing. The heaters in our cars are often taken for hot water heaters, and are a mystery to the passengers, as to how they are heated." The letter is signed by D. Thomson, general superintendent.

WESTERN NOTES.

The Steel Motor Company, of Cleveland, O., has removed its works from Cleveland, O., to Johnstown, Pa. Here the company will immediately double the capacity of its works and otherwise increase and improve its facilities for manufacturing.

The Broderick & Bascom Rope Company, of St. Louis, has recently sent to some of its customers and others a handsome paper weight made of a short section of the company's well known cable for street railways. The paper weight is nickel plated and it makes a tasteful and useful desk ornament.

The L. A. Thompson Scenic Railway Company has recently published a handsome catalogue descriptive of its well known park attractions. These are usually a four track gravity road with loops at each end, the length of the structure being about 800 ft. Effective tunnels are arranged *en route*, built up of papier mache work. Descriptions of a number of these interesting installations have been published in the Street Railway Journal. The pamphlet is illustrated by views of a number of these lines, showing general views of the railway, cars, tunnels, etc.

The Swarts Metal Refining Company, of Chicago, makes a specialty of high grade Babbitt metal adapted to high class engine work and electrical machinery. The Swarts Company is thoroughly experienced in this line and has gained a high reputation for putting out a Babbitt metal of honest make and which it guarantees to give perfect satisfaction. The company does a large business with electric street railways and lighting companies. It also supplies a superior graded waste for power plants and purchases old trolley wire, etc. Its catalogue contains much that will interest all users of metals.

The Fulton Truck & Foundry Company, of Mansfield, O., reports the outlook for the coming year as very bright, and the company anticipates a large business in Imperial trucks and other supplies manufactured by it. The company is discussing the advisability of building a large steel castings plant in connection with its foundry; and this step will probably be decided upon. At the annual meeting of the stockholders of the company held on January 16, the old directors and officers of the company were re-elected. The officers are as follows: W. E. Haycox, president and general manager; M. B. Bushnell, vice-president; C. J. Langdon, secretary and treasurer.

The Standard Boiler Company, of Chicago, has recently moved into new offices, 1120 and 21 Marquette Building, and reports a good business during the past year. These boilers are built by the well known firm, Link-Belt Machinery Company of Chicago, who have installed new and improved machinery for their manufacture, reducing the prime cost as well as making the various parts interchangeable. During the past year a number of fine plants have been installed with Standard boilers, among others the following: 4000 h.p. for the North Chicago Street Railroad Company at its new power station at Hawthorn Avenue; 500 h.p. for the Cincinnati Edison Company at Cincinnati, O.; 600 h.p. for the Western Electric Company at its factory in Chicago, and various others. The company reports prospects for the coming year as good.

Edward E. Ayer, dealer and manufacturer of cedar telegraph and street railway poles, who has his main office in the Old Colony building, Chicago, claims to be the largest producer of white cedar products in the world. His main pole yards are located in Chicago, Menominee, Alpena, and West Bay City, Mich., and has numerous smaller yards throughout Wisconsin and Michigan. For years he has supplied all of the largest telegraph, telephone, and street railway companies in the United States and Mexico. Every pole shipped from his various yards is thoroughly examined by a competent pole inspector, and nothing but the very best stock of full standard specifications is shipped. He now has upwards of 1000 men in his cedar swamps, manufacturing poles for the spring trade. Mr. Ayer claims to carry the most complete stock of street railway poles of any dealer in his line, and this of course means the filling of all orders without delay.

The Adams-Bagnall Electric Company, of Cleveland, is busily at work in turning out the "A-B" arc and incandescent lamps, the former having just been placed upon the market and the latter being now manufactured on orders at the rate of 1200 to 1500 lamps per day. Full descriptions of these lamps will be published at an early day. It will be remembered that the engineers and manufacturers of this company, Messrs. Adams, Bagnall, Cox, Rogers, Pripps, Arnold and Dodd, were originally connected with the Brush Electric Company for many years, and have the benefit of an excellent training in that well known manufacturing establishment. The company has just appointed A. D. Dorman, who was also for several years an employe of the Brush Company, its New York representative, and Mr. Dorman has opened an office in the Havemeyer Building. Mr. Rogers has recently arranged with Chicago and St. Louis houses to handle the incandescent lamps, and a large business is being arranged for in all departments of the company's business.

The Ohio Brass Company, of Mansfield, O., reports a most satisfactory year's business, and the outlook for the coming year is more than encouraging. The establishment of several branch offices, and the adding of many domestic as well as foreign agencies, has resulted in largely increasing the company's sales, which have doubled in amount during the past year over the previous twelve months. This company, always on the outlook for new and important devices of utility, has recently added to its line the following articles:—Type K trolley wire hangers, mine insulator, Walker trolley ear, Walker splicing ear, a full line of straight underrunning devices such as the Detroit section insulator, straight underrunning adjustable switch, straight underrunning adjustable crossover, etc.; also the H. & C. sleet cutting trolley wheel, the adjustable track brush holder, and the Warner electric car heater, all of which are already largely in use, and in many cases have been adopted as standard articles by many of the electric roads in this as well as in foreign countries. The company's manufacturing plant, which consists of a foundry, and thoroughly equipped pattern and machine shops, has been enlarged and its capacity increased by the addition of new machinery and tools. Realizing the requirements demanded by electrical engineers, which make it necessary to have this class of goods acceptable to consumers, no pains have been spared by the company to maintain and improve upon the quality of its material. The company's catalogue, issued last spring, is one of the most complete publications in its line. It contains a well assorted variety of those articles in everyday use and demand by electrical roads, and every purchaser interested in this class of goods will find it both convenient and useful.

The Bradford Belting Company, of Cincinnati, O., the sole manufacturer of "Monarch" insulating paint, has gained a deservedly high reputation in electrical and street railway trade. Monarch paint is manufactured from a newly discovered, valuable mineral, which is extremely rich in its own natural oils, and is especially adapted for armatures, fields, switchboards, conduits, iron and wooden poles, connections, mouldings and other kinds of electrical appliances where high insulation is a desideratum. It is quick drying and makes a lasting gloss equal to varnish. It does not crack, blister or peel off, and is not affected by extremes of climate. Another valuable quality of the paint is that it can be used on heated surfaces of moderately high temperature, and loses none of its properties under 550 to 600 degs. Fahr. of heat. Its qualities enable it to resist the action of acids, alkalies or salines, and for this reason it has been employed with excellent results as a wood preservative. It might be mentioned that surfaces coated with Monarch insulating paint when dry have no odor or taste. The Monarch insulating paint is recommended by the manufacturers especially for street railway motor work where salt is used on tracks, as the salt slush has no effect on it. This use of the paint is by no means experimental as every test possible has been given to it for the past eighteen months. The long established reputation of the Bradford Belting Company is a guarantee that the quality of the Monarch paint will not deteriorate at its hands. This company intends making a very handsome exhibit at the National Electrical Exposition, to be held during the coming May in New York. The company has secured from the exposition association an excellent location, and will give street railway managers an opportunity of inspecting its products and of investigating their value.

List of Street Railway Patents.

U. S. PATENTS ISSUED NOVEMBER 26, 1895, TO JANUARY 14, 1896, INCLUSIVE.

NOVEMBER 26.

ELECTRIC TRAMWAY WITH UNDERGROUND DISTRIBUTION OF CURRENT.—A. Diatto, Turin, Italy. No. 550319.

A circuit closing device comprising a cylinder containing a quantity of mercury, a rod or piston operating within the mercury in said cylinder, and a coupling piece serving to unite the wires of the conducting cable and as a feeder for the current.

ELECTRO-LOCOMOTIVE.—J. J. Heilmann, Paris, France. No. 550344.

Consists in the combination, with one of the driving wheels, of pairs of oppositely arranged pins, each pin passing through a spoke, a spring connected with each pin and acting to force it toward its mate, a hollow armature shaft inclosing the axle and of an internal diameter sufficient to permit relative displacement of the axle and the shaft and arms secured to said shaft, each arm entering between two opposing pins.

DECEMBER 3.

CAR BRAKE.—E. E. LaRose, Providence, R. I. No. 550627.

CABLE ROADWAY.—J. B. Martindale, Chicago, Ill. No. 550631.

A cable adapted to propel vehicles having rigidly fixed to it at intervals a sleeve-shaped bushing with flanged ends, carrying a sleeved hook loosely surrounding said bushing.

DECEMBER 10.

STREET CAR.—W. Robinson, Boston, Mass. No. 551047.

SWITCH FOR UNDERGROUND ELECTRIC RAILWAYS.—A. Rosenholz, San Francisco, Cal. No. 551145.

Consists of a stationary magnetic core projecting from the main conductor, a sealed casing therefor, fulcrumed and turnable in journals or bearings about the main conductor, a flexible insulating sheath or jacket surrounding the junction of the main conductor and core, and a ring and groove joint at the termination of the sheath within the casing.

AUTOMATIC BRAKE AND FENDER.—J. Kurtz, Moore, Pa. No. 551210.

A cross bar, springs and guides therefor, ears thereon, a buffer pivotally connected to the latter, and means for holding the same in a vertical or horizontal position.

DECEMBER 17.

CLOSED CONDUIT ELECTRIC RAILWAY SYSTEM.—F. C. Esmond, Brooklyn, N. Y. No. 551534.

Consists of an insulated supply conductor, working conductor sections, switches and magnets for operating the switches, with a double set of overlapping collectors leading to the motor, and a switch for including a resistance in the circuit between the motor and the rear set of collectors in either direction of motion of the car.

FENDER.—J. Grant, Omaha, Neb. No. 551585.

STREET CAR.—W. R. Dodson, Jermyn, Pa. No. 551621.

Consists of a frame, a seat, a locking bolt passed through the frame and having a transverse bar, a block secured to the seat and having the transverse bars of the bolt passed through it, and a plate hinged to the block and covering the said transverse bar.

DECEMBER 24.

CAR FENDER.—W. M. Watts, Philadelphia, Pa. No. 551802.

A basket mounted upon the front of a series of lazy tong levers, whereby said basket may be shifted to and from an operative position—and a lever adapted to retain said lazy tong levers in a predetermined position.

CAR FENDER.—C. P. Woodruff, Brooklyn, N. Y. No. 551805.

Wheel Fender for Cars.—W. R. Derr, Baltimore, Md. No. 551851.

Comprises a main frame or body portion, a compound tipping bar hinged to the forward end of said main frame, said bar being composed of two members, one of which is hinged to the other, both members of said compound bar normally lying in an inclined position relative to the track and supported at the joint by wheels.

Car Fender.—A. Lutz, Brooklyn, N. Y. No. 551904.

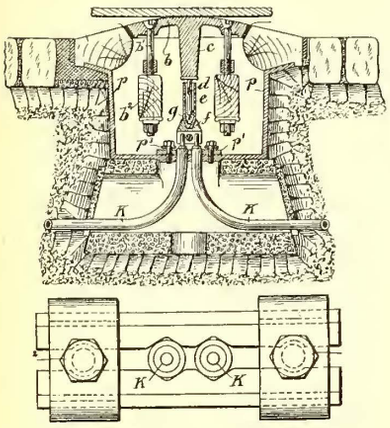
Rolling Support for Car Bodies.—D. L. McQuarrie, Gloucester, Mass. No. 551907.

Consists of a body containing a conduit, a pipe, connecting the ends of said conduit and removable therefrom at said ends, to form a continuous endless conduit, with a series of balls, filling the said conduit, and free to roll therein.

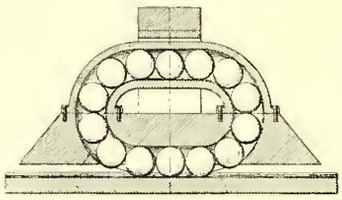
Electric Railway Train Signaling.—W. S. Greene, Covington, Ky. No. 551930.

Car Truck.—D. F. Henry, Allegheny, Pa. No. 551963.

Car Fender.—C. L. Klauder, Philadelphia, Pa. No. 551972.



PAT. NO. 550,319.



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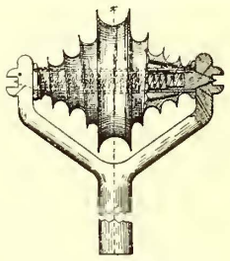


PAT. NO. 552,631.

Electric Signal.—E. M. Phelps, Lynn, Mass. No. 551998.

A circuit controller for use in connection with trolley wires, consisting of a contact and co-operating rod bent to form a double switch arm pivoted at its ends and having its middle or bent portion astride and resting upon the trolley wire.

Underground Current Supply for Electric Railways.—A. Rast, Nuremberg, Germany. No. 552001.

December 31.

Apparatus for Automatically Maintaining Current Upon Moving Vehicles.—H. E. Dey, Brooklyn, N. Y. No. 552,105.

A vehicle, an electric motor embraced in a circuit energized from a suitable source, a motor dynamo or similar converting device, and a storage battery energized from the motor dynamo and adapted to actuate the latter and energize the motor circuit upon a cessation of the main supply.

Street Car Motor.—J. H. Elward, Whitewater, Wis. No. 552109.

Consists of a boiler and main engine, a tank, a receptacle for the exhaust steam, means in said receptacle for condensing the steam, means for forcing the condensed steam into the tank supplemental to the boiler, and means between the tank and the boiler for heating the feed water.

Car Wheel.—W. J. Taylor, Bound Brook, N. J. No. 552155.

Electric Railway Signaling Apparatus.—H. J. Hovey, Evanston, Ill. No. 552181.

Switch Operating Device.—C. E. Sipp, Roscommon, Pa. No. 552206.

Comprising levers pivoted beneath the car and working in unison, whereby the depression or elevation of one raises or lowers the other, and a dog situated in the track and adapted to contact with the levers.

Pneumatic Railway.—H. S. Bolton, Washington, D. C. No. 552231.

A vehicle having a depending hollow arm provided with a valved shoe at its lower end, said arm mounted at its upper end to swing laterally, and maintain open connection with the tank or engine of the vehicle.

Street Car Fender.—F. Fiechter, Philadelphia, Pa. No. 552281.

Electric Signal for Railways.—E. B. Cutten, New York, N. Y. No. 552279.

Car Fender.—A. Fryer, Bath-on-Hudson, N. Y. No. 552283.

Car Fender.—J. W. Harris, Columbus, O. No. 552286.

Comprises a main frame, a front part or tongue hinged to the main frame and having a downwardly projecting arm or lug, a lever-like frame pivoted at or near the bottom of the main frame and having an arm or lug and a link connecting the arms.

Electrical Railway Signaling System.—T. B. Dixon, Henderson, Ky. No. 552316.

Car Fender.—E. B. Clark, Cohoes, N. Y. No. 552348.

Consists of an apron having its sides provided with laterally extending cutaway portions and binding strips flexibly connected together.

Car Fender.—S. H. Coffee, Beverly, N. J. No. 552349.

Means for Operating Electric Railway Vehicles.—E. G. Hoffmann, Charlottenburg, Germany. No. 552369.

Car Fender.—H. Kramer, New York, N. Y. No. 552377.

Electric Railway.—M. H. Smith, Halifax, England. No. 552451.

Consists of a main conductor, sectional surface bar conductors having extended pole pieces, and a magnetic switch comprising a pivoted lever carrying an armature for the pole pieces and carrying a contact piece for the main conductor.

Car Fender.—W. T. Waugh, Waynesborough, Pa. No. 552475.

Rail Bond for Electric Railways.—B. J. Jones, Chicago, Ill. No. 552477.

Electrical Rail Bond.—M. T. Kendall, Melrose, Mass. No. 552479.

Car Brake.—A R. Roney, Chicago, Ill. No. 552486.

Consists of a brake rod, a series of expanders, each comprising a closed vessel containing a volatile fluid and an electric heater also contained in said vessel and submerged in said fluid, said electric heaters being wired in multiple, an electric circuit and means for successively or simultaneously cutting said heaters into said circuit.

Car Truck.—E. F. Goltra, St. Louis, Mo. No. 552493.

January 7.

Automatic Switch.—G. A. Schmittuz, Brooklyn, N. Y. No. 552622.

An automatically movable point, a series of tripping levers therefor, a tripping device mounted upon a car and having a laterally adjustable tripping shoe, and an index mounted upon the car and operatively connected to the tripping device to indicate the position of the shoe.

Trolley.—B. Dale, Milwaukee, Wis. No. 552631.

Automatic Cleaner for Rails of Tramways.—A. Flahaux, Laeken, Bel. No. 552637.

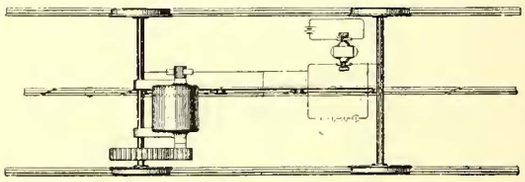
Car Fender.—J. Gibbons, West Troy, N. Y. No. 552639.

Car Fender.—W. P. Young, Pottstown, Pa. No. 552655.

A frame with a cross bar at the front thereof, a fender, a cradle connected with said fender, and knuckles on said fender and cradle intermediate said parts, said knuckles being freely seated on said cross bar, and guards on the fender freely embracing said cross bar.

Car Fender.—M. Sparmo, New York, N. Y. No. 552789.

Consists of a body section, a front pivoted section capable of assuming a position at an angle to the body section, a rock shaft operating the pivoted section, and actuated slides operating said rock shaft and controlled from the body portion of the fender.



PAT. NO. 552,105.

Car Fender.—J. B. Morrow, Oxford, Md. No. 552852.

Comprises a fixed section, a yielding section carried by the fixed section, and a yielding frame interposed between the said sections.

January 14.

Sand Box for Street Cars.—F. C. Murray, Boston, Mass. No. 552922.

A sand box, rotary on a horizontal axis and having a discharge opening in the end thereof, and a valve arranged to open and close said opening and turning in a vertical plane upon a stationary center.

Car Fender.—J. T. Rodgers, Memphis, Tenn. No. 552927.

Car Fender.—W. Burgey, Brooklyn, N. Y. No. 553050.

Car Fender.—S. Ellison, Philadelphia, Pa. No. 553155.

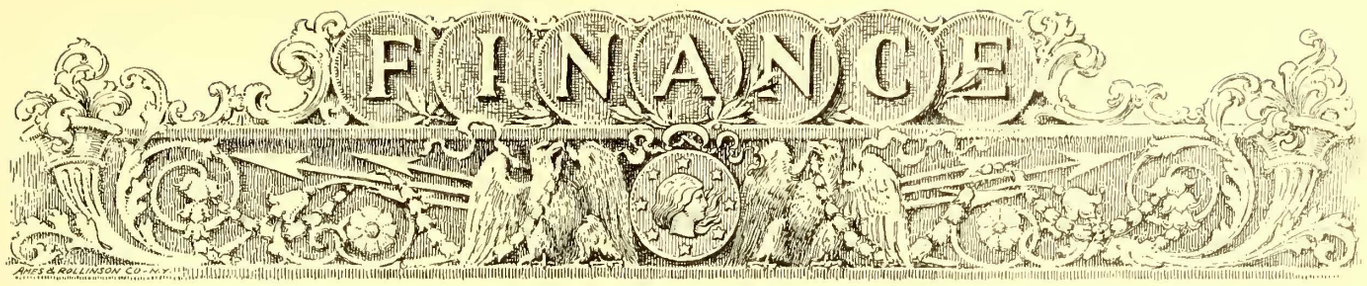
Electric Railway.—Thomas F. O'Connor, New York, N. Y. No. 553176.

In an electric railway, the combination with a suitable way, of a motor vehicle, a slotted conduit extending parallel with the way, an electric conductor having one end stationary and connected with a source of power, and a conducting arm carried by the motor vehicle and traveling in the slot and to which the electric conductor is connected within the conduit.

Car Fender.—C. A. du Quesnay, New Orleans, La. No. 553186.

Car Fender.—W. S. Clement, Westmont, N. J. No. 553208.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of twenty-five cents. Give date and number of patent desired. The Street Railway Publishing Company, Havemeyer Building, New York.



Annual Report New York Railroad Commissioners.

The following tabulation of matter contained in the Annual Report of the Board of Railroad Commissioners, sent out on January 8, referring to the surface railways of the city will be of interest:

Year ending June 30,	1894	1895
Passengers carried, steam roads	162,957,535	161,792,152
" " elevated "	251,692,610	241,126,487
" " surface railways	504,070,025	561,409,498
" " total	918,720,170	964,328,137
Gross earnings from operation	23,911,026	25,477,227
Operating expenses	15,418,848	16,628,452
Net earnings from operation	8,492,178	8,848,776
Income from other sources	576,022	942,961
Taxes and miscellaneous	1,000,211	1,095,472
Interest	2,367,060	2,911,116
Rentals	3,301,897	3,620,246
Dividends	1,577,107	1,993,773
Surplus for the year	812,997	171,130
Passengers killed	48	17
" injured	223	119
Employes killed	185	181
" injured	1,166	630
Others killed	490	496
Others injured	432	376
Total killed	723	694
Total injured	1,821	1,125
June 30,	1894	1895
Capital stock	$88,261,929	$89,693,580
Funded debt	77,574,730	80,180,424
Unfunded debt	9,216,834	12,056,520
Cost of road and equipment	161,007,475	170,647,266

The Board makes a comparison between the accidents in New York State and those in Pennsylvania, the advantage being very largely in favor of New York railroads in the matter of safety appliances for protection of both passengers and employes.

The Commissioners also say:

"The use of power brakes on street surface cars operated by mechanical traction is receiving attention at the hands of the managers of such roads. The necessity for such an appliance is conceded. The difficulty is to procure a brake that will safely answer all requirements. Experiments are constantly being made in this direction, and it is confidently predicted by street railroad managers that in the near future all mechanically operated street cars in large cities will be equipped with power brakes. The shorter the distance in which a car can be stopped, the less danger there is of accident either to persons or property.

"All street cars in this state should be heated during the winter months, and most of the companies have complied with the recommendations of the Board in this respect. A law requiring all street surface cars to be properly heated would secure full compliance in this important matter.

"The Board, in addition, renews generally its recommendations of 1893 and 1894, and urges the Legislature to consider the propriety of embodying, at least, a part of them in some enactment."

Annual Report Connecticut Railroad Commissioners.

The annual report of the Connecticut Railroad Commissioners was sent to the Legislature on Jan. 17. That portion of the report which deals with street railways will be of interest.

The Bridgeport Traction Company, representing 45 miles of road, makes no report of the number of miles run, passengers carried, or the number of employes. The other companies report 7,782,530 miles run, 38,037,474 passengers carried, and 1525 employes.

The report says that in no single instance did the books of the street railway companies supply the necessary data for complying with the law in regard to returns.

The report says that public safety demands the adoption of a power brake on electric cars. The weight of cars and their speed make it impossible to stop them by hand brakes as quickly as emergencies may require. The necessity, or at least the expediency, of their use is now generally admitted. Their adoption has been delayed by a division of sentiment between those favoring an electric brake and those advocating the air brake.

The total street railway mileage in the state was 317. The following general statement is presented in tabular form:

Capital stock issued and outstanding	$8,604,240.00
Bonds issued and outstanding	7,966,000.00
Floating indebtedness	1,123,457.70
Total	$17,723,697.70
Amount per mile	59,167.00
Gross earnings	2,232,201.00
Operating expenses	1,523,191.00
Net earnings	$708,860.00
Interest charges paid	278,136.00
Taxes	76,522.00
Dividends (by eleven companies)	168,630.00

Operating expenses of electric roads in the state have been 68.24 p. c. of gross earnings, and of the steam roads 68.43 p. c.

Abstract of the New Buffalo Franchise.

The following are the principal features of a franchise just granted to the Buffalo Traction Company and approved by the Mayor. The State Board of Railroad Commissioners have, however, refused to authorize the construction of the road.

The company must finish and put in operation 30 miles of road within one year from the date of the grant, and the remainder within three years, delays caused by unavoidable legal proceedings to be deducted.

The company is to use grooved girder rails 9 ins. deep, with flange not more than ¼ in. below the head of straight rails, and on curved rails not more than ⅜ in. above the head. All rails are to be placed on steel ties, with concrete foundation.

The company shall repave and keep in permanent repair all pavement between its rails and 2 ft. outside each of the outer rails. The company is also to repair bridges and viaducts on its route, and to pay for all strengthening necessary on account of the operation of its cars over such bridges and viaducts.

The company must vestibule all closed cars, must provide life guards at the front end, and must adopt such lighting, heating and ventilating methods as may be prescribed by the Aldermen and Council.

The company must employ only citizens of the United States and actual residents and inhabitants of the city of Buffalo in the performance of any work done by it or by any contractor in its employ in constructing, operating or maintaining the road, except engineers, superintendents and managers, and shall pay such employes not less than 17½ cts. per hour in weekly payments.

The fares are to be five cents for cash with universal transfers throughout the system. Childen under ten years of age are to be carried free of charge. Passengers not desiring transfers are to receive from the conductor on the payment of a cash fare a ticket, four of which shall entitle the holder to another ride, said tickets to be void if not used within sixty days. Any members of the police and fire departments are to ride upon their badges. It is also specified that the company must be prepared and willing to enter into an arrangement with the Buffalo Railway Company for a general transfer system at any time when the latter may consent, upon payment, each company to the other, of one-half regular fares. The company is to sell tickets at the rate of three for ten cents with all transfer privileges.

The company is to pay to the city one per cent of its gross receipts.

The company is forbidden to consolidate or lease its property with or to any other company operating within the city limits without the consent of the Common Council.

The franchise life is to be for fifty years and the city is to have the right to acquire the plant at the end of this time at its appraised valuation.

STOCK AND BOND QUOTATIONS.

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

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

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

Company. STOCKS AND BONDS		Issued.	Due.	Quotations. 1895. High.	1895. Low.	Jan. High.	Jan. Low.	Jan. Closing.
ALBANY, N. Y.*—Local quotations to Jan. 18.								
Albany Ry. Co., Stock	100	1,250,000		140	116	136½	136½	136½
Cons. M. 5% bds. (incl. $112,000 in esc.).		500,000	1930	109	105½	....	....	....
Deb. 6% (convert.) bds		200,000	1901	....	....	....	....	....
Wat. T'p'ke & R.R. Co.'s 2d M. 6% bds.		150,000	1919	113½	111	....	....	....
Wat. Turnpike & R. R. Co., Stock.	100	240,000	.....	....	....	....	....	....
1st M. 6% bds. (int. guar. by Alb'y Ry.		350,000	1919	114	113½	....	....	....
BALTIMORE, MD.*—Local quotations to Jan. 18.								
Baltimore Traction Co., Stock	25	5,750,000	.....	21¾	14½	17¾	16¼	17
1st M. 5% bds		1,500,000	1929	111	105¾	110½	110½	110½
No. Balt. Div. 1st M 5% bds		1,750,000	1942	110½	105	110½	107½	108
Ext. and Imp. 6% bds		1,250,000	1901	108	102¾	105	105	105
City & Suburban Ry. Co., Stock	50	4,000,000	.....	51	42½	50	47½	47½
Gen. M. 5% g. bds		3,000,000	1922	111½	107½	112	109½	110
Baltimore City Pass. Ry. Co., Stock	25	2,500,000	.....	76½	69⅝	72	67½	68¾
1st. M. 5% g. bds		2,000,000	1911	117	113¾	115	115	115
Central Pass. Ry. Co., Stock	50	300,000	.....	72½	68	....	....	....
Cons. M. 5% bds. (+ $151,000 in esc.)..		549,000	1932	112	109¾	112	112	112
1st M. 6% bds		151,000	1912	110	110	....	....	....
BOSTON, MASS.*—Local quotations to Jan. 18.								
West End St. Ry. Co., Stock, {common.	50	9,085,000	.....	77¼	57¾	67½	64	65½a
{preferred 8%	50	6,400,000	.....	95¾	85	90	88	90b
Deb. 5% g bds		3,000,000	1902	107	103¾	105	103	105 a
Deb. 4½% g bds		2,000,000	1914	1 7	102½	105¼	104	....
North Shore Traction Co., Stock, {common	100	4,000,000	.....	....	....	....	....	....
{preferred 6%	100	2,000,000	.....	....	....	83	80	....
Lynn & Boston R.R. Co.'s 1st Cons. M. 5% g. bds. (+ $1,677,000 in esc)		3,702,000	1924	101½	101½	....	....	....
BROOKLYN, N. Y.*—New York quotations to Jan. 22.								
Long Island Traction Co., Stock	100	30,000,000	.....	21	5	21	11	18
Coll. Tr. 6% g. notes		2,500,000	1895-7	90	65	....	....	....
Brooklyn Heights R. R. Co. 1st M. 5% bds		250,000	1941	....	....	....	....	....
Brooklyn City R. R. Co., Stock	10	12,000,000	.....	185	151½	172	159	164
1st Cons. M. 5% bds		6,000,000	1941	115	111	112	109	111
Brooklyn, Q. Co. & Sub. R. R. Co. 1st M. 5% g. bds. (+ $350,000 in esc.)...		3,150,000	1941	115	103	102	98	100
1st Cons. M. 5% g. bds		2,500,000	1941	105	80	80	80	80
Brooklyn Traction Co. Stock, {common	100	6,000,000	.....	18¾	8½	10½	7	9
{preferred 6%	100	3,000,000	.....	68½	49	54	48	51
Atlantic Ave. R. R. Co. Gen. M. 5% bds		759,000	1909	110	107½	107	107	107
Cons. M. 5% bds. (+ $1,034,000 in esc.)..		1,966,000	1931	110	108	108	108	108
Imp. M. 5% g. bds		1,500,000	1934	95	85	82	82	82
B'kl'n, Bath & W. E. R. R. Co. Gen. M. 5% bds. (+ $552,000 in esc.)...		448,000	1933	93	87	85	85	85
Coney Isl. & B'kl'n R.R. Co., Stock	100	1,000,000	.....	....	....	....	....	....
1st M. 5% bds		300,000	1904	....	....	....	....	....
Cert. Indebt. 6%		200,000	1910	....	....	....	....	....
B'kl'n City & Newt'n R.R.Co. Stock	100	1,000,000	.....	205	118	....	....	150 b
1st Cons. 5% bds		1,900,000	1939	111	108	109	109	109
BUFFALO, N. Y.*—New York quotations to Jan. 22.								
Buffalo Ry. Co., Stock	100	5,370,500	.....	90	66	80	68	75
1st Cons. M. 5% bds. (+ $1,457,000 in esc.)		3,543,000	1931	109¾	101	106	100	104
Crosstown St. Ry. Co.'s 1st M. 5% bds.		2,200,000	1932	107½	95½	104	100	102
CHARLESTON, S. C.*—Local quotations to Jan. 18.								
Enterprise St. R. R. Co., Stock	25	250,000	.....	....	....	....	....	6
1st M. 5% bds		50,000	1906	....	....	....	....	101
Charleston City Ry. Co., Stock	50	100,000	.....	78	72	....	....	70
1st M. 6% bds		100,000	1915	....	....	....	....	112
CHICAGO, ILL.*—Local quotations to Jan. 18.								
Chicago & So. Side R. T. R. R. Co. Stock	100	7,500,000	.....	17	6¼	6⅞	4⅞	5⅞
1st M. 5% bds		7,500,000	1929	75	60	60	60	60
Exten. 5% bds		3,000,000	1933	52	40	42	40	40
Chicago City Ry. Co., Stock	100	9,000,000	.....	335	300	315	278	278
1st M. 4½% bds		4,619,500	60 d.	102	100½	100½	100¼	100½
Lake St. Elev. R. R., Stock	100	10,000,000	.....	27½	7¼	24¾	18½	21
CHICAGO, ILL.—Continued.								
Met. W. S. Elevated Ry., Stock	100	11,500,000	.....	22	14	17	13¾	14
1st M. 5% bds		12,500,000	1942	79	66	68	65	66
North Chicago St. R. R. Co., Stock.	100	5,500,000	.....	305½	245	308½	280	280
1st M. 5% bds		2,413,000	1906	104¾	102	....	....	....
Cert. Indebt. 6%		500,000	1911	....	....	....	....	....
No. Chi. Cy. Ry. Co.'s 1st M. 6% bds		500,000	1900	105½	105	....	....	....
" " " " " 2nd M. 4½% bds		1,850,000	1927	101	100¾	....	....	....
" " " " " Deb. 6% bds		550,000				100½	98	100¾
North Chicago City Ry. Co., Guar. Stock	100	500,000	.....	600	595	....	....	....
West Chicago St. R. R. Co., Stock	100	13,189,000	.....	135	110	114	100	103
1st M. 5% bds		4,100,000	1928	103½	101½	100½	100½	100½
W. C. S. R. R. Tunnel Co.'s 1st M. 5% bds.		1,500,000	1909	101½	101	....	....	....
Deb. 6% bds		4,000,000	....	102¾	101	100	97½	97¾
Cht. W. Div. Ry. Co.'s 1st M. 4½% bds.		4,040,000	1932	101	101	....	....	....
Chi. Pass. Ry. Co.'s 1st M. 6% bds		400,000	1905	109	108	....	....	....
" " " " Cons. M. 6% bds		600,000	1929	....	....	....	....	....
Chicago W. Div. Ry. Co., Guar. Stock	100	1,250,000	....	600	600	....	....	....
CINCINNATI, O.*—Local quotations to Jan. 18.								
Cincinnati St. Ry. Co., Stock	50	11,000,000	....	115¾	108⅜	112¼	111½	112⅛
1st M. 7% bds		50,000	1896	104	101	....	....	....
1st M. 4% ext'n'd bds		100,000	....	100¾	99	....	....	....
" " 5% " "		150,000	....	102	100½	....	....	....
Mt. Adams & Eden Park Inclined Ry., Stock	50	2,500,000	....	112½	108	112	109¼	109½
1st M. 6% bds		50,000	1900	108	106	....	....	....
" " 6% "		100,000	1905	114	102	....	....	....
Cons. M. 5% bds		531,000	1906	107½	106	....	....	....
Cincinnati, Newport & Covington St. Ry. Co., Stock	100	3,000,000	....	48	24	36	54	34½b
Cons. M. 5% g. bds. (incl. $500,000 in esc.)		3,000,000	1922	100	94	98	97	97½
So. Cov. & Cin. St. Ry. Co 1st M. 6% bds.		250,000	1912	115	114¾	....	....	....
" " " " " " 2nd Cons. M. 6% g. bds. (incl. $250,000 in esc.)		400,000	1932	115	114¾	....	....	....
COLUMBUS, O.*—New York quotations to Jan. 22.								
Columbus St. Ry. Co., Stock	100	3,000,000	....	60½	45¾	50	50	50
Cons. M. 5% g. bds. (incl. $780,000 in esc).		3,000,000	1932	102½	94½	100	95	97½
Crosstown St. Ry. Co.'s 1st. M. 5% g. bds. ($90,000 in esc.)		500,000	1933	103	94	95	90	93
COVINGTON, KY.*—(See Cincinnati.)								
DETROIT, MICH.*—Local quotations to Jan. 18.								
Detroit Citizens' St. Ry. Co., Stock.	100	1,250,000	....	120 b	90	100	100	100
1st M. 6% bds. (+ $1,150,000 in esc)		1,150,000	....	100	100	100	100	100
Fort Wayne & Belle Isle Ry. Co., Stock	100	250,000	....	250	210	250	225	250
1st M. 6% g. bds. ($60,000 in tr.)		340,000	....	100	100	100	100	100
Wyandotte & Detroit River Ry. Co., Stock	100	200,000	....	110	100	110	100	110
Rapid Ry. Co., Stock		250,000	....	....	...	110	100	110
1st M. 5% bds		300,000	....	....	....	96	93	96
The Detroit Ry., Stock		1,000,000	....	....	....	....	....	....
1st M. 5% bds		1,800,000	1925	....	....	....	....	....
HARTFORD, CONN.*—See New Haven.								
HOBOKEN, N. J.*—See Newark.								
HOLYOKE, MASS.*—Local quotations to Jan. 18.								
Holyoke St. Ry. Co., Stock	100	250,000	....	225	200	210	200	200
Springfield St. Ry. Co., Stock	100	1,000,000	....	215	200	215	210	210
Northampton St. Ry. Co., Stock	100	225,000	....	200	160	195	190	190
INDIANAPOLIS, IND.*—New York quotations to Jan. 22.								
Citizens' St. R. R. Co., Stock	100	5,000,000	....	58	34	40	26	27
Cons. M. 5% g. bds. (incl. $1,000,000 in esc.)		4,000,000	1933	96½	82¾	90	81	86
JERSEY CITY, N. J.*—See Newark.								
LOUISVILLE, KY.*—Local and New York quotations to Jan. 22.								
Louisville Ry. Co., Stock, {common	100	4,000,000	....	54½	37	50	46	49
{preferred 5%	100	2,000,000	....	103½	93	101	95	100
Cons. M. 5% g. bds. (incl. $1,263,000 in esc.)		6,000,000	1930	110½	104¾	109	105	107¼

* For detailed description of these and other securities issued, see **AMERICAN STREET RAILWAY INVESTMENTS, a supplement to the STREET RAILWAY JOURNAL,** published annually on March 15th.

Company. STOCKS AND BONDS.		Issued.	Due.	Quotations. 1895. High.	1895. Low.	Jan. High.	Jan. Low.	Jan. Closing.
LYNN, MASS.*—See Boston.								
MINNEAPOLIS, MINN.*—New York quotations to Jan. 22.								
Twin City Rapid Transit Co. Stock.	com.. 100	15,000,000	....	30	11½	25	25	25
	pref. 7%	1,500,000	....	....	....	100	100	100
Minn. St. Ry. Co.'s Cons. M. 5% g. bds. (+ $960,000 in esc.)		4 040,000	1919	100	91	96	93	94
St. Paul City Ry. Co.'s Cab. Cons. 5% g. bds. (incl. $680,000 in esc.)		4,298,000	1937	98½	85	93	90	90
St. Paul City Ry. Co.'s Deb. 6% g. bds.		1,000,000	1900	....	....	90	90	90
MONTREAL, CAN.*—Local quotations to Jan. 18.								
Montreal St. Ry. Co., Stock	50	4,000,000	....	227	168	226	214	215
1st M. 5% bds		300,000	1908	189	184	....	....	....
2nd M. 4½% bds		700,000	1922	....	....	....	....	....
NEW ALBANY, IND.*—See Louisville.								
NEWARK, N. J.*—New York and Philadelphia quotations to Jan. 22.								
Consolidated Traction Co., of N. J., Stock	100	15,000,000	....	31	24	25	25	25
1st M. 5% g. bds		11,711,000	1933	87¾	80	86	78¾	80
North Hudson Co. Ry. Co., Stock	25	1,000,000	....	....	....	....	....	....
Cons. M. 5% bds. (incl. $620,000 in esc.)		3.000.000	1928	....	....	....	....	....
2nd M. 5% bds		350,000	1928	....	....	....	....	....
Deb. 6% bds		500,000	1902	....	....	....	....	....
NEW HAVEN, CONN.*—Local quotations to Jan. 17.								
Fairhaven & Westville R. R. Co., Stock	25	600,000	....	53	50	53	53	53
Winchester Ave. R. R. Co., Stock	25	400 000	....	....	....	....	....	....
1st M. 5% g. bds		500.000	1912	103	101	102½	102	102½
Deb. 6% bds		100,000	1909	102	100	101	100	101
New Haven St. Ry. Co., 1st M. 5% bds.		600.000	1913	102	101	102	102	102
Hartford St. Ry. Co., Stock	100	200,000	....	250	208	219	215	219
H'd & W'th's'fl'd H. R. R. Co.'s deb. 5% bds		1,344,000	....	102	100	102	101	101
NEW ORLEANS, LA.*—New York quotations to Jan. 22.								
New Orleans Traction Co., Stock, common..	100	5,000,000	....	29	11	20	15¾	17
pref. 6%...	100	2,500,000	....	84¾	40	70	63	65
N. O. City & Lake R. R. Co.'s 1st M. 6% g. bds. ($423,500 in esc.)		3,000,000	1943	105	96½	101	99	100
Crescent City R. R. Co.'s Cons. M. 5% g. bds		2,350,000	1943	100	91	95	90	92½
New Orleans & Carrollton R. R. Co., Stock	100	1,200,000	....	126	118¾	126	123	124
1st M. 6 % bds		250,000	1897 / 1906	....	....	....	....	....
2d M. bds		350,000	1905 / 1907	112½	112	....	....	....
Canal & Claiborne R. R. Co., Stock.	40	240,000	....	40	26	48	46	46
1st M. 6 % bds		150,000	1912	....	....	....	....	102 b
Orleans R. R. Co., Stock	50	185,000	....	43¾ b	32½	45	44	44½
1st M. bds		18,000	....	....	....	114	111	111½
St. Charles St. R. R. Co., Stock	50	594,350	....	66	55	68	67	67
1st M. 6% bds		150,000	1912	....	....	....	....	....
NEWPORT, R. I.*—See Providence.								
NEW YORK, N. Y.*—Local quotations to Jan. 22.								
Metropolitan Traction Co., Stock	100	30,000,000	....	112¾	81¼	108	92	103½
Metropolitan St. Ry. Co., Stock	100	13,500,000	....	....	....	....	....	....
B'y. Surf. R. R. Co.'s 1st M. 5% bds		1,125,000	1924	114 1	110	114	113	113
" " " " 2nd M. 5% bds		1,000,000	1905	106	103 1	104½	102	103
So. Ferry R. R. Co., 1st. M. 5% bds		350,000	1919	106	103	106	106	106
Lex. Ave. & P. F. Ry. Co.'s 1st M. 5% bds.		500,000	....	115½	105¾	113	110	111¾
Broadway & Seventh Ave. R. R. Co., Guar Stock	100	2,100,000	....	200	188	197	197	197
Cons. M. 5% g. bds. (+ $4,850,000 in esc.)		7,650,000	1943	117½	109	115	115	115
1st M. 5% bds		1 500,000	1904	110	106½	107½	107½	107½
2nd M. 5% bds		500,000	1914	111½	108½	110	110	110
Sixth Ave. R. R. Co., Guar. Stock	100	2,000,000	....	223	200	220	200	200
Ninth Avenue R. R. Co., Guar. Stock	100	800,000	....	160	146	....	....	160 b
Twenty-third St. Ry. Co., Guar. Stock	100	600,000	....	310	300	308	305	306
1st M. 6% bds		250,000	1909	120	115	115	115	115
Deb. 5% bds		150,000	1906	105	102	104	102	104
B'y. Surf. R. R. Co.'s 1st M. 5% bds		375,000	1924	114	110	114	113	113
42nd St. & G'd. St. Ferry R. R. Co., Guar. Stock	100	748,000	....	330	315	315	315	315
1st M. 6% bds		236,000	1909	116½	115	116	116	116
Cent. Pk., No. & E. Riv. R. R. Co., Guar. Stock	100	1,800,000	....	166	161	165	162	163
Cons. M. 7% bds		1,200,000	1902	118	112½	115	113	114
Bl'cker St. & Fulton Ferry R. R. Co.	100	900,000	....	30	29	30	30	30
1st M. 7% bds		700,000	1900	113	111	110	110	110
Third Avenue R. R. Co., Stock	100	9.000,000	....	196½	150	180	172	174½
1st M. 5% g. bds		5,000,000	1937	122½	118	121	117	116
Second Avenue R. R. Co., Stock	100	1,862,000	....	165	140	165	150	150
Cons. M. 5% bds		1,600,000	1909	110	107	107½	107½	107½
Deb. 5% bds		300,000	1909	105	100	103½	103½	103½
Eighth Avenue R. R. Co., Stock	100	1,000,000	....	365	300	360	340	345

Company. STOCKS AND BONDS.		Issued.	Due.	Quotations. 1895. High.	1895. Low.	Jan. High.	Jan. Low.	Jan. Closing.
NEW YORK—Continued.								
Cert. Ind'bt. 6%		1,000,000	1914	110	103	110	110	110
42nd St., M. & St. N. Ave. Ry. Co., Stock	100	2,500,000	....	76	50	68	58	60
1st. M. 6% bds		1,200,000	1910	117	113	117	113	115
2nd M. Inc. 6% bds		1,500,000	1915	73	54½	70	65	70
Dry Dock, E. B'y. & Battery R. R. Co., Stock	100	1,200,000	....	179	150	170	165	170
Gen. M. 5% g. bds		885,000	1932	116	113	114	113	113¾
Cert. ind'bt 5%	100	1,100,000	1914	105	102	103	100	102
Central Crosstown R. R. Co., Stock	100	600,000	....	200	166	200	190	192
1st M. 6% bds		250,000	1922	120	116	119	119	119
Christopher & 10th St. R. R. Co., Guar. Stock	100	650,000	....	155	149	155	150	154
Union Ry. Co., Stock	100	2,000,000	....	130	100	100	95	100
1st M. 5% bds		2,000,000	1942	106	106	105	100	101½
Westchester Elec. R. R. Co.'s 1st M. 5% bds		500,000	1943	102½	96	99	99	99
NORTHAMPTON, MASS.*—See Holyoke.								
PATERSON, N. J.*—New York and Philadelphia quotations to Jan. 22.								
Paterson Ry. Co., Stock	100	1,250.000	....	31	12	25	22	25
Cons. M. 6% bds. (inc. $250,000 in esc.).		1,250,000	1931	101	85	100	94	98
PHILADELPHIA, PA.*—Local quotations to Jan. 18.								
Union Traction Co., Stock		....	....	....	....	12	10	....
Philadelphia Traction Co., Stock	50	15,000 000	....	100	71	65½	62	....
Coll. Tr. 4% g. bds		1,053,000	1917	100	100	....	....	....
Continental Pass. Ry. Co., Guar. Stock	50	1,000,000	....	134	121	129	....	....
1st M. 6% bds		350,000	1909	115	....	....	....	....
Empire Passenger Ry. Co., Stock	50	600,000	....	....	....	....	....	....
1st M. 7% bds		200,000	1900	120	....	....	....	....
Phila. City Pass. Ry. Co., Stock	50	475,000	....	175	165	176	....	....
1st M. 5% bds		200,000	1910	108	....	....	....	....
Phila. & G'ys Ferry Pass. Ry. Co., Guar. Stock	50	308,750	....	83½	80	85	....	....
Ridge Ave. Pass. Ry. Co. Guar. Stock	50	420,000	....	251	224	245	....	....
13th & 15th Sts., Pass. Ry. Co., Guar. Stock	50	334,529	....	232	222	223¾	....	....
1st M. 7% bds		100,000	1903	124	....	....	....	....
Union Pass. Ry. Co., Guar. Stock	50	925,000	....	206	200	201½	....	....
1st M. 5% bds		500.000	1911	108	....	....	....	....
2nd M. 5% bds		250,000	1910	100	....	....	....	....
W. Phila. Pass. Ry. Co., Guar. Stock	50	750,000	....	225	198	225	....	....
1st M. 6% g. bds		246,000	1906	110	....	....	....	....
2nd M. 5% bds		750,000	1926	105	....	....	....	....
Frankford & S'thw'k P. C. Pass. R. R. Co., Guar. Stock	50	1,875,000	....	339	329	325	....	....
Lombard & So. St. P. R. R. Co.'s 1st M. 5% bds		150,000	1901	90⅜	90⅜	90¾	....	....
West End P. Ry. Co.'s 1st M. 7% bds		132,100	1905	....	....	....	....	....
Citizens' Pass. Ry. Co., Guar. Stock	50	192,500	....	246	272	280	....	....
2nd & 3rd Sts. Ry. Co., Guar. Stock	50	848.160	....	231	212¾	....	....	....
Lehigh Ave. Ry. Co., Stock	50	599,950	....	53	40	51	....	....
People's Pass. Ry. Co., Stock common....	25	740.000	....	67⅝	47½	....	....	....
preferred...	25	277.402	1905	....	....	....	....	....
1st M. 7% bds		219,000	1905	120	118	....	....	....
Cons. M. 5% bds		246,000	1912	61	61	....	....	....
Germantown Pass. Ry. Co., Guar. Stock	50	572,800	....	120	112¾	120¼	....	....
Green & Coates Sts. P. P. Ry. Co., Guar. Stock	50	500,000	....	131	127	127	....	....
1st M. 6% bds		100,000	1898	120	118	....	....	....
Hest'v'e, Mantua & F'r'm't P. R. R. Co., Stock	50	2,500,000	....	66½	63¾	48	....	....
PITTSBURGH, PA.*—Local quotations to Jan. 18.								
Citizens' Traction Co., Stock	50	3,900,000	....	60	55½	56	55	54¾ b
1st M. 5% bds		1,250,000	1927	110½	107½	....	....	112½
Pittsburgh Traction Co., Stock	50	2,500,000	....	70	58	....	....	....
1st M. 5% bds		750.000	1927	110	107	....	....	112½
Duquesne Traction Co., Stock	50	3,000,000	....	36½	26¾	33½	32⅞	....
1st M. 5% bds		1,500,000	1930	105¼	100	102½	102½	102½
P'b'gh, Allegheny & Manch'r Tr. Co., Stock	50	3,000 000	....	40¾	35	38½	38½	39a
Gen. M. 5% bds		1,500,000	1931	107½	103½	....	....	106¾
P'b'gh Union P. Ry. Co.'s 1st. M. 5% bds.		100.000	1901	....	....	....	....	....
Federal St. & P. V. R. R. Co., Stock	25	1,400,000	....	22½	19	19⅜	19⅜	20a
Gen. M. 5% bds.. (new)		1,250,000	1931	104	100	102¾	102¾	....
P'b'gh & Birmingham Tr. Co., Stock	50	3,000,000	....	20¾	12¾	16¾	16	16½ b
Gen. M. 5% g. bds		1,500,000	1929	98⅝	90	97½	97½	98a
Central Traction Co., Stock	50	1,500,000	....	28½	18	27	27	26b
1st M. 5% bds		375,000	1929	105⅜	102½	....	....	....
P'b'gh & West End P. Ry. Co., Stock	50	1,500.000	....	50	29½	....	....	....
1st. M. 5% bds		450,000	1922	104	101	....	....	....
PROVIDENCE, R. I.*—Local quotations to Jan 17.								
United Traction & Electric Co., Stock	100	8,000,000	....	58	45	50	50	50
1st M. 5% g. bds		8,000,000	1933	102½	97½	101	100	100
Newport St. Ry. Co. 1st M. 5% bds		50,000	1910	102	95	100	100	100

*For detailed description of these and other securities issued, see **AMERICAN STREET RAILWAY INVESTMENTS, a supplement to the STREET RAILWAY JOURNAL, published annually on March 15th**

Company. STOCKS AND BONDS.	Issued.	Due.	Quotations. 1895. High.	Low.	Jan. High.	Low.	Closing
ROCHESTER, N. Y.*—New York quotations to Jan. 22.							
Rochester Ry. Co., Stock..... 100	5,000,000	....	45½	30	32	27	30
Cons. M. 5%g. bds. (incl. $1,000,000 in esc.).....	3,000,000	1930	106⅛	99½	106	100	102½
2nd M. 5% g bds. (incl. $750,000 in esc.)	1,500,000	1933	86 b	83	85	85	85
ST. LOUIS, MO.*—Local quotations to Jan. 22.							
St. Louis R. R. Co., Stock..... 100	2,000,000	....	149	125	144	140	144
1st M. 5% bds.....	2,000,000	1900|1910	107	100	....	....	....
Citizens' Ry. Co., Stock..... 100	1,500,000	....	120	65	92	90	91
1st M. 6% bds.....	1,500,000	1907	108½	105	....	....	....
Cass Ave. & Fair Grounds Ry. Co., Stock..... 100	2,000,000	....	100	50	....	....	....
1st M. 5% bds.....	1,911,000	1912	100	98	....	....	....
Union Depot R. R. Co., Stock..... 100	4,000,000	....	200	110	....	....	....
Cons. M. 6% g. bds.....	1,150,000	1918	110⅝	105	....	....	....
Benton, Belle'ne Ry. Co.'s 1st M. 6% bds.....	300,000	1896|1911	102	100	100	100	100
Mound City R. R. Co.'s 1st M. 6% bds.	400,000	1900|1910	105	102	104	104	104
Jefferson Ave. Ry. Co., Stock..... 100	112,000	....	300	125	....	....	....
1st M. 5% bds.....	228,000	....	103	100	....	....	....
Missouri R. R. Co., Stock..... 100	2,300,000	....	210	200	208	208	208
1st M. 6% bds.....	500,000	1907	102¾	100	100	100	100
Lindell Ry. Co., Stock..... 100	2,500,000	....	140	105	136	134	134
1st M. 5% bds.....	1,500,000	1911	105⅛	101½	104	104	104½
St. Louis & Suburban Ry. Co., Stock 100	2,500,000	....	33½	19¾	34	33½	34
1st M. 5% bds. (incl. $600,000 in esc.)..	2,000,000	1921	97½	76	....	....	....
Inc. 6% bds.....	300,000	....	101	45	....	....	....
People's R. R. Co., Stock..... 50	1,000,000	....	25	9	12	10	11
1st M. 6% bds.....	125,000	1892|1902	101	85	....	....	....
2nd M. 7% bds.....	75,000	1902	102	72	....	....	....
Cons. M. 6% bds. (incl. $200,000 in esc.)	1,000,000	1899|1904	88	76	....	....	....
Fourth St. & Arsenal Ry. Co., Stock 50	150,000	....	25	4	18	18	18
1st M. 6% bds.....	50,000	1898|1903	101	98	....	....	....
Southern Electric Ry. Co., Stock {common..... 100	700,000	....	45	40	....	....	....
{preferred 6% 100	800,000	....	88	84	....	....	....
Cons. M. 6% bds (incl. $200,000 in esc.)	500,000	1909	109	105	....	....	....
St. L. & E. St. L. E. R. Co., Stock.. 100	250,000	....	200	99	....	....	....
1st. M. 6% bds.....	75,000	1905	104	102	....	....	....
Baden & St. Louis R. R., Stock..... 100	50,000	....	....	....	....	....	....
1st M. 6% bds.....	250,000	1913	99½	97½	....	....	....
SAN FRANCISCO, CAL.*—Local quotations to Jan. 15.							
Market Street Ry. Co., Stock..... 100	18,616,782	....	45½	36½	45¼	44¾	44½
M'ket St. Cable Co.'s 1st M 6% bds....	3,000,000	1913	125	117¾	121	....	120
Omnibus Cable Co.'s 1st M. 6% bds....	2,000,000	1918	120	117	119	119	118½
Park & Ocean R. R. Co.'s 1st M. 6% bds.	250,000	1914	110	110	....	....	108 a
Park & Cliff House R. R. Co.'s 1st M. 6% bds.....	350,000	1913	104	96	102½	102½	102¼
Powell St. R. R. Co.'s 1st M. 6% bds...	700,000	1912	113	109	....	....	116 a
Ferries & Cliff House Ry. Co,'s 1st M. 6% bds.....	650,000	1914	....	....	....	....	108 a
Geary St., P'k & O. R. R. Co., Stock 100	1,000,000	....	103	99¾	....	....	....
1st M. 5% bds.....	671,000	1921	108	100	106	101	105 a
Cal. St. Cable R. R. Co., Stock..... 100	1,000,000	....	105¾	101½	....	....	105 b
1st M. 5% g. bds.....	900 000	1915	111½	106½	109⅞	109¾	109¾
Sutter Street Ry. Co., Stock..... 100	2,000,000	....	....	....	....	....	....
1st M. 5% g. bds.....	900,000	1918	110½	106½	....	....	110 a
Presidio & Ferries R. R. Co. Stock 100	1,000,000	....	15	15	7½	7½	5 b
Oakland, S. L. & Haywards Ry. Co. Stock..... 100	1,000,000	....	100	100	....	....	....
SPRINGFIELD, MASS.*—(See Holyoke.)							
TORONTO, ONT.*—Local quotations to Jan. 17.							
Toronto Ry. Co., Stock..... 100	6,000,000	....	88⅝	60¾	77	66½	73
WASHINGTON, D. C.*—Local quotations to Jan. 20.							
Capitol Traction Co.	2,000,000	....	....	....	77¼	75	75¼
Metropolitan R. R. Co ,Stock..... 50	750,000	....	103	63	100	97	97
Coll. Tr 6% conv. bds..	500,000	1901	126½	96	114	110	111¾
Belt Ry. Co., Stock..... 50	500,000	....	30	15	....	....	....
Cons. M. 6% bds. (inc. $50,000 in esc.)..	500,000	1921	90	77	84	83	83
Eckington & Soldiers' Home Ry. Co., Stock..... 50	352,000	....	35	15	15	15	15
1st M. 6% bds.....	200,000	1896|1911	105	100	101	100	101
G'getown & Ten'town Ry. Co., Stock 50	200,000	....	....	....	17	15	17
Columbia Ry. Co...... 50	400,000	....	70	45	55¾	50	56
1st M. 6% bds.....	500,000	1914	113	107½	113	112¾	114
WORCESTER, MASS.*—New York quotations to Jan. 22.							
Worcester Traction Co., Stock {common.. 100	3,000,000	....	20	10	14½	12	12½
{pref. 6%... 100	2,000.000	....	89	77½	88½	80	84½
Worcester Cons. St. R. R. Co......	....	....	....	....	....	....	....
1st. M. 5% bds.....	150,000	....	....	....	100	100	100
Deb. 5% g. bds.....	500,000	....	....	....	99	99	99

* See foot note on preceding pages.

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

Annual Reports.

THE ALBANY RAILWAY, ALBANY, N. Y.

Year ending Dec. 31,	1893.	1894.	1895.
Receipts from passengers.....	$414,253	$455,874	$519,387
" other sources.....	4,204	6,044	2,889
" total.....	418,457	461,918	522,276
Operating expenses.....	251,035	298,972	314,319
Earnings from operation.....	167,422	162,946	207,957
Deductions from earnings.			
Interest on bonds.....	39,313	40,697	40,790
Taxes.....	12,645	16,143	16,643
Rentals.....	30,383	30,778	31,223
Other deductions.....	2,202	4,974	
Net income.....	82,878	70,354	119,300
Per cent operating expenses to total receipts.....	60.0	64.7	60.1

NORTH CHICAGO STREET RAILROAD COMPANY, CHICAGO, ILL.

Year ending Dec. 31,	1894.	1895.
Total receipts.....	$2,565,618	$2,780,487
Operating expenses.....	1,347,326	1,311,607
Earnings from operation.....	1,218,292	1,468,880
Deductions from earnings.....	465,648	471,251
Net income.....	752,644	997,629
Dividends paid.....	659,913	659,922
Surplus.....	92,731	337,707
Per cent operating expenses to total receipts.....	52.5	47.2

WEST CHICAGO STREET RAILROAD COMPANY, CHICAGO, ILL.

Year ending Dec. 31,	1894.	1895.
Total receipts.....	$4,181,237	$4,201,477
Operating expenses.....	2,518,627	2,267,195
Earnings from operation.....	1,662,610	1,934,282
Deductions from earnings.....	859,471	902,016
Net income	803,139	1,032,266
Dividends paid.....	1,184,298	791,340
Surplus.....	def. 381,159	240,926
Per cent operating expenses to total receipts.	60.2	54.0

SPRINGFIELD STREET RAILWAY COMPANY, SPRINGFIELD, MASS.

Year ending Sept. 30,	1893.	1894.	1895.
Receipts from passengers.....	$383,602	$368,719	$442,000
" other sources.....	7,571	5,184	
" total.....	391,173	373,903	442,000
Operating expenses.....	272,829	252,269	277,155
Earnings from operation.....	118,344	121,634	164,845
Deductions from earnings.			
Interest on bonds.....		123	12,672
Taxes.....	18,731	18,087	17,964
Net income.....	99,614	103,424	134,209
Per cent operating expenses to total receipts.....	69.8	67.4	62.7

BIDDEFORD & SACO RAILROAD COMPANY, BIDDEFORD, ME.

Year ending June 30,	1893.	1894.	1895.
Total receipts.....	$28,213	$24,219	$24,287
Operating expenses.....	19,471	14,813	12,186
Earnings from operation.....	8,742	9,406	12,101
Deductions from earnings.			5,914
Interest on bonds.....	5,400	5,400	
" " floating debt.....	1,536	722	
Taxes.....	143	269	
Net income.....	1,663	3,016	6,187
Per cent operating expenses to total receipts.....	69.0	61.1	50.1

SCRANTON TRACTION COMPANY, SCRANTON, PA.

Year ending Dec. 31,	1894.	1895.
Total receipts.....	$253,686	$299,322
Operating expenses.....	142,410	157,384
Earnings from operation.....	111,276	141,938
Per cent operating expenses to total receipts...	56.1	52.5

TABLE OF OPERATING STATISTICS.

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

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

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
ALBANY, N. Y.						
The Albany Ry	3 m., Dec. '94	122,382	85,240	37,142	22,579*	14,564
	3 " " '95	132,407	83,928	48,479	21,457*	27,022
	12 " " '94	461,918	298,972	162,947	92,592*	70,354
	12 " " '95	522,276	314,319	207,957	88,657*	119,300
BALTIMORE, MD.						
Baltimore Traction Co	1 m., Dec. '94	85,663				
	1 " " '95	95,673				
	3 " " '94	255 321				
	3 " " '95	289,659				
City & Suburban Ry. Co	12 " June '94	605,123	409,363	195,760		
	12 " " '95	751,720	546,970	204,750		
BATH, ME.						
Bath St. Ry. Co	1 m., Nov. '94	1,462	1,187	275		
	1 " " '95	1,501	1,052	449		
	11 " " '94	18,527	14,303	4,224		
	11 " " '95	20,177	13,242	6,935		
BIDDEFORD, ME.						
Biddeford & Saco R R Co.	12 m. June '94	24,219	14,813	9,406	6 391*	3,016
	12 " " '95	24,287	12,186	12,101	5,915*	6,186
BINGHAMTON, N. Y.						
Binghamton R. R. Co	1 m., Sept. '94	12,597	6,005	6,592		
	1 " " '95	12,553	5,716	6,837		
	9 " " '94	90,741	51,203	39,538		
	9 " " '95	97,075	55,749	41,326		
BOSTON, MASS.						
Lynn & Boston R. R. Co. }	12 m., Sept. '94	1,238,410	746 304	492,106	379.029*	113,077
North Shore Traction Co. }	12 " " '95	1,381,889	784,392	596,997	391,681*	205,316
	1 " Nov. '94	91,628	65,863	25,765		
	1 " " '95	98,540	68,697	29,844		
	2 " " '94	194,355	131.871	62,484		
	2 " " '95	205.371	136,242	69,129		
BRIDGEPORT, CONN.						
Bridgeport Traction Co	1 m., Dec. '94	20,041	11,788	8.253		
	1 " " '95	24,577	12,570	12,007		
	12 " " '94	144.447				
	12 " " '95	303.416	156,240	147,176		
BROCKTON, MASS.						
Brockton St. Ry. Co	1 m., Nov. '94	18,092	10,157	7.935		
	1 " " '95	20,379	16,314	4,065		
	11 " " '94	207,378	133,822	73,556		
	11 " " '95	252,354	153,362	98,992		
BROOKLYN, N. Y.						
Brooklyn Traction Co	1 m., Nov. '94	97,720	55,051	42,669		
	1 " " '95	85,672	53.452	32,220		
	11 " " '94	1,040,346	632,537	407,809		
	11 " " 95	938,717	752,271	186,446		
Coney Island & Brooklyn R. R. Co	3 m., Sept. '94	115.805	62,260	53,545		
	3 " " '95	134,760	61,766	72,994		
	9 " " '94	252,546	162,528	90,018		
	9 " " '95	310,386	182,429	127,957		
Brooklyn City & Newtown R. R. Co	3 m., Sept. '94	148.187	80,608	67,579		
	3 " " '95	137,801	82,296	55,505		
	9 " " '94	441,490	246,675	194,815		
	9 " " '95	452,928	284,634	168,294		
Brooklyn Elev. R. R. Co	12 m., Dec. '94	1,730,848	1055.462	675,386	816,726	d141,340
	12 " " '95	2,082,684	1170 949	911.735	846,745	64.990
Brooklyn Heights R.R. Co.	3 m., Sept. '94	1,304.717	738,963	565,754	495.255*	70,500
	3 " " '95	1,205,075	638.363	566,712	516,726*	49.986
	6 " " '94	2,544.522	1464,846	1,079,676	991.941*	87,735
Brooklyn, Queens Co. and Sub. R. R. Co	6 " " '95	2,351,013	1374,565	976,446	1057.590	d81,144
	3 m., Sept. '94	185,072	109,241	75,831	84,202*	d8,371
	3 " " '95	192,485	108,348	84,137	84,499*	d 362
	9 " " '94	441,756	324,556	117,200		
	9 " " '95	455,580	295,566	160,014		
BUFFALO, N. Y.						
Buffalo Ry. System	1 m., Sept. '94	131.186	70,944	60,242		
	1 " " '95	146,735	70,358	76,377		
	9 " " '94	1,138,152	644,443	493,709		
	9 " " '95	1,252,575	640,975	611,600		
CHICAGO, ILL.						
Lake St. Elev. Ry. Co	3 m., Dec. '94	131,898				
	3 " " '95	156,737	90,160	66,627		
	12" " '94	428.095	290,090	138,005		
	12" " '95	517,301	319,606	197,695		
No. Chicago R. R. Co	12 m., Dec. '94	2.565,618	1347,326	1,218,292	465,648	752,644
	12 " " '95	2,780,487	1311,607	1,468.880	471,251	997.629
West Chicago R. R. Co	12 m., Dec. '94	4,181,237	2518,627	1.662.610	859,471	803.139
	12 " " '95	4,201,477	2267,195	1,934,282	902,016	1032,266
CINCINNATI, O.						
Cinn. Newport & Cov. Ry Co	1 m., Nov. '94	42,609	28,956	13,653		
	1 " " '95	50.302	34,987	16,315		
	11 " " '94	453,911	334,276	119,635		
	11 " " '95	570,935	381,602	189,333		
CLEVELAND, O.						
Cleveland Elec. Ry. Co	1 m., June '94	148,812	101,455	47,357		
	1 " " '95	135,063	76,870	58,193		
	6 " " '94	607,577	407,254	200,323		
	6 " " '95	691,197	457,424	233,773		
COLUMBUS, GA.						
Columbus R. R. Co	1 m., Dec. '94	2,340				
	1 " " '95	3,121	1,919	1,202		
	12" " '95	44,271				
COLUMBUS, O.						
Columbus St. Ry. Co	1 m , Dec. '94	50,085	24,713	25,372		
	1 " " '95	55,408	27.271	28.137		
	12 " " '94	566,811	269,362	297,449		
	12 " " '95	629,995	311,594	318,401		
DENVER, COL.						
Denver Cons. Tramway Co.	12 m., June '94	729,237	449,981	279.255		
	12 " " '95	710,103	432.500	277.693		
	1 m., Nov. '94	57,922	34,369	23,553		
	1 " " '95	54,588	33 774	20,784		
	5 " " '94	313 746	186,368	127,378		
	5 " " '95	322,696	196,519	126 177		

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
DETROIT, MICH.						
Ft. Wayne & Belle Isle St. Ry. Co	6 m., June '95	116,945				
Citizens' St. Ry. Co	6 " " '95	386,575				
Rapid Ry. Co	5½ m., Dec. '95	30,356	15,586	14,770	6,875	7,895
DULUTH, MINN.						
Duluth St. Ry.	1 m., Oct. '94	20,032	8,294	11,738		
	1 " " '95	19,152	7,991	11.161		
	10 " " '94	171,065	93,808	77,257		
	10 " " '95	175,829	77,652	98,177		
GALVESTON, TEX.						
Galveston City R. R. Co	1 m. Nov. '94	16,273	10,815*	5,458		
	1 " " '95	15,848	12,002*	3,846		
	11 " " '94	181,923	120,339*	61,584		
	11 " " '95	200,487	129,113*	71,374		
GIRARDVILLE, PA.						
Schuylkill Traction Co.	12 m. Sept. '94	88.288	56.564	31,724	25,000	6,724
	12 " " '95	90,981	52,851	38,130	29,770*	8,360
	3 m., Dec. '94	22,410	14,492	7,918		
	3 " " '95	23,994	14,155	9,839		
HAZLETON, PA.						
Lehigh Traction Co.	1 m. Dec. '94	10,067	5,894	4.173		
	1 " " '95	10,546	5,085	5,461		
	12 " " '94	97,202	50,605	46,597		
	12 " " '95	119,588	70,888	48,700		
HOUSTON, TEX.						
Houston City St. Ry	12 m., Oct. '95	222,808	149,205	73,603	70,204*	3,399
	1 m., Dec., '94	18,489	9,938	8.551		
	1 " " '95	17,776	11,000	6,776		
JAMESTOWN, N. Y.						
Jamestown St. Ry. Co.	3 m., Sept. '94	34,461	18.023	16,439	4,929*	11,510
	3 " " '95	39.411	19,439	19,972	6,871*	13,101
	9 " " '94	68 412	47,621	20,791	14.724*	6.057
	9 " " '95	74,092	51,630	22,462	15,989*	6,473
KANSAS CITY, MO.						
Metropolitan St. Ry. Co	1 m., Nov. '94	134,548	86,279	48,269		
	1 " " '95	140,890	85,391	55,499		
	6 " " '94	919.991	559,770	360,221		
	6 " " '95	948,131	532,113	416,018		
KINGSTON, N. Y.						
Kingston City R. R. Co	12 m. June '94	46,467	29,038	17,430	9,398*	8,030
	12 " " '95	50,230	31,404	18,826	9,576*	9,252
LAWRENCE, MASS.						
Lowell, Lawrence & Haverhill St. Ry. Co	12 m., Sept. '95	269,740	205.816	63.924	73,423*	d 8,498
	12 " " '95	403,530	262.935	140,595	84,081*	56,514
	1 " Nov. '94	21,897	16,330	5.564		
	1 " " '95	29,207	19,765	9,442		
	11 " " '94	259,910	190,736	69.174		
	11 " " '95	392,638	249,689	142.949		
LONG ISL. CITY, N. Y.						
Steinway Ry. Co	12 m. June '94	273,497	119,014	154,483	68,083*	86,400
	12 " " '95	246.742	139,556	107.186	95,370*	11,816
	3 " Sept. '94	68,932	38,488	30,444	21.390*	9,054
	3 " " '95	108,050	54 946	53,104	28,610*	24.494
	9 " " '94	155,556	84,707	70.849	62,379*	8,470
	9 " " '95	226,283	126.594	99,689	79.926*	19,763
LORAIN, O.						
Lorain St. Ry	1 m., Nov. '95	6,032	4,829	1,203		
	11 " " '95	74,468	40,733	33,735		
LOUISVILLE, Ky.						
Louisville Ry. Co	1 m , Sept. '94	105,026	56,438	48,588		
	1 " " '95	158.725	66,308	92,416		
	9 " " '94	875,604	471.747	403.857		
	9 " " '95	966,698	498,198	468,500		
LOWELL, MASS.						
Lowell & Suburban St. Ry. Co	12 m. Sept. '94	277,029	179.409	97,620	66,624*	30,995
	12 " " '95	329,817	199,346	130,471	66,575*	63,896
MINNEAPOLIS, MINN.						
Twin City R. T. Co	1 m., Nov. '94	161,259	72,093	89,166		
	1 " " '95	162,666	68,349	94.317		
	11 " " '94	1,813,316	816.052	997,258		
	11 " " '95	1,796,352	773,173	1,023,179		
MONTGOMERY, ALA.						
Montgomery St. Ry. Co	1 m., Dec. '94	3,623	2,237	1,386		
	1 " " '95	4,383	1,957	2,426		
	12 " " '94	35,216	21,724	13,492		
	12 " " '95	50,645	27,915	22,730		
MONTREAL, CAN.						
Montreal St. Ry. Co	12 m. Sept. '94	897,838	628.454	269,384	55,363*	214.021
	12 " " '95	1,102 778	652,812	449,966		351,349
	1 " Dec. '94	75,845				
	1 " " '95	94,800				
	3 " " '94	242,959				
	3 " " '95	290,400				
NEW BEDFORD, MASS						
Union St. Ry. Co	1 m., Dec, '94	13,381				
	1 " " '95	16,008				
NEWBURGH, N. Y.						
Newburgh Elec. Ry. Co.	1 m., Nov. '94	3,594	3,142	452		
	1 " " '95	5,818	3,956	1,862		
	5 " " '94	36,388	17,268	19.120		
	5 " " '95	52,737	25,360	27.377		
NEW HAVEN, CONN.						
New Haven St. Ry. Co	1 m., Sept. '94	14,257				
	1 " " '95	19,592				
	9 " " '94	92.476				
New Haven & Centreville St. Ry. Co	9 " " '95	150.649				
	1 " Dec. '94	2,742				
	1 " " '95	4.909				
West Shore Ry. Co	1 " " '94	336				
	1 " " '95	344				

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
NEW ORLEANS, LA.						
New Orleans Traction Co.	1 m., Nov. '94	93,102	58,027	35,075		
	1 " " '95	121,400	62,559	58,841		
	12 " " '94	951,528	620,508	331,020		
	12 " " '95	1,327,776	752,158	575,598		
NEW YORK, N. Y.,						
Third Ave. R. R. Co.	3 m., Sept. '94	622,028	312,976	309,052	87,475*	221,577
	3 " " '95	737,829	366,958	370,871	82,044*	288,827
	9 " " '94	1,576,059	825,906	750,153	255,580*	494,573
	9 " " '95	2,029,812	1,0 9,499	940,313	244,718*	695,595
	12" Oct. '94	2,134,437	1,070 965	963,472	328,467	635,005
	12" " '95	2,650,063	1,528,469	1,121,594	330,590	791,004
Metropolitan St. Ry. Co.	3 m., Sept. '94	1,413,538	820,706	592,832	459,996	132,836
	3 " " '95	1,582,011	800,352	781,6 9	513,131	268.528
	9 " " '94	3,822,470	2.221,755	1,600,715	1,329,013	271,706
	9 " " '95	4,475,001	2 351,317	2,123,684	1,523,377	600,307
Manhattan Ry. Co.	3 m., Sept. '94	2,083.310	1,250,635	832,675	660,228	172,447
	3 " " '95	2,148,530	1,319,129	829,401	766,790	62,611
	9 " " '94	7.371,408	4,089 329	3,282.079	1,960,568	1,321.511
	9 " " '95	7,167,493	4,125,757	3,041,736	2,141,776	899,960
Second Avenue R.R. Co	12 m., June '94	1,018,133	794,765	223,368	131,885*	91,483
	12 " " '95	957,463	734,915	222,548	129,428*	93,120
D. D., E. B. & Bat'y R. R. Co.	12 m., June '94	655,558	464,068	191,490	175,894	15,596
	12 " " '95	730,033	532,245	197,788	136,093	61,695
New York & Harlem R. R. Co.	3 m., Sept. '95	197,628	136,712	60.916	10,100	50,816
42d St., Man. & St. N. Ave. R. R. Co.	3 m., Sept. '94	165,855	132,388	33.467	30,717*	2,750
	3 " " '95	161 121	133,972	27.149	30,700*	d 3,551
	6 " " '94	337,756	261 020	76.736	61,405*	15.331
	6 " " '95	326,773	265,914	60,859	61,400*	d 541
Union Ry. Co.	3 m., Sept. '94	136.588	67.172	69,416	37,674	31,742
	3 " " '95	136,125	74,570	61,555	32,427	29,128
	9 " " '94	364,974	189,974	175,000	118,165	56.835
	9 " " '95	345,292	198,225	147,067	95,323	51 744
Westchester Elec. R.R. Co.	3 m., Sept. '94	28,655	20.588	8,067	6,957	1.110
	3 " " '95	38,512	22,818	15 694	7,428	8.266
	6 " " '95	68,738	42,331	26,407	14,818	11,589
NORRISTOWN, PA.,						
Schuylkill Val. Trac. Co	1 m., Dec. '94	3,165				
	1 " " '95	4,220				
NO. ABINGTON, MASS.						
Rockland & Abington St. Ry. Co.	12 m., Sept. '95	67,815	49,759	18,056	6,010	12,046
NORTHAMPT'N, MASS.						
Northampton St. Ry. Co	1 m., Aug. '94	6,324	2,265	4,059		
	1 " " '95	10,315	3,864	6,451		
	8 " " '95	58,205	29,651	28,554		
OAKLAND, CAL.,						
Oakland Consol. St. Ry. Co.	6 m., June '95	62,342	46,099	16,243		
PATERSON, N. J.,						
Paterson Ry. Co.	1 m., Dec. '94	20,253	13,440	6,813		
	1 " " '95	25,485	15,298	10,187		
	12" " '94	243,881	157,527	86,354		
	12" " '95	298,318	172,901	125,417		
PHILADELPHIA, PA.,						
People's Traction Co'.	12 m. June '94	1,044,159	673,479	370,680		
	12 " " '95	1,660,676	829,815	830,861		
	1 " Sept. '94	137.331				
	1 " " '95	194,103				
	9 " " '94	885,847				
	9 " " '95	1,533,588				
Hestonville M. & F. P. Ry. Co.	12 m. June '94	302 684	215,032	87,652		
	12 " " '95	373,690	268,566	105,124		
	1 " Nov. '94	20,786				
	1 " " '95	44,145				
	11 " " '94	282,887				
	11 " " '95	471,402				
Electric Traction Co.	12 m. June '94	1,900 606	1,120.026	780.580		
	12 " " '95	2,151,853	1,241,584	910,269		
PITTSBURG, PA.,						
Central Traction Co.	1 m., Dec. '94	14,807				
	1 " " '95	15,850				
Second Ave Pass. Ry. Co	1 m. Dec. '95	37,555				
PORTSMOUTH, VA.,						
Portsmouth St. Ry. Co.	1 m., Dec. '95	2 595	1,395	1,200		
	12 " " '95	36.752	16,532	20,220		
POUGHKEEPSIE, N. Y.,						
Poughkeepsie City & Wappinger's Falls E. R. Co.	1 m., Sept. '95	12,002	7,246	4,756		
	9 " " '95	73,155	44,428	28,727		
PROVIDENCE, R. I.						
United Traction Co.	1 m., Nov. '94	118,652				
	1 " " '95	133,628				
READING, PA.,						
Reading Traction Co.	1 m, Nov. '94	11.192				
	1 " " '95	13,146				
ROANOKE, VA.,						
Roanoke St. Ry. Co.	1 m., Nov. '94	2,661				
	1 " " '95	2,885				
ROCHESTER, N. Y.,						
Rochester Ry. Co.	1 m., Oct. '94	68,800	35,105	33,695		
	1 " " '95	71,389	37,999	33,390		
	10 " " '94	618,122	356,598	261,524		
	10 " " '95	719,758	428,431	291,327		
ROME, N. Y.						
Rome City St. Ry. Co.	3 m., Sept. '94	3,258	2,265	993	2,354	d 1,362
	3 " " '95	2,724	1,999	725	35	d 690
	6 " " '94	8,953	7,692	1,261	10,100	d 8,839
	6 " " '95	9,827	8,940	887	4,896	d 4,009
SAGINAW, MICH.,						
Union Ry. Co.	1 m., Dec. '95	9,827	5,819	4,008		
	12 " " '95	127,617	68.957	58 660		
SARATOGA, N. Y.,						
Union Elec. Ry. Co. of Saratoga	1 m., Sept. '95	11,554	6,301	5,253		
	9 " " '95	99,578	52 703	46,875		
SCRANTON, PA.,						
Scranton Trac. Co.	1 m., Dec. '94	22,664	14,038	8,626		
	1 " " '95	29,180	14,035	15,146		
	12 " " '94	253,686	142.410	111,276		
	12 " " '95	299,322	157,384	141,938		
SIOUX CITY, IA.,						
Sioux City Trac. Co.	1 m., Nov. '94	6,844	6,488	356		
	1 " " '95	6,829	6,137	692		
	6 " " '94	45,494	34,104	11,390		
	6 " " '95	40,445	33,995	6,450		
SPRINGFIELD, MASS.						
Springfield St. Ry. Co.	12 m Sept. '94	373,903	252,269	121,634	18,210*	103,424
	12 " " '95	442,000	277,155	164,845	30,636*	134,209
SYRACUSE, N. Y.,						
Syracuse Cons. St. Ry. Co.	3 m., June '94	51.216	44,705	6.511	43*	6,463
	3 " " '95	40,961	44,597	d 3,636	—	d 3,636
	6 " " '94	95,308	87,974	7.335	48*	7,287
	6 " " '95	85,303	92,295	d 6,992	234*	d 7,226
Syracuse St. R. R. Co.	3 m., June '95	68,236	39,491	28,745	24,763*	3,980
	6 " " '95	105,430	67,260	38.170	46,397*	d 8,227
TAUNTON, MASS.,						
Taunton St. Ry. Co.	1 m., June '95	7,571				
	6 " " '95	34,388				
TERRE HAUTE, IND.,						
Terre Haute Elec. Ry. Co.	1 m., Oct. '94	8,661				
	1 " " '95	11,998				
	2 " " '94	20,881				
	2 " " '95	28,303				
TORONTO, ONT.,						
Toronto St. Ry. Co.	12 m., Dec. '94	958,371	517,708	440,663		
	12 " " '95	992,801	489,915	502,886		
TROY, N. Y.,						
Troy City Ry. Co.	3 m., Sept. '94	118,916	57,207	61,709		
	3 " " '95	138,980	66,710	72,270		
	9 " " '94	316,817	155,258	161,559		
	9 " " '95	361,807	181,919	179,888		
UTICA, N. Y.						
Utica Belt Line.	1 m., Sept. '95	14,822				
WASHINGTON, D. C.						
Capital Traction Co.	12 m., Dec. '95	1,063,767	634,013	429,754		
WATERBURY, CONN.,						
Waterbury Trac. Co.	1 m., Nov. '94	15,939				
	1 " " '95	21,886	11,633	10,253		
	11 " " '95	224,941	130,193	94,748		
WILKES BARRE, PA.,						
Wilkes Barre & Wyoming Val. Trac. Co.	1 m., Dec. '95	43,099	19 256	23,843		
	12 " " '94	448,788	214,245	234,543		
	12 " " '95	400,143	196,824	203,319	122,607*	80,711
WILMINGTON, N. C.,						
Wilmington St. Ry. Co.	1 m., Sept. '94	2,900	2,027	873		
	1 " " '95	3,092	1,764	1.328		
WORCESTER, MASS.,						
Worcester Cons. St. Ry. Co.	1 m., Dec. '94	31,712	24,526	7,186		
	1 " " '95	39,054	28,089	10,965		
	12 " " '94	367,226	251,192	116,034		
	12 " " '95	441,603	302,376	138,227		

Financial Notes.

Allentown, Pa.—Suit has been brought by the Old Colony Trust Company, of Boston, to foreclose the mortgage of $200,000 on the property of the Allentown & Bethlehem Rapid Transit Company.

Amherst, Mass.—The Amherst & Sunderland Railway Company has been organized to construct an electric railway which will cost about $75,000. The officers of the company are: President, T. L. Paige, of Amherst; secretary and treasurer, David Barry; directors, Chas. Deuel and H. M. McCloud, of Amherst, Edmund Hobart and M. W. Howard, of North Amherst, and F. L. Whitmore and A. M. Darling, of Sunderland.

Amsterdam, N. Y.—The maps and profiles of the extension of the Amsterdam Street Railway Company, from Akin to Gloversville, have been filed in the offices of the county clerk. G. Morgan is general manager and purchasing agent for the company.

Atlanta, Ga.—The receiver of the Chattahoochee River Street Railway Company has been discharged. The company will be reorganized and the road will be put in operation again.

Appleton, Wis.—The street railway property of the Appleton Edison Electric Company will be sold at public auction during the first week in February.

Auburn, N. Y.—The Common Council has passed an ordinance granting a franchise on several streets of the city to the Auburn Interurban Railway Company. W. H. Pixley and L. S. Ebright, of Akron, O., and Geo. B. Turner and D. L. Ramsey, of Auburn, N. Y., are among those interested.