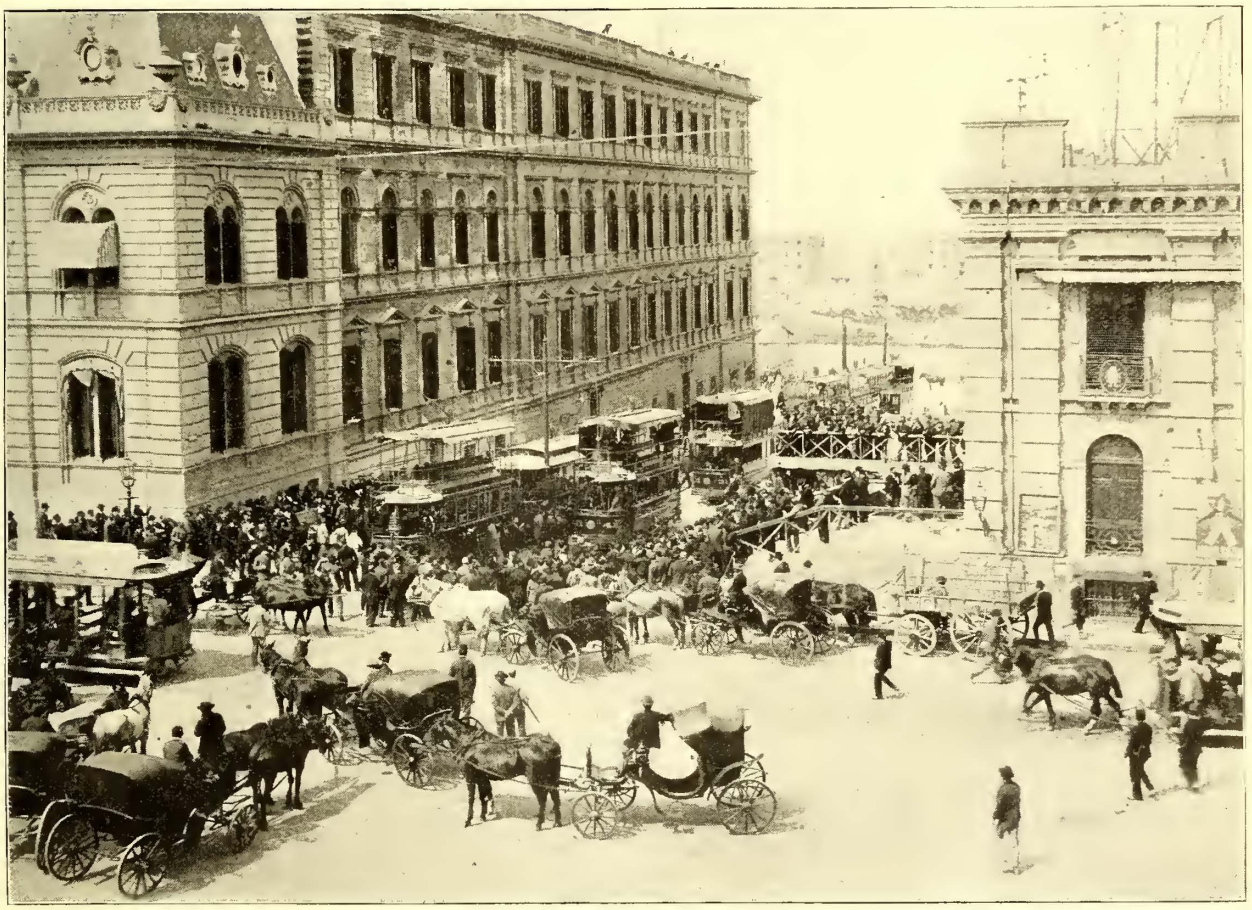
Street Railway Journal

VOL. XV. NEW YORK AND CHICAGO, FEBRUARY, 1899. No. 2.

ELECTRIC RAILROADING IN THE ARGENTINE

Buenos Aires, the largest and most important city in South America and the capital of the Argentine Republic, is situated on the River Plate, which is here about 30 miles wide. The majority of the inhabitants of the city are descendants of the Spaniards who have settled in the country during the last 300 years, but there is also a very large number of foreigners, among whom the Italians are probably the most numerous. The houses are generally of brick, and are usually one story in height. With the rapid immigration which has been setting in the direction of the Argentine and its capital during the past few years, the city has grown and is growing rapidly. The present population is not far from 850,000, and, at the present rate of increase, will probably reach 1,000,000 in three or four years.



OPENING DAY, LA CAPITAL TRAMWAYS, BUENOS AIRES

The great extent of the city makes street railway riding a necessity, and as a result the street railway systems have had an extensive development. Every street in the older part of the city, for a territory covering about two square miles, is traversed by a street railway line, with the exception of one short avenue, the shopping street of the city, from which tracks have been rigorously excluded. The streets in this part of the city are, for the most part, narrow, so that only one track is allowed on a street, and the cars of a line run down one street and up another, making most of the mileage single track. The average width of the streets in this section of the city, from curb to curb, is 25 ft., and the tracks are laid on the left-hand side of the roadway, leaving room for only one line of vehicles, which are obliged to run in the same direction as the cars, so that all traffic on every street in this portion of the city is in one direction only. The sidewalks in these narrow streets are usually but 4 ft. in width. In the newer part of the city, where the streets are 50 ft. wide or above, double-track construction is allowed.

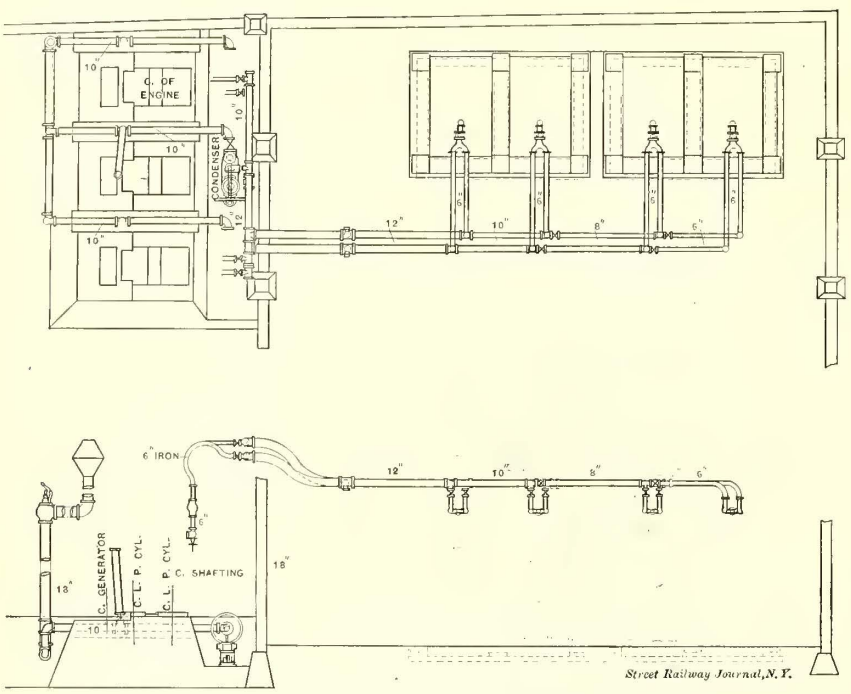
A list of the street railway companies in Buenos Aires, with mileage and a general description of the street railway conditions in that city, was published in the STREET RAILWAY JOURNAL for July, 1898. The railway companies have generally a London office, and they are owned in large part by English capital. Horses are used for the most part, and only two systems have yet adopted electricity. Horses and fodder are cheap, an excellent horse bringing only about $25, while coal is expensive. It is nearly all shipped from Wales, and costs from $6.50 gold per ton up. Nevertheless, the railroads which have

adopted electricity speak favorably of the economical results secured, and electric equipment is being rapidly forwarded.

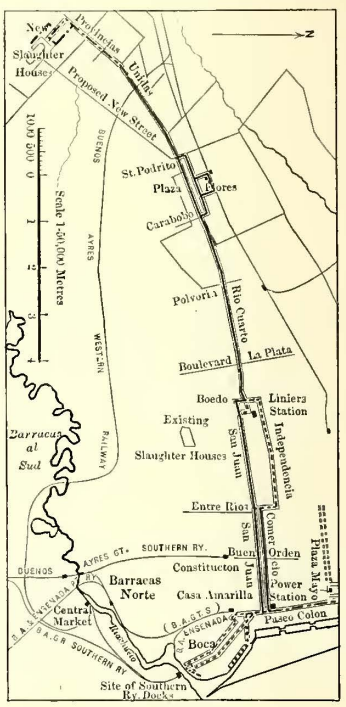
The companies which have already installed electric power on their lines are the La Capital Tramways Company, the greater part of which, comprising about 8¼ miles of double track, is now in operation by electric power, and the Buenos Aires & Belgrano Railways, or Bright's concession, of which a short section now employs electric traction, but which is being rapidly equipped throughout with the improved power.

The system of the La Capital Tramways Company, with which this article directly deals, reaches from the center of the city almost due west to New Chicago, where the government slaughter houses are located, and handles not only a large passenger business but also a large business in the transportation of fresh meat from that point to the city. Some reference has already been made to this traffic in former issues, and as it constitutes a very important branch of the transportation business of the city, and one which might be followed to advantage in other southern cities where the refrigeration of meat is not followed to any considerable extent, some particulars of it may be of interest. The present slaughter houses of Buenos Aires were built by a French company in 1889, at a cost of several million dollars. They have been purchased since by the Government, which rents stalls to the meat purveyors. All the meat consumed in the city comes from these houses, and as there are no refrigerating methods for preserving meat in general use, cattle are killed and the meat distributed to be eaten the same day. The La Capital Company has a contract for transporting all this meat to the city, and about 600 tons are carried on its cars and delivered to about thirty large markets located in different parts of the city. The butchers commence work about 2 o'clock in the morning and all the meat is delivered to the retail markets before 9 o'clock the same day. The special cars for handling this meat were illustrated in the Street Railway Journal for November, 1898, and January, 1899.

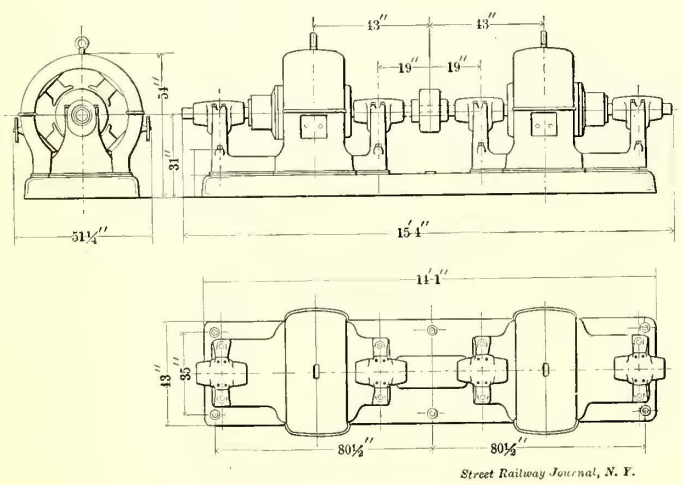
The power station of the La Capital Company is located in the old part of the city, near the end of the line and close to the docks. It consists of a framing of steel, supplied by the Berlin Iron Bridge Company, and filled in with brick between the steel columns. The engine room contains three Ball & Wood vertical compound engines of 450 h.p. directly connected to three Walker generators. The piping is in duplicate, and was furnished by Best, Fox



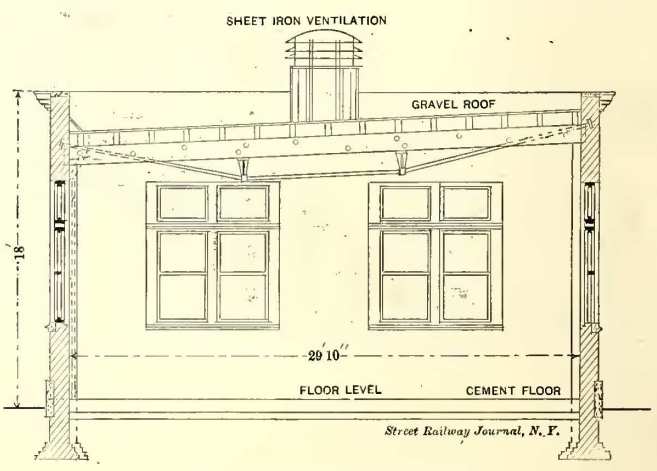
PLAN AND SIDE ELEVATION OF PIPING



MAP OF SYSTEM

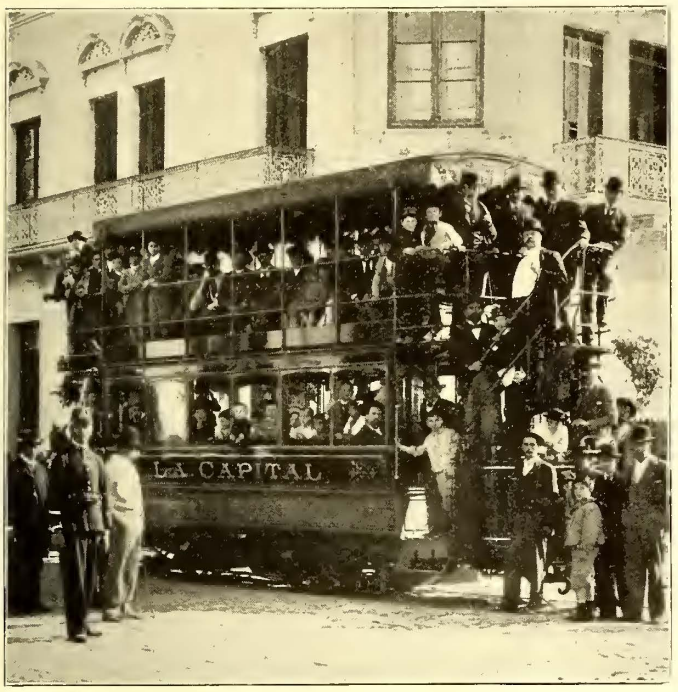


BOOSTER FOR BATTERY



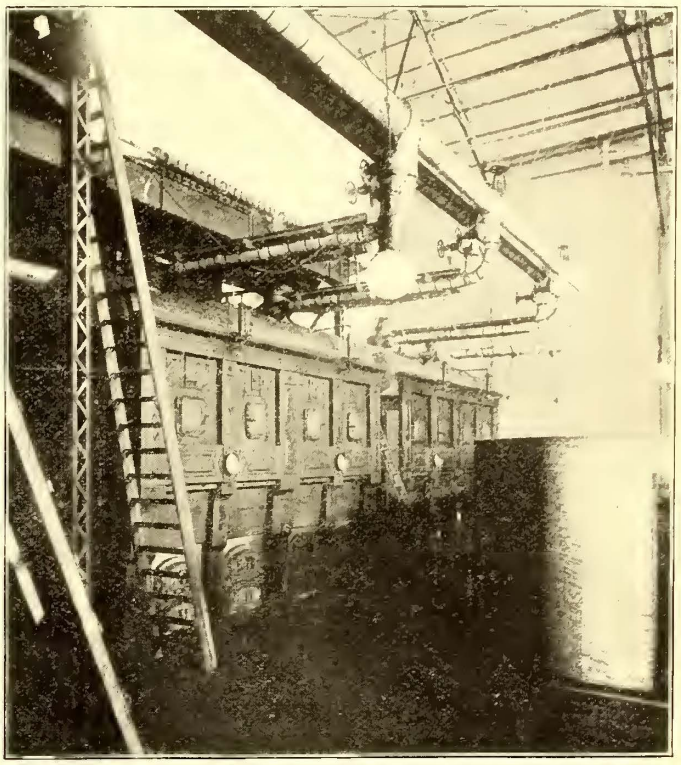
SECTION OF BATTERY HOUSE

& Company. The arrangement of the piping is shown in the plan view of the station, and under normal conditions of working both sets of duplicate pipes are in continuous use. In case of an accident to one set the other is run at slightly higher pressure until the trouble is remedied. Bent pipe is used instead of elbows. The boilers are of the Stirling type, four in number, and of 350 h.p. each. Green economizers and Worthington compound feed pumps are used, and an induced draft apparatus, supplied by the B. F. Sturtevant Company, is employed. The fans

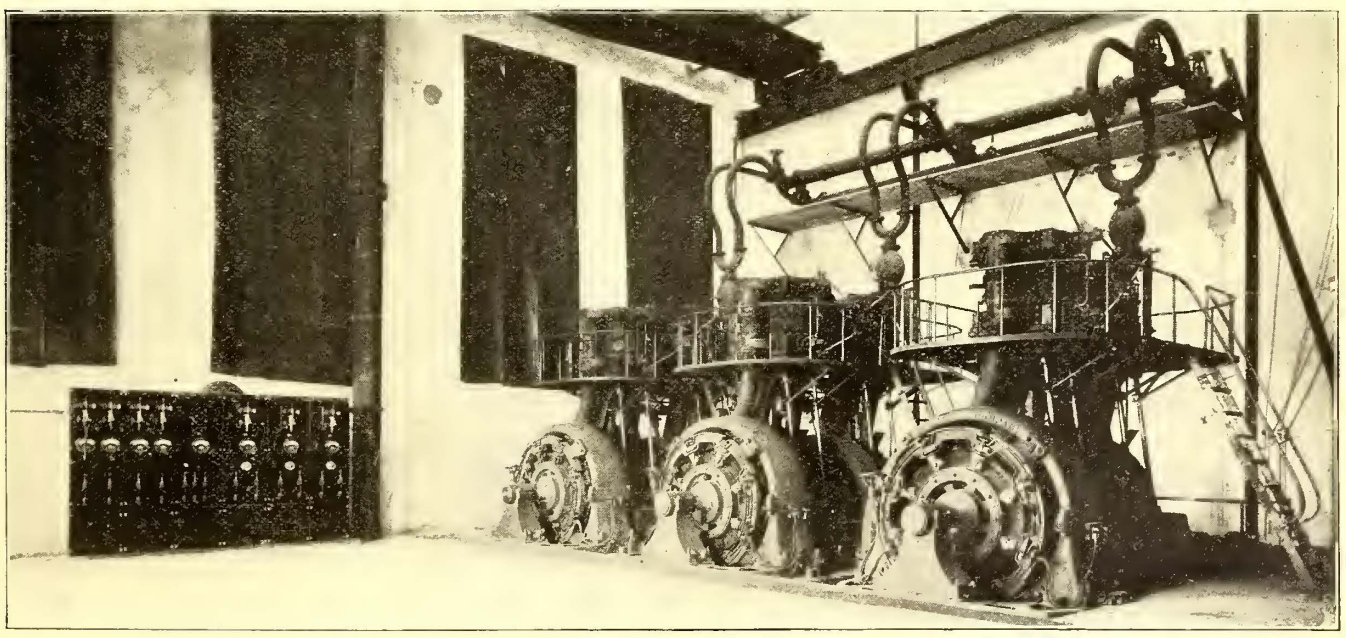


STANDARD CAR

cooling towers, supplied by the Wheeler Condenser & Engineering Company, are in use. The management speak in favorable terms of the use of induced draft, which, under the circumstances existing in Buenos Aires, is particularly valuable. In that city heavy showers come up suddenly, and when these occur the people crowd into the cars, throwing a sudden load on the power station. The



BOILER ROOM



VIEW OF ENGINE ROOM—LA CAPITAL TRAMWAYS COMPANY

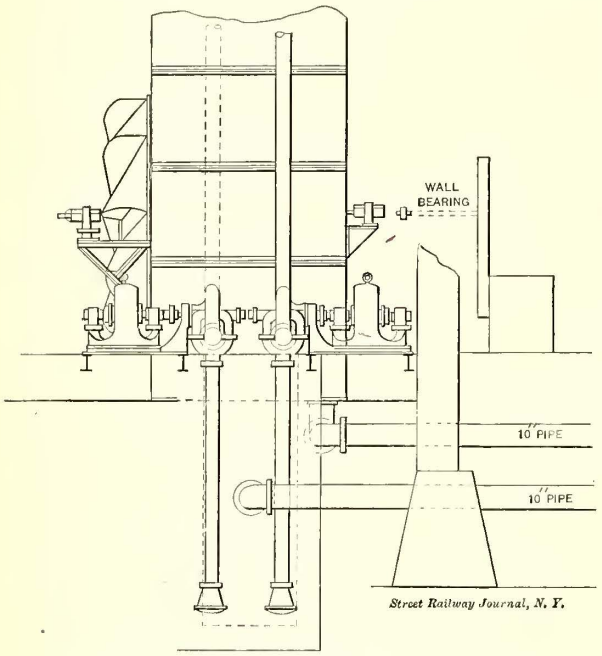
can be run by electric motor or separate steam engine, as desired, but the motor is usually employed. The fans are in duplicate, but arranged with a clutch so that one or both can be driven by either engine or motor. The induced draft apparatus and economizer are both placed over the boilers, as will be seen on the diagram, and by-passes are arranged to cut the economizer out of service if desired. The condensers are of the Conover type, and Barnard use of induced draft enables the station engineer to force the boilers up quickly at these times, and thus take care of this sudden load. The ability to force the boilers at will is also valuable in taking care of the evening pleasure load, which, in summer, is often very heavy.

The company has recently installed, close to the station, a chloride accumulator battery of 1000-h.p. hours capacity for station regulation, and also one of about the same size

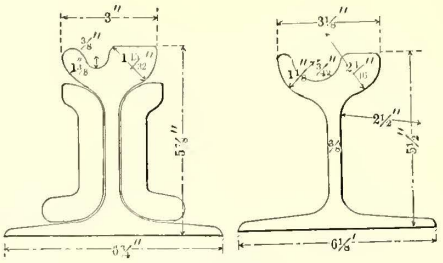
at about half a mile from the further end of the line for maintaining the necessary pressure at that point. Both batteries are fitted with motor-driven boosters; that for the distant battery is a shunt-wound machine of the ordinary type, with current always flowing in the same direction and at about 150 volts. The booster for the station battery is of the differential type. Both boosters were supplied by the Bullock Electric Manufacturing Company.

The track construction, when the electric equipment was first commenced, was that used formerly with horse traffic. The rails were quite soft and of the section shown herewith. An attempt was made to utilize these on part of the line, but it was finally decided advisable to replace them with a modern 9-in. 90-lb. girder rail in the city and a 7-in. 70-lb. rail in the suburbs. The section now employed is that shown above, the grooved rail being compulsory. The 9-in. rails were supplied by the Lorain Steel Company, and the 7-in. rails by the Pennsylvania Steel Company. They are in 30-ft. lengths, as it was found impossible to ship the 60-ft. lengths. They are mounted on 4-in. x 6-in. ties of *colorado quebracho*, which is a native wood, dark red in color, and so hard that spikes cannot be driven into it; holes, therefore, have to be bored for their reception. Ties of this wood practically last forever. They cost about 75 cents apiece, are spaced 2 ft., center to center, and are mounted on 6 ins. of concrete. The joints on the 9-in. rail are all of the twelve-bolt type and most of the track is double bonded with the Brown plastic bond. The special work was supplied by the Lorain Steel Company and the Pennsylvania Steel Company.

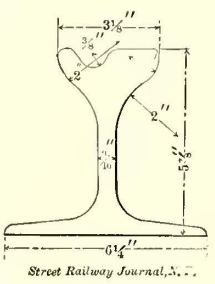
In the original construction tie-rods were used, but it was found that the heavy carts which are in use in this



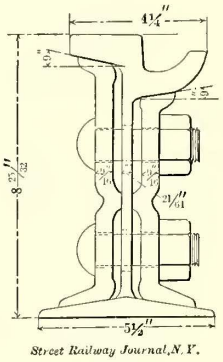
CIRCULATING PUMPS FOR COOLING TOWER



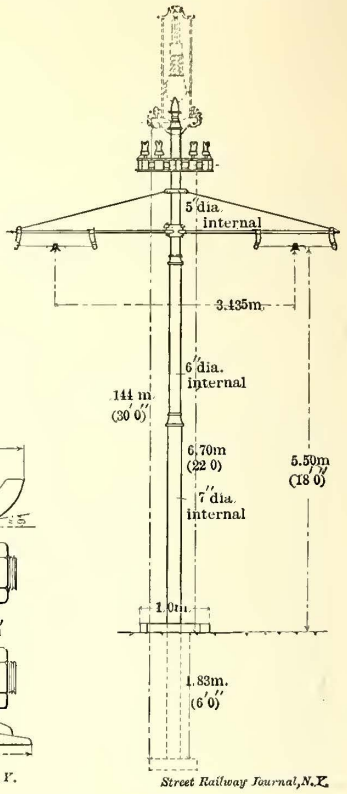
OLD RAILS



OLD RAIL

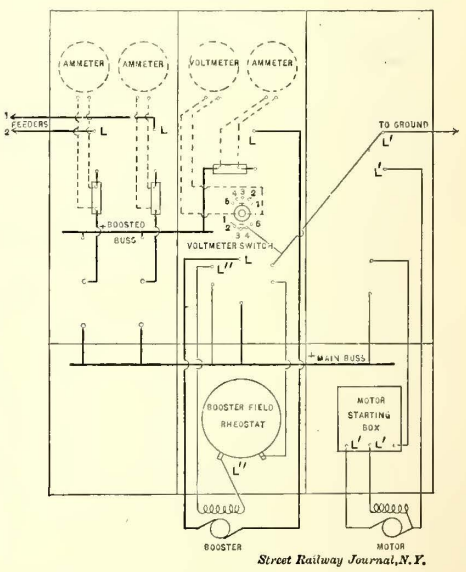


NEW RAIL



POLE

TYPICAL SCENE ALONG ROUTE



CONNECTIONS OF STORAGE BATTERY SWITCHBOARD AT POWER STATION

country broke off the ends of these rods, so that now braced tie-plates are being installed in their place. These native carts weigh from ten to fifteen tons each, and are fitted with wheels about 10 ft. in diameter. They are drawn by bullocks.

All feeders from the power station to Entre Rios, a distance of 1½ miles, are carried underground in creosoted wooden ducts; the rest of the feeders are carried overhead. Below Entre Rios iron poles with ornamental brackets are employed; beyond that point wooden poles are in use. The iron poles, which were supplied by Morris & Tasker, are all fitted with what are called refuges; these consist of a raised area at the base of the pole, about 39 ins. square and 6 ins. high, formed by curb stones and paved in the middle. The line appliances were supplied by H. W. Johns Manufacturing Company and A. & J. M. Anderson, and the feeders and the trolley wire by the Ansonia Brass Company. A number of poles in the center of the city carry arc lights. All the streets are paved either with stone blocks or native wood, and all paving is done by the company.

The cars are all of the double-deck type, with 18-ft. bodies. They were built by the J. G. Brill Company, and are mounted on Brill 21 E trucks. They are equipped with short platforms, and are all of short length on account of the narrow streets in the old part of the city, which would prevent the use of a longer car. The double decks are employed on account of the variable climate, which makes some passengers prefer an open car and others a closed car. The management reports that no accidents have followed the use of double-deck cars, and they seem well suited for the conditions existing in Buenos

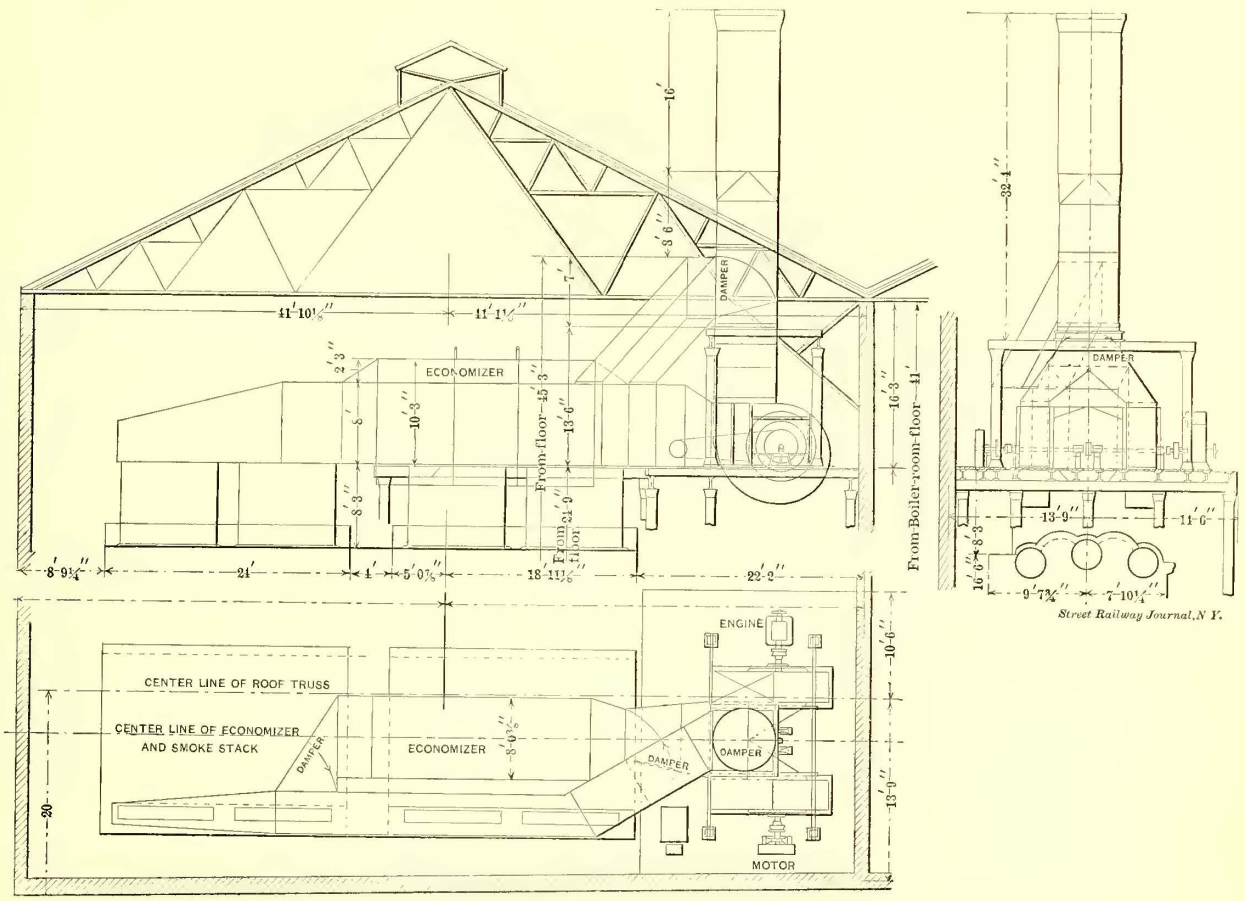
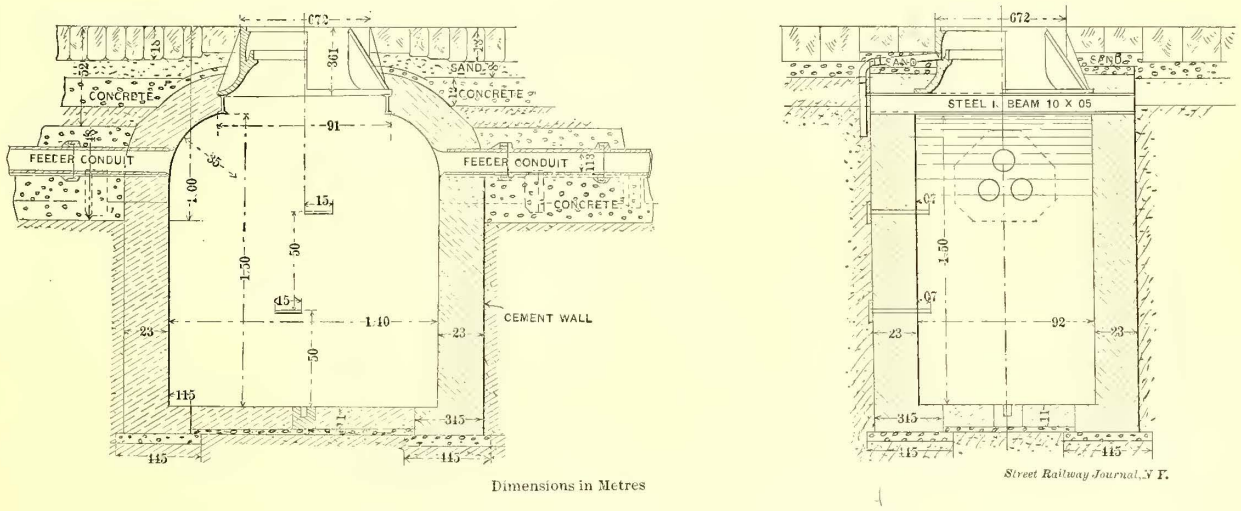
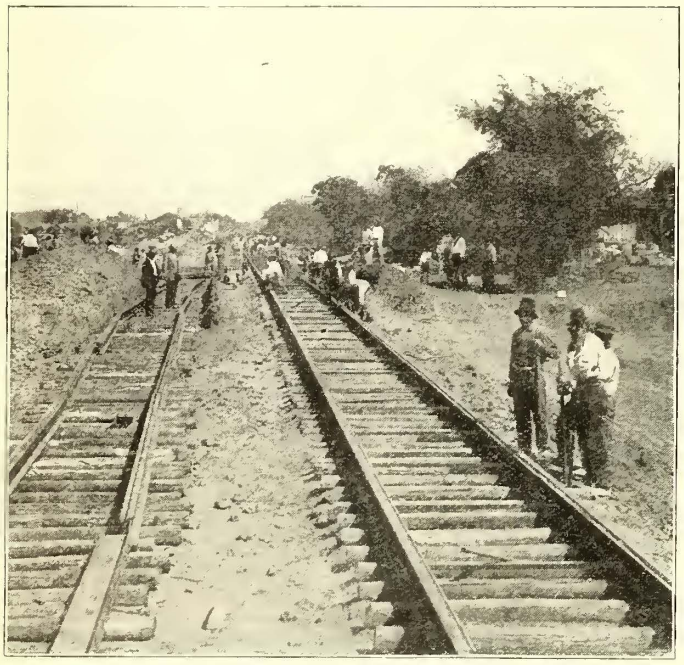


DIAGRAM SHOWING ARRANGEMENT OF ECONOMIZER AND INDUCED DRAFT APPARATUS



LONGITUDINAL AND CROSS SECTIONS OF MAN HOLE

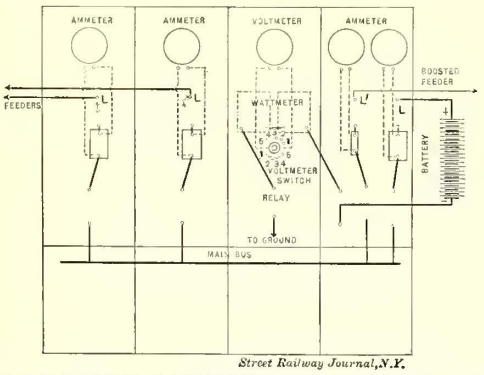
Aires. The usual European regulations in regard to limiting the number of passengers on the cars are in force, and only four people are allowed to stand on the front platform and six on the rear platform. The climate is about similar to that in Richmond, Va., and no car heaters are required. At present one motorman and two conductors are employed on each car, one conductor for the



LAYING TRACK

lower deck and one for the upper deck. Practically all of the motormen and conductors are Italians, as the natives of the country do not seem to take to the work. The wages paid are about $2.25 in paper, which is equivalent to about 80 cents in gold.

The officers of the company are: President, Theo. N. Vail; secretary and treasurer, H. Roberts Parrish; consulting engineer, E. T. Birdsall, M. E.; resident general manager, Charles R. Thursby, C. E.; resident chief engineer, J. W. McCrosky.

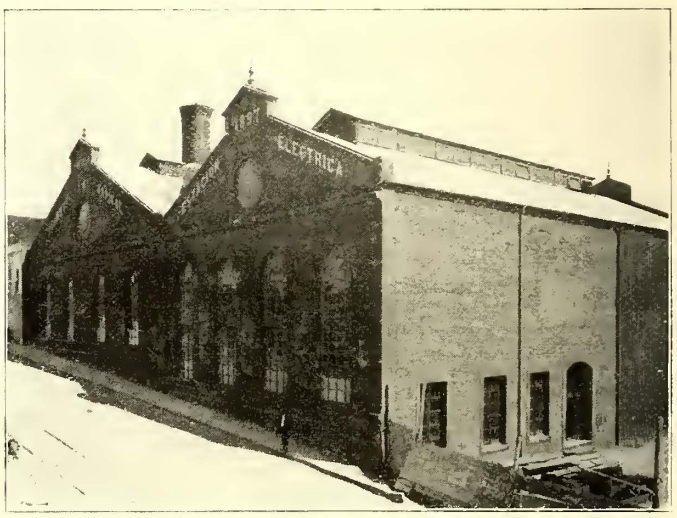


STORAGE BATTERY CONNECTIONS AT BOOSTER STATION

Electric Railroading in Milwaukee

Perhaps the heaviest daily car service on any American street railway is that given by the Milwaukee Electric Railway & Light company, of Milwaukee, from Milwaukee to Waukesha. The distance between these two points is 20 miles, and the winter service is given by two cars, which make the distance in about fifty-five minutes, an allowance of five minutes' wait being made at each end. Each car makes nineteen trips a day, or 380 miles in toto. The cars are double truck, and are made by the Barney & Smith Company.

The fare from Milwaukee to Waukesha is 35 cents single trip, and 50 cents round trip, which is considerably lower than the competing railroad fare, and the electric railway has taken nearly all the business away from the steam railroad. The line to Waukesha has been recently rebuilt, and is in magnificent condition. A large portion of it is over private right of way. A short time ago, on the invitation of General Manager Beggs, Henry Villard and other largely interested stockholders of the North Ameri-



EXTERIOR OF POWER HOUSE

can Company, and Edward E. Higgins, editor of the Street Railway Journal, made a trip over this line to

OX CARTS IN COMMON USE IN BUENOS AIRES

Waukesha in fifty minutes, the speed at places being as high as 45 miles per hour.

The Milwaukee Company's lines now extend south from Milwaukee also as far as Racine and Kenosha, a distance of about 26 miles from the center of Milwaukee, and it will probably be but a short time before the intervening gap between the end of this line at Kenosha and the Chicago & Evanston Railway, now building northward from the Chicago city limits, will be filled up by a connecting railway, completing a through electric railway between Chicago and Milwaukee.

Electric Railways in Madrid and Barcelona

BY F. C. ARMSTRONG.

In spite of the fact that war was being waged last summer by Spain, the streets of Barcelona and Madrid, the two most important cities of the Iberian peninsula, presented scenes of great activity on account of the introduction of electric tramways in both cities by British capital. It is but just to say here that although the sympathies of Great Britain in the late war were supposed to be with the United States, the engineers who were engaged in the work of tramway installation in Spain were not molested in any way, although most of them were Englishmen and among them were a number of Americans.

Perhaps no nation in Europe is less understood by the English speaking people as a whole than the Spanish. While nearly all the other countries on the Continent are overrun each summer by tourists from England and America, comparatively few venture into Spain. As a result many people have formed their ideas of the Spanish from Cervantes' famous novel, and have the impression that they are a brave, chivalrous, but unpractical nation, romantic and dreamy, with little desire for modern improvement and with no habits of industry. While Spain as a nation has suffered from many causes which it is not the purpose of this article to discuss and which have repressed enterprise, both individual and corporate, the Spanish nature is far from being an idle one, and the average workman bears a striking resemblance to the French peasant in his qualities of frugality, temperance and capability for work.

The city of Madrid, the capital of Spain, is very similar in appearance to many other European capitals of the same population, with broad streets and fine buildings, many parks, amusements and manufactures. Barcelona, the largest city in population in Spain, is, on the other hand, a typical seaport town. Most of the houses are of brick, and many of them particularly in the new part of the city, are of hewn stone and of imposing appearance. It is the seat of various manufactures, a number of which are silks, woolens, cottons, calicoes, etc.

The Tranvia de Madrid is owned by an English company, the Tramways Union Company, Winchester House, Old Broad Street, London, which is also the owner and operator of several other continental tramways. The company's lines in Madrid cover the principal streets of the city, and are approximately 17 miles in length. The Barcelona Tramways Company, Limited, is also an English corporation, with offices at the same address in London, and the routes of the two systems are shown in the accompanying maps. When the electric equipment of both lines was decided upon, Alfred Dickinson & Co., the well known English electrical engineers, were appointed engineers to supervise the installation and tenders were requested from thirty firms for the electrical equipment of both lines. In October, 1897, the contract was finally awarded to Dick, Kerr & Co., Limited, of London, for the complete equipment required for the conversion of both systems. The equipment is similar in many respects, as will be seen from the following description:

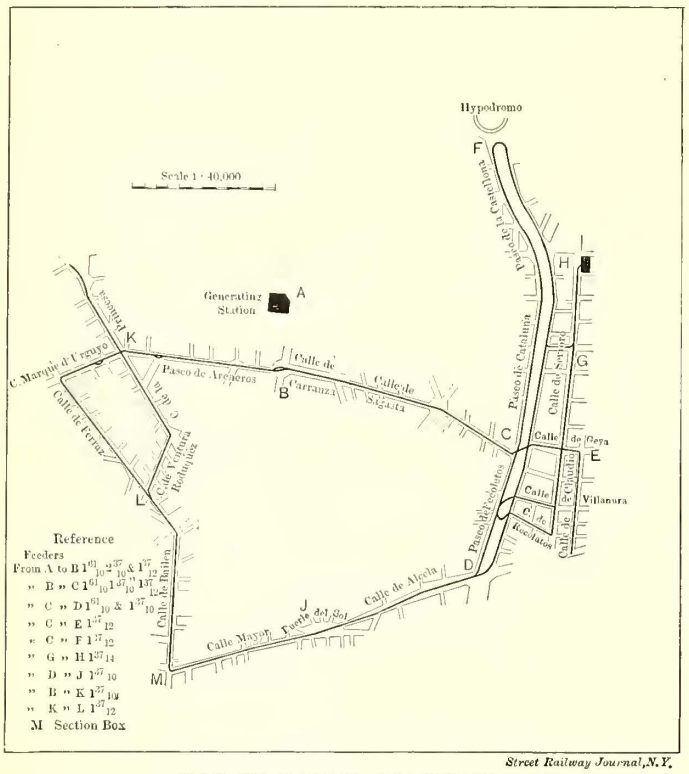
VIEW OF NEW ELECTRIC LINE AT MADRID

POWER STATIONS.

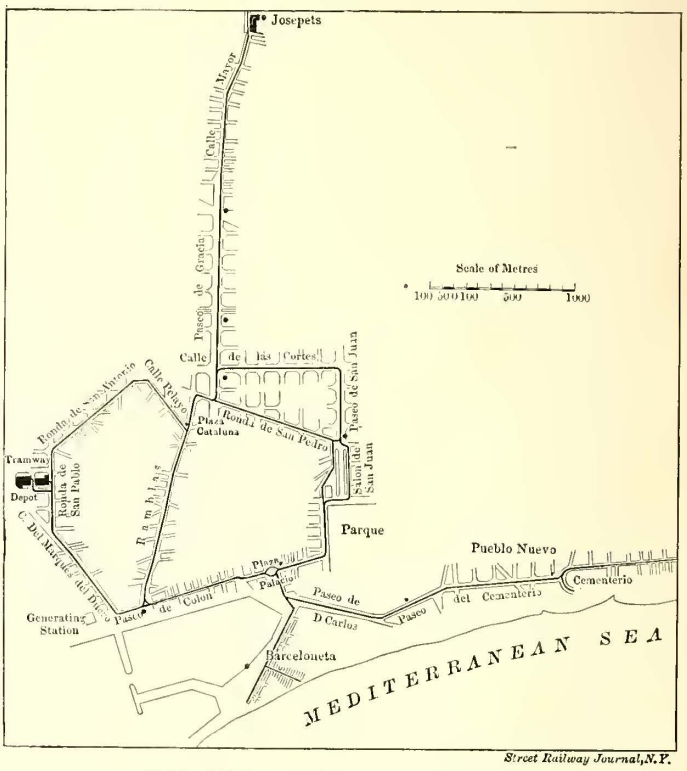
The power station at Madrid is equipped with two water tube boilers, each having 3654 sq. ft. heating surface, and

working at a pressure of 8 atmospheres. The engines are of the Corliss type, cross-compound, having cylinders 20 ins. and 40 ins.x42 ins. stroke. They are coupled direct to compound wound multipolar generators of 425 kw. capacity. Each power unit is provided with an independent Admiralty type surface condenser, operating in conjunction with a cooling tower. This tower has a capacity of dealing with 50,000 lbs. of steam per hour. It is provided with fans for creating an artificial draft, but so far the load has never been sufficiently heavy to necessitate these being put in operation. Indeed, when the full power tests were being made, 800 h.p. was dealt with for twelve consecutive hours, and, strange to say, the water in the reservoir was found to be 3 deg. cooler at the end of the run than at the start. Piping is arranged on the loop system, and consists of mild steel with flanges shrunk on and brazed; all elbows, T-pieces and special fittings are also of mild forged steel and the valves are of specially heavy design.

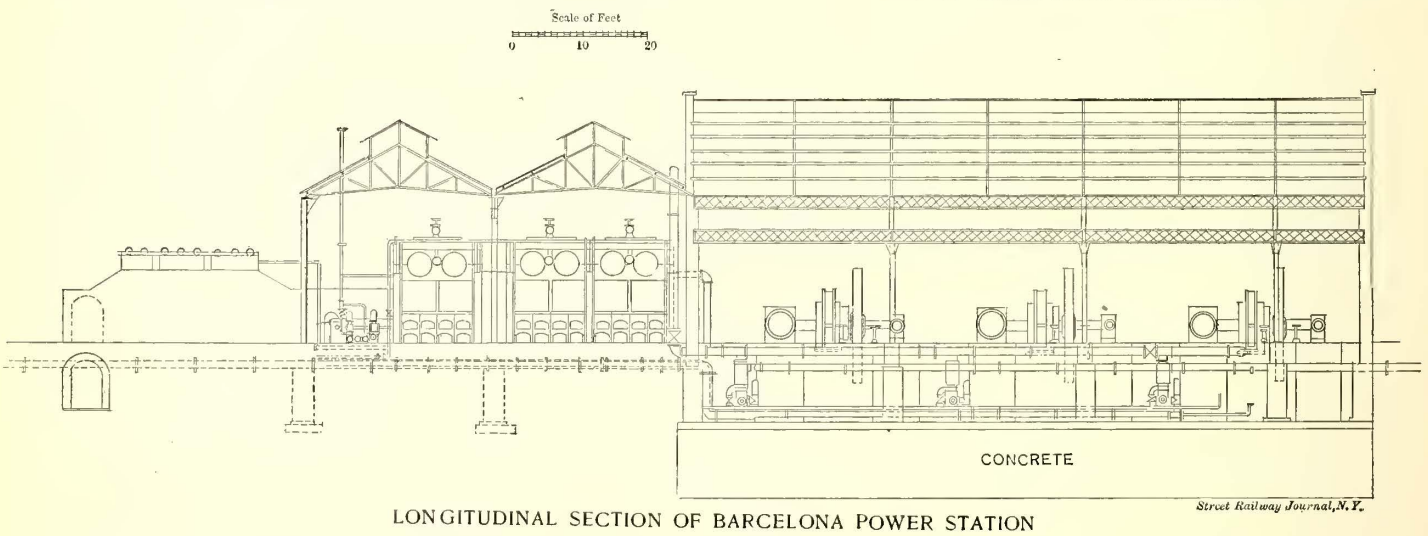
From the generators the current is conducted to the



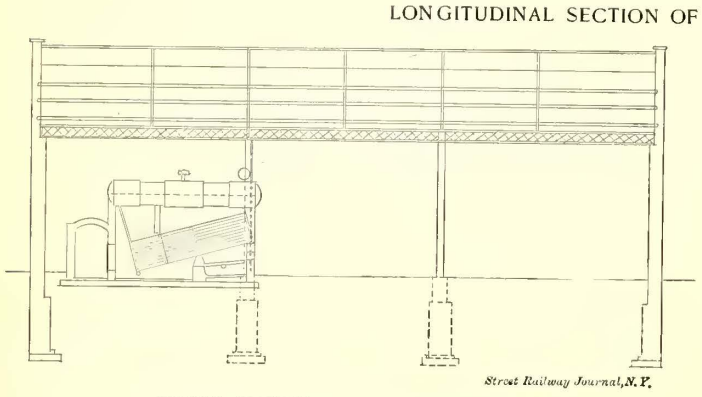
MAP OF MADRID TRAMWAYS



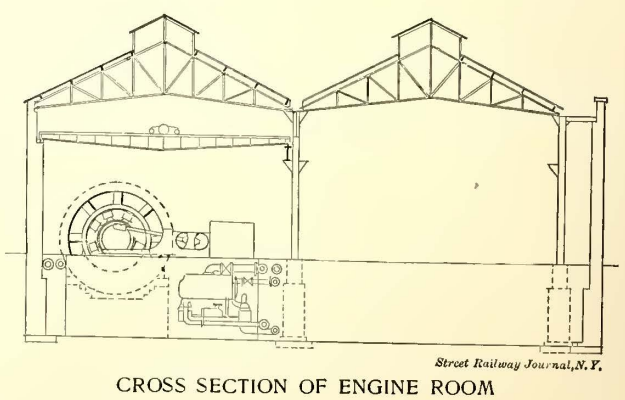
MAP OF BARCELONA TRAMWAYS



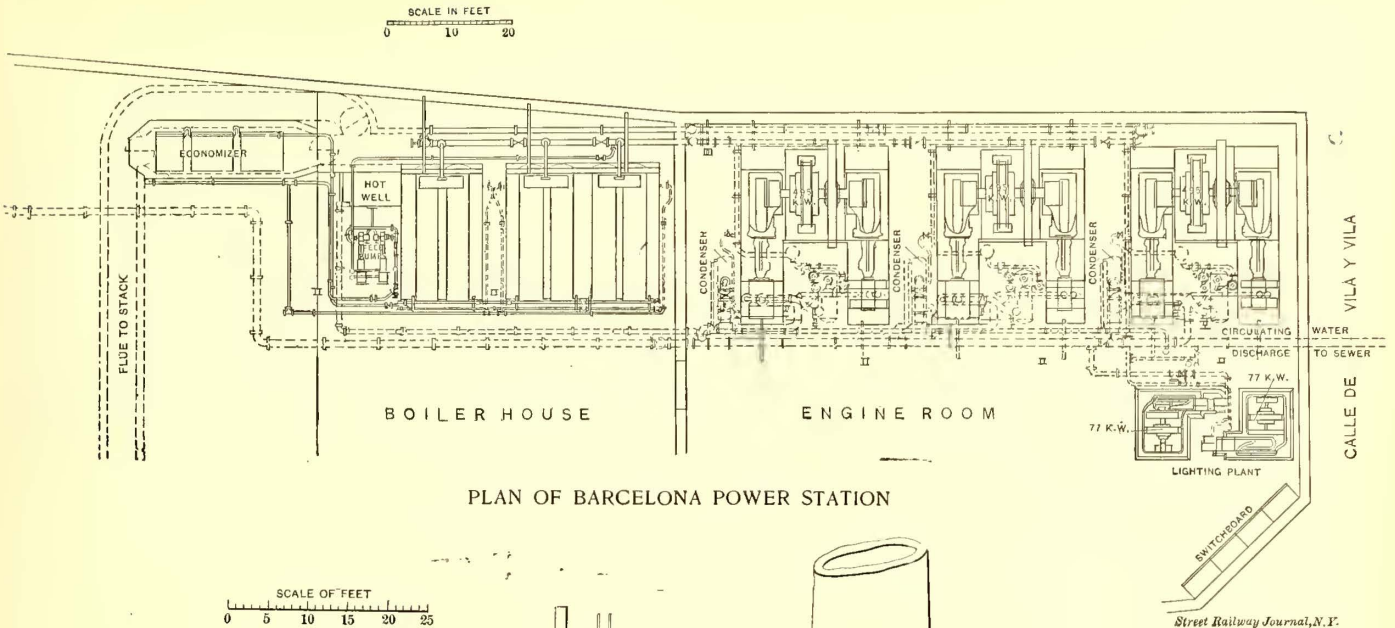
LONGITUDINAL SECTION OF BARCELONA POWER STATION



CROSS SECTION OF BOILER ROOM

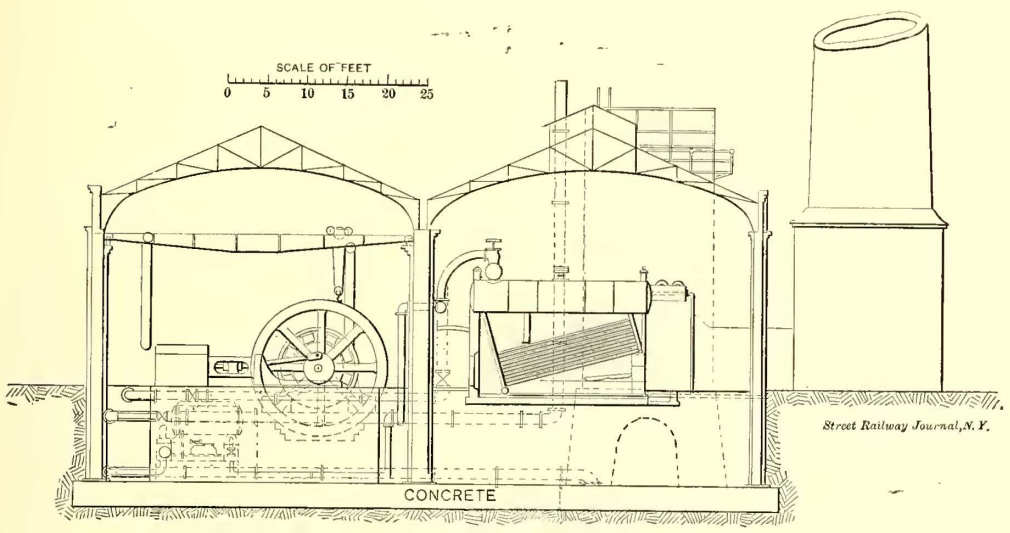


CROSS SECTION OF ENGINE ROOM



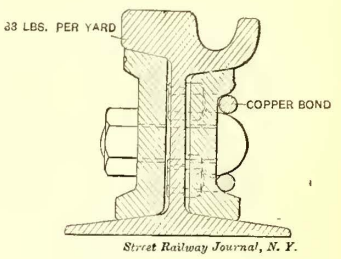
PLAN OF BARCELONA POWER STATION

Street Railway Journal, N. Y.



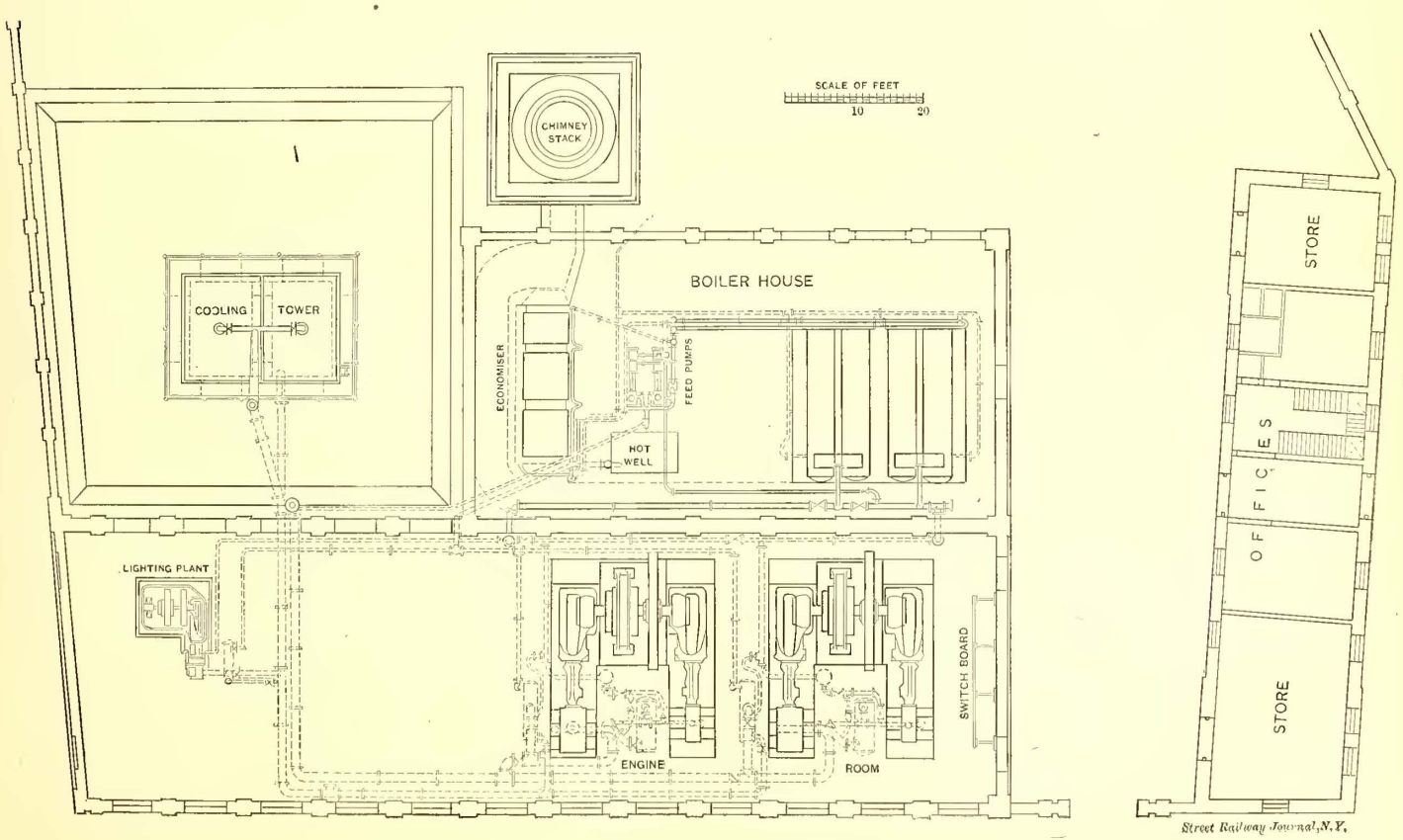
SECTION OF MADRID POWER STATION

Street Railway Journal, N. Y.



STANDARD RAIL

Street Railway Journal, N. Y.

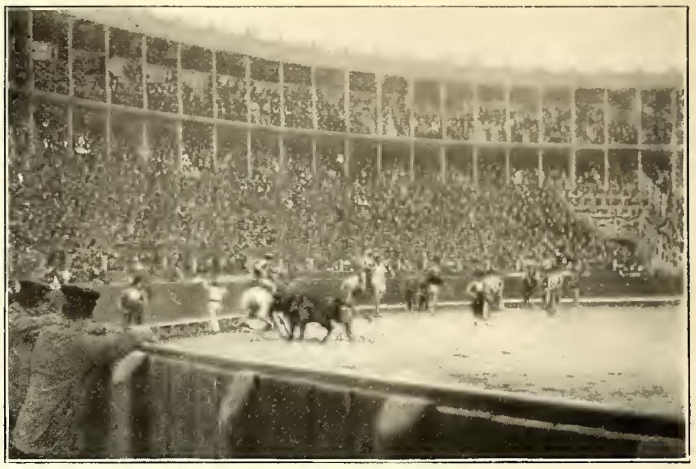


PLAN OF MADRID POWER STATION

Street Railway Journal, N. Y.

switchboard by lead covered cables. The switchboard is arranged on the usual panel system, there being three generator panels, a main output panel and seven feeder panels. In addition to these there is a Board of Trade panel, as the system has been laid with the view to complying with the Board of Trade regulations as to drop and rail return. There is also a special lighting panel which is arranged so that current can be taken either from the supplementary unit or from the main bus bars and distributed to the several lighting circuits.

The power station of the Barcelona tramways is located near the shore close to the southern end of the system, as will be seen from the map, this selection being dictated by the high price of coal in Barcelona and the necessity of operating, condensing and of reducing the transportation charges on fuel. Owing to the treacherous nature of the soil at this point, the foundations were made extremely broad, that for the chimney, which was to be 200 ft. high, being especially elaborate. After considerable investigation, it was finally decided to make the base of the foundation 54 ft. sq. Concrete was first laid to a depth of 4 ft. 1 in. Upon this was placed a layer of 6-in. railroad rails, laid close together, and above these rails was a layer of concrete 2 ft. 5 in. deep; another layer of rails was then laid in a reverse direction and another layer of concrete 2 ft. 1 in. was placed upon these rails; above this was placed a third layer of rails, then 2 ft. of concrete, and finally, 11 ft. 6 ins. of brick work. By this arrangement of raft foundation, the total weight of the chimney on the foundations was reduced to less than 2 tons per superficial foot.



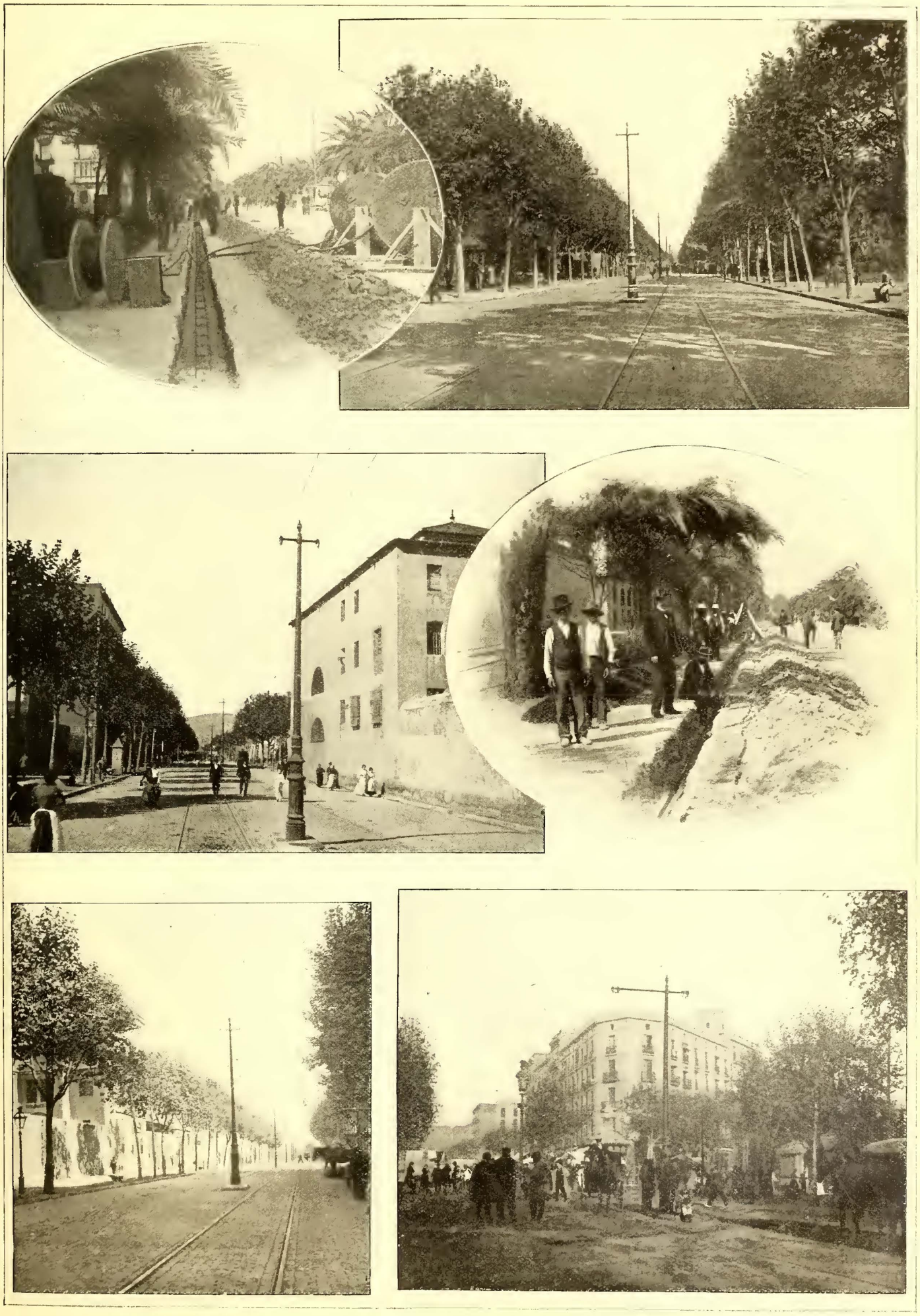
BULL FIGHT AT MADRID

STREET SCENE, MADRID

The boilers are of the water-tube type, and have the same heating surface as those in Madrid, and are equipped with feed pumps, hot well and economizers. The engines are of the Corliss type with similar cylinder dimensions to those in Madrid, and are each directly coupled to a 425-kw. generator. The piping in this station is on the same general plan as that in Madrid, as shown in the plan of both stations, and in each station there is a small supplementary steam dynamo equipment for use in operating all-night cars and car-house lighting. There are two of these at Barcelona and one at Madrid, each consisting of a horizontal tandem compound engine coupled to a 75-kw. multipolar compound wound dynamo. If necessary, these units are also to be used as boosters for the long-distance transmission.

STANDARD CAR, MADRID

POWER STATION, MADRID

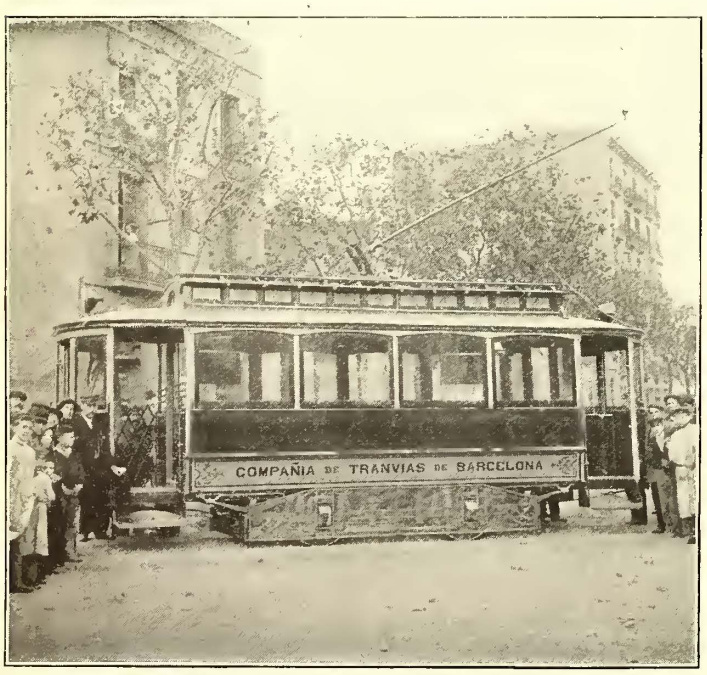


VIEWS OF TRAMWAY AND TRAMWAY CONSTRUCTION IN BARCELONA

SUPPLY SYSTEM

The overhead construction in both cities is generally of the center pole type, though span wire construction is also employed to a considerable extent. The poles are steel tube, with a length of 26 ft. 6 ins., and taper from 7 ins., at a point 6 ft. above the ground, to $3\frac{1}{2}$ ins. at the top, the butt end of the pole being parallel. The poles are bedded in concrete to a depth of 6 ft., and some of them, especially those in the principal street, are most ornate. The whole of the cast iron work for this was done in Spain, and the manner in which it was executed shows that the Spanish art of manipulating iron has not been lost. The brackets of the center pole construction, as will be noticed, are extremely short, and in most instances are not more than 15 ins. in length, and give a remarkably pleasing and unobtrusive appearance to the over-head work. This result is made possible by the use of the lateral or Dickinson type of trolley, which is employed throughout. A section of the base of this trolley, with the arrangement of springs, is shown in one of the engravings on page 81.

All feeders are laid underground, and the distribution from the generating station is arranged as shown in the accompanying plan. The bitumen solid system has been used throughout, the cables being laid in cast iron troughs, supported on suitable bridges, and the whole then filled in solid with bitumen. Distribution is made in Madrid from under-ground boxes at feeding and section points. This was necessary because the authorities would not allow the ordinary type of feeder pillar to be erected. The engravings show the general arrangement of these boxes, the number of connections varying according to the location.



STANDARD CAR, BARCELONA

In Barcelona railway pillar boxes as shown in the cut are used.

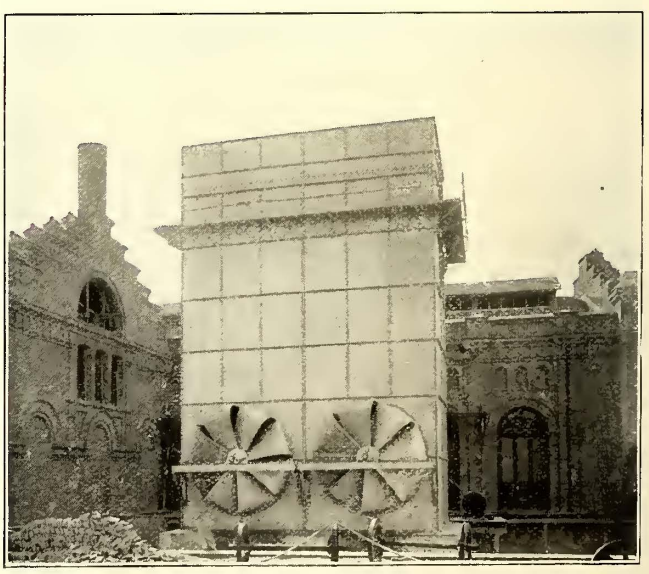
The overhead system is divided into half-mile sections by means of the section insulators, on the same conditions as laid down by the British Board of Trade. The feeder boxes, through which the current is taken from the cables to the line, are supplied with the usual switches and fuses, and, in addition, a pilot wire for testing purposes. This latter wire is also to be used for communicating with the

VIEW ON THE CALLE ALCALA, MADRID

generator station by means of a portable telephone. Where return feeders are employed, and their use is quite general, especially in Barcelona, they are laid in cast iron troughs and bitumen, similar to the outgoing feeders.

TRACK CONSTRUCTION

With the electrical equipment of the line the track has been entirely rebuilt and the gage adopted is 4 ft. $8\frac{1}{2}$ ins. The rail is of the grooved type, weighing 82 lbs. per yard, and rests on a stringer 6 ins. deep, and 1 ft. 6 ins. wide, made of concrete in the proportion of one part of cement to five parts of broken stone, gravel and sand. The rails are double bonded at each joint.



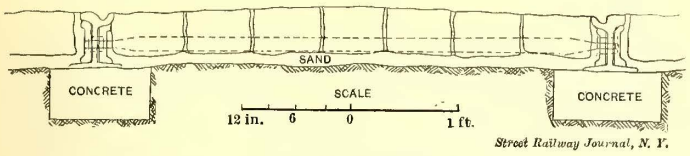
COOLING TOWER, MADRID

ROLLING STOCK.

The cars in use were built to specifications at Saragossa, and are very similar in general appearance to those used in America; in fact they were modeled on American lines, except that extra large platforms are in use. The cars measure over all 25 ft. 2 ins., with body length, inside, of

15 ft. 9 ins. and width of car 6 ft. 11 ins. They carry forty-four passengers, twenty-two seated and twenty-two standing. Eighty-five cars are in use at Barcelona and fifty-five at Madrid.

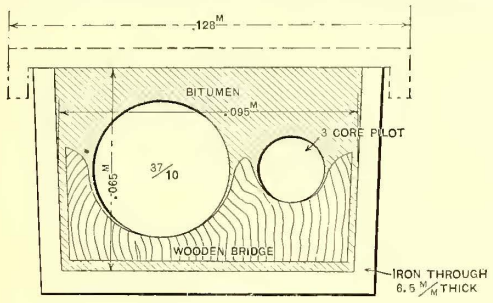
The cars are mounted on trucks of the Brill 21 E type,



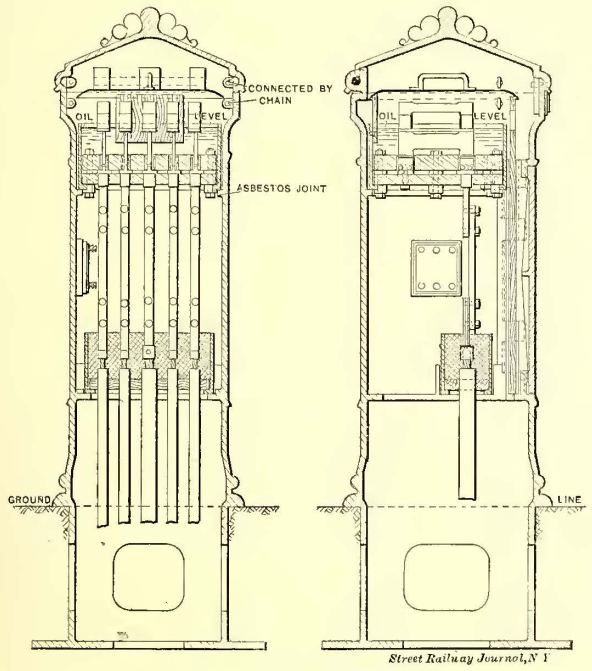
SECTION OF TRACK

with 30-in. steel wheels with cast centers and rolled steel tires, and are equipped with two motors with series parallel controllers. The trolley is of the Dickinson type, as described elsewhere.

Both plants possess peculiar interest from a tramway standpoint, as they are practically the first examples of the electrical equipment of large continental tramway systems upon strictly American lines, viz., the use of slow-speed,



CONDUIT FOR ONE FEEDER



FEEDER PILLAR SWITCH

direct-connected engines with water tube boilers, economizers, single-deck cars, etc. The only important feature in which a departure has been made from standard American practice has been in the use of the Dickinson trolley.

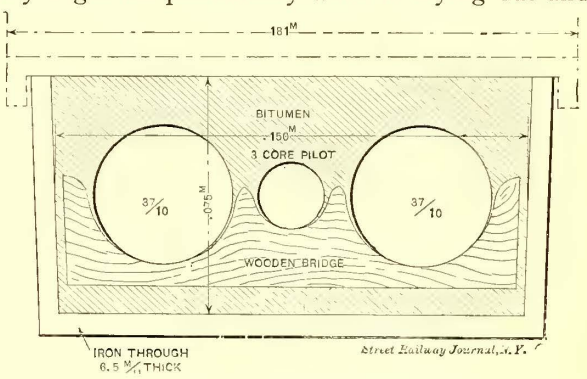
Taking into consideration the extent of these two installations and the circumstances under which they have been made, their successful completion within practically one year from the date of signing of the contract must be regarded as exceedingly creditable both to the consulting engineers, Messrs. Alfred Dickinson & Co., who were responsible for the plans and who supervised the entire installation, and to the contractors, Messrs. Dick, Kerr & Co., Limited, by whose staff the work was carried out without a hitch from beginning to end.

Method of Splicing Cars in Philadelphia

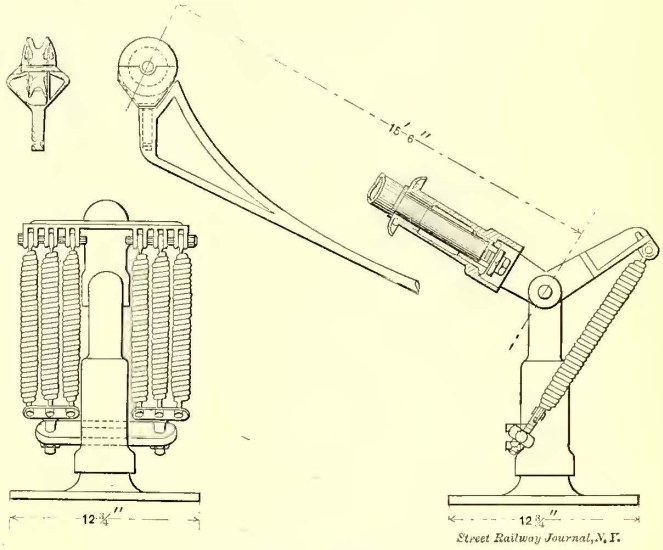
The Union Traction Company of Philadelphia is splicing at its car repair shops quite a number of its old 18-ft. cars, making a new body 25 ft. in length, which is mounted on eight-wheel trucks. In the operation of splicing, the cars are cut in two and the sills are united by a corresponding section inserted with a ship splice, when the whole is reinforced by a steel angle plate 6 ins. x 4 ins. and ⅝ in. in thickness. This is placed on the outside of the sill with the 4-in. limb on the under side. The car is also reinforced by truss rods. The sides and roof are then completed to correspond with the original structure of the car.

An Important Appointment

The Boston Elevated Railway Company has engaged John Lundie, the well-known expert in railroad transportation, as its consulting engineer, for the construction of the new elevated railway in Boston, and Mr. Lundie will shortly begin his preliminary work in laying out and determining the factors in the elevated railway composition as presented by Boston's peculiar conditions. Mr. Lundie's valuable work in analyzing the traffic conditions of the Illinois Central's Chicago suburban lines has given him a high place among railroad experts, and his exceptionally careful study of the Brooklyn elevated railway problems during the past few months has brought him even wider experience. Mr. Lundie's unique methods of attacking railroad transportation questions are the admiration of those who have been privileged to follow them, and his grasp of all the elements entering into any particular case is remarkable.



CONDUIT FOR TWO FEEDERS



DETAILS OF TROLLEY

The Cincinnati & Hamilton Electric Street Railway

In Southeastern Ohio there is now completed a system of connecting interurban electric roads reaching from Cincinnati to Eaton via Hamilton and Dayton, a distance of nearly 100 miles. The lines extending from Eaton to Dayton, and from Dayton to Hamilton, were completed a year ago, while the Cincinnati & Hamilton has just been placed in operation. The road is 15 miles long from Hamilton to the point where it connects with the lines of the Cincinnati Street Railway Company.

The company owns its right of way, which lies alongside a highway owned by a corporation, from whom the railway company purchased the right of way strip. The road throughout its entire length has been chosen so as to lie upon the highest ground, and in this way the high water so frequent in the Miami bottoms will be avoided. The route is very rough, there being but few level stretches in it; the maximum grade is 5 per cent and 1,000 ft. long. There are many sharp curves, but they have been laid out with such extreme care that they can be rounded at a high rate of speed.

The brick power house is located at Symns Corner, some 5 miles from the Hamilton end. It is 143 x 49 ft., covered with a slate roof supported on steel trusses and has cement floors. There are installed two Hamilton-Corliss engines of 600 h.p. each and running at 90 r.p.h. The cylinders are 24 x 28 ins., the fly-wheels 20 ft. in diameter and weigh 27 tons each. The engines are belted to 400 kw. Westinghouse generators.

Four Stirling water tube boilers of 250 h.p. each form the boiler equipment. These boilers are the Stirling Company's standard street railway type, provided with large drums affording liberal steam reserve space and disengaging surface, sudden demands for steam are thereby provided for without the usual attendant danger of entrainment or sudden dashes of water into the cylinders of the engines.

Berryman heaters, Austin separators, Hoppes purifiers and Laidlaw-Dunn-Gordon pumps make up the remainder of the power house equipment.

The furnaces are fitted with two sheet iron stacks 100 ft. high by 5 ft. diameter; these are set on the boiler walls and held in position by two sets of guys. The storage cistern holds 3,000 bbls. and is supplied from two wells 70 ft. deep reaching into the river gravel.

Near the power house is the car barn 152 x 96 ft., with a wing 69 x 41 ft. It is also of brick with a gravel roof.

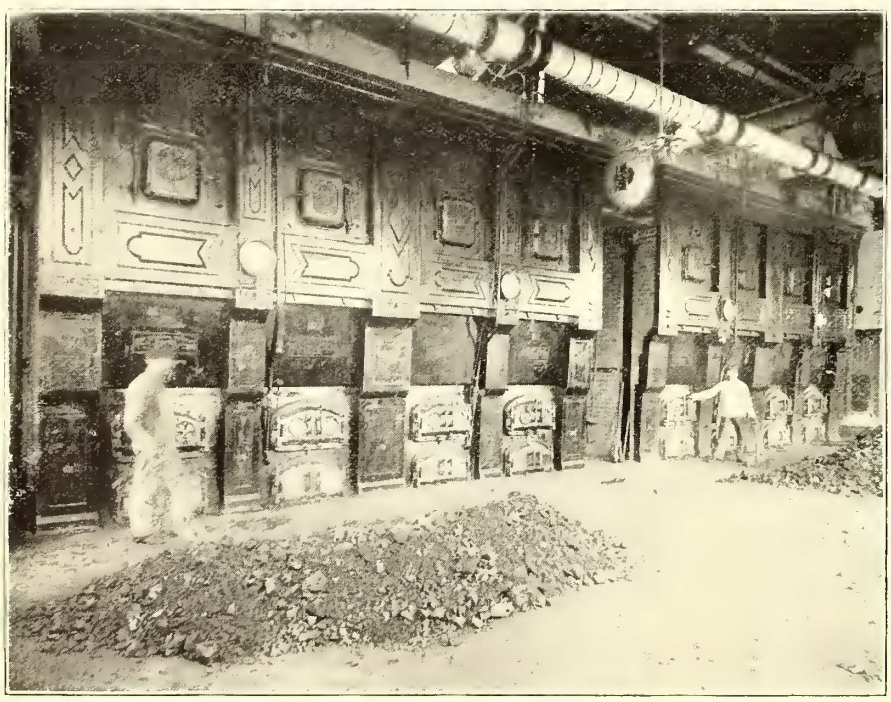
ENGINES

There is room for twelve cars and the repair department is also under this roof.

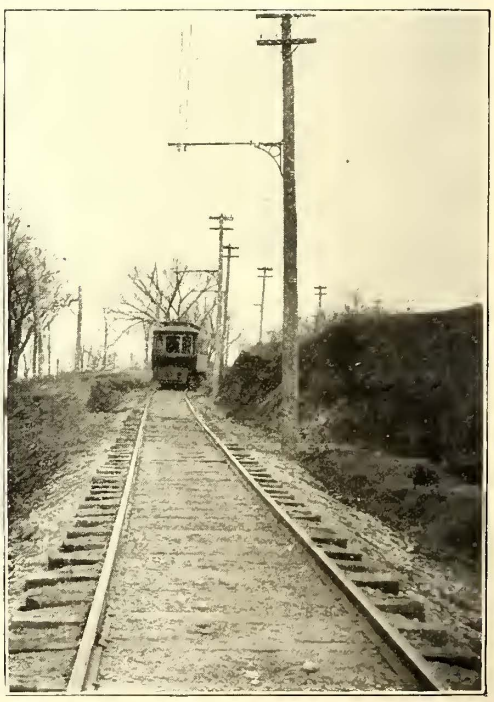
Five fire plugs connected with a fire pump in the power house are located in and around the buildings.

Two No. 0000 trolley wires are used. These are hung from brackets on 7 in., 35 ft. cedar poles, except in the towns of Mt. Healthy and College Hill, where iron poles were demanded by the residents. Three cables of 300,000 c.m. feed the southern part of the road, and two of the same size are required for the northern end. All overhead material was furnished by the Ohio Brass Company. The track is double bonded with No. 0000 Washburn and Moen bonds.

The rails are 70 lb. T section laid on oak ties 6 ins. x



VIEW IN BOILER ROOM



BRACKET WORK

8 ins. x 8 ft. At the joints are 6-bolt angle bars. All special work was made by the Lorain Steel Company. A good heavy layer of ballast, consisting of either gravel or broken stone, is used everywhere. The company bought gravel beds near the line and used two steam engines for hauling its gravel trains.

Eight Kuhlman cars constitute the rolling stock; these are 43 ft. long over all and weigh 25 tons. They are

TERMINAL STATION AT COLLEGE HILL

painted maroon and yellow and are substantial, comfortable and elegant, and are mounted on double trucks of the Peckham Truck Company. They have smoking compartments, are heated with the Consolidated Car Heating Company's electric heaters, and fitted with New Haven registers. The motors, controllers, gears, and pinions and the electric brake are all of General Electric design.

The despatching is by the well-known Garl Telephone system; a portable instrument is carried on each car and plug-in stations are located along the line at intervals of 1000 ft. The road was projected and built by Christy Bros., Akron, O. The officers are Will Christy, president; F. J. J. Sloat, general manager. F. H. Conner was in charge of the erection of the plant.

Roadway Department of the Union Traction Company, Philadelphia

The extent of the system of the Union Traction Company, of Philadelphia, the company owning a greater number of miles of track than any other in this country, has permitted the company to introduce certain methods and appliances into its various departments, which, in many cases, could be adopted to advantage by smaller companies. It is the purpose of this article to describe the practice of one department only, that covering the important subject of roadway. The work of this department embraces not only the care of the track and roadbed, but also the care of the conduits for underground cables, the paving of the entire streets on which the tracks are laid, the care of all the bridges on the system, of which they are seventy, all building repairs, including those on the car houses, power houses and the stables for the draft horses, and the feed and care of the horses. The work is carried on under the supervision of H. B. Nichols, with the designated title of engineer of way.

The forces employed are divided into regular and emergency gangs. All orders and assignments for work are issued from the engineer's office to the foremen of the divisions, of which there are three. The regular gangs have a monthly assignment as to the streets to be covered, and detailed orders to them are issued daily. It is the practice to go over the entire trackage once a year for surfacing, examining and tightening joints, as well as for reversing or renewing angle plates, except where the cast-welded joints are employed.

All paving is also inspected once a year by the regular gangs, while the special forces repair any dangerous holes and attend to complaints, replacing any stones that have been forced from their bed, and repairing the asphalt surface where necessary. The different classes of paving are all numbered, and consist of about an equal amount of granite blocks and asphalt, with some brick. Included in the work of the special gangs is the shoring and protection of all excavations for sewer or pipe connections, whether the excavation is made by the company, by the city or by private parties. The expense for shoring, if for the city or for private individuals, is charged up to the persons or body for whom the work is done.

All jobs for repairs, either to track or paving, or for other purposes, are numbered, and all labor and material are charged to such a number. The labor account for each job number is shown on the daily time sheets, which are forwarded every night, by the time keeper of that division, to the general office. In the issuing of material from the stock room, the amount is first temporarily charged to the foreman of each job, and he is also given credit for any scrap or material returned. The amount of material actually used is given on the material slip, which is forwarded to the general office by the store-keeper. When the job is finished, the amount is charged to the number, and the account of the foreman balanced, but he is held responsible for all work and material.

The care of the special work includes the cleaning of switches, sanding the tracks on the hills and oiling the curves. For this purpose, especially designed carts or wagons, to the number of fifteen, are provided and supplied with pails for oil and sand. On the rear of the cart is a step for the driver, so that mounting and dismounting are rendered easy. Each driver is assigned to a certain district, in which he is expected to keep the switches and curves cleaned and oiled, and the hills sanded. The cost of removing snow and ice is not charged up to each street, as in the paving repair, but goes in as a lump sum. The removal of ice from the track in cold weather is quite an item, as in many parts of the city surface drainage is employed, and water from the alleys runs over the rails and freezes in cold weather.

The engineer of way makes a monthly statement to the president and general manager of all work done during the month, under classified headings. At the beginning of each month also he hands in an estimate of the cost of material and labor required for the current month, and also reports the different classes and amount of track supplies on hand. The material in stock is checked up twice a year, and with the careful records kept, the resources and amount of material on hand can always readily be ascertained.

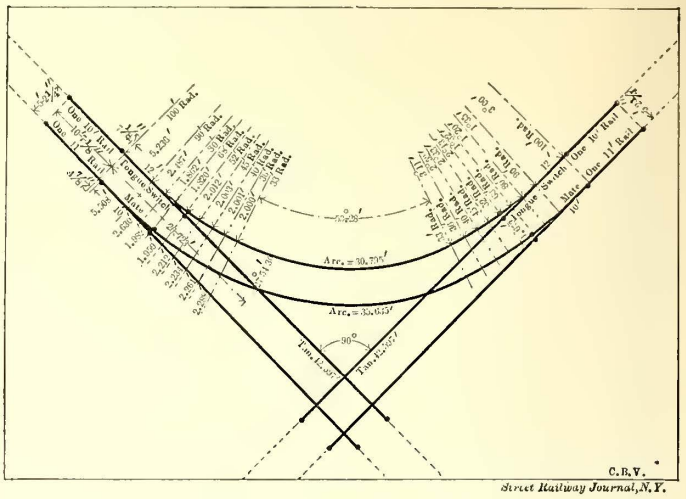
In the consolidation of the various companies into the Union Traction Company the new company inherited a great variety of rail sections, so that the work of keeping the track in repair is very considerable. The cast-welded joint is employed to a large extent on the old rail sections, and about 10,000 such joints are now in service. The standard rail, as required by the city authorities, is a 9-in. girder, but with various head modification. The standard joint plate is 36 ins. long, with twelve bolts. The mileage

also includes about 27 miles of T rail construction on rock ballast. This is the easiest track to keep in repair, and is generally laid on the side of macadam roadway. The company is required to keep in order 35 miles of macadam paving, and for this work a regular force is employed, equipped with steam rollers and other road machines.

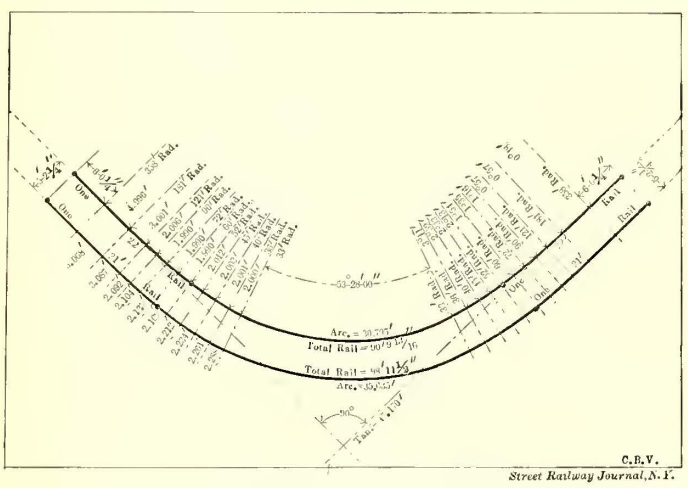
All designs for special work are made in the draughting room, under the direction of the engineer. Each piece of special work is numbered and a record is kept of all repairs required on it. A record is also kept on file of the life of each piece.

SPECIAL TRACK

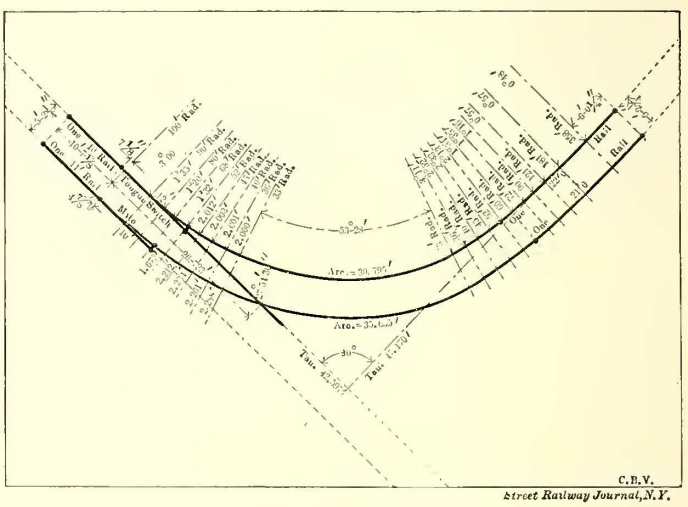
Two standard types of spiral transition switches are employed for all the turnouts on the entire system, one or the other of which installed is depending upon the radius of curve. The accompanying diagrams show the design of these two standards and the cross section at different points, and the table of curves illustrates the method of laying out the spirals. The wearing surface for the switches, frogs and mates is all of manganese steel. In the construction, a very large bolt is employed at the heel of the tongue, and the latter, it will be noted, is reinforced at the base, the sides of the track being under-cut. There are several other special features, including two grooves in the mates, for the wheel flanges, so that with four-wheel trucks the flanges of the front and rear wheel can run in separate grooves. The system requires about 3000



STANDARD CONNECTING CURVE



STANDARD PLAIN CURVE



STANDARD BRANCH OFF CURVE

U. T. CO. ELEMENTS OF NEW 90° CURVE.

	R.	Deflec.	Total Deflec.	Curve. Abs.	Curve. Ord.	Centers. Abs.	Centers. Ord.	Length of Arc. Inside.	Length of Arc. Outside	Tan.	Ex. Sec.
PLAIN.	358	0°-48′	0-48	4.998	.035	0.000	358.000	4.996	5.068	Middle R in 1st col. For Switch R < 60 + Sub. 4.573	Same for Switch if R < 60 +
	181	0 -57	1-45	7.999	.101	2.471	181.017	3.001	3.087	95.844	37 391
	121	0 -57	2-42	10.003	.179	4.304	121.045	2.006	2.092	79.132	29 997
	90	1 -16	3-58	11.990	.295	5.764	90.080	1.990	2.104	68.349	25.106
	72	1 -35	5-33	13.972	.460	7.009	72.123	1.990	2.133	61.453	21.888
	60	1 -54	7-27	15.949	.685	8.170	60.179	1.990	2.162	55.728	19.129
	52	2 -13	9-40	17.938	.985	9.207	52.246	2.012	2.212	51.899	17.218
	45	2 -33	12-13	19.905	1.365	10.382	45.346	2.003	2.234	49.078	15.756
	40	2 -52	15-05	21.849	1.837	11.440	40.459	2.001	2 261	47.170	14.727
	36	3 -11	18-16	23.765	2.411	12.481	36.597	2.000	2 288		
	33	53 -28	71-44	44.759	23.404	13.422	33.748	30.795	35 635		
SWITCH.	100	3 -00	3-00	5.234	.137	0.000	100.000	5.236	5.508	Frog. Angle.	Frog. Lead.
	90	1 -35	4-35	7.715	.301	0.523	90 014	2 487	2.630	20°-00′-33″	30.471
	80	1 -20	5-55	9.569	.472	1.322	80.046	1.862	1.982	21 -28 -07	29.346
	68	1 -32	7-27	11.376	.684	2.559	68.110	1.820	1 959	23 -59 -49	27.892
	52	2 -13	9-40	13.366	.983	4.634	52.245	2.012	2 212	25 -22 -45	27.320
	45	2 -33	12-13	15.332	1.363	5.809	45.344	2.003	2 234	26 -27 -01	26.995
	40	2 -52	15-05	17.276	1.835	6.867	40.457	2.001	2.261	27 -18 -52	26 808
	36	3 -11	18-16	19.192	2.409	7.908	36.595	2 000	2.288	27 -54 -30	26.723
	33	53 -28	71-44	40.186	23.403	8,849	33.746	30.795	25.635		

For any curve.

$\text{Tan}_1 = x_1 - y_2 \text{ cosec } \Delta - y_1 \text{ cotan } \Delta$. $\text{Tan}_2 = x_2 + y_1 \text{ cosec } \Delta - y_2 \text{ cotan } \Delta$.

$\text{Tan}_1 = R_1 \sin a_1 + R_2 [\sin (a_1 + a_2) - \sin a_1] + R_3 [\sin (a_1 + a_2 + a_3) - \sin (a_1 + a_2)]$ &c.—$\text{Tan}_2 \cos \Delta$.

$\text{Tan}_2 = \{ R_1 \text{ vs } a_1 + R_2 [\text{vs } (a_1 + a_2) - \text{vs } a_1] + R_3 [\text{vs } (a_1 + a_2 + a_3) - \text{vs } (a_1 + a_2)]$ &c. $\} \text{ cosec } \Delta$.

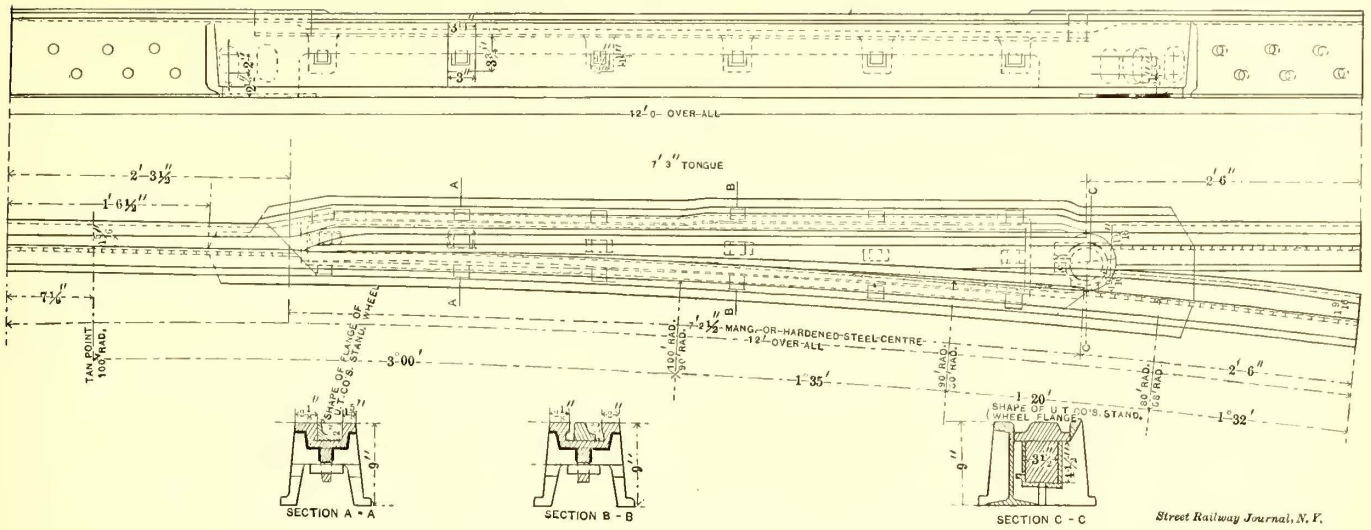
R	From	To	Tangent 90°.	Abs. of Middle Center.	Ord. of Middle Center.
PLAIN.	33	36	.63617 R + 26.176	.31344 (36—R) + 12.481	36.597—.94961 (36—R)
	36	40	.70532 R + 23.686	.26022 (40—R) + 11.440	40.459—.96555 (40—R)
	40	45	.76574 R + 21.270	.21161 (45—R) + 10.382	45.346—.97735 (45—R)
	45	52	.81788 R + 18.923	.16792 (52—R) + 9.207	52 246—.98580 (52—R)
	52	60	.86190 R + 16.635	.12966 (60—R) + 8.170	60.179—.99156 (60—R)
Sw.	52	68	.86190 R + 12.060	.12966 (68—R) + 2.559	68.110—.99156 (68—R)
	68	80	.89159 R + 10.041	.10308 (80—R) + 1.322	80.046—.99467 (80—R)

Formulæ.

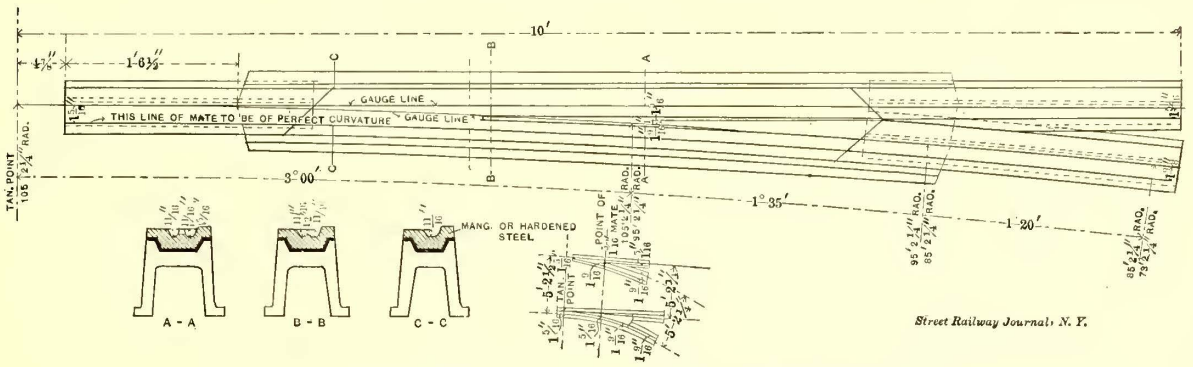
For symmetrical 90° curve:
Tan = R (cos s —sin s) + Abs. S + Ord. S
For symmetrical curve, any angle ;
Tan = Ct. Abs. + Ord. × tan ½ Δ
Ex. Sec. = Ct. Ord. × sec. ½ Δ — R

$$= \frac{\text{Ct. Ord.}}{\cos \frac{1}{2} \Delta} - R$$

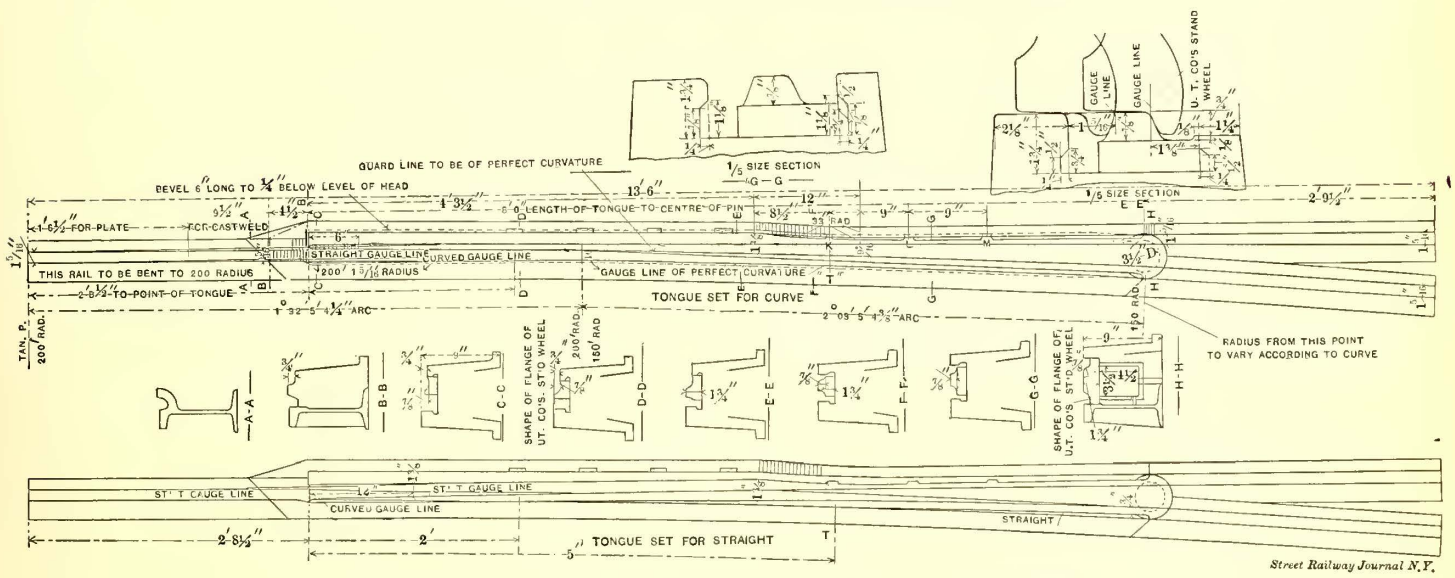
S = end of spiral approach. s = Δ at S.



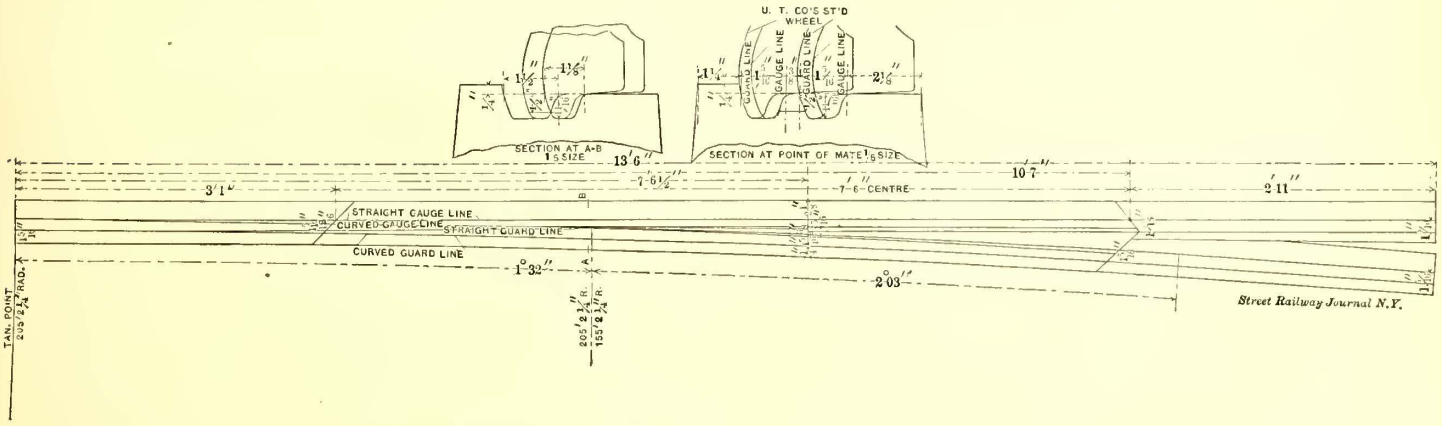
STANDARD TRANSITION SWITCH FOR CURVES UP TO 80 FT. RADIUS



STANDARD TRANSITION MATE FOR CURVES UP TO 80 FT. RADIUS



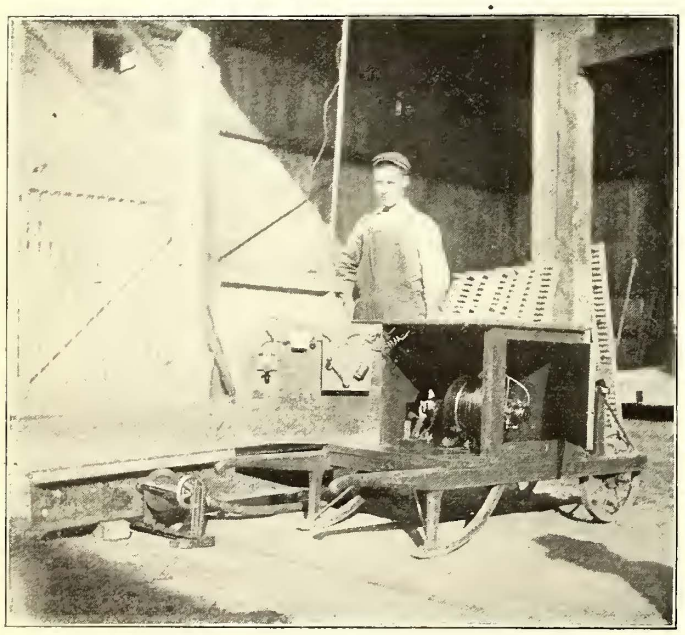
STANDARD SWITCH FOR CURVES FROM 80 FT. TO 150 FT. RADIUS



STANDARD MATE FOR CURVES FROM 80 FT. TO 150 FT. RADIUS

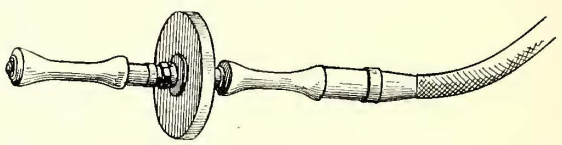
pieces of special work, including steam crossings, of which there are about 135, and the crossings embrace from two to twenty tracks, making about 700 track crossings.

The company manufactures a large portion of its special work, the balance being purchased from the Lorain Steel Company and William Wharton, Jr., & Company. A special shop has been fitted up for track work, and a very complete assortment of tools and appliances have been installed. The track shop occupies a two-story brick building, having a large floor space, and the upper floor, which is served by an elevator, is utilized for setting up and fitting the work; it is the practice to set up complete all curves, crossings and special work, before sending them out. The tool equipment embraces a circular cold saw, operated by an electric motor, heavy punches and shears, a cupola and foundry equipment, two portable hydraulic bending machines, one of 75 tons and the other of 125 tons, both of the Watson & Stillman make. Among these special appliances worthy of note are the beds on which the special work is cast welded. In the preparation of these beds a foundation of concrete, 3½ ft. in depth, is first laid. On the surface of this are steel plates having slots similar to those in the bed plate of the planer, and into these slots are placed the heads of bolts, which serve to anchor the parts



PORTABLE ELECTRIC DRILL

firmly into position. The sand molds are then made around the junction, and into them the molten metal is poured. There is also a second bed with 4-in. T rails, between and beneath the heads of which the anchor bolts are slid. On the opposite side of the shop is a surfacing bed, consisting of a perfectly level wooden floor, reinforced by strips of steel plate ¼ in. in thickness and 3 ins. wide, spaced about 18 ins. apart. By placing rails or special work on this bed, any unevenness in the surface is readily detected. For cast welding simple joints, or where it is necessary to connect rails of different patterns, a mould, consisting of adjustable pieces called chills, is employed, and so designed as to be readily clamped into place. For this class of casting a specially prepared bed is employed. It is in the yard adjoining the shops, and is protected by a temporary cover. In addition to the joint castings and special work the foundry department supplies drain grates and almost all kinds of castings required in this department. The cupola blast is generated by a rotary blower driven by an electric motor. The cold saw mentioned above is also driven by an electric motor, which is started by an ordinary type K controller, but with a water rheostat in place of the ordinary resistance coils. This rheostat is home-made, and consists of a large cask located on the floor above. It is filled with water, in which are two large plates of iron, to which the conductor terminals are attached. To one of these plates is fixed a wooden bar which works in a guide, and is designed to lift the top plate up or to let it down. This bar is operated by means of a rope and windlass from the floor below adjoining the saw. In this way the speed of the saw is readily changed by the windlass rather than the controller. The rails are fed to the saw by a peculiarly designed trolley hoist. The track for the hoist consists of an I beam, about 30 ft. in length, with one end pivoted above and just to one side of the line of the saw bed. The other end of this beam is fitted with wheels which are operated with a hand



PORTABLE EMERY WHEEL

chain, so that it can be swung around on a circular track. This provides a wide range for the hoist, so that pieces of rail may be lifted and readily conveyed to the saw, and in case of a crooked rail, the outer end of the rail can be supported in any position.

For drilling rails, either in the shop or on the line, the company uses a portable electric drill, illustrated on this page. This drill consists of a box or case having two wheels and handles like those of a wheel barrow, on which is placed a 2-h.p. electric motor; the latter is provided with a Stow flexible shaft through which power is transmitted to the drill, which is clamped to the rail in the usual manner. By this arrangement, holes for tie rods, or for other purposes, can be readily drilled. For delivering the current to the motor a pole with a hook to which an insulated conductor is attached, is used. The end of this pole can be hooked over the trolley wire anywhere on the line, while the return circuit is provided by the rail. Another motor similarly mounted and provided with a flexible shaft is employed to operate an emery wheel used for grinding the surface of the rails where the cast-welded joint is employed. The emery wheel is mounted on a short shaft with insulated handles on each side, consisting of thimbles surrounding the shaft. The operator holds the wheel in position by means of the handles, and it is readily adjusted to any surface. A portable motor is also employed for operating a hack saw, so that the rails may be cut at any place on the line. This saw is connected to the rails by means of a frame and clamp, and is capable of sawing a 9-in. rail in nineteen minutes. In connection with the track work there is an auxiliary shop furnished with a number of small iron working tools on which machine repairs are made, and where, also, such small tools and dies as may be required are manufactured.

The track shop is in charge of H. H. Nichols, who has held the position of foreman about two years.

W. D. Young, electrical engineer of the Baltimore & Ohio Railroad Company, writes that that company has not decided to instal the third rail system in the Belt Line tunnel, but has simply been looking into the advisability of its adoption in place of the present overhead structure.

Wrinkles in the Hartford Street Railway Company's System

The thought expended on the little labor-saving devices around a street railway is the best evidence of success, for the successful railway management is a problem of details satisfactorily solved. The Hartford Street Railway Company has introduced many wrinkles, and the following have been selected as being general useful pointers to any system. Mr. Crawford, the general manager, and Mr. Caum, the chief engineer, are responsible for them.

A method of always obtaining dry sand without the cost of drying is an attractive proposition. In Hartford the problem has been solved in this way: Over the boiler room a sealed loft has been built that is used to heat the barn and repair shops. Fig. 1 shows the side elevation of the loft and boiler room. It will be seen that the iron stack from the boiler down stairs passes through this room, and around it is a wrought-iron funnel with a circular opening about 2 ins. wide around the stack at the bottom, and with a flare about 2 ft. wide at the top. The wet sand is introduced into this hopper by a conveyor from the sand pile. This conveyor is run by a motor. The sand when dried by the heat of the stack spreads over the flue of the sand bin, and is perfectly dry by the time it reaches the spout,

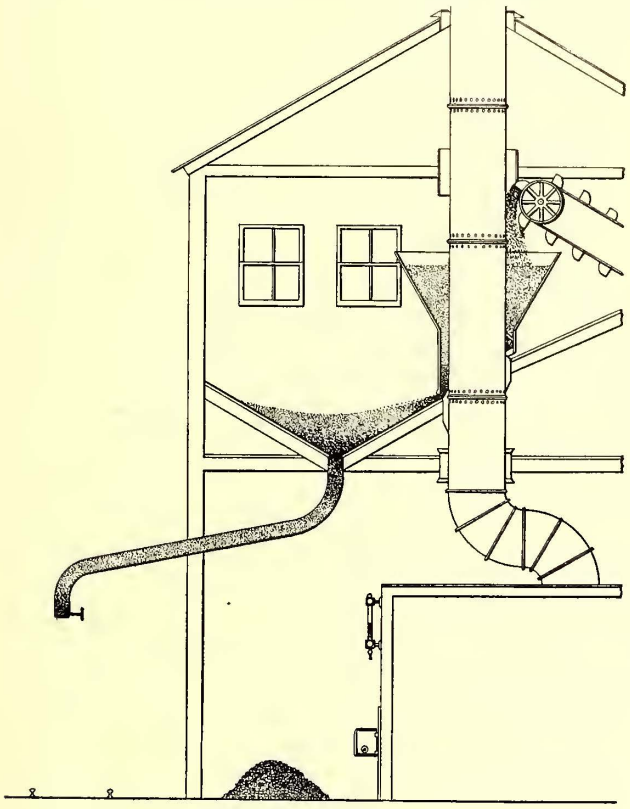


FIG. 1.—METHOD OF DRYING SAND

whence it is delivered into the sand car. In this way the sand is dried practically automatically, and by a heat that would otherwise be wasted.

Eventually Mr. Caum proposes to fill his car sand boxes with sand by a rather novel method. It is not generally known that sand, under air pressure, will flow through a pipe for several hundred feet like a viscous fluid. The pipe itself, however, should curve to changes of direction, and sharp corners with the regular pipe fittings should be avoided. A flexible hose can be used with a valve at the end. This hose can be carried into the car and the sand box filled without the dust and spilling of sand which usually accompanies the replenishing of sand boxes.

The use of the car rheostatic controller, which operates by moving the handle to the right to go forward, and to the left to reverse, leads to accidents. Where a motorman is required at times to operate also a series parallel controller, with a separate reverse, he is liable to move the handle of the controller past the neutral point and reverse the motors in the rheostatic controllers, as this action is just like that of the series parallel controller in passing from multiple to series. Several accidents being attributed to this cause, the Hartford people filed a square hole in the cover of the controller, and into this fitted a metallic block, which projects through far enough to strike the handle when in open position. In this way the motors are protected from being reversed by mistake. A view of the controller with this device is shown in Fig. 2.

Car houses are hard places to keep warm, largely on account of the warping and poor fitting of the doors to their jams. In Hartford a special device is used to draw the door tight, and it is made by the company's blacksmith. The door is swung on the outside, and a long strap-iron U is fastened to the top of the door, as shown at *A*, Fig. 3. The

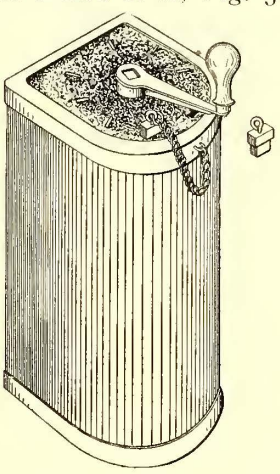


FIG. 2.—CONTROLLER CATCH

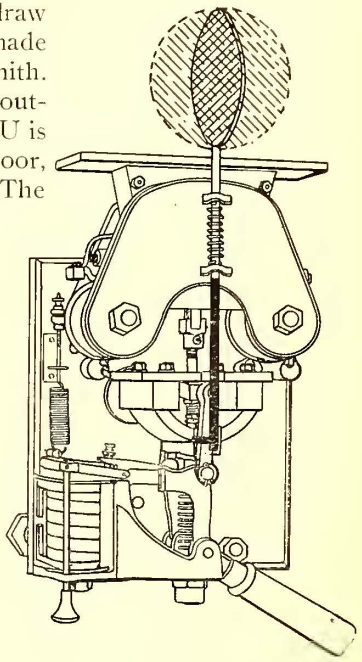


FIG. 4.—CIRCUIT BREAKER SEMAPHORE

wedge-shaped latch is operated by two levers from the barn floor, and is forced into this U, drawing the door tight up to the jam. The result is that the car house can be easily warmed.

Where there are a number of circuit breakers in a row on the switchboard it is difficult at a distance to see which one is open. The Hartford Company has a long narrow power house, and the station engineers have devised a semaphore system to clearly indicate what circuit breakers are thrown. The arrangement is as follows: The toggle joint in opening up the switch jaws strikes a pin, which gives a quarter turn to the semaphore on the circuit breaker and displays a red disc. This is invisible from the engine room floor when the circuit breaker is closed, for it is then edgewise. Each generator circuit breaker is also provided with a semaphore, so that the engineer at a glance can see which units are operating on the system. Fig. 4 shows the general arrangement.

The oiling of a bearing by the oil-can method entails both a waste of oil and manual labor. The conduction of oil to the bearing by a piping system and its withdrawal again after it has worked through the bearing surface the lubrication can be made automatic in its action and does not require the handling of the oil. Mr. Caum has developed for the Hartford Street Railway power station a very complete system.

Each engine has an independent piping system, which can be shut down with the engine; all piping systems are controlled from one point, and a sight feed is introduced into each pipe line. The oil is fed from supplementary tanks in the engine room to the engine bearings by gravity. A tripe valve is used, so that air can be blown through the pipe to clean it out. Five-eighths-in. brass tubing and brass fittings are used throughout. The oiling system can be fed from two independent sources of supply.

The oil house is located at a distance in the rear of the station, and is divided into three fire-proof compartments, which are lighted externally by lamps placed outside the windows. One compartment is for the handling and storage of cylinder oil; another contains the filters, and a third cooling and storage tanks. The oil from the bearings

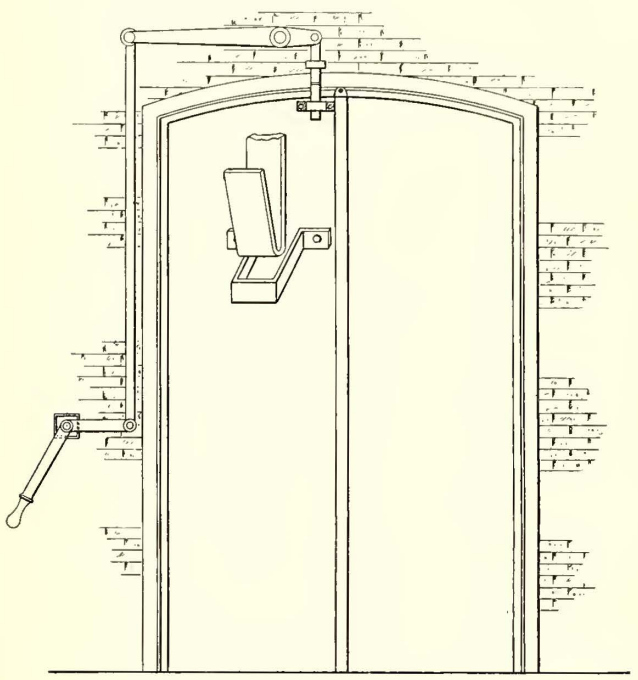


FIG. 3.—CAR HOUSE DOOR CATCH

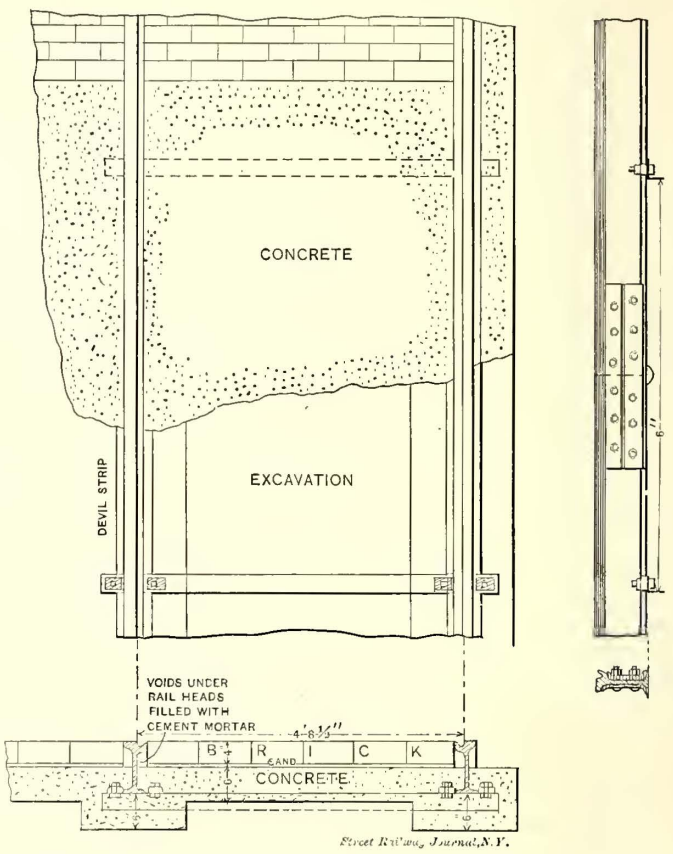
collects in a receiving tank and is forced from this by compressed air to the filtering room, where it is heated and run through filters. From the latter it is forced to the cooling and storage rooms.

There is a duplicate system both in the oil house and up to the air compressor. By turning a two-way valve either supply can be drawn on. The rate of flow of oil through the bearing is about a gallon in two minutes. It is found that the oil does not get worn out as fast when circulated rapidly, and the volume has a cooling effect on a bearing which tends to heat.

The method used for supplying a bearing with oil and drawing it away is accomplished without the slightest external appearance of oil. The engines supplied are horizontal, and the wipers on the crank-pin and the crosshead pin have been dispensed with. The crankhead is lubricated by means of holes drilled at an angle through the cranks from the circumference of the main bearings to the crank-pins. Holes are drilled from the top of the crosshead to the crosshead pin and through the latter to the bearing. This receives oil furnished to the top guides. There is no indication of oil on the white floors and the amount of oil required to supply the waste is extremely low. Even the self-oiling bearings of the dynamos are piped up and supplied with oil by this circulating method, to furnish fresh cold oil during extremely hot weather.

Track Construction on Concrete in Detroit

The Detroit railways were among the earliest in this country to employ concrete for sub-construction in street railway track. The original construction employed by the Detroit Citizens' Railway was a 9-in., 100-lb. grooved rail carried on steel ties spaced 5 ft. centers. The ties were channels 7 in. wide x 7 ft. long and $\frac{3}{8}$ in. thick, with a flange of $1\frac{1}{8}$ ins. deep. They weighed 21 lbs. each. The concrete was laid 6 ins. below the base of the rail and tamped under the ties. It was also laid on top of the ties and carried up



PRESENT STANDARD TRACK CONSTRUCTION IN DETROIT

to within $1\frac{1}{2}$ ins. of the base of the paving. When Belgian paving was used, the latter was then laid on $1\frac{1}{2}$ ins. of sand. The same construction was used with asphalt.

The Detroit Railway, which was built about the same time, used in part wooden ties and in part concrete stringers. The wooden ties were laid on a 6-in. concrete base, between which and the tie was a 1-in. layer of sand. Concrete was also carried up above the ties, and where 5-in. paving was used with a 7-in. rail, the concrete extended to a height of $1\frac{1}{2}$ ins. above the ties. There was then a layer of $\frac{1}{2}$ in. of sand, on which the paving blocks rested. Where concrete stringers were used a trench was first cut 15 ins. deep and 1 ft. wide, a layer of concrete composed of one part of Portland cement, four parts of Louisville cement, eight parts sand and sixteen parts of broken stone, was laid in the bottom of the trench to a depth of 6 ins. The rail, which was 7 ins. high, was then placed in the trench and the 2-in. space between the top of the concrete and the bottom of the rail, with the space on each side, was filled up to the bottom of the pavement with grouting, composed of one part Portland cement, one part sand and three parts of clean fine gravel. The rails were bound together with tie rods placed 10 ft. apart.

The two railways are now under the same management, and the experience of the last three years with both types of track construction have

led to some slight modifications. The stringer construction of the Detroit Railway was found to have gone in spots, and it was thought that this was due in part to the method of holding the rail, which, being with tie rods, did not hold the rail vertical. On the other hand, the heavy ties employed on the Citizens' Railway were not found necessary. The accompanying engraving shows the standard type of track construction now employed by both companies. The present tie is a 3-in. angle bar, and its use is more for keeping the track to gage and the rails vertical, for which purpose it answers better than a tie rod, than it is to support the rails. The concrete is carried down 6 ins. below the base of the rail and covers the ties to a height within half an inch of the base of the paving, which in the engraving is 4 ins. thick. If, however, there should be any soft spots encountered in laying the track the concrete is carried to a greater depth, 2 ft. if necessary, to give a perfectly substantial base for the rail. The management consider the construction illustrated perfectly satisfactory with the clay sub-soil, but with a sand sub-soil would not recommend any type of concrete construction.

After the concrete is laid it is necessary to let it set for five days without running any cars over it if the weather is dry; in the fall when the road is moist it sometimes must be allowed to rest a week. Over 98 miles of track have been constructed in this way during the last three years. The rails are bonded with a U-shaped riveted bond in the base of the rail. The rails are not cross connected, as the axles are depended upon for this purpose, but the inside rails of the double-track are cross connected for 500 ft. by Chicago rail bonds.

As is well known, the Detroit Railway Company installed a considerable amount of electrically welded rail on its Jefferson Avenue line. This rail is still in good condition, and is satisfactory, although the company is not electrically welding any more of its track rails. One chief advantage found with the electrical weld was the good electrical return which it afforded, and the section welded is that upon which the power station is located, so that these rails afford an excellent return to this point, in fact so good that no ground return is employed. In all, about 2 per cent of the welds have broken during the past two years. Where this has occurred the rails have been well bonded.

Changes in Brooklyn

Official announcement has been made that the controlling interest in the capital stock of the Nassau Electric Railroad Company has been purchased by the Brooklyn Rapid Transit Company, owner of the Brooklyn Heights railroad and the two roads will hereafter be operated in complete harmony. The Nassau Company has $6,000,000 capital stock outstanding, and $4,849,000 bonds, and was formed for the purpose of operating the Atlantic Avenue railroad and the Brooklyn, Bath & West End Railroad

It is stated that very few changes will be made at present in the actual operation of either of the companies with the exception that one or two of the Nassau lines will be given a through service to New York via the bridge over Brooklyn Rapid Transit lines. A number of changes in the personnel of the Nassau Company has been made, however, and the present officers and directors are as follows: President, John E. Borne; vice-president, Hugh J. Grant; treasurer, C. D. Meneely; secretary, W. F. Ham. The stockholders of the Brooklyn Rapid Transit Company will shortly vote on the proposition to increase the capital stock of that company to $45,000,000.

LETTERS AND HINTS FROM PRACTICAL MEN

Notes on the Standard Rules and Regulations as reported by the A. S. R. A. Committee

SCHENECTADY RAILWAY COMPANY.

SCHENECTADY, Jan. 14, 1899.

EDITORS STREET RAILWAY JOURNAL:

The report of the committee appointed by the American Street Railway Association has now been publicly printed in your columns, December, 1898, and it is, therefore, open to discussion and criticism.

The intrinsic value of a comprehensive, consistent and equitable set of standard rules would be immeasurable. The accepted usages of a road, of similar roads or groups of roads are the "constitution" of discipline, the rules and regulations are its "by-laws." With good rules intelligently enforced, the employees will be bound into a homogeneous and interdependent body, but with rules that are incomplete, inconsistent or inequitable their enforcement will be a subversion instead of a conservation of discipline.

Beyond their application to the employees there is at present a further use of good rules, and that is their effect on the courts, the municipal and other authorities and the general public. In these days of conventions with open doors, unlimited discussions and publications, of yellow journalism which probes and exploits the inmost recesses of everything, of suits at law during which matters pertinent and unpertinent are "expert-ed" and spread broad among the people, in these days, the rules of a company and the measure and quality of their enforcement are very often matters in which the courts, the authorities and the people at large take a keen interest, an interest the results of which are often felt in unexpected ways. There is, therefore, all the more reason that the rules themselves should be as perfect as experience, observation, knowledge—and a desire for perfection—can make them. The enforcing of them is an important, but secondary matter; good rules will partly enforce themselves, but the task of enforcing rules that are unreasonable, unjust, inconsistent or otherwise imperfect, is an impossible one, and if persisted in may become a two-edged sword to be used against the enforcer.

The task given the committee was a difficult and thankless one, difficult, because in a territory so large as that covered by the national association, conditions of every kind vary so greatly that a rule that would be perfectly just, proper and appropriate in one section of the country, *might*, in another section, be considered very undesirable. Also at present, the varying laws, regulations, ordinances, recommendations, etc., etc., of the legislatures, courts, municipalities and railway commissioners of the several States and Territories would militate against the formation of a general set of rules; that is to say, of a set of rules which—without change of form or meaning—should be applicable to all railways in the United States.

The task was a thankless one, because, if there is one thing that the average superintendent or general manager believes to be perfect and immaculate it is his rules and regulations, and he usually does not take kindly to, and is not grateful for any rules which have not emanated from him directly or in the formation of which he has not had a hand, especially if he sees that in many respects they are not actually a betterment. In this he is somewhat right, as his rules are generally the outcome of local experiences and necesities, and while they are often crude and strongly tinged with local color and personal idiosyncracies, they have been, as a whole, more just, wise, safe and reasonable

than those forced—or sought to be forced—on him by local legislators and muncipalities or by the aspiring, but inexperienced directors of his own company.

Moreover, given that the committee had reported an absolutely perfect and complete set of general rules, the Association has no authority to enforce their use, nor has it the means to obtain or compel such authority. It would have to depend on the willingness of each railway that was a member of the A. S. R. A., and of the many who are not, and would have been met at once with the inertia of conservatism and the literary jealousy of every-superintendent-his-own-author.

It seems, therefore, that the A. S. R. A. has given the gentlemen of the committee a doubly difficult and thankless task, as it is well nigh a useless one, and it will not be exaggeration to say that not one company will change its rules to conform to those of the committee at the present time, nor would one in a hundred do so were the Association to ratify and recommend them. This, the Association should have thought of at the time of appointment of the committee, as they have placed the gentlemen of the committee in a very difficult position, and have led the street railways of the country to expect something that cannot be realized. The name itself is misleading even were the thing itself possible, as a set of rules for voluntary use by any and all railroads in the country might be called "Uniform," or "Universal," or "General," but could hardly be called "Standard" unless their use was in some way obligatory.

If the A. S. R. A. had been less ambitious or more thoughtful and had contented itself with asking its committee to prepare a *uniform* set of *general* rules for submission to the several State associations for action, the task of the committee would not have been so out of proportion to its report—and its thanks.

As a matter of fact, the State associations are, at present, the only bodies that should attempt to standardize rules. They represent at once the largest and smallest division or group of street railways that have mutual and uniform interest as regards legislation, and they are the only bodies that possess—even indirectly—mandatory powers, as they can, if their majority wills it, influence and cooperate with their several State Railroad Commissions in the formation and enforcement of a standard set of rules.

Such a standard set of rules would, at present, be of very great value within a State. Ratified by the State association, recommended by the State Railroad Commissioners and enforced by the State legislature, they would have the effect of laws, would greatly simplify lawsuits arising from their enforcement or their neglect, and in cases where they were strictly adhered to would greatly minimize the damages. They would make a more efficient body of the railway employees affected by them, as these employees would be more "standard" as regards general rules and would not have—as now—to change all their ideas and methods because they changed their location and employer. They would greatly lessen difficulties, arguments and misunderstandings with the general public, as the rules would soon become as well understood as the "five-cent fare" and, having the authority of the State at their back, would be much less liable to infraction on the part of the public.

As the State associations and State railroad commissioners multiply, these rules—amplified and amended to meet larger and more general conditions—could be made uniform between State and State until they become uniform and standard all over the country. This is not a millenial forecast, nor a utopian dream, but a matter that is right upon us and needs recognition. With interurban street railways stretching out until they become inter-State, with companies operating roads that run across State-lines, and, perhaps, across States, it is ridiculous to think that the running across an imaginary line on the ground should change the whole character of an employee's actions.

Going back to the committee's report and taking into consideration all the difficulties in their way, it *was* possible for them to have given the Association a general set of rules that could have been offered to the State associations. Underlying all street railway transportation business, from Maine to Texas, from California to New Jersey, are certain fundamental principles which must be followed by *all* if the public is to be served with safety, convenience, comfort, regularity and punctuality, if employees are to serve with the greatest efficiency and with the least danger, deprivation, exposure and labor, if the employer is to obtain a fair profit on his investment and without needless risk. To expound and explain these principles, to apply them to specific cases, to show their capabilities and their limitations, to embody the whole thing in a clear, concise and consistent form—that is the province of a "general" set of rules and regulations.

Such rules *must*

1. Be *rules*, not suggestions nor advice; such—if pertinent—may be prefixed as an introduction or deduced as corollaries, but must not be masqueraded as rules.

2. Be "general" in the sense that they are applicable without change of intent or principle to all street railways or surface railways within the territory they are intended to cover.

3. Be "general" in the sense that they must contain nothing local or individual, either as regards locality or personality, use or manufacture.

4. Be comprehensive, covering every point in regard to all employees whose duties are in any way in connection with the public—either directly or through their fellow employees.

5. Be perfectly clear and lucid in language, admitting of no double meaning nor obscurity of meaning.

6. Be perfectly free from contradictions either within themselves or with one another.

7. Be in acordance with general usage, experience and observation.

8. Be reasonable.

9. Be just and equitable.

Such rules *should*

10. Be couched in plain, simple, terse language so as to be easily understood, and—if necessary—memorized. Slovenly composition, ungrammatical language, false syntax, obscure expression, involved, complicated and inverted sentences are to be as much avoided as "elegant phraseology."

11. Be arranged in some connected, definite and consecutive manner, and divided into groups having specific relation to certain persons, duties, acts or things. Under each group the rules themselves should be arranged as much as possible in a natural sequence or order, all cognate matters should be brought under one rule if possible, and each rule should be preceded by its subject as a heading. On the other hand, no rule should treat of more than one subject.

12. Be free from repetitions either within themselves or of one another. Repetitions *in* rules and *of* rules do not emphasize; they only weaken. Emphasis should be used only in proportion to the importance of the subject and should be manifested by other means.

13. Be free from unnecessary, irrelevant or axiomatic remarks and directions. Employees for whom these rules

are made must be considered as having ordinary common and moral sense; a street railway is neither a kindergarten nor a Sunday-school.

They should *not*

14. Be unnecessarily peremptory in tone; "must" and "shall" used too frequently lose their force. It is much better on ordinary occasions to say "will" and "should." The imperatives should be reserved for imperative cases.

15. Be addressed to the second person—"you." It sounds—and is—better to address the rules to employees in the abstract, i. e., impersonally, and for this the "third person"—"he" or "they" is necessary. This is somewhat a matter of opinion, however, but there can be only one opinion on the question of sticking to one kind of address in the rules, either "you" or "he" and "they" may be used, but they should not be mixed. In an *introduction* to the rules the less formal style is an advantage, as each individual employee is there being addressed, while in the *rules* the employees as a class or group are being instructed.

16. Threaten. Penalties should form no part of a rule, although they may be an adjunct of the rules. Dismissal for certain specific and proven grave offences, such as drunkenness on duty, lying, dishonesty and wilful disobedience of safety rules, should be made a *rule*, but beyond that, all penalties, punishments and threats had better be kept out of the rules and the "punishment made to fit the crime"—when the crime occurs. Prompt and just punishment in actual practice is all that is necessary, and a few cases of such will do more good than a rule-book full of "bogy-man" threats, very few of which can be carried out in practice.

The above qualifications and conditions contain nothing but what is reasonable and necessary in a matter so important, and it will do the report of the committee no injustice to test it by them and see how near it comes to fulfilling them. This will be done in a future article.

H. S. Cooper.

Methods of Accounting

Binghamton Railway Company,
Binghamton, N. Y., January, 10, 1899.

Editors Street Railway Journal:

I notice your editorial in the January issue, wherein you ask for views upon Mr. Kittredge's article entitled, "An Ideal System of Street Railway Accounts," and would say that the system of dividing and sub-dividing of the accounts as outlined are almost identical with those followed in this company, and the ideas expressed by Mr. Kittredge as to intelligent and perpetual comparisons have been carried on by us for several years, for the constant information of the general manager of the company.

In addition to our ledger showings we have a comparative table (special) book, in which we show a constant comparison of the receipts from each passenger division of the road, from various other resources, the operating expenses in detail, as well as increase and decrease in supplies on hand, floating debt, etc., and a daily comparison of each division's receipts. From this statement the management is enabled to watch the earning capacity of each division of the road, and to decide as to what service such division is entitled, also to determine at a glance whether any leakage occurs in operating expenses and to correct such intelligently. The many other details of information conveyed by this table furnishes to the office at all times the exact standing of the road. I mention this book as giving the same information constantly as by Mr. Kittredge's system without what seems to me a complication of bookkeeping.

More as a matter of asking information than criticism, I wish to express the following: The appearance of the Maintenance and Emergencies (sub-divided) accounts in the Reserves, as Liabilities in the Balance Sheet, as I understand it from the article, act as sinking funds for the pro rating and equalizing of all expense accounts.

If this interpretation be a true one, I am at a loss to understand how these accounts could be intelligently pro rated unless an estimate be based in each case upon the year preceding, and even then the variation of a year might be so great that the following year would be unjustly pro rated. While the distribution of expense in the various accounts through different months or shorter periods, might seem just when one thinks of a large expense of replacement falling on one month the expense of which has really been accrued during preceding months, the question arises, how can the pro rating be properly adjusted, and why is not the actual condition of the expense account of more instant and valuable information to the manager than the study of the balance sheet. For instance, would the showing of the same operating expense for the summer months with increased car service for pleasure rides, etc., be correct as against the winter months, or could the removal of snow and ice be pro rated throughout the summer intelligently, and, in that line, would not an open winter, without storms, or a winter with frequent and heavy storms, make an unjust showing of one year with another? Again, how can a company depend upon the life of a generator and, as they run year after year without repair or replacement, have you not created a false asset which must also appear in the balance sheet, or, without indemnity insurance, how can one intelligently pro rate against accidents?

Perhaps I may be speaking from ignorance or a too limited knowledge of Mr. Kittredge's ideas in this respect, but it would almost seem that the receipts could be even more accurately pro rated, thus enabling the accountant to forecast correctly any report, for any time, the other necessary and valuable information being available only to those who have access to the balance sheets.

From a personal point of view, gathered from the information desired by, and on hand for, our General Manager, it would seem that the supply store system with its *daily* charges and vouchers, together with comparative tables, made up constantly from the ledger, properly divided, gives the actual and satisfactory status of the road at all times, which cannot be furnished more acceptably to management, bond and stock-holders, the public, and the State.

John B. Rogers, Treasurer.

Fitchburg & Leominster Street Railway Company,
Fitchburg, Mass., Jan. 9, 1899.

Editors Street Railway Journal:

I have carefully read Mr. Kittredge's paper on "An Ideal System of Street Railway Accounts," and, in general, can commend it very highly.

It must be remembered that small roads cannot go into the detail of classification or of accounting as deeply as can the larger, and there are a great many small roads. There is a danger line beyond which the expenses of accounting are entirely out of proportion with the income and needs of the corporation. For example, with a road of $75,000 yearly operating expenses, a weekly inventory would be an absurd proposition. The expense of it would be en-

tirely incommensurate with the cost of supplies not going into immediate consumption. Yet it is as necessary for these small roads to have a sound accounting system as the largest. So any "ideal" system of accounts must be sufficiently elastic to be of use to all without too great expense to any. This, it seems to me, is a virtue of the system which Mr. Kittredge suggests.

I think Mr. Kittredge's reasoning in omitting accounts *N* and *O* entirely wrong. If the items of these accounts may be classified as assets, as parts of other accounts, why are they not assets "in themselves?" They are more tangible and more properly classified as assets than goodwill, which is almost illusory, and they are as properly separate as accounts *A* and *B*. These latter accounts could be as easily pro-rated among the others as *N* and *O*. The object of accounting must be accuracy, and pro-rating these accounts is far from that, as actual experience shows.

One thing which Mr. Kittredge neglects is tickets. These little pieces of paper do a big business on many roads, thousands of dollars worth of them sometimes outstanding. They are essentially a liability and must be accounted as such. The practice of carrying receipts for tickets sold directly to revenue is wrong. The minute they are sold they become a liability against the corporation and so remain until used.

Further, it seems to me that the classification of dividends declared and unpaid as a floating liability and taxes and interest as reserve accounts is wrong. These are all *accrued* liabilities, and, as such, should have separate classification. Reserve accounts for sinking, maintenance or emergency funds are in no sense accrued liabilties nor are accrued liabilties, by nature, exactly similar to funds for the payment of outstanding liabilities like bonds or future extraordinary expenditures for maintenance and emergencies.

Why are not express and advertising (in cars) receipts from operation as much as freight or mail?

Robert N. Wallis, Treasurer.

Bergen County Traction Company, N. J.,
Fort Lee, N. J., January 14, 1899.

Editors Street Railway Journal:

The form you give in your January issue (chart of Analysis and Classification of Street Railway Accounts) is practically the same we use for balance sheet.

William N. Barrows, Secretary.

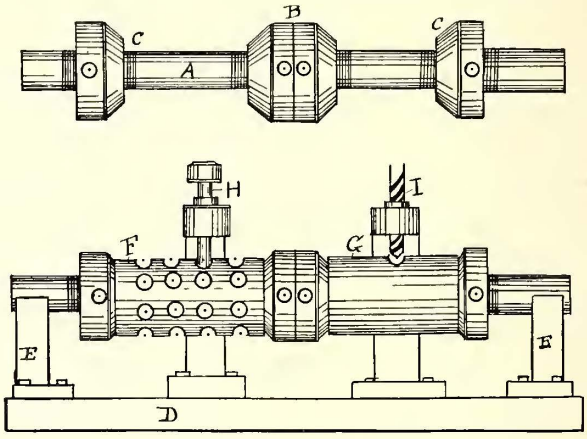
Method of Drilling Armature Bushings

Boston, January 12, 1898.

Editors Street Railway Journal:

They have a way at the West End railway shops here for drilling street railway car axle bushings that is both simple and effective. The rig is especially designed for drilling plug holes in the bushings. A double-end arbor is used, with a drilled bushing on one end and a bushing to be drilled on the other end, as shown in the annexed sketch of the tool.

The arbor (A) is cut with a thread and movable nuts (B) and (C) put on. These nuts are cone-shaped on the sides facing in, and are screwed up on the bushings, as shown in the next view, which represents the bushing (G) in process of being drilled to correspond to the master bushing (F). The arbor rests in the bearings (E) (E), and can be turned easily by the hand. The guide pin (H) rides in the shoulder piece, and the latter is set-screwed to the base piece (D). The drill (I) operates in a leader, which is set-screwed to the base. The nuts for sustaining the bushings in place can be square and tightened with a wrench, or they can be round and provided with holes in which to insert a shaft for turning. As the nuts hold the bushings very firmly in place the machinist can be sure of getting uniformly drilled work. Bolt holes, etc., may be drilled at regular intervals in other lines of work on this device, and at any desired distance from the axis and from



TOOL FOR DRILLING ARMATURE BUSHINGS

each other, regardless of the diameter of the pieces or the length. The jig can be provided with an index plate that can be set for any number of equal divisions and clamped firmly in position. The drill is held in the usual manner, and by means of a variety of sleeves this jig is ready to drill equal spaced holes at the proper distance from centers.

B. F. F.

Amusing Letters

Nearly every railway manager has received letters more or less amusing, asking for a position, damages for a supposed injury to property or feelings, or protesting against some "outrageous" invasion of the author's rights. Below will be found a copy of a letter recently received by F. J. J. Sloat, of the Cincinnati & Hamilton Railway Company.

Hamilton, Ohio, Dec. 19, 1898.

Mr. Sloat and Will. Christie:

Dear Sirs.—The 13 of this Month the No. ten Car Cut My valuabel Dog In Two you have no Pitty for Me I Am Lonesome For My Dog yet I was ofered A Big Prise For My Pet Dog I Would not Take it I would rather have My Dog now What will I do and What will you do My dear Dog is gone.

Yours Most Respectfully,
Mrs. ——— ———.

P. S.—Mr. Sloat Swope has fine dogs get him to give me one In Return For Mine Mr. Sloat you know I Deserve A good Dog.
Mrs. ——— ———.

Great as the loss of her dog must have been to this lady, it was insignificant as compared to the damage recently inflicted upon a gentleman in Brisbane, Australia. His pathetic letter to J. S. Badger, manager of the Brisbane Tramways Company, describing the catastrophe is given below, and should act as a warning to all those who persist in sitting on the hand railing on the top of a double-deck car while escorting ladies home from the theater.

To the Manager of the Brisbane Tramways Company, Ltd.:

Dear Sir.— I regret to have to inform you that on returning from the theater on Wednesday evening last I boarded the first theater car to W'Gabba, and owing to the car becoming overloaded I had to sit on the hand railing on top of the car, with the result that I had my trousers destroyed by being caught on the stone pillar at the north end of the bridge.

As I suffered sufficiently by having to escort a lady home with my pants minus the seat I am sure you will deem it only just that you should suffer the inconvenience of the loss of their value, viz.: £1 1s.

If you have any reason to doubt my assertion you may refer to Mr. ———, who was also a passenger.

I will send you the damaged pants if you wish it.

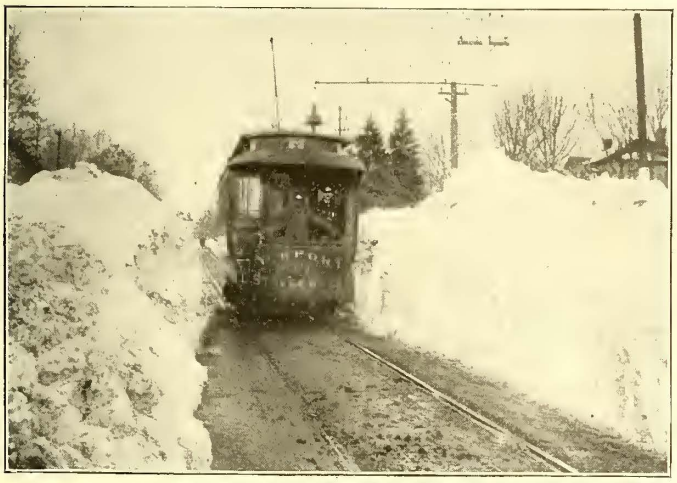
Trusting you will see the justice of my demand and forward cheque for amount at your earliest convenience,

I am, sir, yours faithfully,

———— ————.

Fighting Snow in Newport, R. I.

A snow storm is unwelcome to most railway managers, no matter how well one may be prepared to keep the track clear, and during a heavy storm continuous and arduous work is usually required from every member of the operating force, from the switchman to the superintendent, to keep the tracks open. Many of the New England roads suffered severely from the blizzard the latter part of November. A good idea of the amount of snow which fell at that time in localities where the fall is comparatively light at most times, is shown in the accompanying engraving, which was taken on the Newport Street Railway, at Newport, R. I. The means employed by this company for combating this snow storm are the snow plow, with its long nose set at an acute angle, a snow shovel brigade, and, coupled with these, vigilance and prompt action.



LARGE DRIFT IN NEWPORT

Combined Street Railway and Lighting Station

The Hagerstown Railway Company has recently completed a new station, from which power will be supplied for operating the street railway system and the electric lights for city and other service, both industries being controlled by the same company. The new building is of brick, tasteful in design, with a ground dimension of 80 ft. x 116 ft., and wing for boiler room 45 ft. x 50 ft. The generators are to be driven from a jack shaft, which extends the whole length of the building down the middle of the floor, and is provided with Hill clutches for coupling the different sections. The power is generated by three tandem compound condensing engines of the Standard type, manufactured by the Harrisburg Foundry & Machine Works. They are of the single piston-valve type, and so far are operating to the entire satisfaction of the management. Two of the engines, which are each of 400 h.p., are located at the ends of the shaft, on the opposite side from the generators, and transmit their power by belts to the shaft. A third engine, a 300-h.p. machine, is belted to the middle of the shaft.

The street railway generator equipment consists of two 325-kw. machines of the General Electric make, which are belted from the extremities of the shaft. An 80-kw. generator provides the power for stationary motor service. The lighting generators consist of one 3000-light alternating machine, one 1500-light alternator, one 125-light Brush arc machine, and four 50-light Schuyler generators, all driven by belts from the shaft. The belts are all of Chas. A. Schieren manufacture.

The boiler equipment consists of three boilers of the Berry type, aggregating 550 h.p., and were manufactured by Robert Wetherell & Company, of Chester, Pa.

Among the auxiliary steam equipment are the condensers and steam piping, which were furnished by Best, Fox & Company, and a Spencer damper regulator, which controls all the dampers of the three stacks.

The switchboard is of black and blue marble, the blue portion being occupied by the lighting instruments. This, with its equipment, was furnished by the General Electric Company. The equipment seems to be well designed for the purposes required. As it was necessary to operate both the lighting and railway generators from the same engine, it was found better to install the shaft with clutches and belting, so that either engine, or all combined, can be coupled to each or all of the generators. For these reasons direct coupled units were not installed. The plant has been erected and the machinery installed under the direct supervision of C. W. Lynch, president of the company, the designs having all been made by W. C. Happerley, superintendent.

Business During 1898

In spite of the fact that the United States was engaged in a war during the past year, the electric railway business has been more prosperous than ever before, and probably a greater amount of contracts for new equipment have been awarded than in any previous year. It is certainly true that most manufacturers have not complained of lack of orders during this period.

From data collected recently by the STREET RAILWAY JOURNAL on the output of certain manufacturers of rolling stock, it is estimated that from all the shops in this country manufacturing street cars, between 5500 and 6000 cars were turned out during 1898. During the same period it is estimated that the output of electric car trucks in the United States was from 8500 to 9500, and of car wheels for street railways from 125,000 to 150,000. A certain proportion of the two former and a small percentage of the latter were undoubtedly for export, but it is impossible to say just what proportion was sent abroad.

The secret of success in handling damage cases lies, no doubt, in their being properly looked after from the very start, *i. e.*, from the time they are first reported. How to do this varies as do the different cases, but no case should ever be handled by any one but an honest, careful and experienced claim agent. For such work, men must be naturally qualified; they should ever have the interests of their road at heart, and yet not blinded by too great a prejudice in its favor; they should have sound, shrewd judgment, and be painstaking and careful of detail to the highest degree. Like the true physician, they should be of a happy, calm temperament; and also, like him, should ever be ready to answer a call. The successful claim agent should have the faculty of handling all sorts of people without friction. His keen perception should reveal to him the nature of each case, but he should never betray anxiety for settlement.—From address delivered at the Niagara Falls Convention, 1897.

STREET RAILWAY JOURNAL

FEBRUARY, 1899.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY

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

BRANCH OFFICES:

CHICAGO.....Monadnock Block.
PHILADELPHIA.....931 Chestnut Street.
LONDON.....39 Victoria Street, Westminster.
PARIS.....50 Boulevard Haussman.
COPENHAGEN.....V. Faber-Madsen, 9 Valby Langgade.
BERNE.....Chas. Rochat, 15 A Falkenburg.
MILAN.....Guido Semenza, Via Paleocapa, 4.
VIENNA.....E. A. Ziffer, I Giselastrasse, 9.
MOSCOW: Alexander L. Lineff, 9 Gt. Tchernishevsky Pereulok.

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

TERMS OF SUBSCRIPTION.

In the United States and Canada..... $4.00 per annum.
In all Foreign Countries, per annum..... $6.00 / 25/ / 31 fr
Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

NOTICE.

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

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

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

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

Address all communications to

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

Apropos of the revival of active interest in increased rapid transit facilities in New York city and the more favorable attitude of the municipal authorities on the question of building an underground electric railroad, we take occasion to again point out the impossibility of avoiding or long postponing the building of such an underground road, or of looking forward with equanimity to the future congestion of traffic on Manhattan Island if greatly increased facilities be not provided. The new electric surface lines are proving so immediately and unexpectedly popular that almost as soon as they start into operation the traffic on all the longitudinal lines is dangerously near the topmost limit of capacity. We know now quite closely the ultimate capacity of the elevated lines, except for possible "double decking," and we know also that there is an enormous number of new apartment houses and private dwellings going up in the northern portion of the Island. These buildings must have tenants and the tenants must have transit accommodations for their every day marketing, as well as for business purposes, and better rapid transit facilities are even to-day a crying necessity. What wonder is it, then, that the political powers behind the throne in New York city should execute a *demivolte* and consent to the further consideration of rapid transit plans on broad gage lines—what wonder also that those at present in charge of, and responsible for the transportation of the people of the city of New York should give most serious consideration to financial and engineering problems incident to the construction of such lines, and should resolve to build them as a supplement to the present almost overburdened facilities.

About ten years ago, just before the beginning of the "boom" in electric railroading, there were well-defined rumors that a European syndicate was forming to introduce compressed air as a motive power for street railways on an extensive scale. The immediate success of electricity prevented the syndicate's plans from being carried to fruition, and compressed air has not since figured as a competitor of importance in the street railway field. Within the past five years, however, further experiments in compressed air have been carried on in this country on a somewhat extensive scale, and the results have been such that ample and powerful financial support has lately been secured for compressed air as a motive power. The first large effort of one of the new syndicates will be directed toward the building of "auto-trucks" for handling the trucking business of large cities, now done by horses, and the parent company purposes licensing local companies for this purpose. It is expected, too, that cabs and possibly even omnibuses will next be taken up. Considerable experimental work has also been done in the street railway field, as has been duly chronicled in the STREET RAILWAY JOURNAL from time to time, and within a few months, a twenty-car, five-mile crosstown line is expected to be in operation in New York City by compressed air. It will need a year or more of full operation of this line before even a preliminary idea of the operating expenses of compressed air can be obtained, although reasonably close estimates of everything except depreciation and "contingencies" is now, perhaps, possible. What has been so far demonstrated in New York is, first, that compressed air motor cars will run, and with fair satisfaction to the public; second, that an amount of air, compressed to 2,500 pounds pressure, can be stored out of sight in an ordinary street car, sufficient to run a car from twelve to fifteen miles, under ordinary conditions of track and service, and somewhat more under favorable conditions; and, third, that air at this high pressure can be compressed and "bottled" with reasonable safety, and the pressure reduced by simple means to a point where it can be used in the motors. What is not demonstrated is whether under all working conditions which street cars and trucks have to meet, including collisions, etc., absolute safety to the public can be always assured; whether heavy grade work such as is frequently found in city streets can be done by compressed air motors or any form of self-propelled car employing reciprocating

motion; and whether the costs of motive power and of maintenance will be comparable with electricity. All these demonstrations will come in time, and what is now certain is that experiments on a larger scale than ever before made in this country are already instituted, and will be vigorously prosecuted to a definite conclusion.

The cost of copper has been constantly rising for the last year and more, and, according to all indications, will continue to increase, especially if the consolidation of the copper mining companies of the Northwest, which has been proposed in Boston, the financial headquarters of the American copper interests, is consummated. The use of the metal is, of course, also constantly increasing, and the extent of its employment in the electric railway industry makes the question of its market price an extremely important one to street railway companies. Efforts to find a substitute for copper as an electrical conductor have been numerous. As is well known, the rails are being employed for carrying the return current to the power station much more extensively than formerly, and underground supplementaries are going out of use. Some companies have even gone so far as to lay mains of buried rails, well bonded together, for connecting the tracks with the power station. The chief reason for this, of course, is to save the expense of the copper, but measures of this kind are, on the whole, poor substitutes, so that the announcement of the aluminum manufacturers that they can compete in price with copper, comparing the two metals in their current-carrying capacity, is interesting. Aluminum is practically three and one-half times lighter than copper, and the pure metal has a conductivity of about 63 per cent that of pure copper. Upon these figures as a basis, it is estimated that for electrical conductors of equal conductivity aluminum at twenty-nine cents a pound is cheaper than copper at fourteen cents. The tensile strength of pure aluminum may be greatly increased, without much loss in its conductivity, by properly alloying it, and it is then well fitted for aerial wires, owing also to its lightness. The chief drawback to its use as an electrical conductor at present seems to be the difficulty of soldering or brazing it, but it is said that this objection is being overcome. The material has been employed as an electrical conductor to a limited extent on some of the long-distance lines in the country, chiefly for telegraph and telephone work, and any advances made in the method of adapting it to electrical uses will be watched with interest.

It is the impression in some quarters that under the Light Railways Act, it will be possible to duplicate in England and other parts of Great Britain, to some extent at least, the interurban electric railways now being so extensively introduced in America, but present indications seem to be that while there may be some construction of this kind, it will be in no way commensurate with that of America or with the development of the electric tramway industry. The Light Railways Act was passed principally with the intention of encouraging the construction of lightly built and inexpensive steam trams for the cheap carriage of agricultural products and goods to the nearest trunk line terminal, in cases where the amount of the traffic would not warrant the construction of a regular railway. The control of such light railways is vested in a body called the Light Railways Commission to whom the applications for the construction of such lines must be made. The restrictions on the construction of these roads are made less severe than those which govern tramways proper, and the procuring of the necessary powers is much less protracted and expensive than is necessary for tramways. The intention is thus to encourage the building of these roads for the benefit of the agricultural class who could thus ship their products at a much less expense than that required for cartage. In spite of the fact that the provisions are in many ways liberal, as described, the development of light railways in England has been exceedingly slow. Although those at present are operated by steam, there seems to be no legal objection to their use of electricity as a motive power, but there are a number of reasons which will serve to prevent the rapid development of these lines, even with electrical equipment. One of the difficulties will be that the city tramways are generally controlled by the municipalities with whom it is necessary to make arrangements for running rights and the use of current. Another, and seemingly a more serious objection to those who have studied the development of similar roads in America, is the limitation of speed. This limitation depends upon circumstances, but the usual maximum is twelve miles an hour. The first objection may be overcome, because the right of municipalities to build roads beyond their own limits is not fully determined and they surely ought to be willing to make any reasonable arrangements for terminal facilities with the light railroad companies, because they must recognize the value of the suburban and interurban feeders to their own systems. The limitation of speed, however, is a very great drawback and seems, under the present conditions of public sentiment, almost insurmountable, owing to the opposition of the vested interests of the steam railroad lines. The latter are extremely powerful in England and represent an enormous amount of capital with securities widely distributed. Any attempt to interfere with the earning powers of any of these roads by the construction of high speed electric railways built along the highways *as competing lines* is naturally almost doomed to defeat, although the conditions for their construction be otherwise favorable. On the other hand, the tramway development in England will, of course, be very large, as practically all the corporations which own tramways, or will soon acquire them, are requesting powers to equip with electricity. Public sentiment in England is favorable to the control of the tramways by the municipal corporations, who have undertaken the management of quasi-public enterprises to a much greater extent than in America, Outside of the tramway field there will undoubtedly be a large development in the electrical equipment of suburban and feeder branches of the steam railroads proper and even—in the not far distant future—of the main trunk lines themselves. There is probably no other country in the world that offers the opportunity for high speed electric service as that furnished by the English trunk lines, with their private rights of way, two and four tracks, no grade crossings, and their frequent train service. The population density in the cities and country is very great and these roads can afford to give their patrons far better service than at present.

A New General Formula for Train Resistance

The alchemists of old sought diligently for the philosopher's stone, the inventors of a later age for perpetual motion, and engineers of the nineteenth century have been almost as eager to obtain a general formula which shall reconcile all existing data and experiments upon train resistance. The first two objects of effort are now known to be unattainable, and the third has until now baffled the best minds in the railroad profession. Only a month ago "Locomotive Engineering," which for years past has devoted special attention to this subject, said editorially: "We do not believe that it is possible to devise a formula that will show an approximation of the resistance due to different kinds of trains at different speeds when train tons are the basis of calculation."

A general formula which appears to be applicable to *passenger* trains of all weights, running at all speeds up to the highest limits so far reached, has been lately worked out, however, by John Lundie as a result of a long series of tests of trains in actual service, and is here given to the engineering public for the first time. His methods of obtaining data are decidedly different from, and much more satisfactory than those commonly employed hitherto, where indicator cards of engines drawing trains at constant (?) speed on level (?) track have been made the basis (with an arbitrary allowance for engine friction) of estimates of resistance per ton moved. In order to be of any value such tests must be made in long distance runs, and it is almost impossible to find a hundred miles or more of absolutely level track for the purpose, while it is also difficult to obtain perfectly uniform speed even on a dead level. Mr. Lundie's method of determining train resistance is based on an examination of the speed curves of a train when *coasting* The possibilities of such a method will be instantly evident to an engineer, and it may be said, at once, that the results warrant a decided predisposition in its favor. It is not only possible to obtain the gross resistance due to track and journal friction and air resistance combined, but to differentiate between the air and the friction elements. The frictional resistance of a train being reasonably constant within somewhat wide limits of speed, the speed curve should be a nearly straight descending line from full speed to a point somewhere near a full stop. Now the actual speed curve dips below this straight line, as seen in Fig. 2, clearly showing a decreasing retarding force (due to air resistance), with decreasing speed.

In Fig. 1 are shown in graphic form the results calculated from more than 150 runs made by Mr. Lundie with trains of different weights on the South Side Elevated Railroad, of Chicago. It will be seen that these results, expressed by the location of points on the diagram, cluster around "straight line curves," and that these lines intercept each other, with surprising accuracy, at a single point located at a definite distance above the origin. This indicates, of course, that the first step in obtaining the final formula has been reached, in the establishment of a constant, representing the minimum possible train resistance for all speeds and weights, and it is interesting to note, by the way, that in none of the recorded experiments so far made on passenger or freight trains of all weights has the resistance per ton been less than the figure indicated by this constant—4 pounds.

Mr. Lundie's formula is as follows:

$$R = 4 + S\left(0.2 + \frac{14}{35 + T}\right)$$

where.

T = the weight of the transportation unit in tons (2000 lbs.).

R = resistance in pounds per ton.

S = speed in miles per hour.

It will be seen at once that unlike most previous formulæ, there are here two variables after the constant, namely speed and train weight. Many other investigators have endeavored to accomplish this, but unsuccessfully, and in the formula which has been in most general use in engineering hand-books, that of D. K. Clark, speed only appears as a variable. From a careful study of his

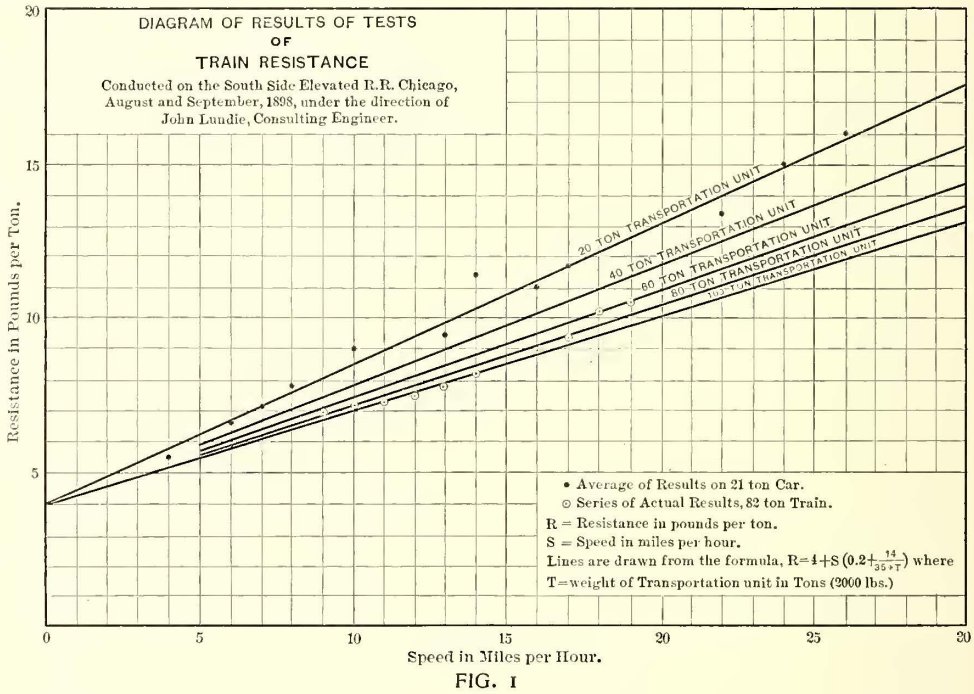


FIG. 1

results, Mr. Lundie developed the formula on the following mathematical basis: the expression by which "S" is multipled is proportional to the tangents of the angles made by the lines developed for different weights, as shown in Fig. 1, and is the characteristic of a rectangular hyperbola which (throughout the range of tests made) co-ordinates quite accurately the relations between train weights and the inclinations of the lines mentioned for corresponding weights. The term 0.2 is an intercept on the axis of y; 14 is the constant product of x and y, with the intersection of the asymptotes as origin; and 35 is an intercept on the axis of x.

The test of any formula lies in its application. Gaged by this test, Mr. Lundie's formula unifies in a remarkably close manner nearly all recently published experiments, together with other formulæ of more limited application, as will be seen by an inspection of the accompanying table. The Stroudley, Sinclair and Dudley tests of train resistance scheduled in this table were brought together by A. M. Wellington in the "Engineering News" in 1892, and referred to as intrinsically worthy of confidence on account of the careful manner in which they were made. To these

we have added further experiments made on the Philadelphia & Reading Railroad in 1889, and on the Central Railroad of New Jersey in 1892, so that a fairly complete range of train weights from 200 to 400 tons, and of train speeds from 40 to 70 miles per hour is given in the table. The Lundie formula checks up all these tests very closely, though in all but one case the results obtained by its use are slightly higher than the observed results. In this connection it may be noted that Mr. Lundie obtained his speed figures by positive methods, having found that speed recorders for variable speeds are not sufficiently accurate owing to the inertia of the moving parts.

These tests are all for heavy railroad passenger trains, upon which Mr. Lundie himself has made no experiments. For trains of from 20 to 100 tons, and for speeds of from five to thirty miles per hour, the Lundie formula is accurate, inasmuch as it is obtained directly from 150 or more observations made by Mr. Lundie in Chicago, as before stated. For lighter units still, the formula agrees with the results of private tests made by several of the great electric companies, and checks very well indeed the Clark formula

$$(R = \frac{S^2}{171} + 7.16),$$

bearing in mind that the latter is generally admitted by engineers to be from one to two pounds too high.

Now it need scarcely be pointed out that when a formula of this general kind, deduced on mathematical principles from a large series of experiments within a comparatively narrow range of action, is found to be equally applicable over a much wider range, a strong presumption in favor of the soundness of its underlying principle is established. It seems practically certain, therefore, that the Lundie formula is thus applicable to the whole range of passenger train traction on straight, level, exposed track in a calm atmosphere. It cannot, however, be said to be applicable to street cars running on gritty or dirty rails, and, in fact, it is unfortunately too probable that no formula whatever can be devised for street railway work for which a large factor of safety would not have to be allowed in practice to provide for great differences in condition of track.

An interesting question now arises as to whether the Lundie formula can be made, with some modifications, applicable to all kinds of train transportation, freight as well as passenger. It does not check the most recently obtained data for exceedingly heavy trains. Tests on the Chicago, Burlington & Quincy Railway, made by the old method of engine indicator diagrams, checked by dynamometer car, show that a 940-ton train of loaded freight cars, running at 20 miles an hour, has a resistance on a straight, level track of 5.5 lbs. per ton. By the Lundie formula this would have been 8.3 lbs. per ton. An extremely heavy train of freight cars on the New York Central, weighing 3428 tons, had an average train resistance, at 20 miles per hour, of about 4 lbs. per ton, or the limiting resistance by the Lundie formula as expressed in the first constant. Other tests on fairly heavy freight train work recently made have shown approximately 6 pounds per ton as an average, when track conditions were good, but these results vary greatly with the condition of the track.

Now it being reasonable to suppose that with the heaviest freight train work, the train resistance will approach the minimum, and the New York Central experiment above referred to, indicating that this minimum is Mr. Lundie's first constant of 4, it would seem that the latter's first constant within the parenthesis, namely .2, must be inapplicable to very heavy freight-train work, and should be, in fact, modified by a variable, probably T. It would be interesting, therefore, to bring together and plot in diagrammatic form, reliable results of a large number of freight-train tests taken with different weights and speeds, to see if a modification of the Lundie formula cannot be made for general application to the heavy class of work, as well as light, and we are inclined to believe that were this experimenting once done there might quite possibly be found a common ground of reconciliation between the two grades of service, by which a formula possessing the general characteristics developed by Mr. Lundie could be made applicable to the entire range of railroad transportation.

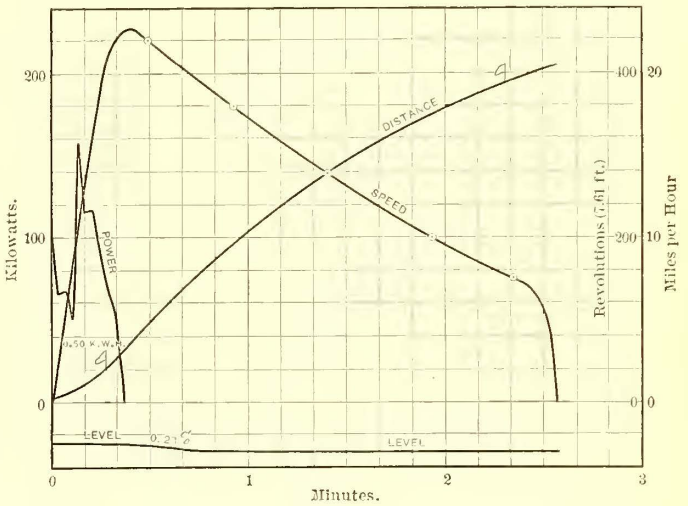


FIG 2.

TABLE SHOWING APPLICATION OF LUNDIE FORMULA TO TRAIN RESISTANCE TESTS.

Test Made By	Year.	On.	Mem.	Average Speed. Miles per hour.	Train Weight. Tons.	Train Resistance. Observed.	Train Resistance. Lundie Formula.
William Stroudley.....	1885	London, Brighton and South Coast.	Single test.....	43.3	376	13.2	14.1
Angus Sinclair.....	1892	New York Central.....	Mean of six tests.	70.	270	19.03	21.1
" "	1892	" "	Single test.....	69.6	270	19.8	21.2
P. H. Dudley.....	1882	" "	Single test.....	51.43	313	16.9	16.35
" "	1889	Philadelphia and Reading.....	Single test.....	60.	242.5	18.35	19.0
" "	1889	" "	Single test.....	63.5	242.5	19.8	19.9
" "	1892	C. R. R., N. J.....	Single test.....	63.2	213	19.0	20.2
Clark formula.....	....	.....	.....	10	100	7.74	7.04
" "	....	.....	.....	10	200	7.74	6.6
" "	....	.....	.....	10	300	7.74	6.4
" "	....	.....	.....	20	100	9.5	10.06
" "	....	.....	.....	20	200	9.5	9.2
" "	....	.....	.....	20	300	9.5	8.8
" "	....	.....	.....	30	100	12.42	13.1
" "	....	.....	.....	30	200	12.42	11.8
" "	....	.....	.....	30	300	12.42	11.3

The Money Centers and Tramway Opportunities of the World

I.—Europe.

At this time when enormous stores of capital are concentrated in a few great money centers of the world waiting investment in more profitable channels than those immediately in sight, and meanwhile earning little or nothing more than the cost to the bankers of caring for them; at a time, too, when all kinds of "wild cat schemes" are being promoted, and mining and other similar enterprises involving serious risks and possibilities of loss of principal are finding supporters and investors, it is not surprising that more and more attention is being given by the possessors and custodians of capital to the almost limitless field of electric railroading in its various phases—city, suburban and interurban—operating, projected or ready for the projector, in all parts of the world. The flow of money into these channels, however, has hardly more than commenced, if we consider the vast number of opportunities which are offered by the densely populated countries of the old world, so large a percentage of whose population is collected together into cities, towns and villages but short distances apart.

It will be useful, therefore, in the interest of capital seeking investment to take a broad survey of the world and note what may and what may not be done in the different countries, and what are the most promising openings for immediate effort. Such a survey, if thoroughly made, would include a discussion of so many elements of general and special problems of investment as to be entirely beyond the limits of any paper, magazine or even book, but there can here be indicated in brief space the lines on which further work can be done in particular countries or sections.

The four great money markets of the world where capital can be obtained for all kinds of home or foreign enterprises, are London, Paris, Berlin and New York—all charged with the duty of finding an outlet for the surplus profits of great manufacturing countries. It has only lately been possible to place New York in the list of first-class international money lenders, as American capital has been so far absorbed in self development and has even been a borrower in the world's money markets to assist in this process, but now, while self development is by no means completed, our annual surplus investment fund is so enormous, due to growing manufacturing, commercial and agricultural profits, that we can no longer use all our own money to advantage, as is shown not only by the low rates of interest prevailing in America, but by the large sums of American money afloat in the markets of Europe, but subject to call home at any time.

In London there is now little or no difficulty in obtaining money for reasonably promising foreign tramway projects, but there is as yet comparatively little real effort made to find them. In spite of low interest rates and large accumulations of money, the London banker as a rule limits his efforts to passing upon projects which may be brought to him, and leaves to promotors the task of taking the initiative and finding the opportunities. Berlin, on the contrary, is eager, active, outward-looking and anxious to find the money making chances. Hardly a ship leaves a German port without bearing an engineer sent by some financial concern to investigate a proposition or a possible opening in some distant portion of the world. German bankers thoroughly understand the profits in electrical enterprises and are anxious to extend the range of their investments. In fact, the recent serious stringency in the German money market is attributed to the immense amounts of money which have flowed into electric railway and lighting enterprises during the past two or three years, many of which have not yet begun to develop their full earning power. Paris has been somewhat slower than Berlin in understanding tramway profits, but is now making heavy investments at home, in Italy, along the Mediterranean, and to some extent in Russia. Brussels, which has always been the headquarters of several syndicates operating horse tramways in all parts of the world, is increasing its investments in this field, frequently in conjunction with German or French capital, by which Belgian capital has been to some extent overshadowed.

America has poured immense sums of money—probably over $1,000,000,000—into street railway development at home, but has so far made little effort to enter into competition with European money centers in the building or promotion of new enterprises abroad. New York is losing great opportunities, for its capitalists thoroughly understand and appreciate the value of electricity for transportation purposes and need no education. Perhaps a change is coming with the new ideas of "expansion," and this certainly ought to be the case, for no field of international investment offers greater promises of satisfactory return.

It is quite certain that, in spite of occasional exceptions, there will be little interchange of capital for tramway investment between the four great money countries themselves. America has money enough and to spare at low rates of interest for American enterprises, and needs none from Europe. Great Britain owns two or three tramways in Germany and has a little capital in France, but this was placed there before the Germans and French waked up to what was going on. It goes without saying that there is no French capital to speak of in Great Britain, and little or none in Germany. German capital is, however, quietly and unostentatiously at work through international banking houses in Great Britain and France, but still to no great extent, and not to the exclusion of local capital in the same investments.

Both German and French capital is found in Switzerland, in Belgium, and in Russia, German and local capital has almost a monopoly in Austria-Hungary, British and German capital controls South and Central America, while all the capitalist nations of the world are gathering their forces for an onslaught upon Eastern Asia, which is the great virgin money making field of the world to-day.

It is hard for the newer countries of the world to conceive how densely settled are the older ones. Observe the following population densities of continents:

Continent.	Inhabitants per sq. mile.	Continent.	Inhabitants per sq. mile.
North America	12.0	Asia	47.9
South America	5.4	Africa	14.2
Europe	93.0	Australia	1.1

Is it possible that Europe will long be contented with a much smaller steam railroad mileage than America and with higher prices for transportation, when the alternative is presented of profitably operating thousands of miles of electric railways in a territory where the population density is over seven times that of America? No matter who or what is injured in the process, better transportation facilities must and will be given to the people of Europe.

In the accompanying table are shown the number of cities of above 20,000 (usually) inhabitants found in the principal countries of Europe, the population of these cities, and the percentage of this city population to the total population of the country. From such figures a quick idea of the relative importance of each country from the municipal transportation point of view may be obtained.

NAME.	Total Population.	Population per Square Mile.	Cities Above 20,000 Inhabitants		
			Number.	Population.	Per Cent to Total Population.
Great Britain	37,731,415	315	382	20,190,568	53.5
Germany	52,279,901	251	161	11,449,000	21.9
Russia (in Europe)	103,703,213	47	87	7,690,159	7.4
Italy	31,102,833	281	62	5,334,000	17.1
France	38,342,948	189	60	7,323,340	19.1
Austria-Hungary	41,358,886	171	41	3,923,558	9.5
Spain	17,565,632	88	22	2,179,256	12.4
Netherlands	4,859,451	384	21	1,632,555	33.6
Belgium	6,410,783	564	17	1,565,809	24.4
Sweden and Norway	6,920,177	17	14	866,158	12.5
Roumania	5,800,000	120	8	533,382	9.2
Switzerland	2,986,848	183	8	449,846	15.1
Bulgaria	3,309,816	83	6	186,055	5.6
Turkey (in Europe)	4,786,545	73	5	316,000	6.6
Greece	2,185,335	87	4	203,225	9.4
Portugal	4,692,113	144	3	460,506	9.8
Denmark	2,185,335	143	3	438,836	20.0
Servia	2,288,259	120	2	80,041	3.5
Luxemburg	217,583	...	1	20,000	9.2

Great Britain.—Existing laws and customs, short time franchises and strict regard for private rights and vested interests are all against the rapid introduction of improved transportation facilities in the British Isles, although much has been done during the past three or four years to overcome prejudice, and considerable headway has been made. Nearly all desirable investments will be taken at home and there will be little or no chance for outside capital, unless working in conjunction with home interests. German and American capital is, however, actually interested to some extent in British tramway development, chiefly through international banking and manufacturing houses. Public sentiment is steadily tending toward municipalization of city enterprises, including that of transportation, and unless this should be checked by poor financial results or admittedly imperfect operation, there will be less and less chance for private capital to engage in such enterprises. There is yet to be built, however, a great network of light railways, to be operated probably by electricity, supplementing the present steam railroad service, and providing for cheap, pleasant and frequent service between cities and towns. Such work will probably be left, for the present at least, to private capital, and if the latter can secure rights of way and terminal privileges within the limits of the cities which they serve, there is quite enough profit in prospect to satisfy the most rapacious of the investing interests. The location and building of such railways will necessarily take time, however, and will be met by vigorous opposition on the part of the existing railroads, unless the latter themselves undertake the work of expanding the transportation facilities of the British Isles, which is quite probable.

Germany.—With nearly half as many cities as Great Britain, and more than half the city population Germany is far more progressive and active in transportation matters, and electric railways are being installed all over the Empire. Here again local capital is dominant and sufficient, and there is little chance for foreign, although in Germany as in Great Britain, immense quantities of American tramway apparatus and material are sold. The home tramway development is controlled to a very large extent by several great syndicates or groups, each composed of banks, promoting companies and manufacturing companies. [See STREET RAILWAY JOURNAL (International Edition) for July, 1898, page 389]. These different groups enter into competition with each other to secure existing and new enterprises, and the amount of capital at their disposal is almost unlimited. Nearly all new enterprises are promoted by some one of these syndicates, for the money influence of the country is very largely concentrated in their numerous banks, and individual outside enterprise will naturally be discouraged. On all good propositions foreign capital can generally be outbid in one way and another, interest rates in Germany being quite low.

Russia.—Russia has been until recently a *terra incognita*—a country jealously shutting itself up and keeping itself aloof from the rest of the world so far as possible. Now, however, foreign enterprise, though hardly welcomed, is not repelled, and in spite of high protective duties, the importations of outside products are very heavy. Among foreign manufacturers none have been more persistent and aggressive than the Germans and Americans, and representatives of manufacturing and business houses of both countries are overrunning the vast Slav Empire and are finding and reporting opportunities for investment. The Russian Government is a borrower in the world's money markets, its borrowings being largely for the purpose of accumulating a sufficient gold reserve to change its monetary system from silver to gold, and as a consequence it has enormous stores of gold already locked up and taken out of circulation. There will doubtless be more or less disturbance of the financial fabric when this change takes place, and provision should be made accordingly, but in general it may be said that with its eighty-seven cities in European Russia and thirty-seven in Asiatic Russia, there should be great chances for money making in the construction and operation of Russian tramways. Individually the Russians are probably well to do, though statistics as to wealth per capita are missing, but the building of the great Siberian railway to the Pacific Ocean and other large projects which the Russian Government has in hand for the development of the immense natural resources of the Empire will doubtless increase individual wealth, but not in proportion to the possibilities for investment.

Italy.—It is somewhat surprising to find that Italy has a larger number of cities above 20,000 inhabitants than France or Austria-Hungary. Italy is not wealthy as a country or in its individual citizens, and there is a great deal of "picturesque poverty" in the peninsula. Nevertheless, it has many tramways already established and more possible locations for others, although to many people it seems a desecration to think of overrunning the land of Cæsar with such twentieth century improvements. German and French capital is quite active in Italy, and frequently comes into competition. The English also own two or three tramway systems, and local capital is, of course, interested to a large extent. The field here is well worth investigation by Americans.

France.—France is self contained and self sufficient so far as money investments are concerned, but is using large quantities of foreign (chiefly American) tramway apparatus and material, purchased by companies formed primarily to control and operate tramway properties. These companies have secured French and, in some cases, Mediterranean rights for handling American apparatus, on advantageous terms, and have not until now found a large enough margin of profit in manufacturing to warrant the building of apparatus in France itself, in view of the larger margins obtainable in purchasing and operating tramways. The principal tramway companies of the country are gradually coming under the control of some one of these promoting corporations, and are thus losing their distinctive character. A number of American engineers and business men are associated

with these French syndicates, and their experience in tramway construction and operation is of great value.

Austria-Hungary.—Extreme Chauviniste or high protectionist ideas prevail in the Austro-Hungarian Empire, and great jealousy of foreign inventors or manufacturers is found as a rule. This can be overcome only by diplomacy, and much of the manufactured products which are supposed to be of home manufacture is, in reality, made in Germany or elsewhere. Germany has a great advantage over other countries in dealing with the dual empire in that so large a portion of the latter's population are German born or of German descent. In fact the difficulties of foreigners doing business at all in a country containing so many different peoples speaking different and troublesome languages are very great, and as a result there is little interference with German and Austro-Hungarian manufacturers in their efforts to keep this business to themselves. The number of cities and the amount of city population is certainly tempting, however, to outsiders, and transportation facilities are by no means perfect though much better in some respects than in other countries of Europe.

Spain and Portugal.—British capital has done much in Spanish tramways during the last two or three years, and those of Madrid, Barcelona, Lisbon, Cartagena, Seville, and others are in their control. France is the great European power most nearly in touch with these two countries, however, and should have decided advantages in obtaining their business. Germany, too, will be favored, while America, in view of recent war complications, would have little chance of success in obtaining valuable concessions. The Spanish people being naturally somewhat indolent in private life, are good patrons of street railways, as is shown in some of the Spanish-American countries as well as in Spain itself.

The Netherlands.—The Netherlands form one of the wealthiest countries of Europe, and have always been lenders rather than borrowers of money, but less in the line of railroad development than of commercial matters. Practically all the Dutch tramways are locally owned, and little is known about them outside. Rates of interest in Holland are so low as to discourage outside enterprise, while it is true, of course, that transportation by the network of canals throughout the Netherlands is so cheap as to make the field for interurban railways probably less promising than in some other countries.

Belgium.—A single great company, the Societe Nationale des Chemin de Fer Vicinaux, controls a large proportion of the tramway and "light railway" mileage of Belgium—no less than 862 miles in all.

As above stated, the Belgians are fully alive to the profits of tramway operation, and have never had to seek outside capital for the development of home propositions. The only way of obtaining a share of tramway development profits in Belgium would be to join forces with local capital, and even this is difficult unless a special and substantial advantage can be shown to the local capital for admitting outsiders.

The Scandinavian Countries.—Norway, Sweden and Denmark are thrifty and prosperous countries, and for ordinary capital requirements do not need to look outside their own borders. Nevertheless, there would probably be no actual repelling of outside capital there to seek investment, but the difficulties of languages would be such as to make it rather hard to form joint syndicates. At present commercial relations with Germany are seriously strained and may quite likely be almost entirely broken off for awhile at least on account of what is considered the high-handed action of Germany in expelling the Danes from Schleswig-Holstein. In trade matters England and the United States would be favored, and there is a very cordial feeling, particularly in Denmark, forAmerica and Americans.

Switzerland.—Switzerland is, in language, part German and part French, and its affiliations are also divided between the two adjacent countries. Nearly all the railways and tramways of the Republic are owned by the cantons, and what private capital is so invested is chiefly French and German. English and American capital would find it difficult to secure a foothold here.

The Balkan Peninsula.—Turkey has for a hundred years been a bone of contention among the European powers, and it can hardly be said that any has permanently obtained great predominance in its councils. At present its cities are being closely examined by a number of European capitalists with a view to tramway possibilities, and it is probable that concessions may be granted in Constantinople and elsewhere. American capital would probably have little chance of success, as it would doubtless be the Sultan's policy to use his franchise conveying powers to further his purposes with some one or other of the European powers.

The other countries of the Balkan Peninsula are more or less subject to European influence, and the conveying of franchises would naturally be matter of some delicacy and would require considerable diplomacy to effect. British capital has so far been successful in several cities of the peninsula.

Frequent and severe punishment for petty offenses should be abolished and a code of rules established worthy of the men and the business they represent. The almost universal practice in punishing minor offenses is to "lay off" the employee from one to ten days, without pay, which is in effect a fine of from two to twenty dollars. The man is soured, his family suffers from the loss of earnings, and if the man happens to be a conductor it is not surprising if he tries to "get even" by nipping fares. The practice is still adhered to by many railway companies, and the offenses which it is supposed to correct still continue. Such a practice would not be countenanced in a manufactory, a store, or in commercial affairs; why should it be on street railways? If the man is valuable enough to be retained in service, why should his family suffer the loss of his wages? If the man were permitted to continue at his work and one-half the amount he would lose by laying-off were assessed as a cash fine, the practice would be condemned in unmeasured terms both by the press and an indignant public. If employees are not amenable to reprimand administered in a proper way, then they have not your welfare at heart, and should be dispensed with altogether.—From paper read at the St. Louis Convention, 1896.

All foremen and sub-foremen should be impressed with the idea that all men under their charge should be treated in a gentlemanly manner, and with the utmost fairness; that there shall be no favoritism in recommending men for promotion, or in shielding them from punishment.—From paper read at the St. Louis Convention, 1896.

Again, as a second suggestion, I wish that we might induce every street railway company in this country to take an active part in this, our association. I sometimes fear that some of the smaller companies, who, as yet, by reason of location or character of travel, have not found it to their advantage to adopt the more recent kinds of motive power, but are still using horses, feel that they have no place in our gatherings.—From address at the Atlanta Convention, 1894.

STREET RAILWAY MILEAGE, CARS AND CAPITALIZATION IN AMERICA

STATES.	No. of Roads.	Electric Railways. Track Mileage.		Motor Cars.		Trail Cars.		Cable Railways. Track Mileage.		Grip Cars.		Trail Cars.		Horse Railways. Track Mileage.		Horse Cars.		Miscellaneous Railways. Track Mileage.		Cars, Engines, etc.		Totals. Track Mileage.		Cars.	
	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898
New England States.																									
Maine	22	152	230	225	290	87	80	....	....	....	....	....	....	3	3	4	4	....	....	....	....	155	233	316	374
New Hampshire	7	63	80	109	137	23	46	....	....	....	....	....	....	4	....	21	....	....	....	....	....	67	80	158	183
Vermont	9	35	77	45	72	4	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	35	77	49	76
Massachusetts	84	1,325	1,632	4,286	5,156	194	147	....	....	....	....	....	....	33	12	444	361	6	....	3	2	1,364	1,644	4,927	5,666
Rhode Island	6	158	181	476	511	152	90	....	....	....	....	....	....	....	....	....	....	....	....	....	....	158	181	629	601
Connecticut	27	372	417	850	918	95	93	....	....	....	....	....	....	....	....	15	....	....	....	....	....	372	417	960	1,011
TOTAL	165	2,105	2,617	5,991	7,084	560	460	....	....	....	....	....	....	40	15	485	365	6	....	3	2	2,151	2,632	7,039	7,911
Eastern States.																									
New York	102	1,559	1,862	4,921	6,684	814	607	55	54	1,214	1,118	55	200	208	197	2,939	1,753	173	180	2,052	2,044	2,085	2,293	11,995	12,406
New Jersey	34	653	686	1,422	1,581	196	160	2	....	2	....	....	....	21	13	66	38	....	....	....	....	676	699	1,686	1,770
Pennsylvania	89	1,658	1,679	3,510	5,152	285	346	27	....	156	....	....	....	14	2	143	20	10	12	7	....	1,709	1,693	4,101	5,518
Delaware	4	32	35	85	90	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	32	35	85	90
District of Columbia	12	83	159	245	583	253	373	28	6	142	42	234	....	44	15	211	81	....	....	....	....	155	181	1,085	1,079
Maryland	9	285	348	761	1,010	136	57	21	21	72	72	36	36	2	....	100	....	2	2	2	2	310	371	1,107	1,177
Virginia	18	184	211	291	342	63	71	....	....	....	....	....	....	9	1	25	1	4	4	5	7	197	216	384	421
West Virginia	5	41	45	38	62	4	10	....	....	....	....	....	....	6	1	8	1	9	7	24	25	56	53	74	98
TOTAL	273	4,495	5,025	11,273	15,504	1,751	1,624	133	81	1,586	1,232	325	236	394	229	3,492	1,804	198	205	2,090	2,078	5,220	5,541	20,517	22,568
Central States.																									
Michigan	33	494	572	1,121	1,174	166	152	....	....	....	....	....	....	....	....	....	....	3	3	4	4	497	575	1,291	1,330
Ohio	68	1,174	1,374	2,347	2,888	960	581	45	20	251	221	108	18	10	2	21	4	3	....	13	....	1,232	1,396	3,700	3,712
Indiana	26	343	395	494	556	230	240	....	....	....	....	....	....	12	10	30	17	....	....	....	....	355	405	754	813
Kentucky	11	178	188	331	334	228	216	....	....	....	....	....	....	40	20	125	125	....	....	....	....	218	208	684	675
Wisconsin	18	282	318	458	562	79	87	....	....	....	....	....	....	4	4	2	2	....	....	....	....	286	322	539	651
Illinois	59	1,113	1,365	2,124	2,528	2,702	2,828	82	82	617	585	522	639	28	26	109	60	20	11	229	5	1,243	1,484	6,303	6,645
Minnesota	9	292	301	671	742	318	6	7	1	40	50	....	....	4	7	6	9	....	....	6	2	303	309	1,041	809
Iowa	27	219	290	283	354	154	154	....	....	....	....	....	....	11	9	22	14	2	3	4	5	232	302	463	527
Missouri	29	489	529	982	1,113	696	516	101	94	326	389	490	370	24	27	62	31	....	....	....	....	614	650	2,556	2,419
TOTAL	280	4,584	5,332	8,811	10,251	5,533	4,780	235	197	1,234	1,245	1,120	1,027	133	105	377	262	28	17	256	16	4,980	5,651	17,331	17,581
Southern States.																									
North Carolina	8	39	37	59	66	12	8	....	....	....	....	....	....	2	2	3	3	2	2	....	....	43	41	74	77
South Carolina	5	10	50	12	62	4	19	....	....	....	....	....	....	35	4	93	12	....	....	....	....	45	54	109	93
Georgia	14	224	225	326	314	42	39	....	....	....	....	....	....	11	11	9	9	9	5	10	6	244	241	386	368
Florida	7	43	44	40	54	10	8	....	....	....	....	....	....	11	11	16	16	....	9	....	14	54	64	66	92
Alabama	16	88	120	111	131	68	96	....	....	....	....	....	....	14	14	42	14	83	79	107	87	185	213	328	328
Mississippi	4	6	6	3	4	8	8	....	....	....	....	....	....	12	6	17	8	2	2	28	28	20	14	56	48
Tennessee	17	216	237	345	335	91	85	1	1	2	....	....	....	5	5	12	5	10	9	10	15	232	252	460	440
Louisiana	11	172	190	470	488	4	55	....	....	....	....	....	....	13	13	19	29	6	....	58	....	191	203	551	572
Arkansas	7	40	34	59	61	41	35	....	....	....	....	....	....	29	27	57	55	5	5	....	....	74	66	157	151
TOTAL	89	838	943	1,424	1,515	280	353	1	1	2	....	....	....	132	93	268	151	117	111	213	150	1,088	1,148	2,187	2,169
Western States.																									
South Dakota	4	7	8	3	3	3	3	....	....	....	....	....	....	6	15	7	13	....	....	....	....	13	23	13	19
Nebraska	10	187	152	210	220	206	152	....	....	....	....	....	....	23	22	24	24	....	....	....	....	210	174	440	396
Kansas	11	107	110	118	96	77	67	....	....	....	....	....	....	22	28	30	31	....	....	....	....	129	138	225	194
Texas	25	267	224	337	273	56	63	....	....	....	....	....	....	54	30	129	60	....	....	....	11	321	254	522	407
Colorado	11	207	215	269	233	213	201	30	30	62	62	80	80	7	7	5	5	22	21	4	32	266	272	633	613
Montana	5	47	65	36	61	16	31	2	....	4	....	1	....	....	....	1	....	....	....	....	....	49	65	58	92
Idaho	1	4	4	2	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4	4	2	2
Utah	5	92	92	105	102	17	22	....	....	....	....	....	....	....	....	....	....	8	18	2	7	100	110	124	131
Washington	21	210	211	186	178	18	28	18	21	45	55	15	15	4	4	6	6	....	....	....	....	232	236	270	282
Oregon	12	114	117	186	142	28	22	3	3	16	16	....	1	5	7	4	8	21	21	14	20	143	148	248	218
California	52	501	557	708	765	119	108	117	127	661	675	43	57	127	99	316	284	67	112	71	77	812	895	1,923	1,966
TOTAL	157	1,743	1,755	2,160	2,075	753	697	170	181	788	808	144	153	248	212	522	431	118	172	91	156	2,279	2,320	4,458	4,320
United States	954	13,766	15,672	29,659	36,429	8,877	7,914	539	460	3,610	3,285	1,589	1,416	947	654	5,144	3,103	467	505	2,653	2,402	15,718	17,291	51,532	54,549
Canada	37	498	634	836	1,242	376	200	....	....	....	....	....	....	12	9	33	20	....	30	....	49	510	673	1,245	1,711

STATES.	Capital Stock. Total.		Increase.	Funded Debt. Total.		Increase.	Capital Liabilities. Total.		Increase.	STATES.
	1897	1898		1897	1898		1897	1898		
New England States.										**New England States.**
Maine	2,427,875	3,351,042	923,167	2,466,000	3,558,000	1,092,000	4,893,875	6,909,042	2,015,167	Maine
New Hampshire	750,000	820,000	70,000	668,500	706,000	37,500	1,418,500	1,526,000	107,500	New Hampshire
Vermont	499,500	880,800	381,300	401,000	656,600	255,600	900,500	1,537,400	636,900	Vermont
Massachusetts	39,330,900	47,978,260	8,647,360	24,288,900	28,625,900	4,337,000	63,619,800	76,604,160	12,984,360	Massachusetts
Rhode Island	8,360,200	8,610,200	250,000	8,644,200	8,844,200	200,000	17,004,400	17,454,400	450,000	Rhode Island
Connecticut	9,686,740	10,875,740	1,189,000	8,967,100	10,645,800	1,178,700	18,653,840	20,921,540	2,267,700	Connecticut
TOTAL	61,055,215	72,516,042	11,460,827	45,435,700	52,436,500	7,000,800	106,490,915	124,952,542	18,461,627	TOTAL
Eastern States.										**Eastern States.**
New York	193,317,661	217,785,952	24,468,291	177,503,556	200,383,778	23,380,222	370,821,217	418,669,730	47,848,513	New York
New Jersey	36,014,000	42,722,785	6,708,785	72,137,250	76,335,208	4,197,958				New Jersey
Pennsylvania	142,038,445	169,420,350	27,381,905	77,078,163	85,021,400	7,943,237	219,116,608	254,441,750	35,325,142	Pennsylvania
Delaware	614,284	717,640	103,356	750,000	750,000	.....	1,364,284	1,467,640	103,356	Delaware
District of Columbia	14,690,100	15,965,300	1,275,200	4,819,800	8,535,691	3,715,891	19,509,900	24,500,991	4,991,091	District of Columbia
Maryland	13,498,150	15,487,000	1,988,850	13,550,000	15,870,000	2,320,000	27,048,150	31,357,000	4,308,850	Maryland
Virginia	6,506,250	7,675,665	1,169,415	5,805,000	6,732,000	927,000	11,371,250	13,807,665	2,436,415	Virginia
West Virginia	1,540,000	1,478,000	*62,000	760,000	959,000	199,000	2,300,000	2,437,000	137,000	West Virginia
TOTAL	407,388,140	461,542,330	54,154,190	316,286,519	361,474,654	45,194,135	723,668,659	823,016,984	99,348,325	TOTAL
Central States.										**Central States.**
Michigan	9,194,846	11,750,200	2,555,354	10,576,700	17,505,450	6,928,750	19,771,546	29,255,650	9,484,104	Michigan
Ohio	65,485,800	72,088,300	6,602,500	27,496,502	32,969,000	5,472,498	92,982,302	105,057,300	12,074,998	Ohio
Indiana	10,397,550	10,906,550	509,000	9,501,000	10,468,000	967,000	19,898,550	21,374,550	1,476,000	Indiana
Kentucky	7,521,900	7,416,900	*75,000	6,663,300	7,020,000	356,700	14,185,200	14,466,900	281,700	Kentucky
Wisconsin	9,435,000	9,876,100	441,100	9,044,000	10,049,000	1,005,000	18,479,000	19,925,100	1,446,100	Wisconsin
Illinois	104,202,525	104,883,185	685,660	79,106,400	74,897,000	*4,209,400	183,308,925	179,785,185	*3,523,740	Illinois
Minnesota	18,809,100	19,334,100	525,000	13,648,000	12,747,000	*901,000	32,457,100	32,081,100	*376,000	Minnesota
Iowa	8,083,000	10,413,000	2,330,000	4,293,000	5,029,000	736,000	12,376,000	15,442,000	3,066,000	Iowa
Missouri	29,490,500	30,328,000	837,500	32,839,000	31,842,000	*997,000	62,329,500	62,170,000	*159,500	Missouri
TOTAL	262,620,221	277,031,335	14,411,114	193,167,902	202,526,450	9,358,548	455,788,123	479,557,785	23,769,662	TOTAL
Southern States.										**Southern States.**
North Carolina	611,000	786,000	175,000	710,000	510,000	*200,000	1,321,000	1,296,000	*25,000	North Carolina
South Carolina	462,000	1,297,000	835,000	205,000	1,340,000	1,135,000	667,000	2,637,000	1,970,000	South Carolina
Georgia	4,548,400	4,048,400	*500,000	4,784,000	5,523,000	739,000	9,332,400	9,571,400	239,000	Georgia
Florida	326,500	531,500	205,000	4,600	204,600	200,000	331,100	736,100	405,000	Florida
Alabama	5,507,800	5,447,800	*60,000	2,665,000	2,645,000	*20,000	8,172,800	8,092,800	*80,000	Alabama
Mississippi	195,000	154,000	*41,000	19,000	68,000	49,000	214,000	222,000	8,000	Mississippi
Tennessee	4,937,500	5,057,000	119,500	4,021,000	4,755,000	734,000	8,958,500	9,812,000	853,500	Tennessee
Louisiana	11,353,000	11,379,100	26,100	9,163,400	9,567,400	404,000	20,516,400	20,946,500	430,100	Louisiana
Arkansas	1,530,375	1,500,375	*30,000	982,000	1,032,000	50,000	2,512,375	2,532,375	20,000	Arkansas
TOTAL	29,471,575	30,201,175	729,600	22,554,000	25,645,000	3,091,000	52,025,575	55,846,175	3,820,600	TOTAL
Western States.										**Western States.**
South Dakota	275,000	375,000	100,000	75,000	.....	*75,000	350,000	375,000	25,000	South Dakota
Nebraska	8,437,500	6,679,250	*1,758,250	4,420,000	2,410,000	*2,010,000	12,857,500	9,089,250	*3,768,250	Nebraska
Kansas	2,615,000	2,705,000	90,000	2,085,000	2,368,000	283,000	4,700,000	5,073,000	373,000	Kansas
Texas	5,952,500	4,622,500	*1,330,000	5,030,000	6,184,000	1,154,000	10,982,500	10,806,500	*176,000	Texas
Colorado	10,355,000	10,355,000	.....	9,719,000	11,261,000	1,542,000	20,074,000	21,616,000	1,542,000	Colorado
Montana	1,700,000	1,620,000	*80,000	1,250,000	1,346,500	96,500	2,950,000	2,966,500	16,500	Montana
Idaho	54,000	54,000	.....	.....	.....	.....	54,000	54,000	.....	Idaho
Utah	1,756,000	1,756,000	.....	1,000,000	1,000,000	.....	2,756,000	2,756,000	.....	Utah
Washington	8,870,000	8,271,300	*598,700	6,200,457	5,759,228	*441,229	15,070,457	14,030,528	*1,039,929	Washington
Oregon	2,516,300	2,520,800	4,500	2,235,000	2,335,000	100,000	4,751,300	4,858,800	104,500	Oregon
California	43,065,240	42,151,230	*914,010	23,626,600	24,673,600	1,047,000	66,691,840	66,824,830	132,990	California
TOTAL	85,596,540	81,110,080	*4,486,460	55,641,057	57,337,328	1,696,271	141,237,597	138,447,408	*2,790,189	TOTAL
United States	846,131,691	922,400,962	76,269,271	633,070,178	699,419,932	66,340,754	1,479,210,869	1,621,820,894	142,610,025	United States
Canada	17,056,600	19,533,100	2,476,500	6,123,000	8,476,452	2,353,452	23,179,600	28,009,552	4,829,952	Canada

*Decrease.

STATES.	No. of Roads.	ELECTRIC RAILWAYS.						CABLE RAILWAY				
		TRACK MILEAGE.		MOTOR CARS.		TRAIL CARS.		TRACK MILEAGE.		GRIP CARS.		TR
	1898	1897	1898	1897	1898	1897	1898	1897	1898	1897	1898	18
New England States.												
Maine	22	152	230	225	290	87	80	....	....	....	....	·aine
New Hampshire	7	63	80	109	137	28	46	....	....	....	....	·hire
Vermont	9	35	77	45	72	4	4	....	....	....	....	·ont
Massachusetts	84	1,325	1,632	4,286	5,156	194	147	....	....	....	....	·setts
Rhode Island	6	158	181	476	511	152	90	....	....	....	....	·land
Connecticut	27	372	417	850	918	95	93	....	....	....	....	·icut
TOTAL	155	2,105	2,617	5,991	7,084	560	460	....	....	....	....	·AL
Eastern States.												
New York	102	1,559	1,862	4,921	6,684	814	607	55	54	1,214	1,118	·ork
New Jersey	34	653	686	1,422	1,581	196	160	2	....	2	....	·rsey
Pennsylvania	89	1,658	1,679	3,510	5,152	285	346	27	....	156	....	·ania
Delaware	4	32	35	85	90	....	....	....	....	....	....	·ware
District of Columbia	12	83	159	245	583	253	373	28	6	142	42	nbia
Maryland	9	285	348	761	1,010	136	57	21	21	72	72	land
Virginia	18	184	211	291	342	63	71	....	....	....	....	·ginia
West Virginia	5	41	45	38	62	4	10	....	....	....	....	·ginia
TOTAL	273	4,495	5,025	11,273	15,504	1,751	1,624	133	81	1,586	1,232	AL
Central States.												
Michigan	33	494	572	1,121	1,174	166	152	....	....	....	....	igan
Ohio	68	1,174	1,374	2,347	2,888	960	581	45	20	251	221	Ohio
Indiana	26	343	395	494	556	230	240	....	....	....	....	liana
Kentucky	11	178	188	331	334	228	216	....	....	....	....	ucky
Wisconsin	18	282	318	458	562	79	87	....	....	....	....	nsin
Illinois	59	1,113	1,365	2,124	2,528	2,702	2,828	82	82	617	585	inois
Minnesota	9	292	301	671	742	318	6	7	1	40	50	esota
Iowa	27	219	290	283	354	154	154	....	....	....	....	Iowa
Missouri	29	489	529	982	1,113	696	516	101	94	326	389	souri
TOTAL	280	4,584	5,332	8,811	10,251	5,533	4,780	235	197	1,234	1,245	1,1 AL
Southern States.												
North Carolina	8	39	37	59	66	12	8	....	....	....	....	olina
South Carolina	5	10	50	12	62	4	19	....	....	....	....	olina
Georgia	14	224	225	325	314	42	39	....	....	....	....	orgia
Florida	7	43	44	40	54	10	8	....	....	....	....	orida
Alabama	16	88	120	111	131	68	96	....	....	...	....	bama
Mississippi	4	6	6	3	4	8	8	....	....	....	....	sippi
Tennessee	17	216	237	345	335	91	85	1	1	2	...	essee
Louisiana	11	172	190	470	488	4	55	....	....	....	....	siana
Arkansas	7	40	34	59	61	41	35	....	....	....	....	ansas
TOTAL	89	838	943	1,424	1,515	280	353	1	1	2	....	TAL
Western States.												
South Dakota	4	7	8	3	3	3	3	....	....	....	....	akota
Nebraska	10	187	152	210	220	206	152	...	....	....	....	raska
Kansas	11	107	110	118	96	77	67	....	....	....	....	ansas
Texas	25	267	224	337	273	56	63	....	....	....	....	Texas
Colorado	11	207	215	269	233	213	201	30	30	62	62	orado
Montana	5	47	65	36	61	16	31	2	....	4	....	ntana
Idaho	1	4	4	2	2	....	....	....	....	....	....	Idaho
Utah	5	92	92	105	102	17	22	....	....	....	....	Utah
Washington	21	210	211	186	178	18	28	18	21	45	55	hgton
Oregon	12	114	117	186	142	28	22	3	3	16	16	egon
California	52	501	557	708	765	119	108	117	127	661	675	ornia
TOTAL	157	1,743	1,755	2,160	2,075	753	697	170	181	788	808	14 L
United States	954	13,765	15,672	29,659	36,429	8,877	7,914	539	460	3,610	3,285	1,58 s
Canada	37	498	634	836	1,242	376	200	....	....	....	....	... la

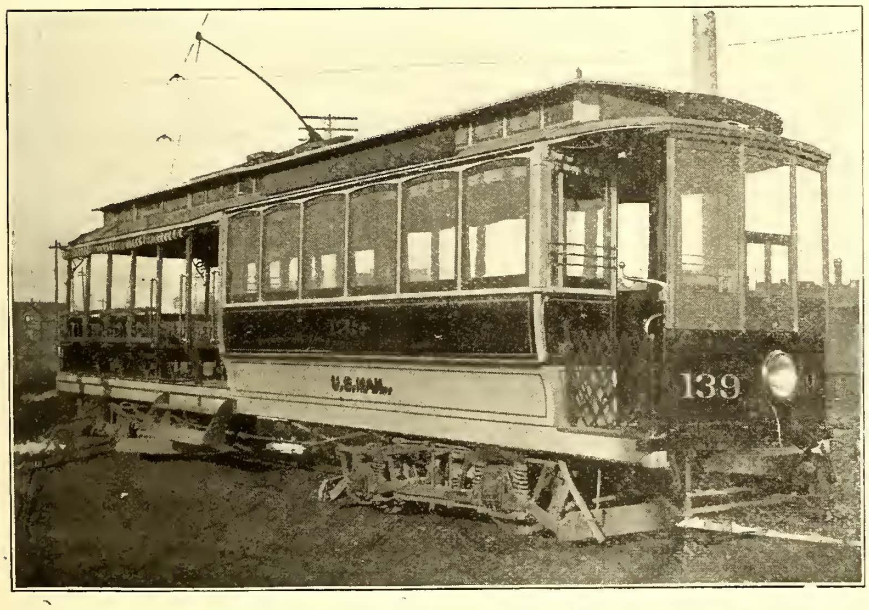
* Decrease.

Improvements in Denver

The Denver Consolidated Tramway Company has recently been equipping some of its cable railways with electric power. In its new track construction the company is using a 72-lb., 6-in., 60-ft. T rail, mounted on 5 in. x 7 in. x 7 ft. creosoted ties, ballasted and thoroughly tampered with gravel.

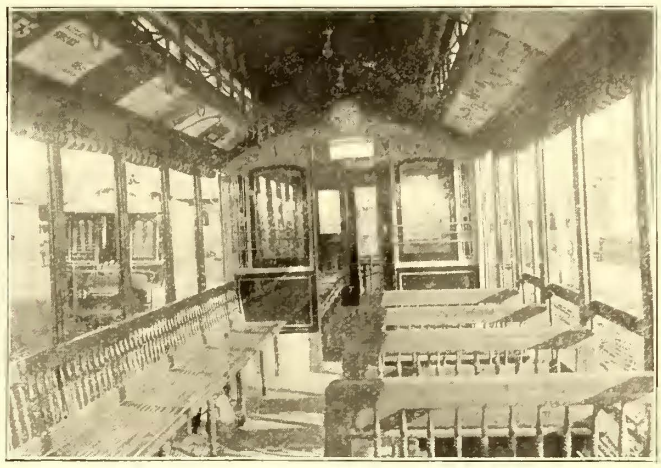
The company has also been experimenting on splicing some of its old 16-ft. cars, each with an ordinary seven-bench trailer to make a 39-ft. combination car, which is a very popular type of car in Colorado. The method of splicing employed is as follows: The cars are mounted on a framing of two 6-in. I-beams extending the entire length of the car, the beams being joined together by stout oak pieces. The running boards are then removed from the trailer and wooden guards put on the sides of the open car, which is fitted with long storm curtains in addition to the ordinary shades. The seating arrangement of the open portion of the car was changed by the removal of the seats on one side and the substitution in their place of longitudinal seats, made up to a certain extent from the seats removed. The object of this arrangement was that, while it afforded nearly the same seating capacity as before, it enabled the conductor to collect the fares more quickly and with perfect safety. The engravings herewith give a good idea of the external appearance of the car and the seating arrangement of the open portion.

The entrance is near the middle of the car at the end of the closed portion of the car, and is of ample width, allowing passengers to get on and off the car at the same time. The company is considering the advisability of protecting this entrance with an ordinary gate or guard for the purpose of minimizing accidents, resulting from people stepping off the car while in motion. It is expected that a large number of cars will be equipped in this way. The closed portion is always at the front end of the car which is always run in the same direction.



EXTERIOR OF COMBINATION CAR

All of the company's cars have recently been fitted with storm fronts, similar to that shown in the engraving of the exterior of the car. A curtain, not shown in the engraving, is put on the motorman's left-hand side for the purpose of protecting him from drafts. All of the cars are now being fitted with the changeable headlight of the Crouse-Hinds Electric Company, of Syracuse, N. Y. The company has also equipped all of its cars with a fender devised by A. L. Lawton, manager of the Colorado Springs Railway. These fenders have picked up a number of persons, as well as dogs, bicycles, and in one instance, a horse. The management reports that it is well pleased with the fender.



INTERIOR OF COMBINATION CAR

Street Railway Mileage and Capitalization in America

In the accompanying inset will be found a most careful compilation of the mileage of electric, cable and horse railways in the United States and Canada; the number and distribution of the cars operated thereon, and the capital stock and funded debt of the operating companies—all arranged by states and sections of the country, and comparison made with corresponding figures for 1897. A similar table appeared in the STREET RAILWAY JOURNAL for October, 1897, in which the 1896 figures were given, and from these two compilations the general growth of the industry in America for the last three years can be understood, as well as the distribution of the increases from year to year.

Contractors for Tramways in Barcelona and Madrid

Elsewhere in this issue F. C. Armstrong describes the new electric railway systems recently installed in the cities of Madrid and Barcelona, Spain. The chief sub-contractors for the railway apparatus used in those plants were as follows:

Generators and motors—British Thomson-Houston Company (Limited).
Engines—E. P. Allis Company.
Boilers—Babcock & Wilcox Company.
Condensers and water tower—Wheeler Condenser & Engineering Company.
Economizers—Green Economizer Company.
Feed wire—Callender's Cable & Construction Company.
Car bodies—Compañia de Ferro-carrilles de Zaragoza.
Car trucks—J. G. Brill Company.
Trolley wire—Felten & Guilleume.
Rail bonds—Neptune, made by Felten & Guilleume.
Rails—Phœnix Actien Gesellschaft

Our experience has been that if the conductors and the passengers will use the transfers as we intended they should use them, we can afford to give them.—From address at the Montreal Convention, 1895.

LEGAL NOTES AND COMMENTS*

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

Heating and Other Accommodations in Street Cars

There was a time—not very far distant—when places of public concourse, such as theaters, lecture halls and churches, had no other means of heating than the foot stoves, which might be carried by some of the more luxurious members of the audience; and long after it was the universal custom to properly heat such places, it was still an unheard-of thing that any public conveyance should be furnished with any other means of heating than the hot brick or the little foot stove.

With the steam railroad there came, first, wood and coal car-heaters, and now, even these are things of the past, and in some States are prohibited by statute, the steam railroad being obliged to furnish steam heat, because of the danger of fire in case of a railroad wreck

It was some years after the street car was introduced before what was then considered a novel luxury was introduced into some of them in the shape of a small coal stove; but now that is almost universal, except where it has been supplanted by the luxurious electric heater supplied from the same current which propels the car and lights it.

As each of the inventions is introduced and becomes established, it ceases, in the public mind, and in fact, to be a luxury, and becomes a necessity; and, in passing from one class to the other, a legal obligation is created, by reason of the general rule, that in the contract between the common carrier and the passenger there is an implied agreement that the latter will be furnished with the ordinary comforts or necessities which are incident to the mode of conveyance furnished. This is the common law, and where there are statutes they have either merely declared it or have imposed additional burdens upon the common carrier by definitions of what are necessities and ordinary comforts.—(Texas & P. R.R. vs. Pierce, 30 S.W., 1122; Boothby vs. R.R., 66 N.H., 342.)

As the electric street railroad is gradually furnishing the same sort of transportation as the steam railroad, and in much the same way, it finds itself assuming new responsibilities, and becoming more and more subject to the same rules which apply to its older rival. Among these undoubtedly is the duty of heating its cars and its waiting rooms, where these are furnished as ancillary to its business at its transfer points. So far as we are aware, there is no adjudicated case of the Appellate courts upon the duty of a street car company to keep its conveyances warm, and upon its liability to passengers for illness caused by the want of proper heat.

That it is the duty of the steam railroad company to heat its cars, and that they are liable where, through negligence, they do not do so, and especially after the attention of the servants of the railroad have been called to the matter, has been more than once adjudicated.—(Ft. Worth & D. C. R.R. vs. Hyatt, 34 S.W., 677; Taylor vs. R.R., 38 S.W., 304; Hastings vs. R.R., 53 Fed., 224.)

This rule, when it shall be applied to the street car, will undoubtedly be applied with due consideration of the difference in the conditions. For the ordinary passenger upon the street car in a city, who steps into the car from the street, warmly dressed, and who leaves it after a ride of only a mile or less, is manifestly not so exposed to the elements as to raise any presumption that a subsequent illness results from such a ride, however inadequately the car was heated; and, on the other hand, upon the question of contributory negligence, a passenger on the street car can, at very small expense and comparatively little inconvenience, leave an unheated car as soon as he becomes aware that its temperature is dangerous to his health, assuming that he is riding through a city street, or is upon a line where the headway between cars is not great, and where he can procure another and better-warmed conveyance.

But when the trolley line reaches out into the country, and becomes intra-urban, the conditions grow more and more like those of the steam railroad, and, as they approximate them, the duty of providing like accommodations and comforts increases. H.

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

CHARTERS, ORDINANCES, FRANCHISES, ETC.

INDIANA.—Construction of Franchise—Extension Validity—Conflicting Franchise—Unoccupied Streets—Completion of Tracks—Constitutional Law—Control of Streets.

1. Acts 1861, p. 75 (Rev. St. 1894, sec. 5450; Horner's Rev. St. 1897, sec. 4143 et seq.), authorizes the organization of street railway companies, which are declared to be "corporate in perpetuity," and provides that such companies shall first obtain the city's consent to the construction of their roads through the streets of any city, and that the act shall not take from the city the exclusive control of its streets. A city passed an ordinance granting a street railroad company a franchise to operate on its streets for a stated period, and afterward extended such period. Held, that the street railway company had not, without further legislation, the right to continue the operation of its railroad on such streets after expiration of the time fixed by the ordinances.

2. Where a street railroad company incorporated under said provisions accepted an ordinance of a city granting it a franchise to operate its road on the city's streets for a stated period, and thereafter sought and secured an extension of such period, it, by so doing, in conjunction with the city, construed said act as giving it no power to occupy streets beyond the time granted by the city, and was bound by such construction.

3. The fact that a city has given a street railway company permission to construct its road on all the streets of the city, and that thereunder such company occupied a portion of the streets, does not make a franchise granted by the city to another company during the life of the former franchise invalid as to streets not occupied by the former company, since its franchise was exclusive only as to streets on which it had constructed its road, and from the time of such construction.

4. Where a city authorized a street railroad company to construct its road on all the streets of the city, and thereafter, during the life of such franchise, authorized another company to construct a street railroad system on the same streets, the rights of the two companies during the co-existence of the two charters, as to unoccupied streets, were equal, and, where one company thereafter constructed its road on any of such streets, its right as to so much thereof as was necessary for the proper operation of its cars was exclusive.

5. A contract by which a city authorized a street railroad company to construct a system of street railroads on its streets, in consideration of an annual payment to the city by such company, and its agreement to repair and clean that part of the streets occupied by its tracks, the fare being limited, and the undertakings of the company secured by sufficient indemnity, is legal and binding as between the city and the company, even though the contract may not be an advantageous one for the city.

6. After passage of two municipal ordinances, one of which granted a street-railroad franchise for a term and the other of which extended it, the city attorney advised the city that the extension was invalid. The city then granted a franchise to construct a street railroad system in the city's streets, including those occupied under the former franchise to another company, on condition that a certain portion of its system should be constructed within a specified time, the contract providing that delays caused by judicial restraint of the construction should not be counted, and delays caused by injunctions against the construction issued because of prior franchises should extend the time for completion for a stated period. The extension of the original franchise was afterward adjudged valid. Held, that the second franchise was not invalid, as granted under a mistake of law or of fact.

7. Where a street railway franchise required the company to complete its road on certain streets within a stated time, and another company, without authority so to do and without consent of the former company or of the city, forcibly took possession of such streets, and extended its road over them, the latter company could not complain that the former had failed to complete its road over such streets within the required time.

8. Act June 4, 1861, sec. 12 (Rev. St. 1894, sec. 5450; Horner's Rev. St. 1897, sec. 4143), requires street railroad companies to first obtain the city's permission to lay their tracks over said streets, and provides that nothing in the act shall deprive a city of the exclusive control of its streets. A company organized under said act was by a city given permission to construct a street railroad system on all the streets of the city. It constructed a road on a portion of such streets, and left others unoccupied. Held, that it could not thereafter take possession of, and extend its road over, other streets without further permission from the city.

9. A valid contract between a street railroad company and a city, whereby the former is given a franchise to construct a street railroad system on the streets of the latter, cannot be abrogated by an act of the legislature.

10. Acts 1897, p. 154 (Horner's Rev. St. 1897, sec 4154), amending act June 4, 1861, sec. 12, which provides that street railroad companies shall first obtain the city's consent to lay their tracks in streets, and that the act shall not deprive a city of the exclusive control of its streets, by adding that, on expiration of a street railroad franchise, the right to use the streets shall forever cease, does not annul an existing franchise to operate on city streets granted by a city under charter authority.—(City Ry. Co. vs. Citizens' St. Ry. Co. et al., 52 N. E. Rep., 157.)

LOUISIANA.—City Ordinance—Watering Street Car Tracks.

1. An ordinance of the City Council of the city of New Orleans which requires corporations operating street electric cars within the limits of the city, upon tracks laid down in the public streets thereof, to water their tracks so as to effectually lay the dust within their tracks, is a legal exercise of the police power of the city. Such an ordinance tends to promote the comfort and convenience of passengers, and the health and comfort of the inhabitants of the city.

2. It is neither indefinite nor unreasonable.—(State vs. Canal & C. R. Co., 24 So. Rep., 265.)

NEW JERSEY.—Street Railroads—Use of Streets—Notice of Location—Judicial and Legislative Acts—Constitutional Law.

A statute (3 Gen. St., p. 3237, sec. 126) authorized borough councils, upon public notice to all parties interested, to grant or to deny to a street railroad a location of its tracks conformably to its route; such grant, if made, to be upon such lawful restrictions as the interest of the public was deemed to require. Upon notice, consent to a location was given, upon the restriction, among others, "that the limit of this consent shall be twenty-five years from the acceptance of this ordinance." Subsequently, and without notice, a supplement to this ordinance was passed that eliminated the above restriction. Held: 1. The municipal act of the "location" of the tracks of a street railroad operated by the trolley system does not involve any private rights. 2. Such location is a legislative, and not a judicial, act. 3. Apart from express statutory requirement, notice is not requisite. 4. The notice required by the act is satisfied when it has been complied with. 5. Whether the action of council was in bad faith is not a judicial question.—(State—Moore et al., prosecutors—vs. West Jersey Traction Co. et al., 41 Atl. Rep., 946.)

NEW HAMPSHIRE.—Extension of Line—General Law—Public Good.

Laws 1895, c. 27, sec. 3, providing for the organization of street railway corporations by general law, and authorizing the court to determine whether the public good requires the building of a street railroad on a proposed route, has no application to an extension, by a previously and specially chartered corporation, of its road, which it was authorized by its incorporation to build.—In re Nashua Street Ry., 41 Atl. Rep., 858.)

NEW JERSEY.—Statutes—Special and Local Acts—Eminent Domain—Compensation—Street Railroads—Franchise—Certiorari—Rights of Taxpayers.

1. The act of June 13, 1898 (P. L., p. 461), entitled "An act to authorize boards of chosen freeholders to widen, straighten, grade and otherwise improve highways under their control, and to provide for the construction of street railroads thereon," is not rendered special or local by the provision that nothing in the act "shall be construed to authorize the construction of a street railroad on any public highway on which it is not lawful at present to authorize the construction of a street railroad."

2. The direction contained in said act that commissioners appointed on condemnation of lands taken for the purpose of widening, straightening, or changing the location of a highway in making their estimate and assessment of damages, "shall take into account the benefits conferred by the improvement on the remainder of any lot or tract of land partly taken," is not unconstitutional.

3. The fact that a street railroad company, with which a board of chosen freeholders has made a contract, under said act, to construct a street railroad upon a public highway under its control, has no franchise, apart from such contract, to construct or operate a street railroad upon such highway, does not give a taxpayer owning land upon the highway a standing to attack the contract. (State—Randolph et al., prosecutors—vs. Board of Chosen Freeholders of Union County et al., 41 Atl. Rep., 960.)

NEW YORK.—1. Statutes—Subject and Title—Separable Provisions.

Laws 1863, c. 361, entitled "An act to authorize the construction of a railway and tracks in the towns of West Farms and Morrisania," authorizing in the first eight sections the construction of a street railway, and in section 9 the construction of a railway to other towns, is not void in toto, as violative of Const. art. 3, sec. 16, providing that no bill shall embrace more than one subject, which shall be expressed in the title, since section 9 may be disregarded as unconstitutional, without affecting the rest of the act.

2. Same—Amendments.

Laws 1892, c. 340, amending Laws 1863, c. 361, entitled "An act to authorize the construction of a railway and tracks in" certain towns, by providing for the consolidation of companies formed thereunder, does not contain more than one subject, and that subject is sufficiently expressed in the title (Const. art. 3, sec. 16), since the amendment is within the reasonable scope of the subject contained in the title of the original act.

3. Charter—Forfeiture.

The corporate life of a company formed under Laws 1863, c. 361, providing in the first eight sections for the construction of street railways in certain towns and in section 9 for their construction in other towns, is not affected by a failure to comply with such section 9, since no authority was acquired thereunder by reason of its unconstitutionality.

4. Same—Special Privileges—Constitutional Law.

Laws 1892, c. 340, amending Laws 1863, c. 361, by exempting the corporations formed thereunder from the provisions of the general railroad act (Laws 1890, c. 565, secs. 93, 95, 98), relating to the sale of the franchise of street railroads, payment of percentage of gross receipts, and repairs of streets, is not violative of the constitution, as amended January 1, 1875, prohibiting the granting of immunities or privileges, since such provisions were conditions imposed by the Legislature, which it had power to take away.

5. Same—Construction—Consent of Municipal Authorities.

The general railroad law (Laws 1890, c. 565, sec. 91) provides that the consent of municipal authorities having "exclusive" control of any portion of a street on which it is proposed to build a railroad must be obtained before proceeding therewith. The department of public parks in the city of New York was vested with exclusive power to locate and maintain all streets, etc., until Laws 1890, c. 545, invested such power in the commissioner of street improvements in the Twenty-third and Twenty-fourth wards as to all streets therein. Held, that as the department of public parks did not have "exclusive" control of streets within the meaning of the railroad act, the commissioner has none such, and hence his consent for the construction of a railroad in such wards is unnecessary.

6. Same—Extension of Lines.

A company "extending" its lines under Laws 1892, c. 676, is not restricted to a mere prolongation of existing branches, since the term "extended" is given a broader meaning by section 90, which provides that any corporation organized since 1884, for the purpose of building or extending a street railroad or any of its branches on or along any street or avenue in any city, town or village, may do so by compliance with the article in which such section is contained.—(Bohmer vs. Haffen, 54 N. Y. Suppl., 1030.)

LIABILITY FOR NEGLIGENCE

DELAWARE.—Action on the case—Declaration—Certainty—Carriers—Injury to Passengers.

1. A declaration in "case" charged defendant with "so negligently and carelessly omitting and neglecting to use proper care and caution in running one of its cars, wherein the said plaintiff was then and there a passenger for hire, that said car ran from the rail with great force and violence," whereby plaintiff was thrown out and injured. Held, sufficiently certain.

2. A count in "case" is sufficiently definite where it charges defendant with "negligently and carelessly running two cars, upon one of which the said plaintiff was then riding as a passenger for hire, upon a certain track, which was then and there, through the negligence and carelessness of the said defendant, improper and

unsafe," whereby the car was thrown from the track, and plaintiff thereby thrown to the ground and injured.

3. A count in "case," which charges defendant with "so negligently and carelessly running a certain car in which the plaintiff was then and there a passenger for hire, and was then riding, that the said car jumped from the track," thereby causing the plaintiff's injury, is sufficiently certain.

4. A declaration in "case" charged defendant with "so negligently and carelessly operating a certain electric car, which was then and there running for the carriage of persons for hire, that thereby the said plaintiff, who was then and there a passenger on said car, was, through the negligence and carelessness of the said defendant as aforesaid," thrown from the car and injured. Held, insufficient, since the statement of facts admits of almost any proof to sustain it.—(King vs. Wilmington & N. C. Elec. Ry. Co., 41 Atl. Rep., 975.)

MINNESOTA.—Injury to Person on Track—Evidence—Question for Jury.

The plaintiff sued for personal injuries received while on defendant's track in a public street, and, against defendant's objection introduced in evidence a special rule of the defendant street-railway company intended for the guidance of its motorman, which provided that "he must keep a sharp lookout to avoid running into pedestrians and vehicles, especially at cross streets. While the car is in motion, the responsibility for safe running rests with him. * * * He will be held responsible for any damage arising from negligence." Plaintiff did not know of the existence of this rule, nor was there any evidence showing how long it had existed. Held, error; that the rule imposed a higher degree of care on the motoneer than the law required, that the jury might have understood that this rule imposed upon him and the defendant an extraordinary degree of care as to travelers on defendant's track, whereas the law imposes only a reasonable degree of care and vigilance in such cases. Held, also, that there was sufficient evidence to justify the trial court in permitting the question of the defendant's negligence and the plaintiff's contributory negligence to go to the jury.—(Isaacson vs. Duluth St. Ry. Co., 77 N. W. Rep., 433.)

NEW JERSEY.—Expert Evidence—Question for Jury.

1. The opinion of an expert witness as to the cause of an accident is incompetent when it is based upon the existence of certain facts and conditions at the time of the accident, of which he has no personal knowledge, and has not heard all the evidence in the case, unless the opinion is elicited by a question entirely hypothetical in form.

2. The opinion of a witness, that the kind of block signals used on a trolley road are not such as to insure reasonable safety to the employees operating the cars of that road, is incompetent and irrelevant; that conclusion being a question for the jury alone to determine from all the evidence in the case.—(Bergen County Traction Co. vs. Bliss, 41 Atl. Rep., 837.)

NEW YORK.—Personal Injuries—Excessive Damages.

A verdict of $3,750 is not excessive for injuries to a healthy woman, fifty-five years of age, which bruised and sprained her, and confined her to her house for two or three months on her physician's advice, and caused permanent prolapsus uteri and congestion, necessitating the wearing of a pessary.—(Rippe vs. Metropol. St. Ry. Co., 54 N. Y. Suppl., 958.)

NEW YORK.—Injury to Person on Track—Contributory Negligence.

Where plaintiff, on a dark night, was driving along the track of a street railway on which its cars would approach from his rear, and there was no room for him to drive outside of its double tracks, and he was familiar with both the street and the street railway's method of operating its cars thereon, in an action for personal injuries he is bound to show affirmatively that he was exercising that reasonable care which the obvious dangers of his situation demanded, as there is no inference that he was free from contributory negligence, in the absence of evidence that he ever looked back or listened for the approach of the cars.—(Johnson vs. Brooklyn Heights R. Co., 54 N. Y. Suppl., 547.)

In an action for personal injuries, caused by negligence, the trial court has discretionary power to reduce a verdict as being excessive.

2. Same—Appeal.

In an action for personal injuries, the evidence showed that plaintiff was a boy eighteen months old, and that his leg was amputated above the knee. The verdict was $15,941.25. The trial judge, in his opinion, stated that the amputation was below the knee, and that, if he could exercise any discretion, he would reduce the verdict, but erroneously decided that he had no such discretion. Held, that the verdict was not clearly excessive.—(Kalfur vs. Broadway Ferry & M. Ave. R. Co., 54 N. Y. Suppl., 503.)

NEW YORK.—1. Review—Conflicting Evidence—Finding of Jury.

The verdict of a jury on conflicting evidence will not be disturbed.

2. Warning from Approaching Car.

Workmen repairing a street about a street-car track are entitled to more warning of an approaching car than the noise it makes in running.

3. Same—Collision with Street Car—Contributory Negligence—Question for Jury.

Plaintiff was rightfully at work on defendant's street-car track, repairing the street, when he was struck by a car whose bell gave him no warning of its approach, but which he could have seen, if he had looked, at a distance of 1,500 feet. Before stooping down to pour tar on the paving, he looked and saw no car in sight. As the tar had to be poured while very hot, it could not be long delayed, and to do so he had to bend over. He swore he did not know the car was near him until he was struck. Held, that the negligence of plaintiff, in omitting to look after he began to empty his bucket, was for the jury.

4. Instructions—Harmless Error.

A refusal to give a specific charge, where the court had already charged correctly the proposition involved, was harmless error.—(Lewis vs. Binghamton R. Co., 54 N. Y. Suppl., 452.)

NEW YORK.—Negligence of Motorman—Child on Track—Burden of Proof.

In an action against an electric street railway for killing a six-year-old boy, the negligence alleged was the omission of the motorman to stop the car before striking the child. The car was running at a speed not to exceed the prohibited rate of more than 12 miles an hour. Plaintiff's evidence showed that, when the car was 71 feet from where the boy was struck, the boy had passed onto the outside rail, and was running directly across the track, but was struck when he had nearly reached the inside rail. The rails were not quite five feet apart, and, if plaintiff's evidence was true, the car traveled more than 17 times as fast as the boy, which would make its speed at least 34 miles to the hour (assuming the boy was running at the rate of 2 miles an hour), which was incredible, in view of the finding that it was not going faster than 12 miles per hour. The motorman testified that when he first saw the boy he was running diagonally by the car, and, "quick as a shot," ran and fell over the rail, and that he immediately lowered the fender and applied the brakes, but to no avail. There was no evidence that the motorman saw the boy, or heard any warning concerning him, except his own testimony. Held, that a verdict for plaintiff should be reversed, since it was as reasonable to infer the motorman was not negligent, as the contrary, and the burden of proof was on plaintiff.—(White vs. Albany Ry., 54 N. Y. Suppl., 445.)

Decision on Cast Welded Rail Joint Patent

In the case of the Falk Manufacturing Company vs. the Missouri Railroad Company and the American Improved Rail Joint Company, which has been pending since July, 1897, an opinion was filed on Jan. 10 by Judges Adams and Sanborn, of the United States Circuit Court at St. Louis. In this opinion the Court finds that while the Falk company's patent sued upon (No. 545,040) has five claims, yet each of them might be said to be practically based upon the following steps, viz.:

1. Cleaning the abutting rails for a short distance from the ends.
2. Heating such cleaned rail ends.
3. Adjusting a mold around such rail ends, and
4. Pouring molten metal into the molds.

After commenting upon the result obtained, in the way of securing what are known as "continuous rails," the Court says:

"In our opinion, without entering into any detailed analysis of the evidence bearing on the state of the art, consisting generally of publications, technical works, mechanical operations, individual experiences, common knowledge and divers patents—all of which have been carefully considered—the efforts of the patentee, as disclosed by this patent, belong to the domain of mechanical skill and not to the domain of invention."

The Court further holds that the Norris patent of 1851 and the Stephenson patent of 1831 are anticipatory of the Falk patent. The Falk company contends, however, that these patents describe inventions which were never tried in practice, and, therefore, do not hold.

It is understood that the Falk company will appeal this decision at once, carrying the matter to the highest courts if necessary, but it holds that even should the patent be finally defeated, it does not follow that its control of the cast welded joint business would be thereby weakened, since it holds numerous other process or detail patents, without infringing upon which it is claimed that no successful cast welded joint can be made.

Recent Annual Reports

BOSTON ELEVATED RAILWAY COMPANY

In the first annual report of the Boston Elevated Railway Company, the directors review the history of the company from its organization in 1894 to its lease of the West End system and its leased lines, which took effect Sept. 30, 1897. The summary of the business for the complete year, ending Sept. 30, 1898, is as follows:

Gross earnings from operation		$9,179,096.35
Operating expenses		6,566,584.16
Net earnings from operation of leased lines		$2,612,512.19
Subway rental	$106,134.35	
Interest on West End funded debt	498,600.00	
Dividend on West End preferred stock, 8 per cent	512,000.00	
Dividend on West End common stock, 7 per cent	635,950.00	
Dividend on Somerville H. R. Company's stock, 6 per cent	9,180.00	
Taxes on West End property	435,860 44	
Total payments under lease of West End St. Ry. Co.		$2,197,724.79
		$414,787.40
Add interest on special deposits		78,156.59
		$492,943.99
Taxes, Boston Elevated Railway Co.	$86,049.74	
Compensation tax under agreement with Commonwealth, act of 1897	80,317.09	
		166,366.83
Balance		$326,577.16
Interest paid to holders of Boston Elevated Railway Company, receipts, Aug. 15, 1898, 2¼ per cent on amount actually paid in		112,500.00
Surplus for the year		$214,077.16

The report shows that work on the plans of the new elevated line has been vigorously prosecuted, and within a short time a large proportion of the structure will be put under contract. Foundations will be begun in the opening of the spring of 1899. The plans for the terminal stations at Roxbury and Charlestown have been completed, and a large part of the required land has been taken by eminent domain or purchased. George A. Kimball is the company's chief engineer of elevated lines, and since the report was issued John Lundie has been appointed consulting engineer, particularly with a view to decisions of car service and operation.

The company's general balance sheet shows as its large items a capital stock of $5,000,000, and a lease account, West End Street Railway Company, of $1,362,023 in liabilities, and in assets, cash on hand and in bank, $5,532,445, and West End Street Railway Company and Somerville Horse Railroad Company bond, property and open accounts amounting to $1,932,048. The company carried 209,561,175 passengers during the year, of which 28,239,880 were free transfer passengers. The car mileage was 32,379,445, and the receipts per total passenger were 4.279 cents.

THE COLUMBUS STREET RAILWAY COMPANY

The annual report of the Columbus Street Railway Company for the year ending Dec. 31, 1898, shows the following interesting figures:

EARNINGS AND OPERATING EXPENSES IN DETAIL

	1897.	1898.
Gross earnings	$605,921	$680,173
Operating expenses	286,874	327,692
Earnings from operation	$319,047	$352,481
Miscellaneous earnings	5,397	8,860
Total receipts—all sources	$324,444	$361,340
Fixed charges	200,151	205,964
	$124,293	$155,376

EARNINGS AND EXPENSES PER CAR MILE

	1897.	1898.
Earnings	$.168	$.183
Expenses—		
Maintenance of way	.006	.01
Maintenance of equipment	.007	.008
Conducting transportation	.046	.046
Power	.007	.007
General expenses	.013	.016
Total expenses	$.079	$.087
Net earings	.089	.096

The balance sheet shows in liabilities, capital stock, $3,000,000; bonded debt, $3,000,000; Crosstown bonds, guaranteed, $572,000; reconstruction reserve, $28,531; current liabilities, $192,301. In assets are plant, property and franchises, construction and equipment, $6,346,755; Crosstown lease and ownership, $572,000; park construction and equipment, $33,115; current assets, $38,393; prepaid accounts and sinking fund, $43,594. The balance sheet surplus is $231,025.

CHICAGO CITY RAILWAY COMPANY

The annual report for the year ending December 31, 1898, including the following figures of operation, is as follows:

	1897.	1898.
Gross earnings	$4,816,516	$4,832,806
Operating expenses and taxes	2,908,982	2,926,490
Net earnings	$1,907,534	$1,906,316
Interest	207,877	207,877
Dividends	1,440,000	1,440,000
Balance for the year	$259,657	$258,439
Depreciation, etc	50,000	90,000
Per cent operating expenses	60.84	60.97
Passengers carried, cable	41,444,646	38,482,628
Passengers carried, horse	691,051	477,313
Passengers carried, electric	53,485,425	57,032,173
Miles run, cable	12,562,610	11,678,020
Miles run, horse	198,860	143,900
Miles run, electric	11,616,530	12,563,380

At the annual meeting, Joseph Leiter, formerly second vice-president, was made first vice-president, and D. G. Hamilton was made second vice-president; other officers and directors remained unchanged. An increase of $2,000,000 in capital stock was authorized.

NORTH CHICAGO STREET RAILROAD COMPANY

The annual report for the year ending December 31, 1898, includes the following figures:

	1897.	1898.
Passengers carried	56,354,147	58,422,077
Miles run	10,644,270	10,916,737
Receipts from—		
Cable lines	$1,421,848	$1,448,652
Electric lines	1,375,638	1,456,908
Horse lines	20,911	15,865
Total	$2,818,398	$2,921,425
Other income	93,153	93,898
Total income	$2,911,551	$3,015,323
Operating expenses	1,319,926	1,390,681
Net earnings	$1,591,625	$1,624,642
Interest, rentals, taxes, etc	636,462	543,666
Dividend paid, 12 per cent	791,943	870,957
Balance, surplus	$163,220	$210,019

WEST CHICAGO STREET RAILROAD COMPANY

The annual report for the year ending Dec. 31, 1898, includes the following figures:

	1897.	1898.
Passengers carried	78,594,932	80,600,505
Receipts from—		
Cable lines	$1,451,984	$1,427,622
Electric lines	2,382,768	2,539,204
Horse lines	13,859	11,634
Advertising, etc	51,307	53,443
Gross earnings	$3,899,918	$4,031,903
Operating expenses	1,929,664	2,017,946
Net earnings	$1,970,254	$2,013,957
Fixed charges—		
Rental of leased roads	$736,465	.....
Coupon interest	.....	$1,198,000
Other interest and taxes	399,720	.....
Dividends paid	791,340	791,340
Surplus for year	$42,729	$24,617

NORTHWESTERN ELEVATED RAILROAD COMPANY

At the annual meeting of the Columbia Construction Company, which has a general contract for building the Northwestern Elevated Railroad, President George A. Yuille announced that in December an arrangement was completed with Blair & Company, of New York, whereby the Northwestern Elevated Railroad Company had secured a loan of $4,500,000 to pay off the outstanding obligations incurred for labor, material and right of way, and to complete the road and put it in operation. In order to secure this loan, the capital stock of the Northwestern Company had been reduced from $15,000,000 to $10,000,000, of which $5,000,000 was in common stock and $5,000,000 in preferred, and the authorized bond issue was reduced from $15,000,000 to $5,000,000. It was agreed that the parties making the loan would receive as a bonus $1,000,000 of the preferred stock and $1,000,000 of the common stock, leaving for the Columbia Construction Company on the final completion of the road and payment of the loan $4,000,000 of preferred and $4,000,000 of common stock.

LAKE STREET ELEVATED RAILROAD COMPANY

The annual report for the year ending Dec. 31, 1898, includes the following figures:

	1897.	1898.
Passengers carried	11,229,590	12,391,020
Gross earnings	$579,961	$633,403
Operating expenses	329,124	324,947
Net revenue	$250,837	$308,456
Taxes	18,612	13,849
Interest on bonds	227,605	221,677
Miscellaneous interest	29,874	37,667
Loop rental	15,707	61,954
Total	$291,798	$335,147
Extraordinary expenses	31,880	.....
Deficit for year	72,841	26,691

NEW ORLEANS TRACTION COMPANY

The annual report for the year ending Nov. 30, 1898, is as follows:

	1897.	1898.
Gross earnings	$1,239,256	$1,311,365
Operating expenses	847,833	801,971
Net earnings	$391,423	$509,394
Other income		39,150
Total		$548,544
Fixed charges		380,013
Balance		$168,531
Dividends, 5 per cent on preferred stock		125,000
Surplus		$43,531

SOUTH SIDE ELEVATED RAILROAD COMPANY

In view of the equipment of the South Side Elevated Railroad Company, of Chicago, by a novel and hitherto untried electric system, the Sprague multiple unit system, the following abstract of President Carter's report to the stockholders, on January 26, will be of peculiar interest:

The company's road was operated by steam power from Jan. 1 to Apr. 20. In that time the operating expenses ranged from 80.8 to 84.7 per cent of the gross receipts. From Apr. 20 to July 27, the operation was partly by steam and partly by electricity, the change being gradual and necessarily involving the additional expense of maintaining two systems. In these months the operating expenses ranged from 70.2 to 75.7 per cent of the gross receipts. Since July 27, 1898, the operation has been entirely by electrical power, and the percentage of expenses to earnings steadily decreased from 63.7 per cent to 55 per cent in December.

All of the above figures include a loop rental of one-half cent per passenger. Not including the loop rental, but including all other operating expenses, taxes, car licenses, etc., the road was operated in October for 47 per cent, in November for 47.7 per cent, and in December for 45.4 per cent. Expenses have not only been on an increasing ratio, but gross earnings have been steadily increasing.

If the entire year be divided into two periods of six months each, the contrast between steam and electric operation becomes more striking. The number of passengers carried during each period is approximately the same. The net earnings applicable to interest and dividends were for the first half of the year (steam and mixed operation) $98,973, and for the second half with electrical operation (mixed in July) were $196,933, or almost double the earnings of the first six months.

The net earnings applicable to dividends on stock during the last six months were at the rate of 3½ per cent per annum, as against but 1 per cent per annum for 1897.

At the time the change in power was undertaken, the road needed about ninety cars to transact its business, and 120 seemed an ample equipment on the new basis, but with growing patronage it has become necessary to increase the total equipment to 180 cars, of which 120 will be motor cars and sixty trail cars.

The operating expenses of the power plant, based on maximum power required of 8,000 h.p. for about four hours each day in the winter months, is about $8 per h.p. per annum, and adding to the above general expenses 10 per cent depreciation, interest, insurance and taxes, the total cost per maximum h.p. per annum does not exceed $15.

Mr. Carter speaks of the Sprague multiple unit system as follows:

"At the time of the last annual meeting we reported that the test of the train equipped by Mr. Sprague, made on the Metropolitan Elevated road, was satisfactory. We began using electric cars in April, had sixty-seven in operation in May, and gradually increased the number until July, when they finally superseded the steam trains. We had minor difficulties to contend with which were met and solved. None of them resulted in injury to any passenger, and none of them involving the control of the train, which has always been complete. I am assured that the difficulties and annoyances were not so great as they were in installing the excellent steam locomotives which they displaced. We believe that the Sprague multiple-unit system has fulfilled expectations. Exhaustive tests have proved the economy of rapid acceleration and long coasting. A schedule speed of 15 miles per hour is easily maintained, and time lost is easily made up. If needed, in order to meet competition, your company has the ability to increase the speed to 20 miles an hour.

"The reliability of the equipment has been fully tested this winter, when 150 cars, all we had, were in daily operation (Sundays excepted) for many weeks.

"We have not been in electrical operation long enough to definitely determine the cost of maintenance, but we have sufficient data to confidently state that it will be low, as low as any other line doing equivalent service, and lower than many surface lines with 18-ft. single truck cars. The advantage of this flexible system on crowded days, for switching and changing the length of trains, is apparent."

The use of storage batteries is also referred to at some length in President Carter's report, and the statement is made that their use is a success, certainly in the matter of keeping up voltage and enabling the road to operate more cars, to furnish increased facilities to patrons and to prevent damage to power house machines under a sudden demand for increased power, while it is claimed, though not as yet fully demonstrated, that the cost of power production is also cheapened.

Another Consolidation in Baltimore

An agreement has been signed whereby a syndicate, headed by Alexander Brown & Sons, secures the right to purchase the entire capital stock of the Baltimore Consolidated Railway by March 30, payment to be made by April 30, and the price to be $37.50 per $25 share. Stockholders may elect to take cash or the securities of the proposed new company. This syndicate is the same one that purchased the capital stock of the Baltimore City Passenger Railway last month, and the agreement probably means the consolidation of practically the entire street railway system of Baltimore.

Uniforms for Employees

Hackett, Carhart & Company, of New York, one of the oldest and most reliable clothiers in the country, are now making a specialty of supplying uniforms of all kinds for employees and officials, and are paying particular attention to the requirements of employees on street railways and steam roads. This company has not been content with following the old methods of turning out this class of work, but has introduced a new and improved system whereby it is enabled to furnish high grade uniforms at reasonable prices. It cordially requests superintendents and purchasing agents to send for samples and estimates.

Chicago Street Railway Franchises

The following official statement has recently been issued by Charles T. Yerkes, relating to the Chicago street railway properties:

There is considerable misunderstanding regarding the legislative position of Chicago's street railway franchises. The impression which prevails in Wall Street is that it is necessary to secure an extension of franchises, before 1903, or the various roads will pass to the control of the city. It is also claimed that a repeal of the Allen law becomes necessary and a new measure adopted by the General Assembly of the State of Illinois before there can be any renewal of franchises, inasmuch as the City Council of Chicago has practically failed to extend the street railway franchises for fifty years under the present Allen law.

These premises are wrong. The street railways of Chicago are nearly all operated under 99-year franchises; at least all of the important lines, which include the Chicago City Railway Company, operating on the South Side, and the so-called Yerkes properties, operating on the West and North Sides. This disposes of the socialistic talk so recently rampant in Chicago respecting probable municipal ownership.

The franchise position of the street railways is briefly as follows:

Under authority granted by the State, the Chicago City Railway Company was granted a 99-year franchise from Feb. 14, 1859 The Yerkes properties on the North and West Sides hold franchises for 99 years; that on the North Side dating from 1886 and that on the West Side dating from 1863. Under the terms of these 99-year franchises it was provided that the City Council of Chicago should grant ordinances in periods of 20 years, permitting the use of and designating streets under specific terms. The first 20 years was passed without feature, and not until 1883 was there any trouble regarding the extension of time for the use of the streets. At that time the elder Carter H. Harrison, then Mayor of Chicago, saw fit to make political capital out of the street railway and demanded that a compensation be exacted for a renewal of the ordinances granting the use of certain streets already occupied and others which there was a desire to occupy.

In 1883 there was need for improvement in the street railway systems of Chicago, and it was not deemed wise to antagonize investors by precipitating a legal fight over the question of authority to declare occupied streets vacant. It was also important that new streets be acquired. In consequence the street railway companies agreed voluntarily to pay the city $50 per car per year for an extension of ordinances for another 20 years. It is notable that the Mayor, the elder Harrison, publicly stated that he had invariably been advised by eminent counsel that the city had no authority to displace the street railway companies who were in possession of streets and that the 99-year franchises could not be abrogated.

So far as the legal position is concerned there is no change at present. The same reasons exist to-day, however, for a peaceable solution of the franchise quesion that did in 1883. It is not desired to disturb the confidence of investors by what might be an almost endless litigation over the authority of the city to abrogate the use of streets in which cars are now operated. It was with this end in view that the Humphrey's bill was proposed and a compromise reached, which resulted in the Allen bill. If 50-year ordinances could have been obtained from the city under this bill there would have been no danger of a long legal fight.

Since it has been found that there is little hope of securing any results from the existing state of things in the Chicago City Council, recourse is to be had to the State Assembly, which convenes in Springfield, Jan. 4. There is a rabid demand for the repeal of the Allen law, but this is not likely to occur, but, instead, some sort of amendments made whereby a compromise is had. A number of bills have already been prepared, but it is yet much too early to say what the precise nature of the compromise will be.

Change in the General Electric Company

John McGhie has resigned his position as manager of the advertising department of the General Electric Company, in order to undertake important and responsible work with the "American Machinist." His headquarters will hereafter be at Cleveland, Ohio, to which city he will move his family from Montclair, N. J. Mr. McGhie's management of the General Electric Company's advertising business has been able and painstaking to an unusual degree, and the record which he leaves behind him is one with which both his principals and himself have every reason to be satisfied.

W. J. Fransioli, formerly general manager of the Manhattan Railroad Company, of New York, has associated himself with the Ameriean Air Power Company.

NEWS OF THE MONTH

The Boston & Albany Railroad is trying an interesting experiment which should also be of interest to street railway managers. This consists of sprinkling its roadbed with non-flamable and practically odorless oil for the purpose of freeing the tracks from dust. In addition to removing the dust the oil sprinkling keeps the rain from washing away the roadbed, destroys vegetation, prevents frost from penetrating and injuring the roadbed, lessens the noise of trains, and by preventing dust greatly reduces the danger of hotboxes. It costs $150 a mile to sprinkle the roadbed, and one sprinkling a year is sufficient.

The Boston Elevated Railway Company has 456 miles of overhead electric feeder lines, 63 miles of underground electric feeder lines, 133 miles of underground conduit duct, 68 miles of underground electric return lines and 2.8 miles of submarine cables. It owns 3370 electric motors, 1274 electric box cars, of which 884 are twenty-five foot bodies, and 1292 electric open cars, of which 724 are nine and ten bench, 11 mail cars, 3370 electric motors and 236 cars and electric snow plows.

The recent stoppage of traffic on the underground electric conduit road on Sixth Avenue, New York, for several hours, was due not to flooding of the conduit, as has been erroneously stated in the press, but to the overloading and consequent burning in two of a main feed wire furnishing current to one of the sections of the line. This line is now being operated in a somewhat temporary way pending the completion of the new 70,000 h.p. station, and the final feed wire system to be installed in connection therewith.

A 15-ft. flywheel in the Birmingham Traction Company's plant at Pittsburgh, Pa., burst about 10 o'clock on the night of Dec. 11, and did considerable damage. A 300-h.p. engine was wrecked and a portion of the building suffered considerable damage. No one was hurt.

The Rochester (N. Y.) Railway Company suffered serious loss on Jan. 1 from fire, which destroyed its State Street barns, and twenty-one cars that could not be saved in time. The cause of the fire is unknown.

The following bills have been introduced in the Senate at Albany, N. Y.: One requiring all street cars to be equipped with "automatic, trip and drop front fenders" (violators are punishable by a fine of $100 for each day a car is run without such fenders; also one providing that whenever any street car is delayed for five or more minutes, passengers shall receive transfer tickets good at any time for a continuous ride on any line of the company. Violation renders companies liable for damages in $250, to be recovered in civil action by passengers to whom transfer is refused.

The street railway company at Marinette, Wis., has decided to place heavy curtains on both ends of its car to protect the motormen.

All the surface and elevated railroad companies in Greater New York were compelled by the city authorities during the recent grippe scare to thoroughly fumigate all their cars, including all mats, matting, rugs, etc., used therein.

President Gaston, of the Boston Elevated Railroad, states that for the year Oct. 1, 1898, to Oct. 1, 1899, the number of transfers issued by the Boston Elevated Railroad shows a larger increase than for any year in the history of transportation in Boston. In the past eight years the number of passengers carried have increased 52 per cent, while free transfers have increased 251 per cent. During the last fiscal year the number of passengers increased 5 per cent, while transfers increased over 19 per cent.

A suit was recently brought against the Rochester Railway Company for five cents, this being the amount the plaintiff claimed was due him as change for ten cents which he handed a conductor on the defendant's road. The conductor swore that the plaintiff gave him five cents instead of ten, and as he was able to bring witnesses to prove this, the suit was decided against the plaintiff, who had to pay the costs.

The Bloomington (Ill.) City Railway Company, on Dec. 17, turned the receipts of its Normal line over to the Normal Library Association, and the cars were in charge of the young ladies of that association as conductors. Nearly $200 was added to the funds of the library as a result of the day's operation. A chaperon rode on each car to assist the young ladies.

It is stated that thirty employees of the Newport News & Old Point Railway & Electric Company, formerly the Newport News, Hampton & Old Point Railway Company, divided $16,000 between them recently, the gift of J. S. Darling, president of the old company, and his son. Individual amounts were based on time of service. One man received a check for $1,000, and several conductors received $750 each.

The Columbus (Ohio) Street Railway Company is considering the advisability of placing the weather forecasts printed on neat cards in all its cars. The local weather station will probably furnish the printed cards daily, and it is believed this departure will add to the popularity of the street railway lines.

Definite plans are said to be under active consideration at present for a reorganization of the Kings County Elevated Railroad Company, with a view to its consolidation with the Brooklyn Elevated Railroad Company. The Kings County reorganization committee has recently held several meetings, and a plan will, it is said, before long be issued to stock and bond holders of the road. It is stated new securities will soon be issued for equipping the road with electricity, etc.

The Rochester (N. Y.) Railway Company has adopted a novel carrier for cigars, and will place a number of them in its cars. The device is made of nickeled tin, and has places for four cigars, the idea being that when a man boards a car with a lighted cigar which he desires to save he can place it in the carrier until he leaves the car.

The combination open and closed cars which have been in operation on the lines of the Nassau Electric Railway of Brooklyn, and which were described in the STREET RAILWAY JOURNAL for November, 1898, have not been very popular with the public. To overcome some of the objections raised, the company has made a number of changes in five of the cars, and if it is found advisable the changes will be made in all of the combination cars on the road. The principal improvement consists of four levers placed on the rear platform, by which the conductor can open any one of the side doors without leaving his place. Both bell ropes have been placed on the outside of the car, so that conductors will not have to open a door to ring up a fare or give the motorman the signal to go ahead or stop. The loud noise caused by the slamming shut of the side doors is also done away with on the improved cars by the insertion of a rubber strip in the door jamb, while a rubber knob prevents a similar noise when the doors are opened. In addition to these improvements a rubber matting about half an inch thick has been placed along the side step of the car to keep the passengers and conductors from slipping in stormy weather, and the upright iron bars used as hand rails have been incased in rubber. A gutter has been added to the side of the car also to keep the rain and water from dripping down upon the conductor as he passes along the step. The gutter runs toward the rear of the car and empties the water over the rear platform.

The lines of the East Liverpool Railway Company, of East Liverpool, Ohio, were tied up for several hours recently on account of a strike of the employees. The trouble was caused by the discharge of a motorman who was a member of the motormen's union, but was finally settled by a compromise, and the men returned to work.

The Syracuse Rapid Transit Railway Company has voluntarily placed in operation a new scale of wages for motormen and conductors. Since 1896 the pay of the men has been 13½ cents per hour for the first twelve months, 15 cents for the next twelve months and 16½ cents after that. From now on the pay for the first three months in service will be 14 cents an hour, for the next three months 14½ cents, for the next six, 15 cents, for the next six, 15½ cents, for the next six, 16 cents, and for the next six and thereafter the men will receive 16½ cents an hour. This new schedule will be particularly advantageous to the new men, as under it the average pay per hour for the first two years will be 15 cents, instead of 14 cents as formerly. Men who have been employed by the company for more than two years will be given the best runs. In addition to the above increase in wages the company has notified all its motormen that they will be furnished fur overcoats at the company's expense. The coats are to be worn only during the hours of duty, and are to be returned to the station foremen at the end of the day's run.

The annual report to the Legislature of the New York Board of Railroad Commissioners was made on Jan. 4, and contained the following general statistics:

Year ending June 30.	1897.	1898.
Capital stock	$126,978,482 50	$132,844,303 33
Funded debt	104,823,698 57	130,179,166 90
Unfunded debt	23,254,380 39	31,806,542 42
Cost of road and equipment	221,665,039 63	233,635,396 51
Gross earnings from operation	29,911,428 02	31,884,384 20
Operating expenses	18,117,799 48	19,153,716 55
Net earnings from operation	11,793,628 54	12,730,667 65
Income from other sources	1,262,358 95	1,457,501 55
Gross income from all sources	13,055,987 49	14,188,169 20
Taxes and miscellaneous	1,408,719 61	1,459,469 96
*Interest paid and accrued	5,392,037 45	6,022,776 79
*Dividends	5,387,164 96	5,799,359 32
Surplus for the year	604,506 70	631,007 34

* Includes respectively interest and dividends paid by lessors from rentals received from lessees as follows:

	1897.	1898.
Interest	$1,549,001 67	$1,666,068 34
Dividends	2,581,054 96	2,729,894 32

The Niagara Falls & Lewiston Railway (the Great Gorge line) operating down the bluff at Niagara Falls, carried 288,791 passengers during the year ending June 30, 1898, and ran 163,013 passenger car miles. Its average operating earnings per passenger were 25.4 cents, and its operating expenses 7.31 cents. Its total receipts, however, amounted to 29.64 cents per passenger, of which all but .15 cents was consumed in paying operating expenses and fixed charges. The cost of operation per car mile was 17.25 cents, and the total receipts per car mile were 52.44 cents. The total operating expenses and fixed charges on this line were 51.98 cents per car mile.

An incident showing the fallacy of some of the arguments put forth by the advocates of municipal ownership of street railways occurred in St. Joseph recently, when the St. Joseph & Benton Harbor Railway & Light Company secured the contract to light and heat the court house and jail at St. Joseph for three years for $3,900. The county formerly did this work itself, and paid over $6,000 for the years 1896, 1897 and 1898. The building committee refused to give W. Worth Bean, president of the above company, the contract for the lighting in 1899, but by persistent effort he finally secured it by showing actual results. The citizens are pleased at this saving to the county.

The work of reorganizing the Metropolitan West Side Elevated Railroad Company, of Chicago, Ill., is about completed, and the company will soon be placed on a sound financial basis.

The Chicago Electric Traction Company, of Chicago, Ill., has filed a mortgage for $500,000 to the Manhattan Trust Company of New York, and John Kean for first mortgage 5 per cent thirty-year gold bonds.

The Toledo Traction Company of Toledo, Ohio, principally through the efforts of Thomas H. McLean, general manager, has been able to entirely break up the labor union of its employees, and the leaders of the local union, which is known as Division No. 49 of the Amalgamated Association of Street Railway Employees of America, have surrendered its charter to the head association.

The Union Traction Company, of Rutherford, N. J., was sold at receiver's sale on Jan. 27, to the reorganization committee representing 90 per cent of the bondholders. The purchase price was $20,000 over the indebtedness, which, as shown by the receiver's report, was $852,000.

A serious head-on collision occurred on the line of the Worcester & Suburban Street Railway on Dec. 22, near Leicester, Mass. A very heavy fog hung over the tracks at the time, and an inbound car ran into an out-bound car that should have waited at the turnout. Neither of the motormen could see the other car until it was too late to avert the accident. Two persons were killed and several injured.

It is stated that inquiries from China for railroad material and electrical equipment of American make are very numerous, and there are prospects of extensive deals in these branches in the spring.

Vice-President Webb, of the Baltimore & Northern City Railway Company, which company has recently purchased the capital stock of the Baltimore City Passenger Railway Company, and the Baltimore, Middle River & Sparrow's Point Electric Railway Company, has made the following statement: "The property is in the hands of people who are financially able to carry out any contracts they may undertake, and it may also be assumed that they are not only able but determined to vigorously protect their interests from attacks by any competitor. While the syndicate has not yet fully developed its plans, the field has been sufficiently canvassed to warrant the statement that certain territory will be entered that will add largely to the revenue of the combined lines. As the purchase was made for investment purposes, it will, of course, be the general policy to fully develop the earning capacities of the three roads, and one of the most effective ways of doing this is to give every possible convenience to the public. The City Passenger system, as is well known, lacked suburban lines, and the consolidation with the Baltimore & Northern and the Middle River road will not only give to the new system a suburban mileage of fifty-three miles, but puts the new company in a position to acquire additional territory at any future time."

It was announced last month that the Fifth Avenue Stage Line, New York, had been purchased by the Third Avenue Railroad Company, and that automobile electric carriages would be substituted for the horse stages.

While sawing down a dead tree in Brooklyn, recently, a laborer was stricken insensible by an electric shock. The tree had been used for supporting a span wire of the trolley road, and in some way the insulation had become worn.

The Third Avenue Railroad Employees' Mutual Relief Association of New York gave its annual entertainment and reception at the Lexington Opera House, on Jan. 27. A very excellent vaudeville entertainment was given, after which dancing was indulged in. This relief association is one of the most prosperous in the country, its success being largely due to the interest taken in it by the officials of the Third Avenue Railroad Company.

The Northwestern Electrical Association held its annual convention in Milwaukee, Wis., Jan. 18, 19 and 20. The meetings were well attended and the papers and discussions were pronounced most interesting and valuable by all present.

The National Electrical Light Association will hold its twenty-second meeting in New York, May 23, 24 and 25, 1899. The headquarters of the association will be at the Murray Hill Hotel, where accommodations can be had on the American plan at $3.50 and upward per day, and on the European plan at $1.50 and up. The Electrical Exhibition Company will hold its annual electrical show at Madison Square Garden, under the auspices of this association during May.

The Manufacture of Special Work

The New York Switch & Crossing Company has made a number of additions to its works at Hoboken, N. J., during the past year, and is now better able than ever to supply all classes of special work. Among the new tools installed by the company is a large 16 ft. planer with a range of 36 ins. × 18 ins., used for planing switches, a new cold saw for cutting the deepest girder rails, several radical drills and smaller planers, a punch for punching a 1½-in. hole through 1-in. iron, an electric jib crane, etc.

The company reports doing an excellent business during the past year, and among other street railway companies supplied by it with special work were the Union Railway Company, of New York; Brooklyn Heights Railroad Company, and Coney Island & Brooklyn Railroad Company, of Brooklyn, the Consolidated Traction Company, and the North Hudson County Railway, of Jersey City and Hoboken, and the Hartford Street Railway, of Hartford, Conn.

The New York Switch & Crossing Company has also turned out a large amount of steam railroad and construction railroad parts, notably for the J. P. McDonald Company and for the United States Government railroads in the Brooklyn Navy Yard and Indian Head Proving Grounds. The company has also supplied a large amount of special work for export mostly of the T rail type.

New Interests in Compressed Air as a Motive Power

Late in December and early in January, there were organized several companies with large capital, intending to use compressed air for various purposes, and in view of the financial standing and importance of the interests involved in this movement to place upon the market a new motive power, it is advisable to explain the status of the parent and affiliated companies.

The American Air Power Company, of New York, was organized in January, 1898, as a consolidation of the American Air Power Company, of New Jersey, the General Compressed Air Company, of New Jersey, and the Compressed Air Power Company, of New York. The first two companies had been engaged in developing the Hardie motor, and the third the Hoadley-Knight motor. The capital stock of the consolidation company was $7,000,000, and A. A. McLeod, formerly president of the Reading Railroad system, became the company's president.

In January, 1899, the International Air Power Company, of New Jersey, was formed with a capital of $7,000,000. Later on it was announced that this company had secured from the American Air Power Company exclusive rights for all its letters patent in foreign countries; rights for all patents in North and South America, except those bearing directly upon street railway traction, were reserved by the American Air Power Company. The principal stockholders of the International Air Power Company are said to include some of the strongest and best known street railway and other capitalists in America.

Following the organization of this second company is that of the New York Auto Truck Company for $10,000,000, and the Chicago Auto Truck Company, while a similar company for Philadelphia is to be organized. The International Air Power Company will retain large holdings of stock in these three companies and in others which will be formed in different cities, and will manufacture and sell to them complete compressed air trucks intended to do a general city trucking business, replacing and gradually driving from the field the present horse trucks.

The directors of the New York Auto Truck Company are J. H. Hoadley, Richard Croker, ex-Senator Arthur P. Gorman, Robert McKinstry, Nathan Strauss and Lewis Nixon, owner of the Crescent Shipyards, of Elizabethport, and designer of the United States battle ships Massachusetts, Indiana and Oregon. The directors of the Chicago Auto Truck Company will include Joseph Leiter and associates.

The International Air Power Company has purchased for manufacturing purposes the works of the American Wheelock Engine Company, in Worcester, and the Rhode Island Locomotive Works, in Providence. The new auto trucks will be built at the company's Providence works, and air compressors for the auto truck business in Worcester.

The American Air Power Company is now equipping with compressed air motors and apparatus tweny cars for the Metropolitan Street Railway Company's Twenty-eighth and Twenty-ninth Streets crosstown line, and the Ingersoll Sargent Company has practically completed a four-stage compressor to furnish the necessary motive power. The compressed air power station for the Twenty-eighth and Twenty-ninth Streets line is located at the foot of West Twenty-fourth Street, and work is going on rapidly upon the engine foundations, boilers, etc., while in a small temporary shop near by, the motors are constructed.

A full description of the Hoadley-Knight motors of the American Air Power Company and of the engineering features of the four stage compression was given in the STREET RAILWAY JOURNAL for August, 1897, page 487.

Latest Progress in the Application of Storage Batteries to Electric Railways*

BY JOSEPH APPLETON

The history of the storage battery in this country is curious, and probably comprises more troubles and trials than any other branch of the electrical industry. I think it will be generally acknowledged that a storage battery "per se" should be one of the most useful adjuncts in every branch of electrical engineering, but the failures that were recorded in the earlier days proved that the storage battery was not then the commercial success those interested would have us believe. Until 1894, the use of storage batteries in this country proved most disastrous to all concerned. The reasons were many, but may be summed up briefly as follows:

1. The batteries were poorly designed.

2. No attention was paid to the mechanical features, the chief idea being to get the greatest capacity for the lightest weight.

3. The batteries were much over-rated, their full capacity being given as their normal working capacity.

In addition to this the storage battery business generally was in an unsatisfactory and weakly condition. Litigation was the principal cause. The fear of protracted and costly lawsuits prevented capital being invested in the business, and frightened prospective users from purchasing storage batteries.

Now, the conditions are very different. You are all familiar with the changes which have been made during the last five years in the commercial end of the business. All the disturbing elements have been removed, and the business has been put on a proper and substantial basis. These results are best seen from the diagram, Fig. 1. The figures for 1898 have not been tabulated, but they will show that the use of storage batteries is progressing more rapidly than ever:

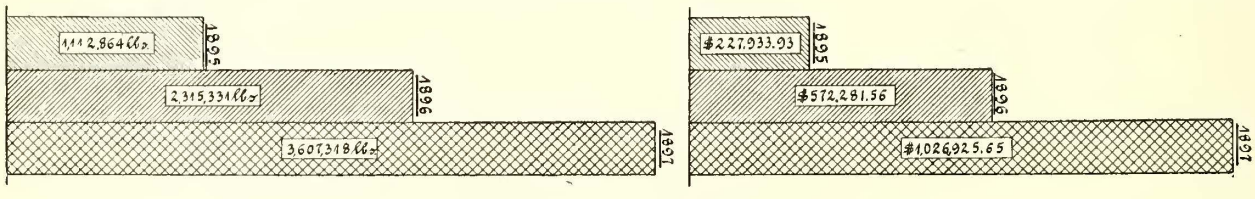


FIG. 1.—DIAGRAM OF SALES OF STORAGE BATTERIES

	Weight of plates alone.—Lbs.
1894	349,000
1895	1,112,800
1896	2,215,300
1897	3,607,300

(Or ten times the business of 1894.)

The storage battery is entirely different from any other piece of apparatus which is used for supplying electrical energy, being constructed and operated on the principle of chemical action, instead of mechanical motion. There must naturally be a vast difference between these two principles.

In the mechanically operated apparatus, or generator, the output of electrical energy is the result of the conversion of the mechanical energy applied to it while in action, and the regularity of the output is dependent on the steadiness of the mechanical energy applied, and the satisfactory running of the generator and motive power. The operation is purely mechanical, and is subject to the interruptions to which all moving machinery is liable. Again, such apparatus, if overloaded to an excessive degree, give visible signs of distress, and, if the overloading is very great, or is continued, will probably give way in some mechanical feature.

In a storage battery hundreds of horse power can be silently stored, and thousands of horse power delivered for a short period, with no apparent action or change in the battery. The action is purely chemical, and as long as the respective elements are there to be acted upon it will surely continue.

It is this fact that makes the storage battery so reliable. Such a thing as instantaneous failure or interruption of the delivery of energy is impossible, except, of course, in the case of mechanical injury to the battery from an external cause. Any mechanically operated apparatus is liable to interruption through breakage or injury to one of its parts, but in a storage battery the chemical action will continue, and consequently the output of energy until all the material on the plates has been converted.

An overload has not the same effect on a storage battery as on a mechanically operated generator. For a short period an overload, even of great extent, does not injure a storage battery. It causes the chemical action to take place more rapidly, or, to be more exact, causes more material to be subjected to the chemical action, and this, if not continued too long, or repeated too often, does not affect a good storage battery. Moreover, if the overload is continued too long, it does not mean the sudden failure and collapse of the battery and complete interruption of the output, but is shown by the premature depreciation of the plates in the battery. It may not be noticed for months or even years.

One of the most valuable features of a storage battery is that it will safely take care of any sudden and momentary overload in the system, such as grounds or short circuits, and if operating in parallel with generators or rotary converters, will relieve them of such overloads and consequent strain. I have frequently seen batteries burn out grounds on an underground system, discharging for a short time at an enormous rate. And in the case of batteries operating on railway loads, it is a common thing to see an occasional momentary discharge at a rate equal to twice the hour rate of the battery. The modern storage battery is designed to stand such occasional extreme discharges, and do so without injury.

It may be well to consider, before going further into our subject, the question of the rates of charge and discharge of storage batteries, and their capacity at different rates. Of course, this will vary somewhat with different types of battery, but not to a great extent. The more rapidly you discharge a battery the smaller is its available capacity. For example, the curve, Fig. 2, illustrates the available capacity of a storage battery when discharging at any rate between the ten-hour and one-hour rates. That is to say, when the battery is completely discharged in ten hours and in one hour. It is only within the last few years that a one-hour discharge rate has been possible with a storage battery, and it is very largely due to the fact that storage batteries can be discharged at such rapid rates that their use has been growing so rapidly.

In large engineering problems the storage battery is used chiefly to supply large amounts of electrical energy for short periods, and by increasing the allowable rate of discharge the size of the battery required is consequently reduced. In connection with this question of the reduced capacity of storage batteries at rapid rates of discharge, there is frequently a mistaken idea that if the capacity of a battery is thus reduced, the efficiency is correspondingly impaired. This is not so at all. It is only the available capacity of the battery which is reduced by polarization, or, in other words, the chemical action when taking place at such rapid rates can only reach the active material which is on the surface of the plates and immediately exposed to to the electrolyte. Hence, in reality, the actual capacity of the battery is not reduced, only the available capacity, and when the battery is recharged, only the active material that is acted upon has to be converted and not the entire amount of active material. There is a slightly greater loss in efficiency when discharging at a rapid rate due to the internal resistance of the battery, this being the C^2R loss.

Storage batteries are not free from trouble, any more than any other apparatus, but, under favorable conditions, the comparison is much in favor of the storage battery. No piece of apparatus yet made is perfect, and its usefulness and consequent general adoption may be said to be proportional to the predominance of its useful features, over its weaknesses or troubles. The rapid growth in the use of the storage battery during the last few years is the best proof possible that its troubles are very small compared to its advantages.

As is the case with all machinery and apparatus which have to be operated continually for any length of time, the results obtained depend not entirely on the design and construction, but on the care and judgment with which it is operated. This fact is particularly noticeable to any one who is constantly brought into contact with different plants and installations, as I am, and under different management, or sometimes mismanagement, in all parts of the country, and this subject alone would afford a very interesting and profitable topic for discussion and consideration.

In the early days the storage battery manufacturers, in order to maintain a bare existence, had to jump at every opening for the use of a storage battery, whether the conditions warranted it or not, and, in order to do business, accepted contracts drawn entirely from the purchaser's point of view, without regard to the capabili-

* Abstract of paper read before the New York Electrical Society Jan. 12, 1899.

ties of the storage battery, and guaranteed results which, to say the least, were extremely difficult to realize. What the results of all this was you know very well.

Now, things are entirely different. The business is on a commercial basis, and it is not a question of getting an order at any price, but securing business which will prove satisfactory and permanent. Now, storage battery manufacturers will insist on proper conditions for the operation of their batteries, or refuse to put them in. This is as it should be, and I think I am perfectly safe in saying that during the last four or five years there has not been a storage battery installed in this country, except under conditions which justified its use. Of course some experimental applications have been made which may or may not prove satisfactory, but this does not come under the head of the general application of the storage battery.

It should be distinctly understood that all conditions of electrical distribution are not suitable for the use of storage batteries, and that it is more to the interest of the manufacturer than the purchaser to confine himself only to those situations which are suitable, for every failure which is recorded is heard of one hundred times to every success.

Now, that by this method of doing business, confidence in storage batteries is being regained, and proper relations have been established between manufacturers and users, the growth of the use of storage batteries will be still more rapid, for it is now realized that when storage batteries are installed and operated under proper conditions the result will invariably be satisfactory.

The trend of electrical engineering is to-day toward the concentration of generating machinery, the highest possible economy in operation, and the utilization of motive power and generating ma-

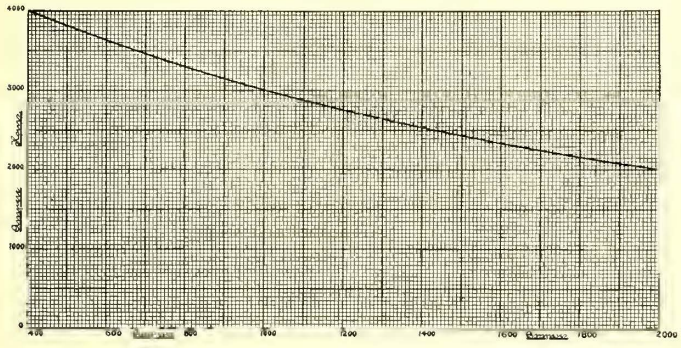


FIG. 2.—CURVE SHOWING CAPACITY OF CELL WITH DIFFERENT RATES OF DISCHARGE

chinery to the fullest extent, so that the investment may produce the greatest return. These conditions make the storage battery indispensable, for without its aid it is impossible to maintain a constant load on the power house.

Every application of electricity has its time of maximum output or "peak," and no matter how many different applications are supplied from the same system, their peaks will not fit in so as to even matters up, but, on the contrary, it is found that in many cases the peaks occur at about the same time. This is particularly noticeable with a railroad and lighting load. Again, concentration of generating machinery means a much larger area for distribution, and the necessity of sub-stations, in order to keep down the investment in conductors, and experience shows that in the majority of cases storage batteries are cheaper than the copper alone, which would otherwise be necessary, leaving out the advantages at the power house. This means that the storage battery will now play a most important part in all electrical problems, and be of sufficient importance and value to warrant the conditions being made suitable for its use instead of, as in early days, being dumped in at any time to fill up a gap and smooth over any difficulties which cropped up.

It used to be customary to refer to European practice, to show what could be done with storage batteries, and even now, I believe that some people think that European batteries and methods are superior to ours in this country. In connection with this idea there is one thing which I particularly wish to emphasize, and that is, the difference between American and European conditions.

In Europe storage batteries are not subjected to the severe work they have to stand here. They are looked upon more as a reserve, and are not expected to discharge at their maximum rate every day, and, perhaps, twice on some days.

As an example of this, I will tell you what one of the Tudor Company experts from Germany said when he was over here last spring. He was attending the National Electric Light Convention at Chicago, and one of the features of that convention was the large storage battery plant, which the Chicago Edison Company had installed. During one afternoon, while the convention was being held, a very heavy thunderstorm came on, and the battery was called upon suddenly for its maximum rate of discharge, and the full rated capacity was taken out. The maximum rating of this battery was a complete discharge in one hour. Our German friend thought that was doing pretty well, but, when I told him that this storage battery was installed under contract, which allowed the battery to be discharged at this rate every day during the winter, he was horrified, and said:

"You must not let them work the battery in that way; tell them they must hold it as reserve." We told him that if we did that we should not be able to do any business, and that we simply had to meet these conditions, and could do so without any difficulty. This instance will show why batteries are maintained at a lower figure in Europe than here, and why it has been customary to refer to the behavior of the battery in Europe. It is a fact that we have now in this country many storage battery installations which surpass any thing in Europe, both in size and method of operation.

The methods of applying storage batteries in connection with electrical engineering work are so numerous that it would be impossible to deal with them all this evening, so I have selected a few for consideration as showing clearly the great flexibility of the storage battery as an adjunct to any scheme contemplating the generation and transmission of electrical energy.

In a lighting and power station the maximum load occurs for only a very short period during the year. In one station I know of 50 per cent of the investment in generating plant and underground conductors is only used for 154 hours during the year. This statement may seem astonishing, but will be found to apply to many such stations. Where these conditions exist it will readily be seen how great are the advantages of storage batteries as auxiliaries. Their cost per kilowatt of output for short periods, such as these peaks, is less than the generating machinery which would have to be provided if they were not used, in addition to which there are other ways in which they prove advantageous in the operation of the plant.

The application of storage batteries to such stations, such as this, can be made in two ways, viz., at the main power house or in sub-stations. Each method has its own advantages, and should be determined in each case by the conditions which exist.

When batteries are placed in sub-stations they will relieve the generating plants of the maximum load as just described, and also effect a large saving in the underground system of conductors, as, at the time of maximum load, the conductors between the main generating station and the sub-stations are relieved of that portion of the load which is carried by the batteries, and distributed from the sub-stations.

The use of large water power as a motive power for generating stations from which electrical energy is transmitted and distributed over extended areas is growing. Take, for example, the Niagara and other plants. In connection with such installations storage batteries play a very important part. The power from such a plant is largely sold for manufacturing purposes and is charged for at so much per horsepower per annum, the power being available twenty-four hours per day, while mills and factories using this power do not usually run for more than ten hours per day. Therefore, a man who requires a maximum of 100 h.p. for ten hours a day, or 1000 h.p. hours, really has to pay for 2400 h.p. hours, while he uses only 1000, and probably less; for the average, rarely, if ever, exceeds 70 per cent in the maximum.

With a strong battery capable of supplying 50 h.p. for ten hours, or 500 h.p. hours, he need only pay for one-half the amount of 50 h.p. for 24 hours, as the battery will furnish the remainder, and can be charged during the fourteen hours he is not using the power. In addition to this, the battery will take care of any fluctuation above the average and enable the man to buy the average amount of power he requires, instead of the maximum.

Such an installation has been made by the Buffalo Street Railway Company. Before describing this installation, I would like to mention the different methods of installing storage batteries in connection with railway plants. These may be divided into two classes.

First—Where the battery is installed at the power house to take care of the peak of the load, and the fluctuation of the generators; and,

Second—Where the battery is installed at the end of a long feeder to keep up the pressure at that point, and to obviate the necessity of sending the maximum amount of current over the long feeders from the power house.

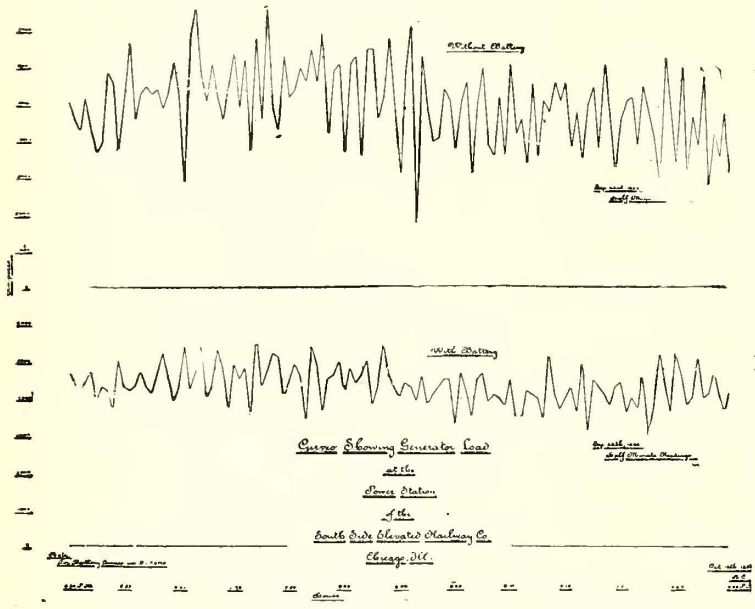
We will consider an installation of each kind and their respective methods of operation.

The Buffalo Street Railway Company's plant* is of the first class, and is especially interesting inasmuch as it is operated in connection with the Niagara Falls power. They operate practically all the cars within the city limits, and have a steam plant capable of

* See STREET RAILWAY JOURNAL, July, 1898.

delivering 7,000 electrical h.p., in addition to which they take 2000 h.p. from the Niagara Falls power, this current being transmitted in the form of high tension alternating current from the Niagara Falls to the power house, and being then transformed by rotary converters to the ordinary 550-volt direct current.

The storage battery is installed at the main power house and is connected directly in parallel with the steam plant and rotary converters. When a storage battery is installed at the power house, and is connected directly in parallel with the generators on the



FIGS. 3 AND 4.—CURVES SHOWING REGULATING EFFECT OF BATTERIES ON SOUTH SIDE ELEVATED RAILWAY

bus bars some means have to be provided for regulating the voltage of the battery to suit the generators. As you know, railroad generators are over compounded, the voltage rising as the load increases, while with the storage battery the reverse is the case, the voltage decreasing as the discharge increases. In order to make the battery work properly in parallel with generators of this type and take the fluctuation of the load, keeping the generators constantly loaded, means of compounding the battery have to be adopted. This is done by using a compound motor booster in series with the battery, which is so designed as to increase its voltage in proportion to the increase of the load, thereby enabling it to take its proper share and keep the load on the generators constant.

The battery discharges during the morning and evening peak, and is charged between times, and also at night from the Niagara Falls power. By the aid of the battery they are enabled to make very much more use of the Niagara Falls power. Before they installed the battery they were only able to shut down their steam plant from 11:30 P. M. until 5 A. M., during which time the rotary converters carried the entire load, which averaged about 600 h.p., while they were paying for 2000 h.p. With the aid of the battery they are enabled to shut down their steam plant from 7 P. M. to 7 A. M., and about eighteen hours on Sunday. In addition to this they are enabled to utilize very much more of the Niagara power.

An illustration of the second method of using storage batteries for railroad work is seen in the case of the battery in the installation of the South Side Elevated Company of Chicago. This company operates an elevated railroad about 9 miles long, all their trains being equipped with the Sprague multiple unit system. The power house is located approximately at the centre, and the two storage batteries near each end of the line, and are connected directly across the system without a booster. The charge and discharge of these batteries is controlled by the drop of the feeders from the power house to the batteries, this drop varying according to the load on the system from 10 to 80 volts. When the load of the system is light the drop in the feeders is small, and there is voltage enough to charge the battery. When the load becomes heavy the drop on the feeders is increased, this consequently causes the batteries to discharge into the line. The method of operating is entirely automatic, the batteries discharging at times of heavy loads, and charging at times of light load, thereby keeping the load on the generating station practically constant. The two battery rooms, each containing 248 cells, have a capacity of 1000 h.p. when discharging at the hour rate. The curves, Figs. 3 and 4, show the result which the batteries have had on their generating plant. The first curve, Fig. 3, shows the load on the generators when they were operating the entire system without batteries. The second, Fig. 4, shows the load on the generators under the same conditions with the batteries in use.

It will be noticed from these curves that when the power house was operating without the battery during the peak of the load the maximum load was 7500 amps., with sudden fluctuations of 5300 amps., while with the batteries in operation the maximum load at the power house under exactly the same conditions was 5700 amps., and the fluctuations only 2000 amps. Thus, the batteries have increased the capacity of the power house by about 2000 amps., and steadied the load on the generators to the extent of nearly 3000 amps. Those acquainted with the operation of street railway plants will appreciate such results.

Each battery is connected to the power house by two special feeders in addition to the general system of conductors, so that the proportion of charge and discharge can be regulated according to the conditions of the load.

If it is found that a battery is being discharged more than it is being charged, an extra feeder is connected between it and the power house, so that it will be relieved of a portion of the load. By this means a very complete control can be maintained of the battery from the power house, and the most efficient method of operation secured.

A battery installed at the end of a line in this way, not only increases the capacity of the power house and saves the investment in copper by making it only necessary to transmit over the feeders the average amount of current required, instead of the maximum, but at the same time it maintains the proper voltage at the end of the line, thereby enabling the motors to run at the point of highest efficiency. Of course the line must be long enough to justify the use of a storage battery and to supply sufficient drop in voltage over the feeders to make the battery operate automatically as the load varies.

A variation in voltage at the end of the line, between conditions of maximum load and minimum load of 10 per cent, is ample to make the battery self regulating, and take care of the fluctuating load without a booster. The following figures taken from a storage battery installation of this description installed some two years ago, will show the advantage from a commercial point of view.

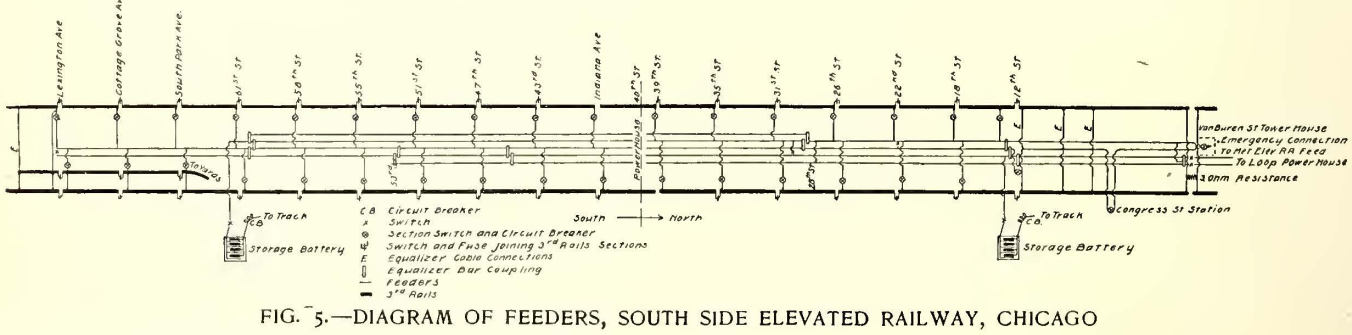


FIG. 5.—DIAGRAM OF FEEDERS, SOUTH SIDE ELEVATED RAILWAY, CHICAGO

The conditions were as follows: The length of this line at the end of which the battery was installed, was 7 miles from the main power house, running into the suburbs of a large city. The increase of traffic on this line warranted its extension 4 miles further, making a total of 11 miles from the power house. When the extension was made, it was found that the feeders were quite inadequate to carry the increase of load, and it was unnecessary to provide additional power at the end of the line, either by laying additional feeders, installing a small power house at that point, or putting in a storage battery sub-station. Each method was carefully considered, and the following figures show the result. If additional feeders were laid of sufficient sectional area to provide the proper working voltage at the end of the line the cost would have been $273,000, figuring on the basis of $1.00 per foot,

laid for 1,000,000 c.m. feeders. This was, of course, prohibitive. The cost of a small power house of sufficient capacity to take care of the load in that section of 750 kw. would have been $85,000. The cost of a battery sub-station complete, including real estate, was $33,000, or a saving of $52,000 over that of the power plant.

The cost of operation has proved exceedingly satisfactory, showing a saving of some $1,350 per month, or $16,000 per annum over the cost of operating a power house of such a size. The cost of operation includes all attendance, taxes and depreciation and interest.

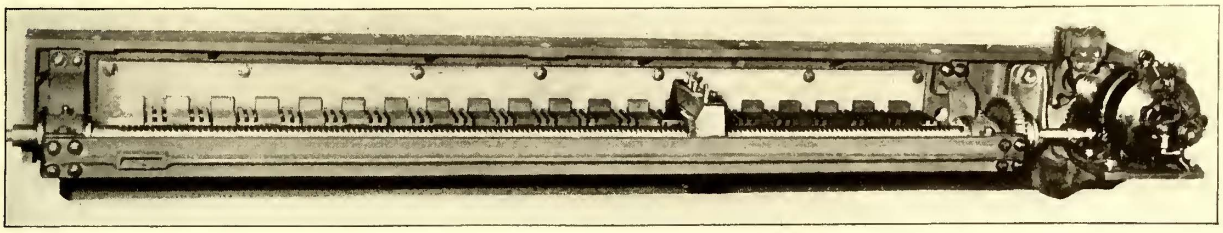


FIG. 6.—SWITCHING DEVICE FOR END CELLS

One of the most interesting and important storage battery installations recently made is that in connection with the underground trolley system of the Metropolitan Street Railway Company of this city. This company's system covers a large area, and it has utilized storage batteries in sub-stations. Two are now in operation, one at the foot of West Twenty-third Street and the other at Thirty-second Street and Fourth Avenue.

I will briefly outline this plant and method of operation. The battery consists of 540 cells, each containing fifty-one plates, 15 ins. square. The dimensions of the cells are 4 ft. x 21 ins. x 24 ins. The battery is divided into two sections, 270 cells in each, which are operated in parallel. This is done to keep the sizes of the cells within practical limits and to enable them to be more easily inspected and cared for. A cell 8 ft. in length, which would be the size if but one battery were used, is too large to be satisfactory. The capacity of the complete battery is 8000 amp. hours, with a one-hour rate of 4000 amps.

The function of this battery is to take care of a portion of the morning and evening peaks, and to take up the fluctuations of load at all times. The method of operation is as follows: Sufficient cells are provided so that the voltage of the battery just balances the average voltage of the system; consequently, when the battery is connected to it, it acts as an equalizer and does not charge or discharge except as the fluctuations occur. When the battery discharges on a peak and is being charged during the hours of light load, a booster is connected in series with it to regulate the amount of a charge and discharge. The output of the booster and, consequently, the charge and discharge of the battery, is controlled by varying the strength and polarity of the shunt field. This is done by a special form of switch which makes the operation very simple.

The daily work of the battery is about as follows: From 7 to 9 A. M. it discharges on the peak. From 9 to 12 it floats on the system as an equalizer. From 12 to 3 or 4 P. M. it is charging. From 4 P. M. to 8 P. M. it discharges on the peak. From 8 to 12 midnight it is floating on the system, and after midnight the battery is given its principal charge, this being continued until the battery is full.

An interesting application of this sort has recently been made on a small railroad plant in Montpelier, Vt.* This plant was, I believe, the first railway plant in this country operated exclusively from rotary converters with a storage battery auxiliary. The line operated is about 9 miles long, and the sub-station is located about 3 miles from one end. The power is furnished from a power house on the Winooski River, the current being generated by three-phase alternators at 2200 volts. This current is carried to step-up transformers and is raised to 6300 volts. At this pressure it is carried to the sub-station, a distance of 8 miles. In the sub-station step-down transformers reduce this to 480 volts, at which pressure it is fed into the rotary converter. The capacity of this converter is 160 kw., and is specially wound for running directly in parallel with a storage battery, its characteristic curve being similar to a shunt-wound generator. That is to say, as the load increases, its voltage would fall. By this means the battery will take care of all fluctuations, maintaining a fairly constant load on the rotary. The battery consists of 248 cells, each containing eleven plates 10 ins. square. The one-hour rate of this battery is 200 amps. The maximum load on the line is 300 amps. Of this the rotary carries 125 and the battery 175. The greatest amount of load on the line is nearly 300 amps. Such an installation shows clearly the advantages of battery regulations on a fluctuating load. The size of the rotary is reduced practically one-half and the load on it kept almost constant.

Most of the plants mentioned have been those of a large size, supplying a large amount of energy. It must not be imagined that storage batteries are applicable only to these large stations. The variation of load on the rotary is 50 amps., while the variation of results obtained from their use are just as satisfactory in the case of smaller stations, but I have referred to the larger ones as being of more interest.

* See STREET RAILWAY JOURNAL, September, 1898.

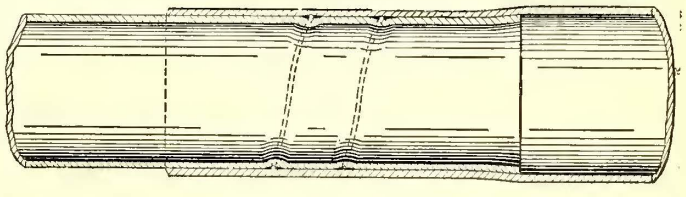
Increase in the Use of Aluminum for Electrical Conductors

The Pittsburgh Reduction Company, manufacturers of aluminum, report an extended increase in the use of this material for electrical purposes. The company itself has had 10,000 h.p. of current transmitted by aluminum conductors for the last two years, and the Niagara Falls Hydraulic Power & Electric Company has used a considerable amount of this material for electrical conductors. Among the longer lines which have employed this material is one at Snoqualmie Falls for the transmission of power from the Falls to Seattle and Tacoma, where more than 80 miles of wire is in use. The Standard Electric Company, of California, the Pennsylvania Railroad Company, the Bell Telephone Company, and others, have also employed the material to a considerable extent on their conductor systems for telegraph and telephone conductors.

The Pittsburgh Reduction Company is installing two 14-in. and four 10-in. mills with continuous drawing benches for the manufacture of aluminum wire for use as electrical conductors, and expects to have as large facilities as any mill in the country for this work.

Orders for Street Railway Supplies

Elmer P. Morris, of New York, manufacturers' agent for some of the largest and most representative supply houses in America, reports an unusually large number of orders during the past month for the specialties he handles. This is particularly true of assembled commutators, made from drop-forged copper and tubular-iron poles and brackets. A cut of the poles he carries in stock is shown herewith. These are made in two or three sections as desired, and at each joint are bound with wire, which is swaged and keyed into place in such a way as to give enormous strength to the pole. These are guaranteed to stand a hydraulic pressure from the inside of 200 lbs.



SECTION OF POLE

Mr. Morris has recently opened several new branch offices for the convenience of street railway companies at a distance from New York. One of these is in the Betz Building, Philadelphia, and will be in charge of George E. Pratt; another is at Niagara Falls, N. Y., and will be in charge of C. J. Harrington.

New Cars Built in St. Louis

The accompanying illustrations show two new cars recently built by the St. Louis Car Company for the Bloomington (Ill.) & Normal Railway Company and the Birmingham (Ala.) Railway & Electric Company. These furnish a good illustration not only of the new era in American street railway car building which has set in with the development of long suburban and interurban lines,

ELECTRIC CAR FOR BLOOMINGTON & NORMAL RAILWAY

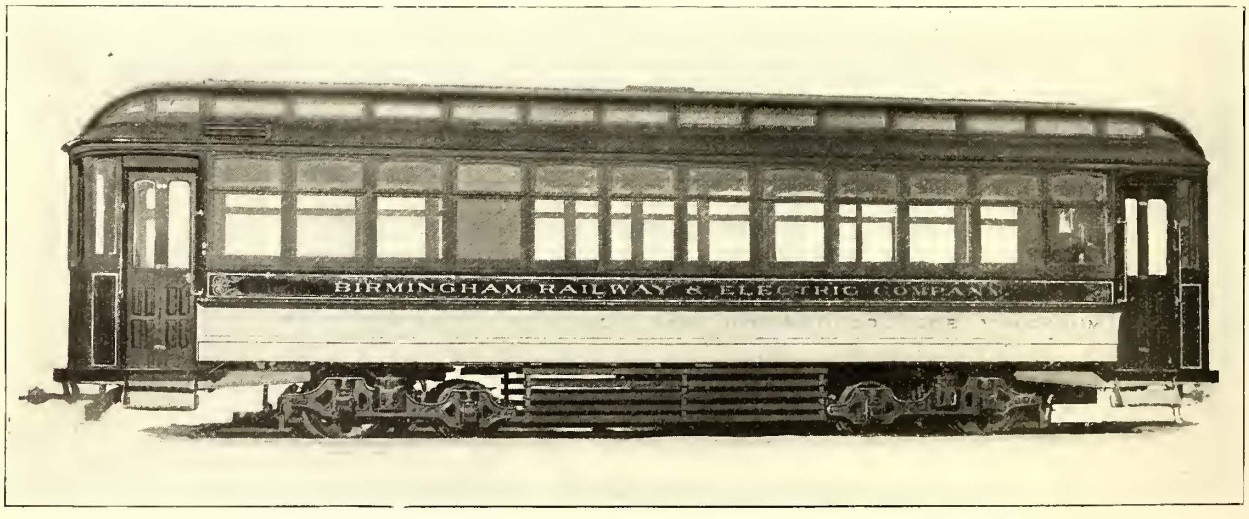
and which has had no little effect upon street railroading in cities proper, but also of the good work of the St. Louis Car Company itself, which, with its new factory, now practically completed, will be one of the greatest street railway car manufacturing establishments in the world. The lines of these cars are graceful, and it is evident that careful thought and care have been given to every detail of their construction as affecting the carriage of passengers. The twelve windows of the Bloomington and Birmingham cars guarantee lightness in winter and lightness and airiness combined in summer. The square sides give roominess of car inside, and the patent vestibules of the St. Louis Car Company protect the motormen, conductors and passengers. In fact, the Bloomington car particularly, closely resembles in general appearance the passenger coaches of the Limited Express between New York and Chicago.

These cars are mounted on the new No. 18 double track of the St. Louis Car Company, illustrated on page 115. Orders for large numbers of these trucks have already been taken by the St. Louis Car Company, in spite of the fact that they have been in the market but a short time.

The Walker Company has received an order for the electrical equipment of eighteen cars in Krementschoug, Russia, and thirty-six cars for the Omnibus and Tramway Company, of Rome, Italy.

Electric Locomotives on the Orleans Railway Terminal in Paris

The plans for operating the terminal of the Orleans Railroad in Paris by electric locomotives, some particulars of which were given in the STREET RAILWAY JOURNAL for June last, have since been determined upon. The line, whose service is very similar in character to that of the Baltimore & Ohio Railroad in the Belt Line tunnel, in Baltimore, has a length of 3700 m., of which 3100 m. are underground, and electric locomotives are to be employed to avoid the gases of combustion in the tunnel. The substitution of electric locomotives for steam locomotives will take place at the Austerlitz Depot in the outskirts of the city, while a stop is made to discharge passengers, and from that point to the main station at the Quai d'Orsai trains will be drawn by electric power. The power station will be near the Tolbiac Bridge, and will contain two units of 1000 kw., each producing three-phase current at 5500 volts and 25 cycles. This current will

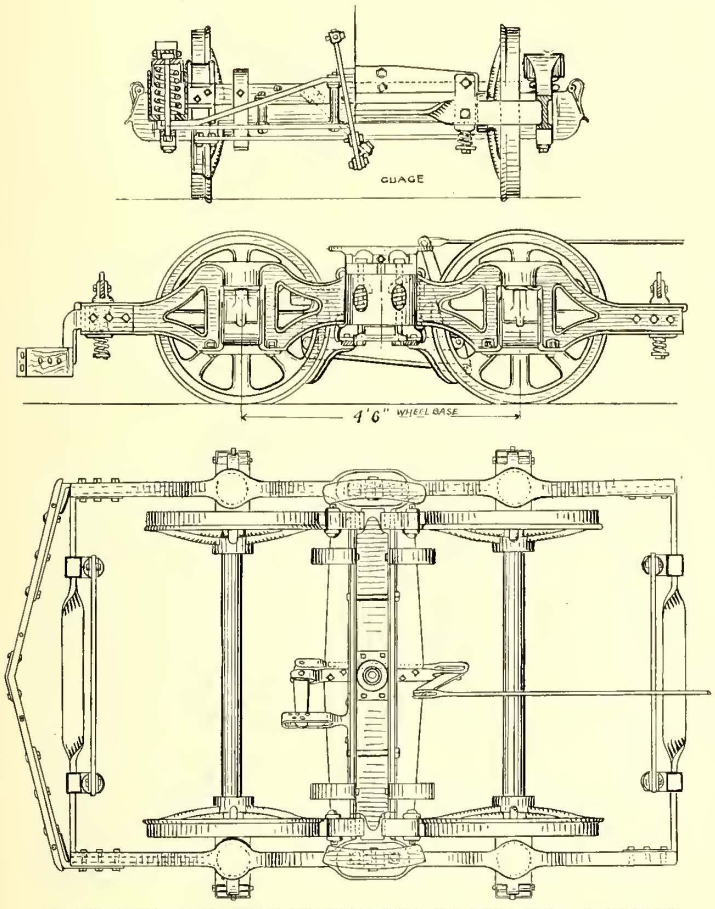


ELECTRIC CAR FOR BIRMINGHAM RAILWAY & ELECTRIC COMPANY

be transmitted to three sub-stations, one in the power station itself, one at the Austerlitz Depot, and one at the Quai d'Orsai Depot, where it will be transformed to a 500-volt continuous current for lighting and traction. In the two latter sub-stations will also be located a battery of accumulators in parallel with the rotary converters to regulate the voltage and insure lighting at a period of the night when the power station is not in operation. Each power station will also contain static transformers for reducing the current from 5500 volts to 340 volts and two 250-kw. rotary converters operating at 500 r.p.m. Each of the batteries will have a capacity of 1100-amp. hours.

The electric locomotives will be operated by a continuous 500-

volt current by means of a third rail carried on blocks of paraffined wood resting on the ties. There will be eight locomotives supplied by the General Electric Company, similar in general appearance to the Baltimore locomotives. Each locomotive will be of 500-kw. capacity, will weigh, empty, 40 tons, and loaded, from 45 to 46 tons, the weight necessary to draw a train of 250 tons, including the locomotives, from the Quai d'Orsai



PLAN, END AND SIDE ELEVATIONS OF THE NO. 18 TRUCK

station to the Austerlitz station in seven minutes without intermediate stops. It is estimated that the traction consumption of power will be about 1,420,000-kw. hours per year for the normal number of 150 trains per day, empty or loaded. It is estimated that the trip from Quai d'Orsai to Quai Austerlitz in seven minutes without intermediate stops will consume about 27 watt-hours per ton. The average train of 200 tons, including engine, will absorb, it is thought, 600 kw. at starting and 250 kw. at full speed. The expense of building the power station, sub-station, supplying the rolling stock and building the transmission line is estimated at $610,600, and it is expected that the entire road will be in operation by January, 1900.

Calendars for 1899

Numerous calendars for the year are still being received, and many of these bear evidence of most careful designing, and in a number of cases very large sums of money must have been spent in their preparation. Among those received since Jan. 1 is one from the Joseph Dixon Crucible Company, of Jersey City, bearing an interesting reproduction of a young college girl in gown and mortarboard, evidently on the day of her graduation; another one, issued by the Ashton Valve Company, of Boston, Mass., shows two little girls at play; a very elaborate calendar, by Mayer & Englund, of Philadelphia, Pa., shows a large lithographic reproduction of a young woman's head in colors; the Peckham Truck Company, of New York City, is sending out its large wall calendar, which has become well known to the street railway field; R. D. Nuttall Company, of Allegheny, Pa., is sending out a calendar bearing a large cut of the Nuttall gears; the Van Dorn & Dutton Company, of Cleveland, Ohio, is sending one composed of twelve sheets, one for each month, each sheet showing and describing one of the Van Dorn specialties, including trucks, armature lifts, gears and pinions, etc. In addition to the above, two other very handsome calendars have been received, one from the J. G. Brill Company, and the other from the Sprague Electric Company. The one from the Brill Company is unusually elaborate, and consists of six large sheets, upon each of which is printed a reproduction of a famous painting, the six reproductions being "The Three Fates," "Spring," "Good Morning," "Love Wins," "Butterflies," and "Cinderella." Each sheet contains also the calendar for two months. The Sprague calendar is one of the handsomest and most thoroughly practical ones received. The upper part is a copy of a celebrated painting, while the calendar proper, printed from a good size type, forms the lower half. Both parts are mounted in a mat and nicely framed. D. E. Goe, manager of the advertising department of the Sprague Company, has a great reputation for doing this kind of work, and in doing it just right.

Convention of Manufacturers

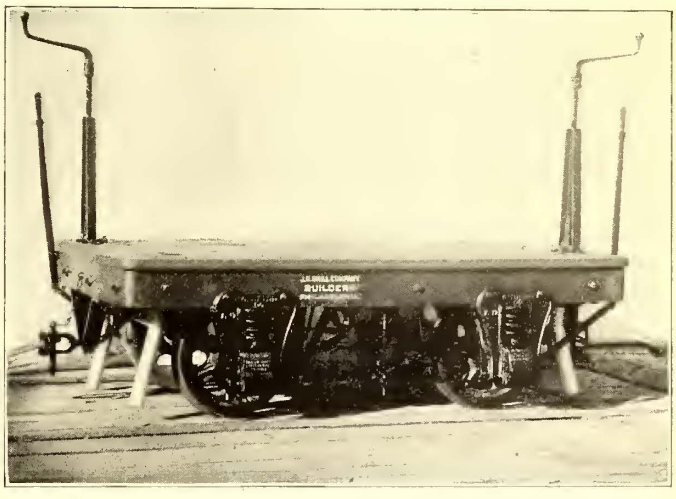
The fourth annual convention of the National Association of Manufacturers of the United States was held at Cincinnati, Ohio, Jan. 24, 25 and 26, 1899. The meeting was well attended, and subjects of interest to American manufacturers were discussed. The following officers for the next year were elected: President, Theodore C. Search, Philadelphia; secretary, F. P. Wilson, Cincinnati, Ohio; treasurer, Charles A. Schieren, New York. The next meeting will be held at Boston, Mass.

Special Number

The twentieth annual number of "The Tradesman" of Chattanooga, Tenn., is a very elaborate number. It has been most carefully prepared, and will be found valuable as a book of reference to all interested in the growth of Southern trade.

Electric Locomotive

The accompanying illustration shows an electric locomotive recently built for the Deadwood & Delaware Smelting Company by the J. G. Brill Company. It is a powerful little affair, although it measures but 8 ft. in length and is only 5 ft. 3 ins. wide. It stands 2 ft. 3 ins. to the floor, and is furnished with a w.p. No. 5 motor, with two K 10 controllers. The wheel base is 4 ft. and the gage of the track 36 ins. Its small size and compactness made it possible to use a light pedestal gear arranged to take the motors. Four Brill sand boxes are placed within the frame to give an equal and complete distribution of sand when it is necessary. The convenience of a machine of this kind is hardly to be estimated by those who have had no experience with them. One man can handle almost all the loads that may be necessary about an establishment.



ELECTRIC LOCOMOTIVE

In this case the machine is a flat car as well as a locomotive. It is intended for use within a mine and on the surface as well. A third rail transmission of power is to be employed, and the General Electric Company put on the necessary electrical equipment. It is interesting to note that an electric locomotive, as adapted to every-day commercial uses, is coming to be more and more employed. Electricity is available in a large percentage of all manufacturing establishments and railway tracks are equally commended. A small expense for overhead wires or for third rail conductors makes a machine of this kind possible, and its convenience is much greater than a pair of horses, while the economy is in favor of the electric machine, which, when not in use, is not "eating his head off."

Water-Softening Plants

BY N. O. GOLDSMITH

The advantages of water softening are not generally understood or appreciated in this country. The process was discovered nearly sixty years ago by Dr. Clark, of Aberdeen, Scotland, and since that time it has been extensively adopted in England, not only for softening the water supply of whole towns and cities, but also for various requirements of the mechanical arts. Hundreds of water-softening plants are in successful daily use in Great Britain, France, Belgium and Germany. The mechanical features of these may differ according to the ideas of the designer, but all make use of the same chemical process. These plants are softening water for steam boilers, railways, woolen and cotton mills, paper mills, iron works, dye works, tanneries, etc. From this it will be seen that the process is not a new and untried one, still in the experimental stage, but one which is as well established, and whose advantages are as well recognized, as are those of the exhaust steam heater in this country. As an apparatus for furnishing suitable and desirable feed water for boilers, it is also the cheapest purifier of any merit in the market. The common mineral impurities soluble in water are silica, iron, carbonate of lime and magnesia, sulphate of lime and magnesia, and chloride of lime and magnesia, also the chlorides and sulphates of soda or potash. The lime and magnesia and iron salts are known as the scale-forming impurities, and are the ones which are removed by water softening. At the same time that these are removed, the mud or silt which the water may contain is also removed, and the organic matter reduced. The sodium and potassium salts do not form scale and are not removed by this process, nor is it possible to do so by any process of purifying water, with or without the aid of heat. The only means of removing sodium or potassium salts from water is by distillation, and this is the process which takes place in the boilers. The lime and magnesia salts are held in solution by means of the acids with which they are united. Water softening, therefore, is a process of removing from the lime and magnesia these acids which hold them in solution. The expense due to softening water is extremly low, first, because the carbonates are gencrally more abundant in waters than the sulphates or chlorides; second, because the Clark process will remove a higher percentage of carbonates than any other method, which would be practical and economical enough to use for industrial purposes.

The following table is copied from the report of W. J. Dibdin, chemist for the London County Council, who conducted a series of experiments on water of the New River Company:

Date, 1895.	Before softening.		After softening.		Percentage of reduction.	
	Hardness.	Bacteria.	Hardness.	Bacteria.	Hardness.	Bacteria.
December 16..	17.4	96	5.4	12	68.4	87.5
" 18..	17.4	110	5.0	6	71.3	94.5
" 20..	17.4	60	8.5	16	51.2	73.4

Hardness is expressed in degrees, Clark, and bacteria given in colonies per cubic centimeters.

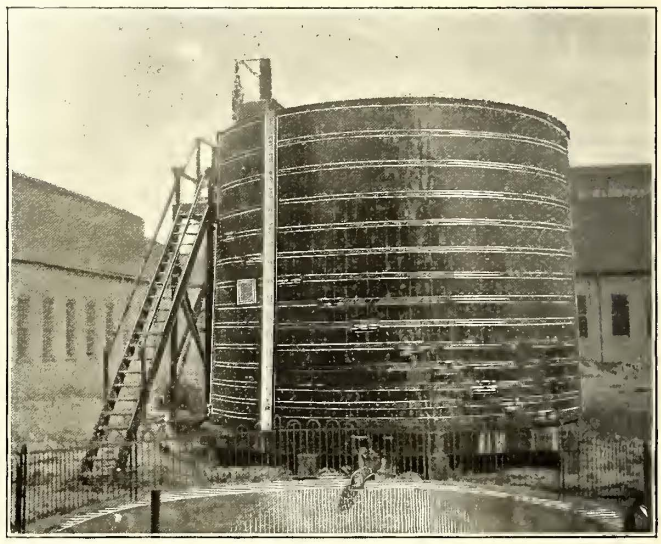
The most approved method for softening water is known as the intermittent settling tank plan, in distinction from the continuous method of purification, in which the water is always moving and is purified in transit. Where the quantity of water required is comparatively small, much more satisfactory results are obtained by using the intermittent settling tank plan than would be possible with the continuous system.

The apparatus is extremely simple, and consists of two or more open tanks, or one tank and a storage reservoir. These tanks may be constructed of wood or iron, as preferred. They are generally made cylindrical, and usually located out of doors, convenient to the boiler room. This has the advantage of not crowding up the boiler room, while there is no danger of the water in the tanks freezing while the plant is in daily use. The size of the tanks depends upon the quantity of water required per day, and the number of times it is convenient to fill them. Each tank is placed upon a heavy platform carried upon foundation piers, and is provided with a mechanical stirring device to be used in mixing water with chemicals. This stirring device consists of a paddle revolved by the simple gearing turned by hand, or preferably by light power. This paddle stirs up from the bottom of the tank the lime sludge of previous precipitation; this floats in the water, hastens the chemical reaction, and causes the new finely-divided precipitate to gather into large flocculent or wooly flakes, which settle quickly as soon as the water stops moving. The simplicity of this means for stirring and agitating the water is self-evident; it does not have to be cleaned to keep it in working condition; it requires from ½ h.p. to 3 h.p. to operate it, so that the amount of steam is extremely small.

The softened water after settling is taken from the tanks by means of a hinged floating outlet pipe, which rises and falls with the level of the water; by this means the clearest water is always drawn from top of the tank.

Inlet connections through which to fill the tank, and wash pipe connections through which to wash lime sludge from tanks, are placed in the bottom. The washing of the settling tanks need be done only when lime sludge becomes deep enough to interfere with stirring; ordinarily, once a week or a fortnight is sufficient. All that is required is to open wash valve, start the stirring device, and mix up the lime sludge with the water, which is always left in the bottom of the tank, for it is soft enough to run out through the wash pipe. The time and labor of cleaning is but a small percentage of that required for exhaust or live steam heaters, and it is not necessary to do the work on top of the boilers in a hot, stifling atmosphere.

A sheet iron chemical tank is placed on top of the settling tanks; in this are placed the reagents used for softening; they are mixed with water and washed into the tanks while filling. By reason of



WATER SOFTENING PLANT AT COLUMBUS

the currents of water caused by the water rushing into the tank, the chemicals are partially mixed with the hard water; this mixture is completed by the revolving paddles of the stirring device, which are started as soon as the filling of the tank begins, and continues to revolve until the tank is full. This method is very efficient, involves no expensive apparatus which requires constant cleaning and repairs, and is very economical in steam. Tank indicators are generally placed on tanks to show level of water, and operating platform is arranged alongside of tanks from which the man in charge mixes reagents and tests the water. The testing of the water is made necessary because of the exact treatment, and the variation which takes place in all waters. The test is extremely simple, and any man of ordinary intelligence can understand and use it.

The advantages of this apparatus are as follows:

First: There are no automatic chemical feeds which continually vary, and thus furnish either an excess or an insufficiency of the chemical solution.

Second: In moderate sized plants the apparatus can be operated by the engineer, or his assistant, without interfering with the regular work.

Third: The constant quantity of raw water collected in the tanks is treated with practically an uniform amount of chemical reagents, therefore an uniform character of softened water is furnished. The simplicity of this plant makes it possible for the unskilled workman to obtain as good results as an expert chemist.

Fourth: The mechanical stirring which results in agitating the raw water with the chemical reagents insures an intimate mixture, and very materially hastens and completes the chemical reaction.

Fifth: The sludge of previous purification which has settled to the bottom of the tanks is mixed with the water by the action of the stirring device; this insoluble matter moving in the water gathers up the new finely-divided precipitate and hastens the clarification of the water.

Sixth: The sludge collected in the settling tanks relieves the filter beds, so that the filter can be run five or six times as long,

without cleaning, as would be the case if all the sludge was intercepted by the filters.

Seventh: The settling tanks do not require washing oftener than once a week therefore, the amount of water required for cleaning is a very small percentage of the total amount purified.

Eighth: The length of time which the water stands is necessary in order to get complete chemical reaction. No chemical reaction is instantaneous, therefore the element of time is necessary.

Ninth: The perfect quiet of the water gives an opportunity for most complete settling, rendering unfiltered water clearer than that from any other apparatus not using filters.

Tenth: The operations of this apparatus are the same as those followed by the chemist in the laboratory, with only such modifications as are necessary to suit the conditions.

Eleventh: This arrangement of settling tanks permits an accurate daily report to be kept of the amount of water evaporated in the boilers.

Inasmuch as it is not practical to use settling tanks having capacities sufficient to permit the water standing long enough to perfectly clear itself, we advocate passing the water through a mechanical filter, merely to clarify it by removing the floating lime sludge. For this purpose all that is necessary is to employ gravity or pressure filters, and use a sand-bed as a filtering medium. By this means perfectly clear, soft water is obtained.

There are twenty-three water softening plants in this country, erected in accordance with the most approved plans. These plants are furnishing softened water for ice factories, dye works, laundries, electric light plants, street railway power houses, steel works and various manufacturing concerns, some of which have been in results The illustration shows a 2,000 h.p. water-softening plant, daily use over three years, and all are giving most satisfactory which has been in service since April 26, 1896, at the Columbus Central Railway Plant, Columbus, Ohio. It was installed by the We Fu Go Company, of Cincinnati, which controls the sale of these plants.

The following is an analysis of the raw water from the wells of that company, before softening, in grains per U. S. gallon:

Silica	1.25
Oxide of iron	4.250
Carbonate of lime	10.650
Carbonate of magnesia	5.325
Sulphate of lime	5.525
Chloride of soda	.670
Total residue	27.675

A sample of the softened water from the plant while in actual service, was sent to Professor Webber, of Ohio State University, in May, 1896, and was analyzed by him, and found to contain the following impurities in grains per U. S. gallon:

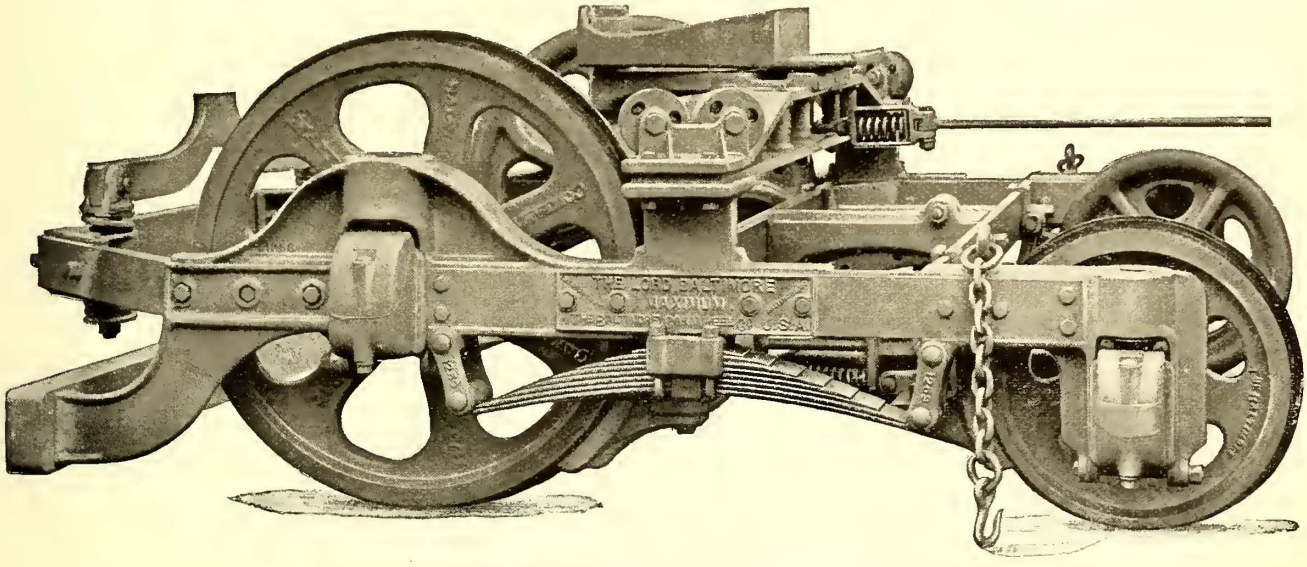
Silica	1.067
Oxide of iron	None
Carbonate of lime	1.508
Carbonate of magnesia	0.202
Sulphate of lime	1.609
Chloride of soda	None
Soluble salts (sulphates and chlorides of sodium and potassium)	8.490
Total residue	12.876

The Tramway Company of Brussels reports for the eleven months ending Nov. 30, 1898, gross receipts, 4,838,402 francs; number of car kilometer, 6,183,939. A little over 40 per cent of the car kilometer run was by electric cars.

Maximum Traction Truck

The illustration accompanying this article is the latest design of a maximum traction truck of the Lord Baltimore type, manufactured by the Baltimore Car Wheel Company, and of which some particulars were published in the last issue without illustration. The design of the truck is such as to bring 66 per cent of the weight upon the driving wheels, without it is claimed any liability of derailing the small wheels. The metal bolster centre plates, as shown, may be pivoted directly above or near the centre of the driving axle; the body bolster centre plate at its front end is recessed to receive the main car body bolster, to which it is secured by bolts through the base and end. Double taper roller side bearings are provided, as shown, upon which the chafe plates of the body press. These rollers are self-oiling, by being made hollow, and packed with saturated waste, and revolve upon steel thimbles.

The truck frame is made up of cast steel pedestals, having housings for graduated spiral springs, which rest on top of the journal boxes, so that the entire load is cushioned. The side members are bolted directly to the pedestals, and are diagonally braced securely between the wheels. The end cross bars are bolted to the main pedestals, and are drawn in at an angle to support the suspension bars, so that in curving these members do not come outside the rail. The truck is so designed that the motor is mounted outside the driving axle. There are two half elliptic springs suspended below the side frames by links, and to which the weight of the body and load is transmitted by steel flat-posts depending from and secured to the truck bolster, which play in guides formed by the bars of the side frames.



LORD BALTIMORE MAXIMUM TRACTION TRUCK

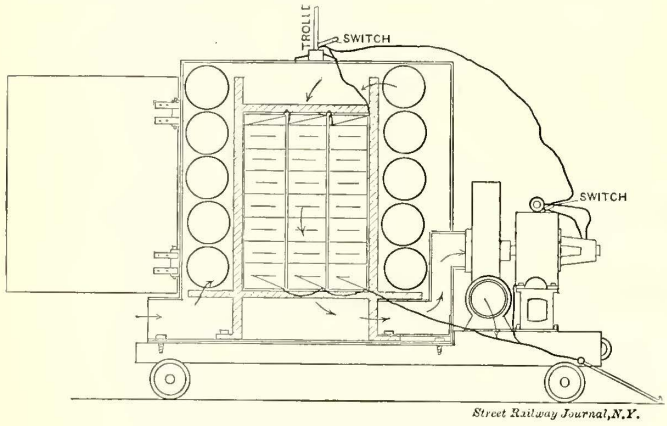
The brake mechanism is so designed that the shoes are applied to the inside of the wheels, and the levers are so proportioned as to bring about 70 per cent of the braking power upon the driving wheels. The brake beams are operated by levers, acting from the pivotal point of the truck; the top end of the operating lever works in a channel in the base of the truck bolster centre plate, so that they are always held in line and no quadrant is required for operating the brakes on curves. Spiral springs are introduced in the brake rods between the trucks, which equalizes the braking power on each truck, so that each wheel receives its proper proportion of the braking force.

All the working parts of the brake mechanism have large bearings with steel thimbles and suitable oil holes, and are placed at the centre line of the trucks, out of the way of mud and dust thrown up by the wheels. These trucks have all the stability claimed for centre bearing trucks of most approved design with the advantage of maximum weight available for traction. With the exception of the brake shoes and wheels, all parts are of steel and malleable iron; and in the design, special attention has been given to relieving the shearing strain upon the bolts. Dust-proof and oil-tight axle boxes are provided, in which either felt or waste feed may be employed as desired. The care and thoroughness with which the trucks are built is in keeping with all the products turned out from this well-known establishment.

The Barcelona (Spain) Tramway Company has petitioned for a number of additional rights for extending its trolley system.

Portable Hot-Air Blower

The accompanying engraving shows an interesting portable hot-air blower for drying armatures and fields, invented by W. R. Gaither, auditor of the South Chicago City Railway. The importance of keeping the insulation of these parts of an electrical



PORTABLE HOT AIR BLOWER

motor dry, and the advantage of doing this artificially after the motors have been in service on a wet day, is generally recognized by repair men, but the trouble and expense of removing armatures and fields from the casings and transporting them to a drying oven are so considerable that it is not often done. It is to simplify this process that the portable blower illustrated is intended.

The blower, which is mounted on flat wheels and is adapted to be drawn by hand, is brought alongside of the cars in the car house at night, over the pits as they stand. The blower is equipped with electric heaters and blowers, and has a trolley for making contact with the overhead wire. Upon reaching the car the blower is put in operation and the hot air is blown through the nozzle directly into the motor casing so that it acts directly on the armature and field insulation, accomplishing the same results as if the armature and fields were dismounted and transported to a stationary oven. Mr. Gaither estimates that it will require only 6 h.p. to generate 200 deg. of heat in a volume of air discharged from the nozzle at a rate of 300 cu. ft. per minute. This would reduce the cost of current for operating the device to about 50 cents for ten hours' use, and he thinks that in very wet weather the blower would pay for itself in a very short time in preventing burn-outs, especially with the open style of motor.

The special advantages claimed for the device are: First, that no extra labor in drying out armatures and fields is required, as the device takes only a few minutes and no skill to operate it or move it; second, the blower is valuable anywhere that current can be obtained, and of course wherever there are cars whose motors should be dried out, this condition prevails; third, the blower is portable and cleanly; fourth, it can be used without the heaters if desired, to blow out dust and dirt from the motors; fifth, the heat can be regulated to any degree, so that quick or slow drying can be secured.

Boiler Tube Cleaner and Flexible Shaft

The device illustrated in the engraving herewith is for the purpose of removing scale from the tubes of boilers of the water-tube type. The cleaning device consists of a conical shaped head, having a taper of about ¾ in., and composed of discs, with pivoted arms between each pair. At their outer extremities, these arms carry tooth cutters about 1⅛ ins. in diameter, and these arms with their cutter discs are set spirally in the head. A series of guide bars placed on the shaft back of the head not only serve to guide the tool in the tube, but provide bearings in which the operating shaft revolves. In the process of cleaning, the cone which is somewhat smaller than the tube, is inserted, and given a rotary motion up to about 1600 r.p.m. The centrifugal force causes the arms to fly out, bringing the cutters by the impact of vibratory movement in contact with the scale on the walls of the tube. This action causes the teeth to cut into and disintegrate the scale, which is then flushed out by means of a stream of water that is fed continuously into the tube by a hose as the process goes on. The cutting wheels not only remove scale, but when it is removed lose their vibratory motion and simply burnish the tube, and do not injure or expand the tubes, no matter how thin they are. The effect of burnishing the tubes after cleaning, serves to polish the interior by removing even the mill scale and so makes it impossible for scale to adhere

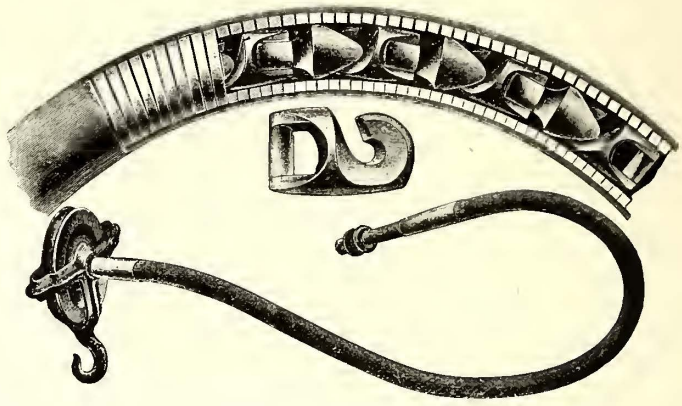


FIG. 2.—CLEANER FOR CURVED BOILER TUBES

tenaciously. This renders subsequent cleaning relatively easy, while it adds greatly to the efficiency of the boilers, by improving the circulation, increasing the radiation, and thus economizing in fuel consumption. The head is adjusted in the tubes by means of a sectional rod united by snap couplings. The rod is given a rotary motion by means of a driving pulley, having a sleeve with a key way through which the rod slides, and by means of a handle at the outer end the operator can move the head at will back and forth in the tube, while the rotary motion continues.

For cleaning curved tubes, a flexible head of the same shape

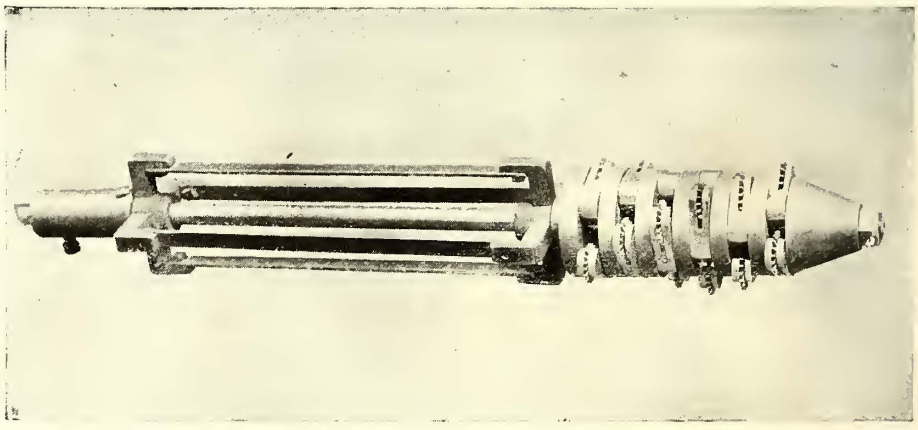


FIG. 1.—HEAD FOR BOILER CLEANER

and a flexible shaft are employed. This shaft, as shown in Fig. 2, is composed of solid brass links of peculiar shape, which hook into each other, and in turn are enclosed in a closely fitting spirally wound tube, which is flat on the inside, and provides a smooth bore in which the link chain operates. The whole is then encased in a tube of specially prepared rubber which is not effected by oil, which allows for oil lubrication of the flexible shaft, while it protects it from the flushing water, which is led into the tube in the same way as described for the straight shaft.

The tube cleaner and shaft are manufactured by the Union Boiler Tube Cleaner, whose works occupy part of the Imperial Power Building, 240 Penn Avenue, Pittsburgh, and which is equipped with a very complete assortment of metal working tools. The tube cleaner was put on the market in 1895, and the company has received many flattering testimonials as to its efficiency, and guarantees that it will sustain all the claims made for it. It is the practice of the company either to sell the tube cleaning device outright, or rent it to steam users by the year. The company also contracts to clean boilers for a stipulated sum per horse power. In all cases where a sale or lease is effected, an expert is sent without charge to install the device and give instructions for setting up and using. With this machine a man can clean from twenty to fifty tubes a day, depending upon their condition, and whether it is the first or second cleaning.

The use of the flexible shaft, which the company manufactures, is not confined to the operation of the tube cleaner, but may be employed in any situation where power is to be transmitted, or has been transmitted by any other type of flexible shaft. It is stronger in construction than most shafts of this character, and is especially adapted for use with portable electric motors for drilling or reaming bond or bolt holes in track rails or steel plates of any description.

A New Type of Cast Welded Joint

The application of the system of cast welding in rail joints has become so general that any new methods of cast welding the ends of rails are matters of public interest. The accompanying engravings illustrate a new type of cast welded joint brought out during the late fall of 1897 and the season of 1898 by the Milwaukee Railjoint & Welding Company, of Milwaukee, Wis. As will be seen, this joint differs from other cast welded joints both in form and substance. It extends along the sides of the rail for about 15 ins., and projects out at the joint of the rail, but not below the rail. It is composed of both cast iron and steel and is put upon the track by cleaning a small space around the rail joint about 2 ft. square down to the top surface of the ties and by cleaning the rail ends by the use of sandblast. A steel sleeve, shaped so as to form a cavity around the rail ends, is then riveted upon each side of the rail at the joint. After the rail ends have been heated, this sleeve is filled with melted iron. The latter fuses to the web and flanges of the rail and the steel sleeve, making a solid joint composed of both steel and cast iron.

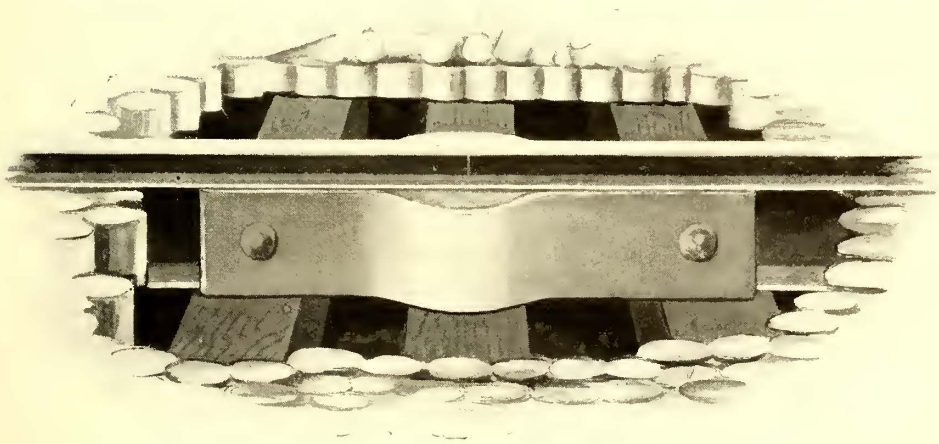


FIG. 1.—SIDE VIEW OF JOINT

As will be seen from this description but little work is required on the part of the street railway company in preparing its track for cast welding on joints upon this system. It is not necessary to remove or displace any ties. The roadbed is not disturbed, and the blocking removed from around the joint is quickly replaced.

About half a mile of track was welded with these joints in the late fall of 1897 upon the line of the Milwaukee Electric Railway & Light Company, of Milwaukee, and during the year 1898 ten thousand joints were welded upon the lines of the same company, including the welding of a suburban line from the city of South Milwaukee to the city of Milwaukee, a distance of about eight miles of exposed track. On this line to South Milwaukee a joint was used at distances from 500 to 1000 ft. to provide for the contraction and expansion of the rails where they were exposed; but subsequent welding on other lines of exposed rail demonstrated that it is not necessary to have a slip joint in order to make a cast welding of rail joints upon exposed track. The work being properly done, these joints will hold as well on exposed rails as upon embedded tracks, and the contraction and expansion seems to be entirely overcome by the strength of the joint.

This method of joint also seems to afford a perfect electrical bond. The electrical conductivity of the line welded between the city of South Milwaukee and the city of Milwaukee, by tests made by the Milwaukee Electric Railway & Light Company, varied from 118 per cent to 126 per cent, thus exceeding the conductivity of the rail itself from 18 per cent to 26 per cent, being the highest conductivity upon record given to any electric rail.

The success of the joint is proved by the work it has done, the welding made in the late fall of 1897 having stood to the present time without a single joint breaking, and the percentage of breakage upon the 10,000 joints welded during the year 1898 has been less than one-half of one per cent.

In the spring of 1898 the Milwaukee Electric Railway & Light Company gave to the Milwaukee Railjoint & Welding Company

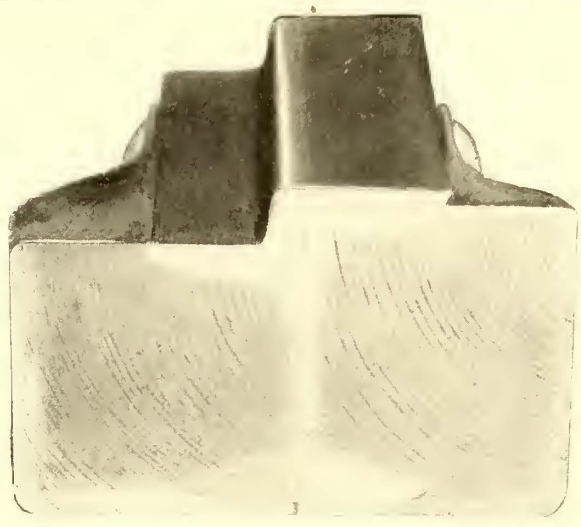


FIG. 2.—SECTION OF JOINT

a contract for 1,000 joints, and in the summer another contract for 10,000 more joints, and when these were completed, gave it a contract for 1899 for 20,000 joints, which will complete the welding of the entire system of the Milwaukee Electric Railway & Light Company in the city of Milwaukee, it having had welded, during the season of 1896-97, about 15,000 joints made by another company.

One of the cuts herewith shows the joint longitudinally as it looks upon the track, with the necessary paving cleared away to enable the making of the joint. (Fig. 1.) Fig. 2 shows a sectional view of the joint sawed one-half of an inch from the meeting of the rail ends. It shows the steel jacket around the outer part of the joint, the web of the rail in the center united to the cast-iron filling, which is fused to the rail web and flanges and to the steel jacket around the joint.

The Milwaukee Railjoint & Welding Company reports a very encouraging outlook for a large amount of welding during the season of 1899. It has its own patents, which, the company claims, cover very broadly this form of joint.

A New Repair House

The Advance Electric Company, which is an old established supply house in Indianapolis, has opened a department for the repair of street railway motors and other electrical apparatus. The company has engaged as foreman of its shops, David Fryer, a man of eighteen years' experience in this class of work, and whose ability and skill are recognized by many electrical men throughout the Central States.

The company tests all its windings and coils before sending them out, and is proud of the fact that in a long experience in the lighting field, it has never yet had a single piece of work returned on account of bad workmanship. Eighteen years' experience in the shop has bred a familiarity with every type of machine on the market, and the company keeps constantly on hand armatures and field coils for all the standard machines.

Located in Indianapolis, one of the best railroad cities in the Central States, the shipping facilities of the new company are unexcelled. The company's standard is best work and best material at moderate prices. The company has lately been reorganized with increased capital and is able to do street railway repairing on a large scale. Harry B. Marsh, the newly elected president, and Charles H. Talmage are in charge of the active management, and the reputation of these gentlemen is a guarantee that their work will be satisfactory.

A street railway company of San Diego, Cal., is using salt water for sprinkling its tracks. Electric sprinkling cars are employed.

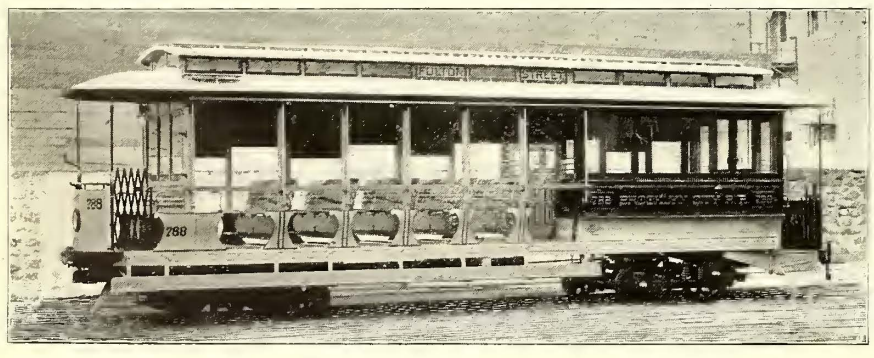
New Combination Car of the California Type

The Brooklyn Heights Railway Company has just put in operation a new car of the California type, which, from its large size and arrangement of details, is of considerable interest. It is very similar in general appearance to the large cars recently put in service by the Metropolitan Street Railway Company of New York, but differs from them in several important details.

The first thing to be noticed is the fact that there is no step on the sides of the closed body of the car, and the body has no hand-rail. Experience with other cars of this style showed that this was a very necessary and important change. In the cars previously built for the Metropolitan Railway by the Brill Company, the sill ran through from crown-piece to crown-piece. This, of course, raised the rear platform, or that of the closed end of the car, very high, and considerable difficulty was found when old people and children attempted to enter. In the new car the sills run only to the end of the body, and the platform is dropped in the usual way, by the use of platform knees. This slight alteration brings the platform down practically as low as that of the open car, enabling it to be reached by a step only 13¾ ins. from the rail, with a 13-in. riser. All the new cars now in course of construction for the Metropolitan road are also having this change introduced.

The length of the car over the corner posts is 36 ft., the length over the buffers being 44 ft. It is 6 ft. 6 ins. wide at the sills and 7 ft. 2 ins. at the post. On the front or open end of the car the platform is 3 ft. 8 ins. Ample strength is secured for the side sills by plating them with iron. The closed section is 11 ft. 2 ins. over the end panels, and has two double doors. The open section has seven cross seats, two of which, setting against the forward bulkhead, have stationery backs. Along the open portion there are the usual folding steps at the sides. These steps are 18½ ins. from the ground, with a 13-in. riser. The height in this case from the head of the rail to the under side of the sill is 28 ins. Brill maximum-traction trucks with a 4 ft. wheel base are used under the car. The wheels are respectively 30 in. and 20 in. in diameter. There are two w.p. 50 motors.

The ends of the car are provided with angle-iron buffers, and gates are used on one side of the rear platform, with a Brill folding gate on the opposite side. The seats in the closed compartment are longitudinal and covered with spring rattan, seating fourteen passengers; the open portion accommodates thirty-five, making a total of forty-nine seats. The closed compartment is finished in



COMBINATION CAR IN BROOKLYN

cherry throughout, with three-ply quartered oak ceilings. Cherry and ash are used for the finish in the open section.

Push-buttons are placed on each post, to signal the conductor. There are two 12-in. Dedenda gongs with disappearing buttons. There are two sand-boxes. The headlights are in the dasher. The trolley board extends the whole length of the car. The grab-handles of the posts are of ash, set in solid bronze sockets. Each of the seats in the open part of the car is fitted with a Brill round-corner seat end panel; by their use it is possible to bring the curtains down to the floor without catching or tearing—a feature which renders the open part of the car dry and comfortable in storms, and is one of the reasons why cars of this class are being so favorably received.

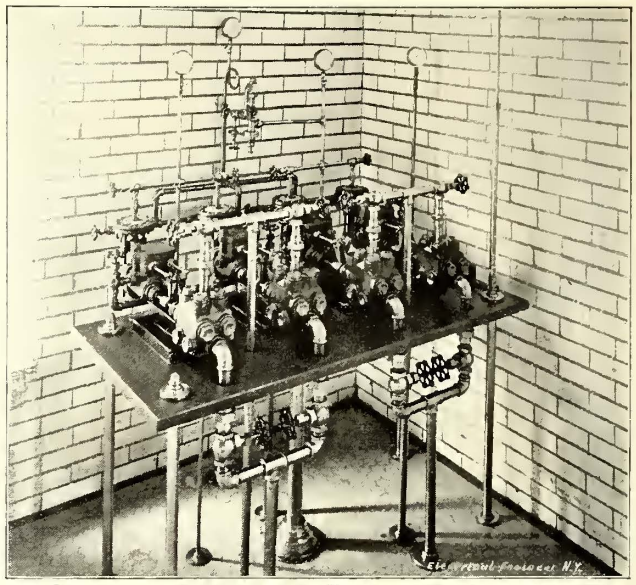
The weight of the car without motors is 17,200 lbs. The trucks weigh 3,250 lbs. each. The California car, with the modifications which are going on in its design and construction since its introduction in the East, is rapidly coming into favor wherever a large traffic has to be accommodated.

The Compagnie des chemins de fer sur routes, of Algiers, has ordered eight new cars with double Walker equipment and Dickinson trolley.

Automatic Lubrication

The economy of power generation in an electric railway system is often the determining factor in the financial success of the road, and the modern power station is equipped with every device which tends to reduce the operating cost. Among the many minor improvements in this line there is none which has met with greater favor, perhaps, than that of the automatic oiling of the wearing parts, for it not only reduces largely the labor of attendance, but provides a sure and cleanly system of lubrication.

A very ingenious, but simple and effective, system of oil distribution is that used in the power station of the Missouri-Edison



PUMPS FOR LUBRICATORS

Electric Company, of St. Louis. The system was designed by the Siegrist Lubricator Company, of that city. The oil is circulated under pressure, and the arrangement of the pumping apparatus is shown in the accompanying engraving. These pumps, which are four in number, are of the smallest size of duplex steam pumps, were especially designed for this work, and are mounted on a slate-top table in a corner of the engine room. The pumps are connected in pairs, and one of each pair serves as a relay. One pair is designed to pump the engine lubricating oil, and the other the cylinder oil. The oil is pumped to the different bearings, where the sight feed-oil cups are located. The rate of drip from each oil cup can be regulated at will by a thumb screw, but the piping system is so arranged as to close the drip feed if the pressure on the piping system is lowered more than 2 lbs. The only thing required then to control the oiling system is to open or close the one globe valve placed in the main oil-supply pipe The closing of this valve stops the oil at every oil cup within a few seconds, thus preventing any waste of oil after the engine is stopped. The oil is piped back from all drips of the engines and generators to filters located in the basement.

The cylinder oil is controlled in the same way as the engine oil, through sight-feed lubricators for each cylinder, placed at a convenient height from the floor. The pressure maintained in the cylinder lubricating system is, of course, slightly higher than the steam pressure.

The lubricators employed in the system are illustrated in section in the accompanying engravings. Fig. 2 shows an ordinary pressure oil cup, which is placed in the same position as an ordinary oil cup. The opening D connects with the feed. As soon as the oil enters the cup it acts upon the diaphragm, raising the small valve from the seat C, thereby allowing the oil to flow in drops or in a stream, according to the wishes of the engineer, who can regulate it by the small regulating screw A. When the pressure is relieved the valve automatically closes the cup, as already described, preventing the waste of oil.

The cylinder-lubricator is illustrated in Fig. 3. This device is screwed in the steam pipe in the same position as the ordinary lubricator, and the opening D is connected to the cylinder oil-pipe line by a small ¼-in. pipe, so that the lubricator would be supplied with cylinder-oil under pressure. As soon as the oil enters the

lubricator it acts on the diaphragm B, lowering the small valve from the seat C, thereby forcing the oil in drops or in a stream up through the water in the sight-feed glass and into the steam pipe, to be carried by the steam into the cylinder of the engine. The rate of feed in this cylinder can be regulated by the screw A. The

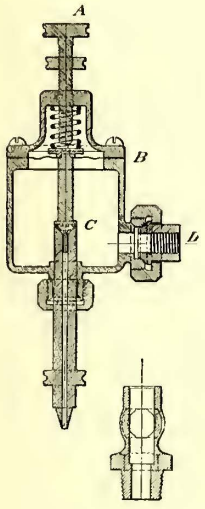


FIG. 2

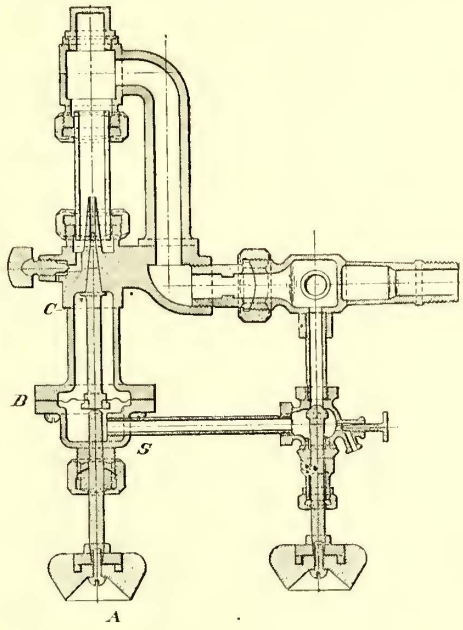
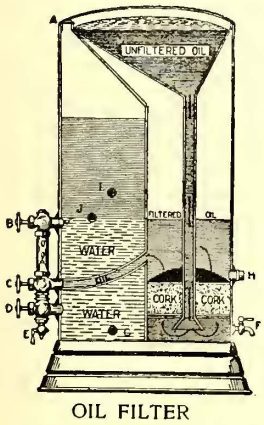


FIG. 3

steam connection shown beneath the diaphragm acts instantly to close the valve in case the oil pressure should fall below that of the steam, thus keeping the glass free from oil.

Oil Filters

The handsome oil filters of the Kosmic Oil Filter Company, of Easton, Pa., are now found in many of the largest power stations throughout the country. In this filter the oil, instead of being clarified by passing downward simply through some straining material, is passed upward through a layer of cork, and, in addition, is permitted to rise for a considerable distance through a body of water, this latter process effectively removing all impurities that might possibly make their way through the cork.



OIL FILTER

As will be seen from the cut, a partition divides the filter into two compartments, this arrangement possessing the advantage of enabling one part to be cleaned without interfering with the other. By regulating the center valve, which controls the flow of oil from one compartment to the other, the degree of purity can be seen as it passes up through the water in the glass tube, and the whole process can be regulated by the engineer in charge according to the purity of oil desired.

Carbon Brushes

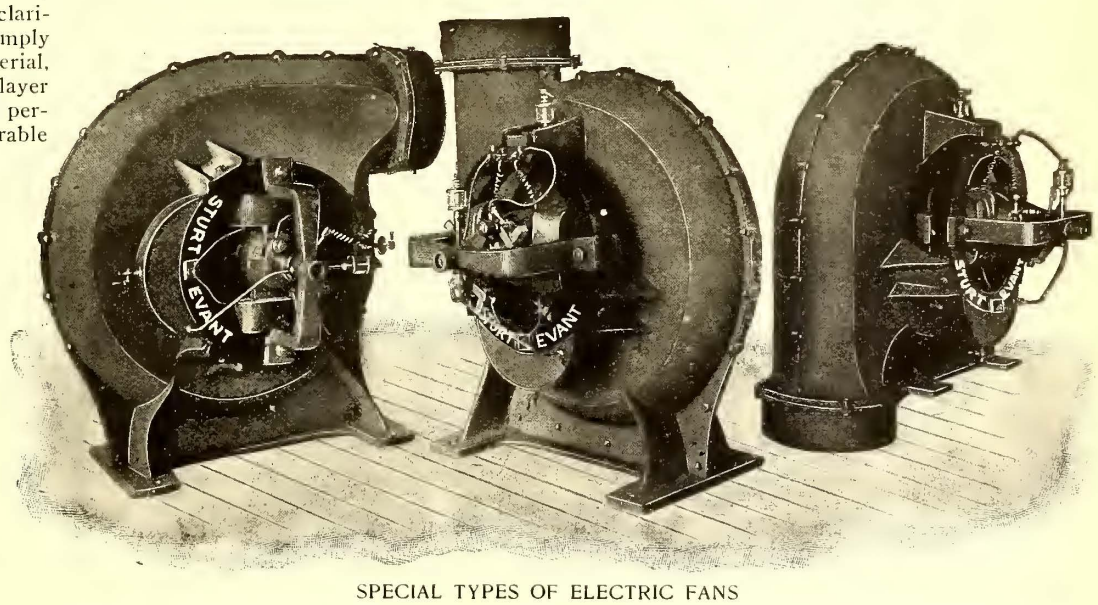
A treated carbon brush for motors, generators and dynamos, especially designed for saving the commutator, is manufactured by the Le Valley Vitæ Carbon Brush Company, of New York. This brush has come into very extensive use, and numerous testimonials to the satisfaction given by it are being received, one street railway company writing that the Vitæ brush had run nearly 19,000 miles on one of its street railway motors. Although these products have been in use for only two years they have been adopted as standard by a number of leading street railway and electrical companies after severe tests.

The manufacturers claim that the Vitæ brush does not cut or wear the commutator, that it wears many times longer than other brushes on the market, is thoroughly self-lubricating, never gumming the segment tips, requires little attention, runs from 7 to 10 deg. cooler than other brushes, and having great conductivity it conveys the current without loss; and, further, that it leaves no deposit of dust in the motor, which is one of the causes for short circuiting.

Special Types of Electric Fans

The rapid development in the employment of electric fans for ventilating and other purposes, has led the B. F. Sturtevant Company, of Boston, Mass., to prepare special designs suitable for special conditions. The shells of those illustrated are of cast iron, like the regular monogram blowers and exhausters manufactured by this company. The one upon the left, as is evident from the position of oil cup and oil tank, is designed to be attached to a vertical wall, and to discharge directly upward. That at the centre may be placed upon the floor to discharge in the same direction, while that upon the right is designed for vertical downward discharge.

The motor is of the bi-polar type, the field rings and pole pieces being of wrought iron, and the frame accurately centered and held securely in place by bolts introduced through lugs projecting from the side of the fan. The general internal construction consists of drum-wound armature, having a commutator with ample brush surface, and of reaction brush holders with fibre graphite brushes. Yokes extending from either side of the field ring, and provided with ring oiler boxes, serve to support the armature shaft. All trouble from oil is avoided by conducting the overflow through tubes to the small receiving tank beneath and attached to the field ring. Fans of this type are built in sizes ranging from 18 ins. to 6 ft. high, and designed to deliver air under pressure ranging from 1 oz. to 5 ozs.



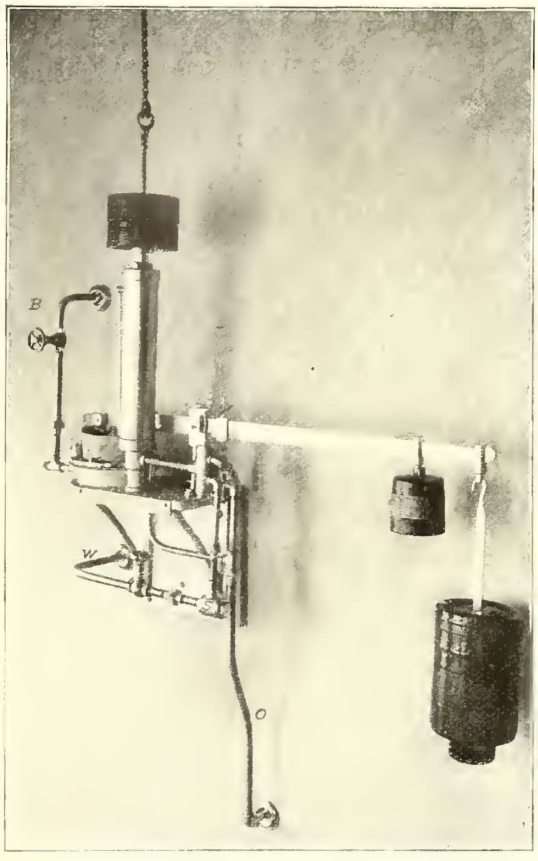
SPECIAL TYPES OF ELECTRIC FANS

An instance of the progressiveness of the technical press was recently shown by "Lomotive Engineering" of New York. This paper's entire editorial office was burned out in the recent Home Life Insurance Building fire, and yet the paper appeared very nearly on time with its usual amount of valuable and interesting matter. This necessitated almost superhuman efforts on the part of the editors and managers, and they are certainly to be congratulated upon their success.

Improved Hydraulic Damper Regulator

A machine for accurately regulating the steam pressure of boilers by regulating the admission of air to the fires through the dampers is shown in the engraving herewith. This regulator can be easily erected in the boiler or engine room and connected to the dampers to control from one to twenty boilers.

Referring to the illustration, B is the steam pipe connection coming through the wall from the boilers, W is the water connection for supplying the water that operates the damper motor, and S is a strainer to prevent foreign matter from getting to the damper water valve. By unscrewing the cap at the end of the strainer any collection of matter can be cleaned out without breaking the pipe



HYDRAULIC DAMPER REGULATOR

connection. The overflow pipe for carrying off the discharge water is shown at o. The valve controlling the water passing to and from the damper motor is operated by a lever, to which weights are attached, and by placing the proper weights upon the lever, the regulator can be set to close the dampers at any desired steam pressure. The machine can also be used for testing steam gages without removing them from the boilers.

All the parts of the apparatus have been carefully designed from a scientific and engineering standpoint, and it is claimed that for simplicity of construction, neatness in finish and sensitiveness in operation this regulator is not surpassed by any other on the market. It is guaranteed that a change of one-half pound to the square inch of boiler pressure will open or close the heaviest dampers. The apparatus is made by the Patterson Damper Regulator Company of Baltimore, Md., and was designed by George F. Patterson, president of the company, who has been for many years almost exclusively engaged in handling damper regulators, and is, therefore, well acquainted with the requirements.

The Increasing Demand for Car Fenders

The danger to life and limb incident to the increased speeds at which electric cars are now run through crowded city thoroughfares as well as through less densely populated suburband and interurban districts has brought very forcibly, and often very painfully, to the minds of street railway general managers the necesity of equipping their cars with proper and efficient life-saving devices Up to a comparatively recent period, fenders, if used at all, were generally added as an afterthought, whereas now they are rapidly coming to be considered a nearly indispensable part of the equipment, and are often given considerable attention in the specifications for rolling stock.

The magnitude to which the car fender business has grown is shown by a recent report of the Consolidated Car Fender Company, of Providence, R. I., manufacturer of the Providence fender. Since starting in business four years ago, this company has equipped 5000 cars with its device, and the Providence fender is now in practical use in more than eighty cities and towns in the United States and Canada. The Metropolitan Street Railway Company, of New York, has alone purchased 1188 equipments.

The Consolidated Car Fender Company reports that orders and inquiries already received this year clearly indicate that the demand for its fender during 1899 will far exceed that of any previous year. Among the orders just completed are fenders for all the motor cars of the Auburn City Railway Company, Auburn, N. Y.; the Middletown-Goshen Traction Company, Middletown, N. Y.; the South Chicago City Railway Company, Chicago, Ill., and the Van Brunt Street & Erie Basin Railway Company, of Brooklyn, N. Y. A large number of Providence fenders were also recently furnished the Ottawa Car Company, Ottawa, Ont., and will be placed on new cars now being built for street railway companies in Canada. The Consolidated Company is daily receiving orders from one or more of the many roads using its device for new equipments to be placed on new cars that are being added to the various systems. The business received in this way alone is sufficient to keep its factory running full time without the new business that is continually coming in. In order to fill all demands promptly, it is found necessary to carry in stock not less than 1000 full equipments.

The steady and rapid growth of the business of the Consolidated Car Fender Company is a practical illustration of making "the best" regardless of the first cost.

Personal

MR. S. DANA GREENE has been appointed general sales manager of the General Electric Company.

MR. A. E. BURLAND, superintendent of the Newport Street Railway Company, of Newport, R. I., on Dec. 25, was presented a testimonial of esteem by the employees of the line.

MR. F. P. MOONEY has resigned his position as general superintendent of the Cortland & Homer Traction Company and the Cortland & Homer Electric Company, of Cortland, N. Y.

MR. H. A. EVERETT has been elected president of the Cleveland Electric Railway Company, of Cleveland, Ohio, in place of Mr. H. E. Andrews. Mr. Charles L. Pack has been appointed vice-president.

MR. O. M. RAU, chief electrician of the Milwaukee Electric Railway & Light Company, will temporarily fill the position of superintendent of the lighting department, in place of S. G. Coleman, who recently resigned.

MR. HENRY N. RANSOM, who is well known in the street railway field as New York representative of the Consolidated Car Heating Company, will soon be married to Miss Gillet, daughter of Mr. Ainslie M. Gillet, of Albany.

MR. T. H. ANDERSON has been elected general manager of the Somerset Traction Company, of Skowhegan, Maine, to relieve Mr. R. B. Shepperd, the president of the road, who has heretofore held the title of general manager also.

COL. EUGENE GRIFFIN, of the Volunteer Engineer Corps, and first vice- president of the General Electric Company, was recommended last month for appointment as Brigadier General, for valuable service rendered in Porto Rico during the late war.

MR. J. M. SHENK has resigned from the presidency of the Lebanon & Annville Street Railway Company and the Lebanon & Myerstown Street Railway Company, both of Lebanon, Pa., on account of other duties requiring his attention. Mr. S. P. Light was elected president in his place.

MR. H. F. PARSHALL, of London, has secured the gold medal of the British Institution of Electrical Engineers, for his paper on "Earth Returns for Electric Tramways," delivered before the Institution on April 28, and reprinted in the STREET RAILWAY JOURNAL for June, 1898, page 322.

MR. F. C. ARMSTRONG, engineer with Dick, Kerr & Company, Ltd., of London, was married on Jan. 11, at Cobourg, Ontario, to Miss Helen R. McCallum, of Cobourg. Mr. and Mrs.

Armstrong sailed for Liverpool on the steamship Teutonic, Jan. 25, and will live in one of the suburbs of London.

MR. CHARLES SHELDON has resigned the position of general manager and treasurer of the Consolidated Car-Heating Company, of Albany, N. Y., to become manager of the Chihuahua & Pacific Railroad, with headquarters at Chihuahua, Mexico. Mr. Frederick W. Kelley, who has been Mr. Sheldon's assistant, has been appointed general manager and treasurer of the Consolidated Car-Heating Company.

MR. WM. E. COOKE, representing the London syndicate controlling the tramways system at Perth, Western Australia, arrived in Perth late in December and commenced immediately upon the work of converting the horse tramways to electric. He states that owing to the heat of the climate, the hilly nature of the city, the badness of the roads and the large and scattered area within the city boundaries, Perth is an excellent street railway city.

MR. J. W. HICKS, superintendent of the Rochester Railway Company, and Mr. Thomas Hicks, assistant superintendent, were very pleasantly surprised by beautiful gifts from employees of the road, at Christmas time. These gentlemen are very popular with the company's men, and to show their esteem the employees raised a fund and presented Mr. J. W. Hicks with a handsome parlor cabinet of solid mahogany, and Mr. Thomas Hicks, with a fine easy chair of solid mahogany.

MR. W. R. MASON, who was representing the Walker company at St. Louis at the time of the consolidation of that company with the Westinghouse, has been appointed manager of the St. Louis office of the Siemens & Halske Electric Company. Mr. Mason is well known in the street railway field, and his large acquaintance, railroad experience and characteristic energy and perseverence would naturally make him a valuable acquisition to any company closely identified with the electric railway or lighting interests which secured his services.

EX-BALLIES H. CRAWFORD, THOMAS MASON AND MICHAEL SIMONS, ex-members of the town council of the city of Glasgow, Scotland, and Mr. J. Murry Smith, of the "Glasgow Evening News," are in America, and will visit a number of the principal cities of this country. The main object in making this trip is to interest the American Government in the International Exposition to be held in Glasgow in 1901. This exposition will afford American manufacturers an excellent opportunity to exhibit their goods to the Scottish people, and advantage will undoubtedly be taken of this opportunity by a large number of firms. The gentlemen from Glasgow will also pay particular attention while in America to electric railways, and will inspect a number of prominent systems.

MR. JOHN E. ANGER, recently with the John Stephenson Company, Ltd., has accepted the position of master car builder of the Electric Railway & Tramway Carriage Works, of Preston, England. The formation of this company was mentioned in a recent issue of the STREET RAILWAY JOURNAL, and it proposes to do a large business in the manufacturing of tramway cars. Mr. Anger is well known in the car building industry in this country. He began his career in this business with the Gilbert Car Manufacturing Company, of Troy, N. Y., in 1869, and remained with that company until the close of the year 1876, when he accepted a position in the car building shops of the New York Central Railroad Company. He remained with this latter company for about five years, when he resigned to enter the employ of the Jones Car Manufacturing Company, whose factory was then located at Schenectady, N. Y. When these shops were leased by the Gilbert Car Company, Mr. Anger was offered a position with this company again as first foreman, but was soon promoted from one position to another until he was made superintendent of the Schenectady plant. When the Gilbert Car Manufacturing Company abandoned its Schenectady plant, Mr. Anger removed to the company's Green Island plant, where he was assistant to Mr. F. A. Stanley, then general superintendent. He remained with the Gilbert company until it became insolvent, when he accepted a position with the Jackson & Sharp Company, of Wilmington, Del., with whom he remained for about four years, or up to last spring, when he became associated with the John Stephenson Company, at its Elizabeth plant. He installed the entire machinery at the latter plant and remained with the Stephenson company until the middle of December, when he decided to accept the offer of the Electric Tramways & Carriage Company. Mr. Anger is forty-five years of age, and being naturally of an inventive turn of mind has made many improvements facilitating the construction of cars. He has also taken out a number of patents in the line of trucks and car seats, and at the present time is engaged on several other improvements in car building. He has always won the good will and best wishes of his employers and associates.

Obituary

MR. W. BARTLETT, chief engineer of the St. Louis & Suburban Railway Company, of St. Louis, Mo., died at his home on Jan. 16, 1899.

MR. E. K. STONE, for many years general manager of the Quincy Horse Railway & Carrying Company, of Quincy, Ill., died recently at his residence in Quincy.

MR. M. C. BULLOCK, for many years president of the Bullock Manufacturing Company, of Chicago, Ill., died in that city on Jan 12. Mr. Bullock was born in 1838, at Granville, N. Y., and spent the early years of his life on a farm. Being attracted to the trade of a machinest, he served his apprenticeship in a shop near his home, and then traveled from State to State for the purpose of gaining wider experience in his chosen vocation. He was connected with a number of well-known manufacturing companies, and also did considerable engineering work, until 1878, when he started the Bullock Manufacturing Company. Through his tireless efforts this business was placed upon a successful basis, and he gradually broadened its scope until it included the manufacturing of rock drills, air compressors, hoists, diamond drills, steam engines of all kinds, etc., the latest being the Willans high-speed engine. Mr. Bullock has been failing in health for over a year, but his death was unexpected.

AMONG THE MANUFACTURERS

DICK, KERR & COMPANY, LIMITED, of London, have sold five Walker car equipments for the West Hartlepool Tramways, owned by the British Electric Traction Company.

MESSRS. McCLAVE & HAMILTON, of New York, are representing in New York and vicinity, James Bonar & Co., manufacturers of steam appliances, and the Pittsburgh Feed Water Heater and Engineering Company.

JOHN A. ROEBLING'S SONS' COMPANY, of Trenton, N. J., has published its new price list for all kinds of bare and insulated telegraph, telephone and trolley wires, underground cables, lamp cords, etc.

THE COLUMBIA INCANDESCENT LAMP COMPANY, of St. Louis, Mo., is sending out its new catalogue, containing five full-size reproductions of the various styles of direct and alternating-current incandescent lamps which it manufactures.

GEO. A. PARMENTER, Cambridgeport,, Mass., manufacturer of the Parmenter fender and wheel guards, reports that among other orders lately closed is one for the equipment of the entire system of the City & Suburban Railway Company, Washington with Parmenter fenders and wheel guards.

CARD CASE.—The Electrical Installation Company, of Chicago, Ill., general street railway contractors, are sending to their friends a very handsome and useful pocketbook and card case. The case is made of black leather and contains compartments for cards, papers, etc. This little souvenir will be heartily appreciated by all those fortunate enough to secure one.

PENCILINGS.—One of the daintiest catalogues of the season has just come from the press of the Dixon Crucible Company, of Jersey City, N. J. This little pamphlet bears evidence of most careful thought in its preparation, and tells in a very lively and interesting manner what the requirements of a good lead pencil are and how Dixon pencils fully fill all these requirements.

THE BIBBER-WHITE COMPANY, Boston, is sending to its friends a very acceptable souvenir, consisting of a combined calendar and thermometer for desk use. The Bibber-White Company reports that the past year has been an unusually good one in the street railway line for it, while business for the new year is starting off with a pace that bids fair to tax its present capacity.

THE BAKER HEATER, manufactured by Wm. C. Baker, of New York, claims to satisfactorily solve the problem of heating street cars, particularly long interurban cars. This system of heating was fully described in the last issue of the STREET RAILWAY JOURNAL, and the company reports that its apparatus is in use on a number of systems, and that inquiries and orders are being constantly received.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has found it necessary, on account of the increased growth of its business, to establish a branch office in New York City. This office will be located in the White building, 95 Liberty Street,

and will be in charge of Edwin S. Boyer, formerly of Philadelphia. All orders or inquiries sent to the New York office will have prompt attention.

THE CARNEGIE STEEL COMPANY, LIMITED, Pittsburgh, Pa., has placed an order for 5000-h.p. Pittsburgh feed-water heater and purifiers for its new plate mill. This is the third order placed with the manufacturers of these heaters by the Carnegie Company, and is good evidence of the fact that they are giving good satisfaction. This makes 33,500-h.p. Pittsburgh heaters in the Carnegie plants.

JAMES BONAR & COMPANY, of Pittsburgh, Pa., have made arrangements for special agencies for the sale of their Pittsburgh feed-water heater and purifiers, Bonar gage cocks and Bonar oil filters for the New York territory, with Messrs. McClave & Hamilton, 141 Broadway, New York, N. Y., for New England, with F. W. Ashcroft, 63 Oliver Street, Boston, Mass., and for Mexico, with Robert J. Campbell, City of Mexico.

THE CHAPMAN VALVE MANUFACTURING COMPANY, of Indian Orchard, Mass., announces that it has a complete stock of Chapman gate valves for water, high and low pressure steam, gas, oil, ammonia, air and brine. This stock has been placed in Philadelphia, so that the trade and users of valves in the Middle Atlantic States can have orders filled without delay. The headquarters of this company in Philadelphia are at 40 North Seventh Street.

THE SPRINGFIELD MANUFACTURING COMPANY, of Bridgeport, Conn., has met with pleasing success in the introduction of its wheel-grinding machines. A number of these are now in course of construction, and several have been shipped within the last few weeks. Among these may be mentioned one for the Boston Elevated Railway Company, and one to South America. One of the grinders now building will go to a large road in Japan.

HEYWOOD BROTHERS & WAKEFIELD COMPANY, of Boston, Mass., among other contracts, recently supplied all the seats for the three handsome cars built by the Laconia Car Company for the Newton Street Railway Company, of Newton, Mass., and which were described in the last issue of the Street Railway Journal. These seats are of the Henry reversible type, and were chosen for their handsome appearance and strength and simplicity of construction.

LUNDELL MOTORS.—The Sprague Electric Company, of New York City, has published another of its elaborate and valuable catalogues for which this company is famous. This pamphlet is devoted to a detailed description of the Lundell motors and their application to Linotype machines, printing presses, metal and woodworking machines, elevators, horseless carriages, etc. The book contains a number of curves showing the remarkable efficiency of these motors.

THE M. MITSHKUN COMPANY, of Detroit, Mich., reports that its business has increased largely of late, and that prospects in general are excellent. The company has been established a long time, and is well known throughout the entire country. It is able to furnish at short notice steel rails of any desired weight, and these are kept in stock and ready for immediate shipment. The company also has on hand locomotives suitable for construction purposes, steam shovels, and other railway and contractors' supplies.

A GOOD LIGHT for night construction, shop work and heavy metal heating is a nearly indispensable part of the equipment of an up-to-date street railway. One of the best lights for this purpose on the market is the Wells light, manufactured by the Wells Light Manufacturing Company, of New York, and it has been adopted as standard by many of the leading railways and contractors of the country. It is being used extensively in the new conduit construction of the Metropolitan Street Railway Company in New York.

THE SIMPLEX ELECTRICAL COMPANY, of Cambridgeport, Mass., in its new catalogue for 1899 fully describes its very complete line of electrical heating apparatus. This company has gone very extensively into this subject, and manufactures heating and cooking articles of almost every conceivable description, including portable stoves, tea-kettles and stands, electric chafing-dishes, boilers, flat-irons and radiators, and heaters for waiting rooms and electric cars. The car heaters are in extensive use, and are giving good satisfaction.

ELECTRICAL SPECIALTIES.—The Sterling Supply & Manufacturing Company, of New York City, has issued its catalogue for 1899, and in this will be found descriptions of the numerous street railway "Sterling" specialties. These include registers, safety brakes, insulation, commutator bars, car fenders, sand boxes, etc. There is no line of goods in the street railway industry more widely or favorably known than the "Sterling" specialties, and the company reports an excellent business for the past months and splendid prospects for the coming year.

THE BERLIN IRON BRIDGE COMPANY, at East Berlin, Conn., has just shipped several carloads of bridge material to the Hawaiian Islands. It is believed this is the first American bridge that was ever put up in these islands. The contract for this bridge was obtained through the Berlin Iron Bridge Company's regular established agency located at Honolulu, and men will be sent from the United States to put up the bridge, which is for highway travel. It consists of one span of 200 ft. 40 ft. wide, and will be located across a river in one of the larger towns of the islands.

W. B. UPTON, who has been engaged as the principal assistant engineer of the Capital Traction Company, of Washington, D. C., in its work of changing its cable railway to the open conduit electric system and in the building of the new power station illustrated in the last issue of the Journal, has resigned from that position, as his work has now been completed. Mr. Upton has resumed his practice as consulting engineer, with headquarters in the Washington Loan and Trust Building, in Washington, and is making a specialty of open conduit electric systems, electric power stations and building engineering.

THE BONNER RAIL WAGON COMPANY, of Toledo, Ohio, is putting upon the market an express wagon so built as to be mounted on a truck adapted for electric railway track. Until recently three of these wagons have been running between Toledo and Bowling Green. They are connected up in a train, and are drawn by an ordinary motor car to distribution points. The rail wagon is then switched out of the main track, the wagon is run off the track, horses are attached, and distribution is commenced. On the return trip the wagon reaches the main track, is run upon the truck and taken in train to the central city. This system appears to have some advantages in special places.

THE WAGNER ELECTRIC MANUFACTURING COMPANY, of St. Louis, Mo., on account of the increasing demand for its goods in the Northwest, has decided to establish an agency at Chicago. The agency has been placed in charge of George B. Foster, late of J. Holt Gates & Company, who will make his headquarters at room 1519, Marquette building, but will spend considerable of his time traveling through the territory of the Northwest, placing before the companies of this section many Wagner specialties. Mr. Foster's territory includes the States of Minnesota, Wisconsin, Iowa, Northern Michigan, the western part of Southern Michigan, the northern part of Illinois, and the northern part of Indiana.

MESSRS. J. G. WHITE & COMPANY, are the consulting engineers and purchasing agents of the Deep Leeds Electric Transmission Company, of Victoria, Australia, a company organized to erect a complete plant for supplying energy for all mining purposes to three mines in Victoria. Contracts have already been made for electric apparatus with the General Electric Company, for engines with the Buckeye Company, for boilers with the Babcock & Wilcox Company, for condensers and pumps for power house with the Wheeler Condenser & Engineering Company. The mine pumps themselves, which are to be mounted on the same bed-plate with the motors, but geared to them, are to be manufactured in Australia.

THE UNION ELEKTRICITATS GESELLSCHAFT, which owned the German rights for all the patents of the General Electric Company, of America, took possession on Jan. 1, 1899, of the electro-technical factory, operated hitherto by the Aktien Gesellschaft, Ludwig Loewe & Company, whose entire business consisted in manufacturing the apparatus required by the Union Company. Wilhelm Laue, formerly on the board of directors of Ludwig Loewe & Company, has become a member of the board of the Union Company, and will occupy the position of managing director. The Union Company announces that the large increase of its capital in manufacturing facilities enables it to comply most promptly with the steadily increasing requirements of its business.

THE WORKS of the New Process Raw Hide Company, of Syracuse, N. Y., were destroyed by fire Dec. 19, resulting in a complete loss of the plant. At the time of the fire the company was running overtime on orders. Since the day of the fire this company has been working with its characteristic hustle to get a new plant in operation, and will be ready to run again by the first day of February. The new works will be located at 305-309 North State Street, Syracuse, the business office remaining at 348 West Washington Street. The product of the New Process Raw Hide Company has become known in about every section of the world that there is machinery in operation. Its raw-hide pinions are

well known in the electric railway field for their lasting qualities and freedom from noise.

HERMANN HEINRICH BOEKER & COMPANY is the name of a new firm organized Nov. 15, 1898, in Berlin, the members of which are H. H. Boeker, formerly connected with the Bergische Stahl-Industrie, of Berlin, and Moritz Boeker, engineer, of Remscheid. The selling business of the Bergische Stahl-Industrie, which is primarily a manufacturing company, having become too large to be well taken care of under its own name, it has turned this business over to the new firm, which intends to furnish a medium between manufacturers and customers of different countries, to handle agencies, etc. For instance, the new firm has received of the Standard Air Brake Company, of New York, the exclusive right of selling its air brake equipments in Germany, and other agencies are desired.

LARGE ORDER FOR BOILERS.—The Babcock & Wilcox Company has received from Westinghouse, Church, Kerr & Company the largest stationary boiler order that has ever been placed. The boilers are for the power plant which the Westinghouse Electric Company have contracted to build for the Third Avenue Railroad Company, of New York, at 218th Street and Harlem River, and which is to be constructed by Westinghouse, Church, Kerr & Company. The order covers sixty Babcock & Wilcox forged steel-type boilers of 520 h.p. each, or an aggregate of 31,200 h.p. The boilers are to be capable of carrying 200 lbs. steam pressure. They will supply steam for compound condensing engines of 64,000 nominal h.p. in the aggregate. Further particulars of this order were published in the last issue of the STREET RAILWAY JOURNAL.

ARTHUR W. FIELD, of Boston, is doing an excellent business in the many street railway specialties for which he is agent. Mr. Field is now the representative in New England of a number of the most important manufacturing companies in the country, and represents the Peckham Truck Company, American Car Company, Ruggles' rotary snow plows, Price's friction brakes, Wheeler reflectors, Brandon metal paints, etc. In fact, Mr. Field is ready to supply practically anything which goes into the equipment of a company's rolling stock. By enterprise, ability and careful attention to the wants of his customers, he has succeeded in securing an excellent business. His recent calendar is extremely attractive. Mr. Field has also just sold, as New England agent for the American Car Company, fifty open nine-bench cars and thirty open twelve-bench cars to the Boston Elevated Railway Company, delivery to be made May 1.

J. HOLT GATES & COMPANY, Marquette building, Chicago, report the following recent sales: Armour Glue Works, Chicago, one 225-kw. 500-volt generator, two 150-kw. 500-volt generators, seven 50-h.p. motors, two 100-h.p. motors, two 150-h.p. motors, one 30-h.p. motor, two 25-h.p. motors, all made by the Card Electric Company, Mansfield, Ohio; Deering Harvester Company, Chicago, seven 500-light transformers, five 400-light transformers, three 200-light transformers; Elkhart Lake Electric Light Company, Elkhart Lake, Wis., two 10-h.p. single-phase motors and transformers and direct dynamos, attached to large storage batteries for electric launches, Armour Glue Works, Chicago; one $3,000 switchboard, Pierce & Robinson, Chicago; one $700 switchboard, residence of P. D. Armour, Jr., Chicago; one 300-light electric light plant, with Nash gas engine direct connected.

ONE OF THE handsomest souvenirs that has come to hand is being sent out by the United States Projectile Company, of Brooklyn. The souvenir is for use as a paper-weight, and is a six-pounder projectile such as was used so effectively by our navy at Manila, Santiago and other places, but has been nicely nickel-plated so it will not rust. To comply with the Government ballistic test one of these projectiles must penetrate a steel plate 3 ins. thick without showing a crack or fracture of any kind. The United States Projectile Company is well known to the electric railway field as manufacturer of the patent hot-pressed pinions, of which upward of 50,000 have been sold since their introduction. The company has a very extensive and model plant, and during the war with Spain the Government orders for projectiles kept the plant running day and night, almost to the exclusion of all other work, but the company reports that it is again prepared to fill orders with reasonable promptness for its well-known pinions.

WIRE GAGE AS A SOUVENIR.—A very convenient souvenir in the shape of a combination foot rule and wire gage is being sent out by the Standard Underground Cable Company, of Pittsburgh, Pa., as a reminder that it is prepared to promptly fill all orders, large or small, for bare copper, iron or steel wire, weather-proof annunciator, office or magnet wire, galvanized steel strands, rubber-covered wire or cables, lead-covered cables for underground or aerial use, armored submarine cables, cable hangers, terminal or junction boxes and underground conduits. These various products are the results of many careful and costly experiments and tests by the corps of skilled experts constantly in the employ of the company, and the sixteen years of experience that the Standard Underground Cable Company has had in this line guarantees its competency to satisfactorily fulfil all contracts intrusted to its care. The little rule and wire gage is made in three sections, which fold upon each other, and it will be found very convenient for frequent use.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has recently booked many orders from England for street railway motors. There are 262 motors and eight generators to be turned out with all possible speed. An abstract of the contracts on hand is as follows: For the Hull Tramway Company, ninety-two electric ralway motors to equip forty-five cars and one track sweeper; for the Halifax Tramway Corporation, twelve motors to equip six cars; for the Bradford Tramway Corporation, forty-eight motors to equip twenty-four cars; for the municipality of Norwich, which has control of the tramways in that city, eighty motors to equip forty electric cars, and four electric generators to be installed in the power house of the Norwich Tramway Corporation, to generate the current for the operation of the line; for Coventry, twenty motors have been ordered to equip ten cars, and the order has been augmented by a call for two power generators. Plymouth has an order for ten motors and two power generators for operation of local electric railways.

THE WARREN ELECTRIC MANUFACTURING COMPANY, of Sandusky, Ohio, has appointed J. Holt Gates & Company, 1426 and 1427 Marquette building, Chicago, general agents for its apparatus in the Western territory surrounding Chicago. The Warren Electric Manufacturing Company has recently placed, through J. Holt Gates & Company, a 15,000-light alternating-current plant for the great new power and light plant of Armour & Company, at their extensive works at the Union Stock Yards, Chicago. This plant will consist of one machine of 7000 16-c.p. light capacity, at 1100 volts and 7200 alternations; also two 3600-light machines, at 1100 volts and 7200 alternations. These alternators are of the inductor type, and will be operated by rope drive from Corliss engines of 2000 h.p. and 1100 h.p. each, to which engines will also be attached Walker direct-connected power generators. It is stated that the Warren alternators were selected on account of their close regulation, high efficiency, low temperature and ability to stand "grief." The Warren Electric Company is now prepared to build 10,000-light machines, both single and two-phase, in its new factory, and has about sixty machines on order at the present time. Its new plant at Sandusky, Ohio, is modern and up to date.

RECENT DESCRIPTIVE MATTER CONCERNING MECHANICAL DRAFT.—The B. F. Sturtevant Company, of Boston, Mass., has brought out within the past few weeks a number of new pamphlets and circulars setting forth the advantages of mechanical draft for factories, power stations, etc. One of these circulars, entitled "Draft Without a Chimney," explains why the B. F. Sturtevant Company has taken down its tall chimney and substituted mechanical draft, and states that an annual fuel saving of nearly $1,000 has been secured thereby. The company has also found it necessary to issue a second edition of the lecture on mechanical draft for steam boilers, delivered at the Cornell University by Walter B. Snow, of the engineering staff of the B. F. Sturtevant Company, in order to meet the demand for information on this important subject. In addition to its mechanical draft system the B. F. Sturtevant Company manufactures generators and motors and direct-connected units for all classes of service. Its catalogue, Bulletin G, illustrates a unique generating set, in which both the engine and generator are entirely inclosed, although practically accessible through suitable doors. Such a device is of manifest utility wherever the atmosphere is laden with dust. All these circulars will be mailed on request.

BENT GLASS.—It is a well-known fact that bent glass adds to the attractiveness of any building or store front, in fact, a single pane gives extra tone to the whole structure. To those contemplating building or making alterations, it is important to know that common double thick glass can be bent to any part of a circle not exceeding half circle. Polished plate can also be bent in the same manner. The difference in appearance between the two lights after bending is hardly perceptible, in fact, when set in a building it would require an expert to detect any difference at all; however, there is quite a difference in the cost; bent double thick glass is only about one-fifth of the cost of bent plate glass, which is considerable of a saving in the construction of a building. The curving or bending of double thick glass takes away the waviness, gives a polish to the glass, and adds to its strength

and resistance to high winds and severe storms. This was clearly demonstrated in the city of St. Louis by the tornado that visited that city May 27, 1896. The largest manufacturer of bent glass exclusively in the United States is the Oriel Glass Company, of St. Louis, Mo. This company manufactures all kinds of bent glass for buildings, show cases, fancy furniture, etc., the product being all of superior make and finish, and shipped in large quantities, not only to all points in the United States, but also to Canada and Mexico.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, Mo., has had a successful career of eight years in the general electrical supply business, and has experienced a phenomenal growth in its various departments. This is especially noticeable in the street railway department, which has developed through the company's tireless efforts to supply what the trade demand, into a very satisfactory and gratifying business. This company carries in its St. Louis stock a very large and complete assortment of all supplies pertaining to street railway business, and it has succeeded in establishing an excellent reputation for making shipments with promptness and despatch, and its growth is undoubtedly due to a large extent to its prompt delivery of goods, as street railway companies fully appreciate the advantages of being able to secure the majority of their goods from stock, thus obviating the necessity of tedious and often exasperating delays on the part of manufacturers. It seems more than likely that the Western Electrical Supply Company, situated as it is, in the Southwest, which enables it to reach a large and spacious territory, will continue to increase its large business in this line, and receive the hearty support of street railway companies. This company represents some of the largest and best-known manufacturers of street railway supplies in the country, and is therefore able to furnish many specialties in this line which a street railway may require. It has recently issued a very complete catalogue, confined strictly to street railway supplies, and which may be had for the asking. This book was described in the January issue of the STREET RAILWAY JOURNAL, and will be found of value to all street railway companies.

New Publications

Powers of Municipalities. By Allen Ripley Foote. Paper. 79 pages. Published by the Robert Clarke Company, of Cincinnati, Ohio.

This is a discussion of the report on the municipal problem of the special committee of the National Municipal League.

The Customs Tariff of Japan, in Effect January 1, 1899. Paper. Published by Japan-American Commercial and Industrial Association, Times Building, New York.

In this pamphlet are given the ad valorem and specific duties contained in the new tariff law published March 29, 1897.

Massachusetts Institute of Technology Courses in Electrical Engineering and Physics. Paper. 65 pages. Published by the Institute.

This contains a full description of the laboratories, etc., of these courses, which have come to be the most popular in the Institute.

American Trade Index. Flexible linen. 276 pages. Published by the Association at its office in Philadelphia.

This is a descriptive and classified membership directory of the National Association of Manufacturers of the United States, arranged for the convenience of various buyers, and is a valuable book for its purposes.

Mechanical Features of Electrical Traction. By Philip Dawson, A. M., I. M. E. Paper. 16mo. 123 pp. 14 plates. Published by authority of the Council Institute Mechanical Engineers, London.

This is an excerpt from the minutes of recent proceedings of the Institute of Mechanical Engineers, containing a paper read by Mr. Dawson before the Institute and the discussion thereon. Many of the plates and tables are of much value.

Third Rail Electric Traction. By Charles Henry Davis and W. G. Howells. 84 pages. Paper. Illustrated. Reprinted from the "Municipal and Railway Record," New York.

In this article, which has been printed in pamphlet form, the authors briefly review the subject of surface contact and underground electric railway conduit systems. The greater part of the article is devoted to illustrations of the chief systems which have been proposed or are in use, and the authors deserve great credit for having collected and put in permanent form so much interesting data of this character.

The Technology Review. A Quarterly Magazine published at 71 Newbury Street, Boston, by the Association of Class Secretaries of the Massachusetts Institute of Technology. Price $1 per annum, 35 cents per copy. Volume I. No. 1. 143 pages.

This is a new quarterly of interest chiefly to the students and alumni of the Massachusetts Institute of Technology, but containing articles of general interest to those working in scientific fields. Its first number contains an article on the "Function of a Laboratory," by Silas W. Holman, together with reprints and fac simile of early institute documents and letters descriptive of the new buildings, and general institute news.

Up-to-Date Air Brake Catechism. By R. H. Blackall, Air Brake Instructor and Inspector on the D. & H. R. R. 240 pages. Illustrated. Price, $1.50. Published by Norman W. Henley & Co., 132 Nassau Street, New York City.

The increased use of heavy double truck electric cars has made the subject of air brakes an extremely interesting one, so that the book mentioned contains much of value to the street railway engineer. It is written in the popular catechism style and contains nearly a thousand questions with their answers. It is fully illustrated, and the engravings include two large folding plates of the Westinghouse quick-action automatic air brake and the 9½-in. improved air brake.

The Story of the Railroad. By Cy Warman. Cloth. 12mo. 280 pages. Illustrated. Price, $1.50. Published by D. Appleton & Company, New York.

This book pictures the building of the earlier transcontinental lines across the true West. It tells the story of the engineer who found the way and who was the pioneer of permanent civilization among the Indians and the buffalo of the plains and in the mountains. Historically, the book is valuable, because it gives a comprehensive sketch of a great subject in a brief compass, and, furthermore, the strange and picturesque phases of life which are depicted are full of immediate interest. An actual war, now forgotten, for the possession of a cañon in Colorado, is vividly described by the author, who has shared in the work of the railroad men, and who made a special journey through the West to gather fresh material for this valuable and entertaining book.

Matter, Energy, Force and Work. A Plain Presentation of Fundamental Physical Concepts and of the Vortex-atom and Other Theories. By Silas W. Holman, Professor of Physics (emeritus) Massachusetts Institute of Technology. 257 pages. Price, $2.50. Published by the Macmillan Company, New York.

To all who know Prof. Holman's keen, clear and intelligent brain, and his ability in putting before a student or reader an accurate conception of fundamental physical facts and theories, this book will instantly appeal as a valuable addition to their engineering library. Chapter I. deals with the established fundamental facts about substance and matter, motion energy in its various forms, force work and measurements. Part II. deals with speculations on matter and energy, including treatises on the function of theory and hypothesis, the kinetic theory of gases, Le-Sage's theory of gravitation, the vortex-atom theory, and the nature of energy and matter.

Trade Catalogues

"Nir" Rubber Wire. Published by the National India Rubber Company, Bristol, R. I. 24 pages.

Electric Fans. Published by the B. F. Sturtevant Company, of Boston, Mass. 8 pages. Illustrated.

Who Uses Mechanical Draft? Published by the B. F. Sturtevant Company, of Boston, Mass. 18 pages.

Lundell Motors. Published by the Sprague Electric Company, of New York City. 72 pages. Illustrated.

Pencilings. Published by the Joseph Dixon Crucible Company, Jersey City, N. J. 16 pages. Illustrated.

Electric Heating. Published by the Simplex Electrical Company, Cambridgeport, Mass. 50 pages. Illustrated.

Columbia Lamps. Published by the Columbia Incandescent Lamp Company, of St. Louis, Mo. 24 pages. Illustrated.

Catalogue. Published by the Sterling Supply & Manufacturing Company, of New York City. 32 pages. Illustrated.

Rubber Covered Wire and Strands. Published by the John A. Roebling's Sons Company, of Trenton, N. J. 6 pages. Illustrated.