Street Railway Journal.

Vol. XII. *NEW YORK AND CHICAGO, JULY, 1896.* *No. 7.*

ELECTRIC RAILWAY CONSTRUCTION IN GERMANY.

BY LOUIS J. MAGEE.

"What is your title?" asked the German Emperor of a celebrity who was being introduced with several other special visitors to Berlin in the foyer of the Opera House. "I have no title, Your Majesty." "Ah, then, Herr Ingenieur," replied the Emperor.

Whether this incident means that there are very many engineers in Germany or that engineers are held in high esteem, it is certainly true, that the engineer holds a high place in Germany to-day, and is especially honored by the Emperor.

HANDSOME CENTER POLE CONSTRUCTION IN HAMBURG.

The city engineer of Bremen, for instance, is a frequent guest at the White Palace in Potsdam, and his schemes for deepening the Weser River have been closely followed by the Emperor. It is remarkable with what penetrating interest His Majesty follows improvements in details of his warships and ships of the merchant marine. The two large liners now being built for the North German Lloyd and to be launched next summer, were fully described to the Emperor in a special audience recently. The plans for the trolley road recently installed in Berlin were also submitted to the Emperor and promptly returned to the engineering authorities, after suggestions of no little value had been traced in pencil by the Emperor. Under these conditions the people who formerly had to win all their laurels with the sword, have hopes of appreciation and advancement in the lines which gain fame in other countries. The Emperor is very much interested in electricity at present, has upon one occasion attended a lecture at the Technical High School in Berlin, and has in his private rooms in the Palace with the aid of certain models, made himself intimately acquainted with the modern methods of electric propulsion of vehicles.

With especial reference to electric traction, it is in a way a hindrance and in another way an advantage, that each city has at the head of its technical affairs a skillful, experienced engineer who takes great pride in the streets. The city engineers, for instance, of Hamburg, Berlin and Bremen, are men of Continental fame whose opinion is sought outside of the bounds of Germany, each being a specialist in some department of city engineering; one, for example, having given especial attention to the building of sewers, another to the laying out of parks and another to the harbors. The city is divided into districts, and each district is given to an engineer who is entirely responsible for every change made in or below the streets in his district. If plans are presented for an electric street railway, the position of each pole must be shown by the contractors and these district engineers can immediately tell them whether they are liable to strike a sewer or a gas pipe in thus locating the poles, or whether the city contemplates widening the street at that point or removing houses. In this way the street is utilized to its maximum advantage, the various services of tubular posts, gas, water, telegraph, telephone, electric light, etc., do not conflict with each other and everything is done decently and in order. None of these official positions is given as reward for party politics, and as a general thing the engineers to be found in these positions are at the very head of their respective lines of work.

The especial elements of electric street railway work in Germany seem to be, as far as they differ from American methods, as follows: first of all, the financial side of the question. A tramway line is rarely installed for the sake of demonstrating a system, but is dependent upon traffic which may be surely counted upon. In some cases where lines were built in small towns where the traffic was rated as very low, it has been found that a good many more passengers were carried by the electric cars than would have been fair to calculate upon, just as in America; but as a general thing, only good paying lines have been taken up for the introduction of electric traction. In all such cases, the result has been, as in America, a marked increase in the receipts, and a decrease in the expenses.

In the case of existing street railways having horse traction where the finances were so good and the traffic so large that the introduction of electric traction might be expected, the great hindrance has been the shortness of the concessions. Many of the franchises which were given in the early days of street railway traction will run out in fifteen or twenty years, and this period would not be sufficient for the amortization at a reasonable rate of the new capital to be invested in electric traction. Most of the street railway companies have contracts with the cities according to which they not only have to pay to the city a percentage of their receipts, but also have to give over to the city at the expiration of their franchises their complete railway system as it stands, without remuneration, and their rolling stock at book value, or perhaps at its rated value. This makes it necessary for the street railway companies to demand a lengthening of the franchises before they can see their way clear to go to extra expense in electric installation. In many cases such a lengthening of franchises has been absolutely refused by the cities; in other cases the franchises have been lengthened, and the tramway companies have accepted in part payment of this lengthening of the franchises, certain sacrifices, like the additional paving of streets and the installation of some lines which can hardly pay. For instance, after the cholera scare in Hamburg when the cemeteries had proved inadequate, a new cemetery was laid out at such a great distance from the city proper that the ordinary means of conveyance would certainly prove inadequate in times of special epidemic. The street railway company undertook the building of a line to this cemetery, and expects to build funeral cars with compartments for the bodies and trail cars for the friends of the deceased. In general, the contracts which the cities have drawn up with the street railway companies are models of thoroughness in which nearly every possible point which could be thought of has been covered. The result is that things run very smoothly; there is very little litigation and very little discussion, because most of the points of conflict have been threshed out at the making of the contract. The reason why this is possible is that the men who make the contracts, that is, the mayors of the cities (burgermeister) are men whose profession is to be mayor. The mayor, for example, of Bremen, was formerly mayor of Breslau, and before he was mayor of Breslau he had experience in all departments of managing a city. Again the mayor of Magdeburg, was formerly mayor of Erfurt, and when he was called to Erfurt he brought with him experience as mayor of a smaller city. In Erfurt he went through all the work of closing a contract with the street railway company on the basis of which the old horse tramway company was reorganized. He gained so much experience in this that he is able to dispatch any business in connection with the Magdeburg tramways in a most prompt and intelligent manner.

This great principle of good city housekeeping is everywhere noticeable in Germany. The Germans cannot understand that Americans are able in their private enterprise to build up such enormous industries and carry on with such acuteness and skill the great works which have made America's fame everywhere, and at the same time are willing to put up with such wretched municipal management. For example, the question of just what is the best kind of stone, wood or asphalt for paving streets and just what is the most favorable contract to make for keeping the pavements in repair, is evidently a question of technical experience. The Germans say that they are careful that their wives should purchase the best food at the lowest prices and keep their tables good and their houses neat, why should we not see to it that we have solid pavements, well laid out parks and clean streets at the very lowest possible price, and what can accomplish this but good engineering and by keeping hold of people for the experience that they have gained? Perhaps a good many Americans think that municipal office should be open to everybody and should be paid for on the principle that all should have a chance to have such office, and if salaries were not paid the poorer population would not have a chance for the office. The Germans hold a little different idea of municipal office, namely, that it is not something to give to a man as a reward for service of good or bad political nature, but rather, a duty to be rendered to the commonwealth. The result is, that the aldermen are chosen from men who have gained large experience in business of technical ways and won an experience which is valuable for the Commonwealth, and which they are able to give to the Commonwealth. One alderman spends his time in looking after the orphans which the city places all over the country; another alderman takes the hospitals under his charge; another has the electric light, and another the street railways. Hardly any of these aldermen are paid. The list of unpaid officers of the city of Berlin, including hundreds of Commissioners of the Poor, Common Councilmen working at the park, Electric Light Commissioners, Fire Board, Tax Assessors, etc., makes a volume as large as the New York Telephone Directory.

Now, after the question as to whether there is enough traffic possible to warrant the installation of an electric line, or whether an existing horse line can get a long enough franchise to allow it to calculate upon as much profit for the future years as it is getting by horse traction, and after the question of satisfying the city as to the amount which that corporation demands in the interests of its population are all settled, come the technical difficulties. The Post and Telegraph Administration, the Director of the Fire Department and the City Police have to be reckoned with. The city Police President asks the Director of the Fire Department and the engineering authorities of the town if they are suited as to the technical propositions made. Each department goes into the plans carefully. The Fire Department makes perhaps some specifications as to the distance apart that the section switches must be placed. The subject of keys for the section switches, rubber gloves, cutting pliers for the trolley wires, etc., are gone into carefully. At the same time the telegraph authorities of the district in question are making their demands as to the protection of the telephone lines. In some cases they ask the railway companies to put baskets of wires directly under the telegraph and telephone wires. In some cases, in fact most cases, they are content with the wooden moulding which is attached directly to the upper side of the trolley wire. The railway companies are also obliged to insulate everything that goes on the top of the car, that is, the trolley base, arm and wheel. The experience gained in the various towns as to the efficacy of certain methods of protecting the small current wires, that is, the telephone and telegraph, from any damages which they might get from contact with the street railway lines, the experiments as to the difference in potential between the earth and the rails, the practicability of this or that method of regulating the feeders, etc., all coming in to the Central Telegraph Office at Berlin, they are in a position to give instructions to the various district managers. One would think this mass of detail sufficient, but during the last few years there has been still another hindrance in electric railway construction, namely, the Law for Small Railways, the Kleinbahn-Gesetz. While this law contains many advantages for small towns, enabling them to get money from the principal governments into which the country is divided and thus have the advantages of traction from one town to another which private enterprise perhaps could not supply, and while this law also regulates many debated questions as to the use of provincial roads, that is, the roads connecting one town with another, roads which go beyond the jurisdiction of any municipal government, there is one clause in it providing that all the street railway equipments shall have to be passed upon by the railway authorities in their district. For instance, let us take a common car equipment for the city of Leipzig. The company which has ordered the apparatus is satisfied with it, even to the color which the cars shall be painted; the telegraph authorities of the Empire are satisfied with the propositions as to running of lines and protecting them; the city engineers have made all the corrections they wish to as to the setting of the poles, and work can almost begin; but there is an engineer in Dresden connected with the Imperial Railways whose business it is to look after all electric street railways coming into his district, that is, in Saxony. Doubtless, he has a good deal else to do with his railways proper, but despite his regular duties he finds it possible to go so much into detail that he insists upon the company having an automatic cut-out on its cars instead of a fuse. In a moment the practice of all America and all Europe up to date is set aside, and the automatic cut-out has to be provided. One could almost ridicule this way of doing things, if it were not true that in nearly every case such recommendations on the part of the authorities have been good ones and have tended toward improvement in the art. The use of an automatic circuit breaker, for instance, on a car was demanded by the official in question, before hardly anything had been said or done on this subject by railways in America, and probably before the subject had been broached in Europe.

Finally, all the permissions having been given, exact drawings for the car bodies are sent to one of the four or five car shops, which, by the way, turn out work of most admirable quality, the motors and dynamos are under way, the steel poles are turned out, fifty a day, to exact drawings and with exact specifications for the steel, so that the bending test as the poles are accepted comes usually within about one per cent of the specifications; the ornamental castings for the poles are ordered from the iron founders, the local installing engineers go around to the houses and get permission to put on rosettes wherever they can, and so the work goes on. Meantime the authorities frequently give very valuable suggestions and often allow the company to go ahead before some problems are entirely solved. While the telegraph authorities of Germany have, of course, been vigorous in protecting their own interests on the ground that telegraph and telephone are important public service not to be disturbed by anything else, they have made every effort to make the railway also practical and at the same time strengthen their own service and make it less sensitive to the influence of street railway currents, so that any odium of old fashioned conservatism cannot be applied to the Germans when one carefully considers that their principle is to go ahead slowly, to avoid having to straighten out a disagreeable complication afterwards.

While the road is being built, the power station may be giving a good deal of trouble, in that the building commissioners of the town are very strict as to the interior arrangements as well as the exterior architectural form of power house and car houses, and sometimes there have been delays on this score. Of course, however disagreeable this may be, it really prevents companies from putting up unsightly power houses with bad looking, low, or even dangerous chimneys in the midst of a crowded population. The facades of most of the power houses, even in the smaller towns, look solid and neat. In some cases power is furnished by existing lighting stations at from 2½ to 3½ cents per kilowatt. In some cases this price means delivered at the switchboard, and in other cases means delivered at the lines, that is, the power station comes in for expense of the feeders. The city of Hamburg is interested in the electric lighting plant in that it receives a certain percentage of the receipts; it therefore, in allowing the tramway company to build an electric line, may make a condition that current should be taken from the lighting station.

VIEW OF CONDUIT CONSTRUCTION IN BERLIN—SHOWING YOKES UNDER SIDE RAIL.

It is a significant fact that last December, during the heaviest lighting season, more current was given out for the street cars than was used for the lights.

Hamburg has the largest electric street railway in Europe to-day. This summer will see about 320 electric cars in operation and all the horses and one steam line replaced by electricity as far as the lines of the principal company are concerned, although there is one company which still has something to do in changing over its lines.

Berlin sent its engineers all over Europe on several visits to see everything that had been done up to date. They had an accumulator line which did not give satisfaction or in fact cause any especial notice and was shortly abandoned. They had done nothing about traction until they suddenly came to face the problem of transporting the

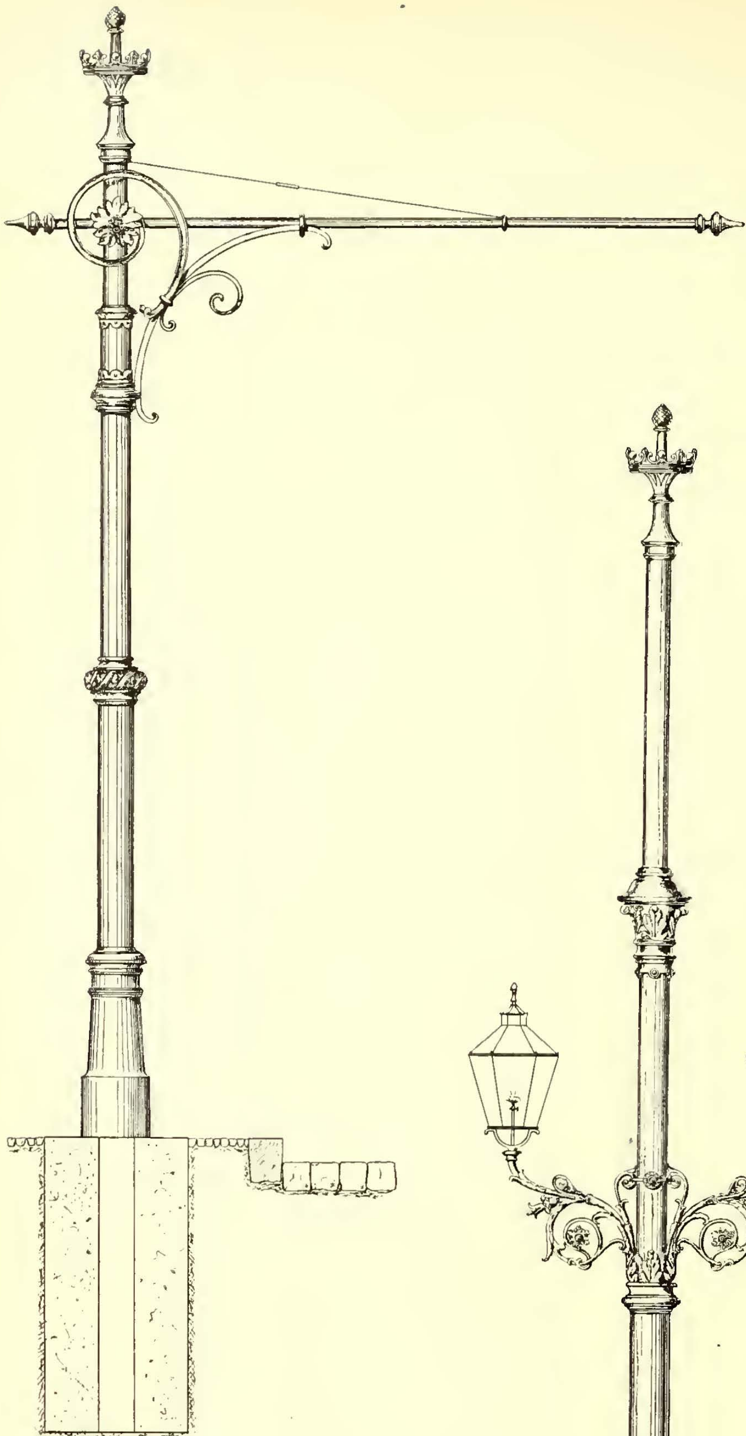


FIG. 1.

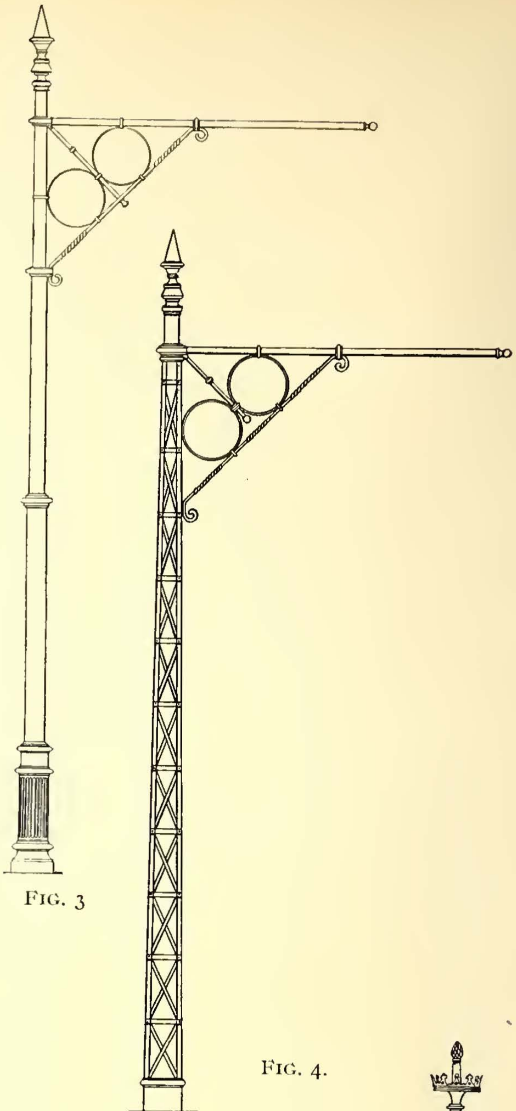


FIG. 3

FIG. 4.

Fig. 1.—Single bracket pole—Berlin—scale 1:40.

Fig. 2.—Combination span wire and gas lamp pole—Berlin—scale 1:40.

Fig. 3.—Single bracket pole—Remscheid—scale 1:60.

Fig. 4.—Single bracket pole—Erfurt—scale 1:60.

Fig. 5.—Single bracket pole—Leipzig—scale 1:60.

Fig. 6.—Span wire pole—Berlin—scale 1:60.

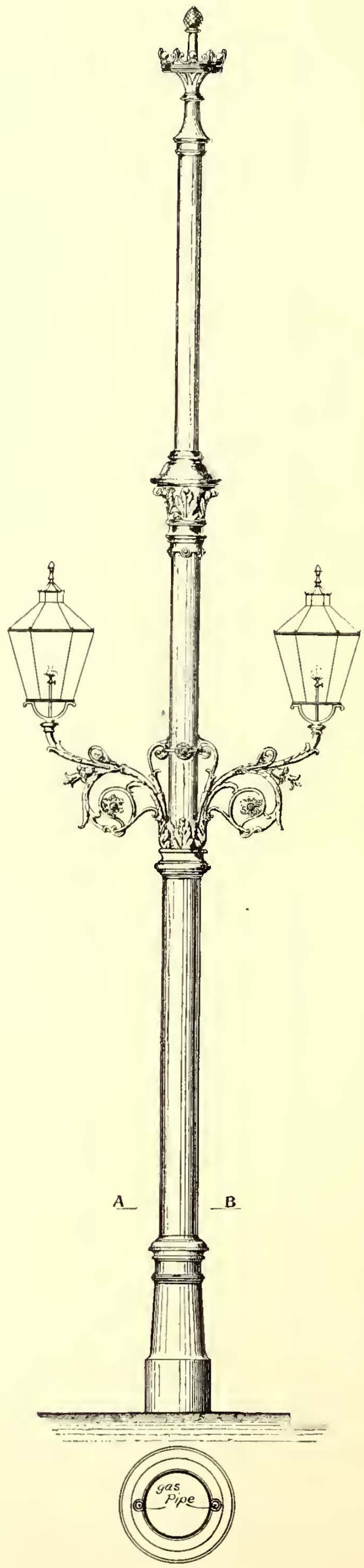


FIG. 2.

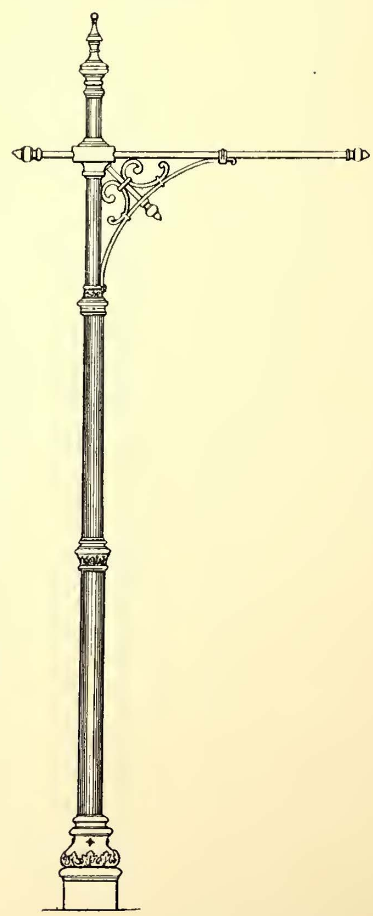


FIG. 5.

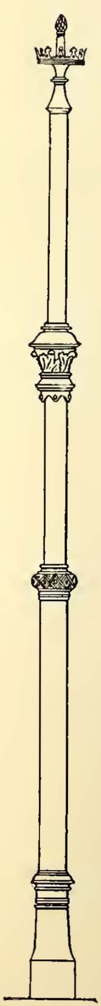


FIG. 6.

REPRESENTATIVE GERMAN ELECTRIC RAILWAY POLES.

crowds to the National Exposition now in progress. Three long lines were then fitted out connecting different parts of the city with the Exposition. The interesting feature about these lines is that they contain about two miles of underground conduit. This they call in Germany the "mixed" system. They run in the broadest streets of the city where the streets are comparatively free with the trolley line, and when they come into the crowded, thick part of the city, the conduit is used. The conduit is similar to that used here on the Lenox Avenue line in New York, and in Washington, except that the yokes are smaller. The conduit is under one rail as it is in Buda-Pesth. The Berlin lines, which the Union Elektricitäts Gesellschaft has built, have plows on their cars which can be inserted into the conduit or taken out by an ordinary hand lever, operated by the motorman. This makes the system very flexible and the change from the trolley to the

TROLLEY POLE IN BERLIN.

conduit takes place without any trouble. The Union Elecktricitäts Gesellschaft is building about ten miles of this conduit in Brussels over a street where the King drives frequently, and does not want a trolley line, and where the trees are so low that the trolley line would be difficult to build.

Most of the cities and larger towns in Europe are provided with electric lines or have contracts for them; so that one can really say that Europe is not much behind America in this way. Of course, there are not so many cars, as the cities in Europe cover a comparatively small area; people live mostly in the cities and the advantages of suburban life are not so much enjoyed in most of the cities as in America. The 1,700,000 inhabitants of Berlin live under fewer roofs than the population of a city only two-thirds the size in America, so that they are more crowded together and do not have so many individual homes.

The electric traction methods being employed in Germany do not vary essentially from the American practice. There are four companies in Germany competing vigorously for every possible electric road. Some of the roads run more economically than others and some of them look better than others, but in appearance the average visitor would find them the same as the roads in America. The companies have made a specialty of substantial overhead line work, and their poles all stand straight and their wires are put in such a workman-like manner that they look as if they would stand a good many years of operation. In fact the overhead work of the road built in Bremen nearly five years ago looks better to-day than on the average American road. The Hamburg line is a model of overhead work and the prejudices of the Hamburg public have been entirely overcome by the carrying out of the work in an artistic manner.

As a rule, the cars in Germany are smaller. Some of them are designed for only sixteen passengers, and the largest for twenty. A fixed number of passengers are allowed to enter the car, and when the seats are filled nobody is allowed to stand up, so there is no crowding in the car. The platforms are allowed to carry at most five in front and six behind. There are however some German cities where the cars are permitted to be crowded *ad libitum*. The average speed of the car through the town is about eight miles an hour and outside the city limits ten miles. It is not likely that the German authorities would ever be brought to see that the requirements of city life as to high speed traction on the surface would admit of such speeds as the cars in some of our American cities are allowed to take. The German in all departments of his work is careful above all things of human life. There have been very few accidents with the cars of the electric roads installed up to date. Most of the companies take out an insurance policy, paying a certain fraction of a per cent of their receipts to cover them against any damage to passengers or people passing in the streets.

The insurance system of Germany is an interesting and complicated subject. The Government does a great deal for the protection of the working class. Every employe earning $500 a year or less is insured in the Government insurance fund for death and invalidity, the employe paying half and the employer half. This is not only true of the industries in general, but house servants are also included. A housekeeper pays five cents a week for her cook's insurance. The industries are divided into groups, for instance, fine mechanics, street railway drivers, trainmen etc.; each has its board of inspectors and paid officials. These boards of inspectors agree upon certain rules tending toward the greater safety of employes, thus reducing the chance of accident and the consequent drain upon the insurance fund. For example, several accidents had taken place with tower wagons; the board of inspectors under which the electric companies came requested that some special safety appliances be used on the tower wagons.

The power stations are usually fitted with condensing steam plants of the greatest possible efficiency. If condensing water is not to be had cheaply board towers are frequently built and the warm water falls down a height of forty or fifty feet over these boards into a little reservoir, being cooled and partly evaporated by this process; it is then used over again. Labor is so cheap that mechanical stoking is not much resorted to. The various types of water tube boilers similar to the American are largely used, and there are a good many fine boiler manufacturers in Germany. Coal is usually pretty dear, costing about $2 at the pit and delivered anywhere from $4 to $5 in Berlin, Hamburg and thereabouts. With such coal prices traction expenses amount to about three and a half to four cents per car mile including the following: all labor, fuel, oil, waste in the power house, all the labor required for cleaning and keeping the motor gears and wheels and trucks in good repair, also all labor and repairs on the line, that is to say, everything which really enters into the department of mechanical traction as apart from horse traction. This amount per car mile does not include the motorman and conductor, and does not have anything to do with the rails, or cover any financial writing off or interest on the plant. Lower results than this figure have been obtained with coal as high as $4 per ton. And in cases where there were heavy grades and few cars equipped with two motors, the cost runs higher. Most of the electric cars in Germany are equipped with only one motor. The Union Electricitäts

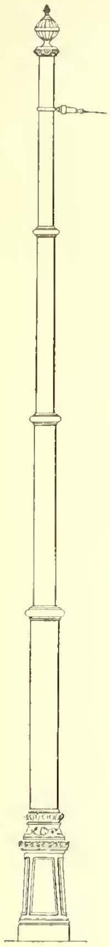


FIG. 7.

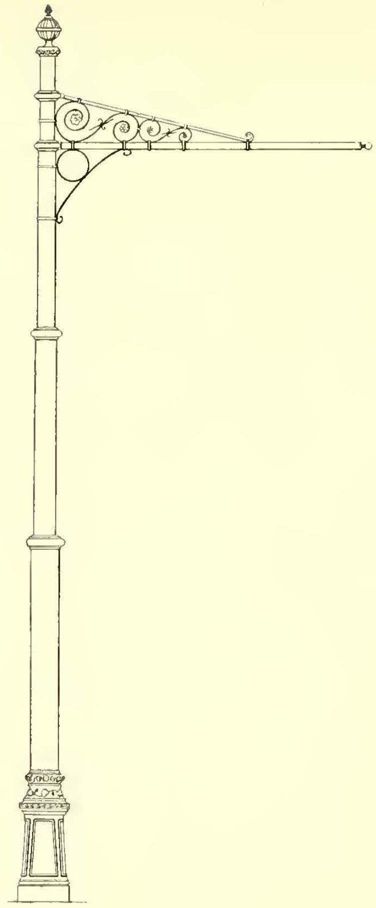


FIG. 8.

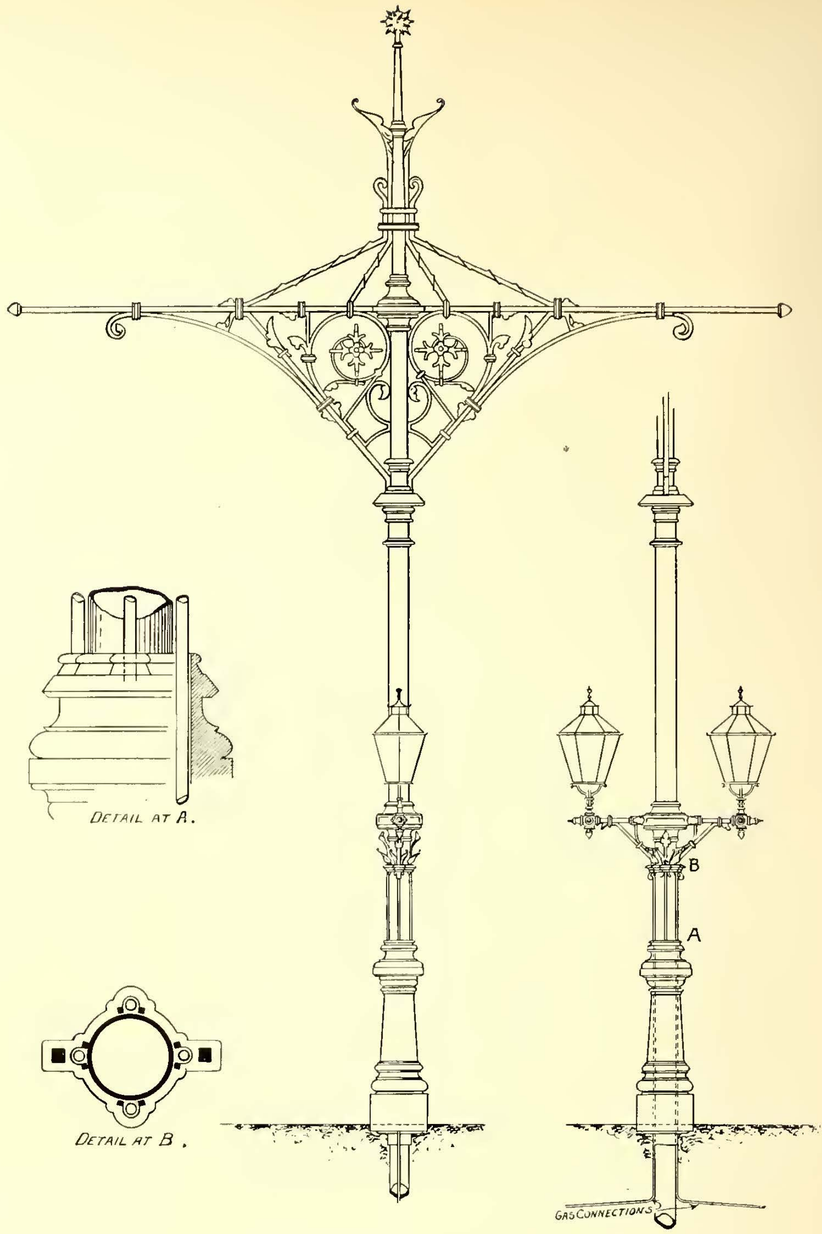


FIG. 9.

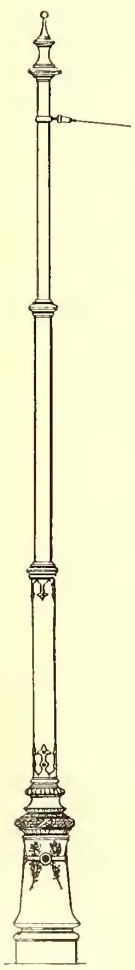


FIG. 10.

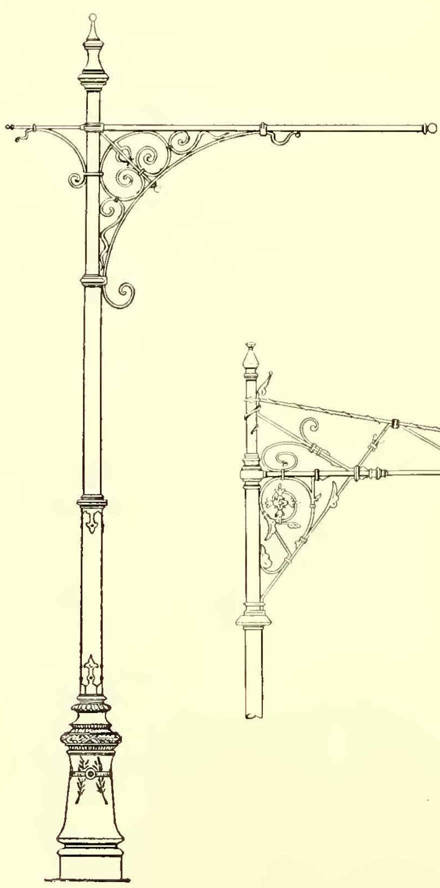


FIG. 11.

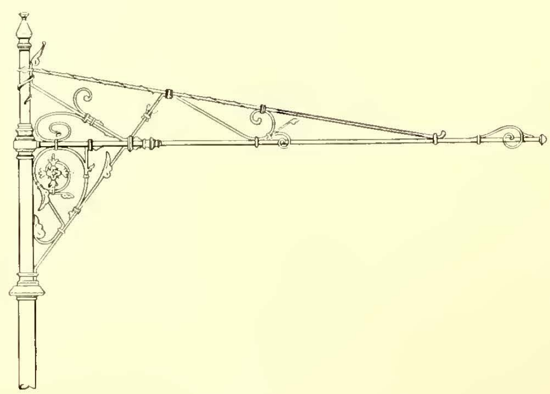


FIG. 12.

Fig. 7.—Single bracket pole—Liège—scale 1:60.

Fig. 8.—Single bracket pole—Liège—scale 1:60.

Fig. 9.—Combination double bracket and gas lamp pole—Hamburg—scale 1:60.

Fig. 10.—Span wire pole—Wiesbaden—scale 1:60.

Fig. 11.—single bracket pole—Wiesbaden—scale 1:60.

Fig. 12.—Bracket for two trolley wires—Hamburg—scale 1:60.

REPRESENTATIVE GERMAN ELECTRIC RAILWAY POLES.

Gesellschaft equipped a line in Remscheid near the lower Rhine with a grade of 10.6 per cent, which is probably the steepest street railway grade in Germany. The railway authorities predicted that a car would not mount this grade, but that was some years ago. They have learned a good deal on these subjects, just as all the rest of the world has in the last five years.

A good many roads cannot stand the expense of a conductor, and they have cash fare boxes. Most of the roads in Germany have the zone system, the smallest fare being ten pfennigs, or about two and a half cents; this carries a passenger a little over a mile, or, to be more exact, about two kilometers. The next fare is fifteen pfennigs and twenty and twenty-five pfennig fares are rarely collected. The average receipts per car kilometer on good paying roads in Germany are between twenty-five and fifty pfennigs per car kilometer, that is, between ten and twenty cents per car mile. Probably Berlin is the only town where the average receipts for all the lines of a city come up to fifty pfennigs; the average in Hamburg is only thirty-six pfennigs, and a town like Bremen of about 200,000 inhabitants with twenty-five electric cars has average receipts of thirty-five pfennigs per car kilometer (fifteen cents per car mile).

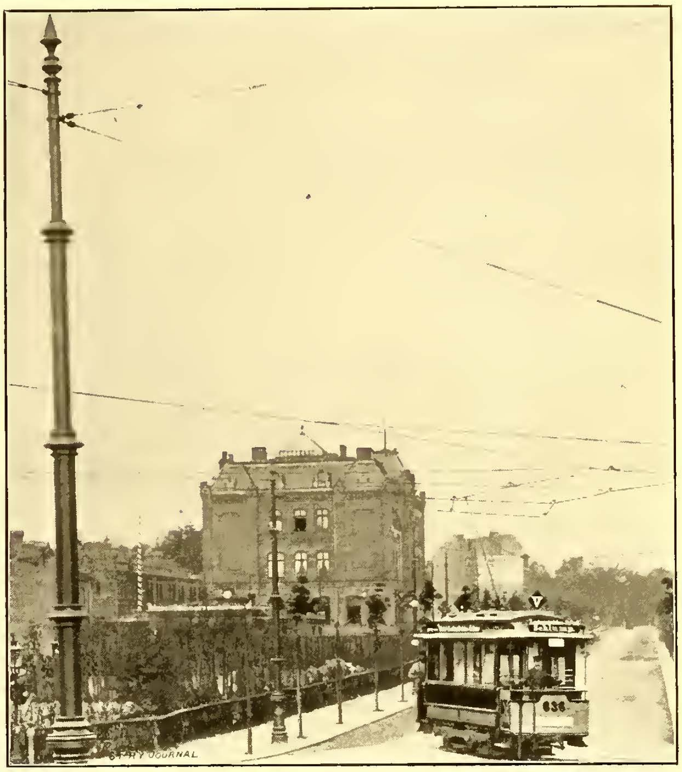
Some of the companies like the Hamburg and Bremen, build their own car bodies, and the Hamburg cars are especially admired. Partly because the climate is not severe in winter and partly from hygenic reasons the cars in Germany are not heated to any extent. In fact, Germans do not keep their houses as warm as Americans do, and do not suffer so in the street cars if they are not heated. There is also less suburban traffic and artificial heat is less necessary for that reason. Electric heaters are not considered especially economical, and stoves are considered uncomfortable and take up one seating space, although stoves have been tried on one street railway in Germany. Where heating appliances are used they are usually on the coal brick system. These bricks are put in a little door from the platform and they consume slowly in the tube which passes along under the seats and out below the car or at the top of the car. The driver can keep the car sufficiently warm by putting in two or three of these "briquettes" in the morning only, or in severe weather again at noon. This makes the heating for a car cost something like fifteen or twenty cents a day.

Electric bells are used a good deal in street cars for the convenience of the conductor and passengers. The cars only stop at fixed stopping places which are indicated by iron signs on which is clearly written "Stopping Place of the Berlin Street Railway." These signs are also painted on the trolley poles in case of electric roads, and sometimes only a colored ring is sufficient, as in America.

Accumulators are largely used in Germany for lighting purposes, but in spite of frequent trials no accumulator lines have remained long in operation. There is an experiment going on in Hanover which some engineers consider the best solution of the street railway question. Many others consider that that of Berlin just installed, if it should prove a success, will be the best solution for large cities. This is the mixed system, namely, the trolley wherever possible and the conduit for streets in the heart of the city.

Accompanying this article are illustrations of some of the poles used for tramway work in various cities in Europe. In some cases the designs have been modified by the city engineers to suit their tastes or to especially harmonize with the ironwork already in their streets. Existing gas chandeliers have been made over to go well with the trolley poles, and a good deal of special work has been done so as not to disturb the streets any more than is necessary. The Germans may not be so particular for the luxuries in their drawing rooms that we enjoy in America; at any rate the average German housekeeper has not half the good taste of her American cousin in making a dainty and inviting home, but if the Germans fail in this respect, they certainly do have a pride in an orderly street, and the bent and twisted wooden poles with spur marks on them used in America for arc lamps and telegraph lines, and the plain iron pipes standing at all sorts of angles and anything but perpendicular which disfigure so many of our streets, would not be allowed in Germany. Even if the Germans get trolley roads in all their cities a few years later than do Americans, and get them in so they will look well, perhaps in the end their policy to put a little more money in at the start, figure exactly on the strain which overhead lines make upon their poles, calculate exactly the sizes of their poles and see that they are set at such a cant that they will pull up straight will be the best.

The electric railway companies have in their work installed a great many rosettes on the houses to do away



VIEW IN HAMBURG.

with poles. In cases where the owners of the houses refuse rosettes, of course, a pole has to be placed. There are about 4000 rosettes already installed. They are provided with rubber buffers so that the vibration of the wires is not communicated to the house to any great extent.

The Pottstown Passenger Railway Company has issued a handsome circular and poster descriptive of and illustrating Sanatoga Park, a pleasure ground owned and managed by it. The engravings show that the park must be a particularly attractive point for picnics, excursions, camping parties, etc., which have the use of it free of charge. It is a tract of 107 acres, and lies about three miles east of Pottstown on the Schuylkill River. Naphtha launches, merry-go-rounds and other entertainments are provided. Mechanics are now engaged on the construction of a large pavilion with a capacity of 6000 people, located on an eminence overlooking Lake Sanatoga. The pavilion will contain a dance floor, stage, restaurant, etc. An electric fountain and fireworks form additional attractions.

A change has been made in the ownership of the Toledo Electric Street Railway Company, although the management of the road will still be in the hands of Jas. J. Robinson, whose long experience especially fits him for the place. The present officers of the company are: president, Jas. A. Blair, of New York; vice-president and treasurer, John B. Dennis, of New York; secretary, W. Robinson.

OPERATION

Studies in Economic Practice.

By C. B. Fairchild.

Shop Methods, Tools and Labor Saving Devices of the Chicago City Railway Company. Part I.

Quite a number of the larger street railway companies of the country, on the change from horse to mechanical traction, inherited from the old regime repair shops that in design and equipment were inadequate to handle the new and heavier work that is an incident to the change in motive power. A relic of this kind is found in the repair shops of the Chicago City Railway Company, but by a skillful arrangement of tools, the introduction of modern methods of practice and the use of labor saving devices, the shops are made to turn out all kinds of work in about as large quantities and as cheaply as in some of the more modernly constructed shops. The one principal criticism to be made on street car repair shops generally, especially in the iron working department, is that the tools or machines are too light for the work required of them. It is better to have extra heavy machines, as these will do light work as well as the smaller tools, and not be overtaxed with the heavy work.

The repair shops of the Chicago City Railway since last October have been under the direction of C. E. Moore, master mechanic, under whose supervision a number of important changes have been made. For instance, a low basement that was not formerly used has been employed as a storeroom for wheels and castings of every description. A space for stairs and a trolley hoist was cut through the floor and the basement was lighted by gas and more recently by electric lights. This added largely to the storage capacity of the shops and relieved the main floor of a large accumulation of castings. The capacity of the shops has also been increased by the addition of a monitor story over a portion of the building. In order to support the additional weight larger roof truss rods have been introduced in the main building. The new addition will accommodate the departments of light work, including the tin shop, upholstering department, broom department, pattern making and electric work.

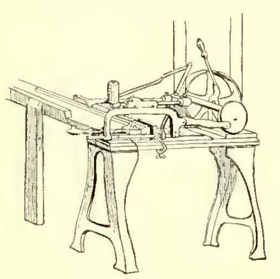
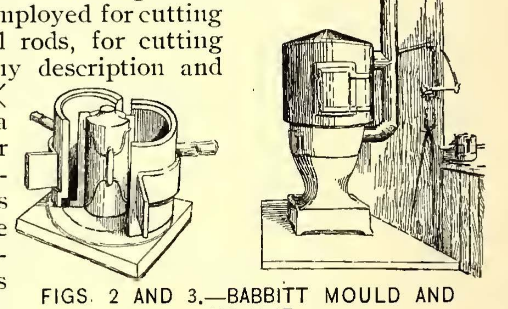


FIG. 1.—HACK SAW.

During the month of May the average number of open cars run through the shops for overhauling and repairs was about nineteen per day, as against thirteen during the corresponding month last year, with only twelve additional men. This is the highest record in the history of the shops.

Another important change worthy of note is that in the iron department the workmen's benches are set out about three feet from the wall, so that vises may be attached to each side and a double crew of men can work at each bench. The principal reason however for such an arrangement is that the floor can be kept cleaner and the space under the bench does not become a dumping ground for odds and ends. It permits of the floor being swept throughout, and in the summer time it allows the workmen to avoid the direct rays of the sun which would beat upon them were the benches near the windows. The benches are lighted with two stands of gas fixtures which come through the middle of the benches near each end, and have folding burners with wire screens at the end. The top edges of the benches are also faced with a steel plate ⅜ in. × 1¾ in., set in flush with the top of the bench. This protects the edges from wear and also gives a straight edge which is of service in laying off work. At one end of the row of benches is a surfacing table consisting of a heavy iron plate, 4 ft. × 5 ft., set flush with a heavy frame. As its name implies this table is used for surfacing up or straightening bars or other shapes.

Among the tools not always found in street railway repair shops is an automatic power hack saw (Fig. 1) from the Millers Falls Manufacturing Company. This is employed for cutting up bars and steel rods, for cutting keys, pins of any description and bars up to 4 ins × 4 ins. There is a side table or trough for holding the long rods in place and these are clamped together by means of a hand wheel. After being clamped in place, the saw is started and takes care of itself until the cuts are made, the only attention required being to readjust the rods when one cut is made. There is also a six-tool turret lathe, a combination of the Fox and turret lathes and one of the machines exhibited at the World's Fair. With the use of this tool brass hangers, pull-offs and other parts for overhead work are quickly and economically turned into shape. They are bored, counterbored, faced off and threaded for the cap with one adjustment to the chuck, the different tools being previously adjusted in their separate heads. The same machine will cut all kinds of threads and screws and is handy for every kind of electric work as well as chucking, boring and the cutting of inside and outside threads.



FIGS. 2 AND 3.—BABBITT MOULD AND FURNACE.

Another economical device is that of a babbitting furnace and moulds for babbitting the armature bearing boxes. This furnace (Fig. 3) was designed by A. J. Rosier, foreman of the machine shops and is a cannon type of coal stove. The barrel is of cast iron with a large circular sheet iron hood resting upon the outer surface and having a hinged door about a foot square to give entrance to the caldron. The latter is set in the top of the stove casting, is eighteen inches diameter and has sufficient capacity for holding about 300 lbs. of metal. One smoke flue leads from the stove proper into the chimney and another from the hood which conveys the offensive gases of the metal directly into the flue. The scrap is placed in the caldron and when melted is dipped out with ladles having handles about three feet in length. The most interesting part of the process consists in the moulds in which the boxes are placed for babbitting. These are shown in Figs. 2 and 4 and have an iron base about a foot square. Above this are two semicircular cases hinged together at one side and fitted with long handles for opening and closing. The iron base carries a mandrel of the proper diameter for the bore on which are X ridges which leave their impress on the babbitt and which answer for the oil channels. There is also a lug or core for the oil hole. A pair of boxes are first placed in position around the core. There is then inserted opposite each split a thin strip of metal which is held in place by a groove cut in the mandrel and which serves to divide the metal when poured. The boxes and strips being in place, the outside shell is closed around and held by means of a U-shaped clamp that is driven on with a hammer. After the metal is poured the clamp is removed and when the boxes are taken out a new set is readily adjusted. By this method one man can pour and chip about thirty sets a day. The boxes are then placed in a proper case and are surfaced upon a boring mill and are ready for service.

The shops are also equipped with two moderate sized punch and shears and more recently there has been added a very heavy combined punch shears having a capacity for punching a two inch hole through a 1½ in. bar and for cutting six inch plates up to 1½ ins. in thickness and with dies and punches that are readily adjustable.

A heavy universal miller has also just been added to the shop equipment. This machine is the largest size made and has a universal index head for spiral milling, making one of the most useful machines to be found in railway shop equipment. In the steam pipe department is a thread cutter that will thread pipes up to six inches in diameter.

Compressed air has heretofore been employed to a limited extent for the operation of air lifts and for other purposes. There are two air trolley lifts, one of which is a telescope lift and is employed chiefly for loading and unloading the cable grips to and from the transfer wagons. Recently however an additional equipment for the utilization of compressed air has been added. An old heater boiler has been repaired and put in position near the air pump, which is of the ordinary Westinghouse locomotive type. This boiler will be used as a reservoir and will increase the storage capacity by 150 cu. ft. This additional supply will be utilized for the operation of air jacks for the lifting of cars and air lifts for transferring motors, for cleaning cushions, boring holes in car sills, and other work about the car shop, cleaning castings by sand blast and also for sanding glass. There will be a number of additional air hoists, and air whistles in place of gongs will be employed for morning, noon and dismissal calls.

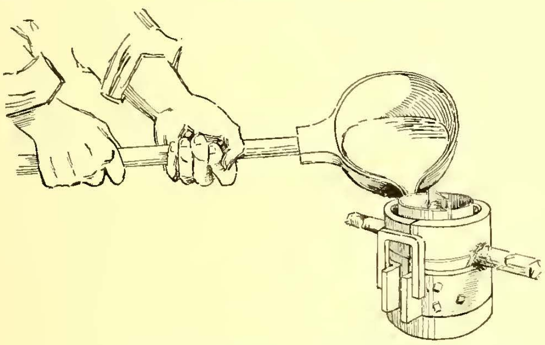


FIG. 4.—CASTING BABBITT IN ARMATURE BOXES.

Another commendable arrangement noted is the provision of a separate department kept under lock and key and in charge of an attendant, in which are storage bins for the valuable scrap and valuable metals that are used about the place. Thus there are bins for the copper, antimony, tin, lead, zinc and babbitt. The material is weighed out to the moulders and the castings are also weighed so that the metal is all checked up, a certain per cent being allowed for shrinkage, so that a careful watch is kept over all the valuable metals.

A well equipped brass foundry is an adjunct of the shop, and in this there are eight furnaces. These are all hooded in for the removal of the offensive gases, and here all kinds of trimmings and all brass work employed in overhead and other construction is manufactured. It is proposed to erect a small cupola about eighteen inches in diameter by five feet in height for melting the coarse composite metals employed in the casting of the grip dies. In this way the company expects that a very large saving will be made in the coal consumption and that it will avoid the expense of graphite crucibles which have heretofore been employed and which have a life for only seven or eight charges. For the cable service about 2700 new dies are required per month. This use consumes about 21,200 lbs. of metal, the mixture being copper, tin and lead. A saving will also be effected by the process of moulding which is to be employed and which is known as the block method. A split pattern will be used and the halves fastened permanently to each side of a half inch iron plate. Holes are made in the ends of the plate to receive the flask pins. The flask and follower are rammed up around the mould and plate, the pouring hole being left in the cope side. The follower being lifted off and the plate with the pattern removed, the parts are again placed together when a complete mould is formed.

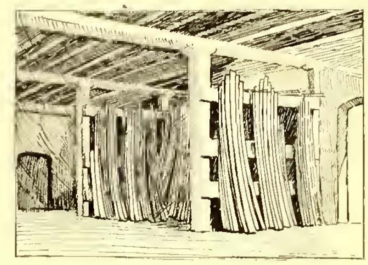


FIG. 5.—BAR IRON STORAGE DEPARTMENT.

The following mixture is employed for trolley wheels:

40 lbs. copper.
5 lbs. tin.
1½ lbs. lead.
½ lb. zinc.

Adjoining the master mechanic's office is a new tool room in which all small tools are kept in suitable cases, numbered and labeled to be readily found. The tool room is in charge of an attendant who hands out the tools to the workmen on checks as they may require, and a careful watch is kept to prevent the loss or breaking of tools or drills. To one man is assigned the duty of sharpening and grinding all the tools so that they will be kept to an exact size and always be in order, and so that when a job is to be done the workman will know that the cutting tool is of proper size. It is especially important that twist drills be ground properly. In the tool room are also kept many small parts, such as files, lag screws, small rivets, screws and the stub steel from which tools are manufactured.

The bar iron storage department is near the shears and near the door of the blacksmith shop. Here the iron bars are all placed on end and the different sizes and qualities are separated by pins or partitions fastened to the supporting posts, as shown in Fig. 5. This method of storing the bars on end is considered more economical than where racks are employed. Three sides of a square contain the metal thus stored, while around the outside a like amount is placed and serves to brace the frame structure in both directions. In this position the metal is more readily removed for use in the shop than when it is resting on racks. In the latter case it frequently takes two or three men to draw a bar out, but where placed on end one man can easily handle them, and being in this position they are more readily inspected.

Near the shears are the reels (Fig. 6) on which different sized chains are wound. There are ten of these reels. They are about a foot wide and from fourteen inches to twenty inches in diameter, and are mounted about a foot above the floor. When a piece of chain is needed it is readily unwound and cut off at proper length by the shears. The ends are carefully looped up so that the reels present a neat appearence.

A hand truck is used for transferring wheels and axles between the pit room and the wheel press, the latter being located in the machine shop. The truck is a simple platform, about five feet long and two feet wide, having a low strip along each edge. The truck wheels are about eight inches in diameter with a two inch tread, and the front axle is swiveled by a king bolt. To load a pair of wheels the truck is placed alongside and by means of an incline they are very easily rolled on to the platform. As the truck has a handle it is easily drawn over the floor by one man, the axle traveling endwise.

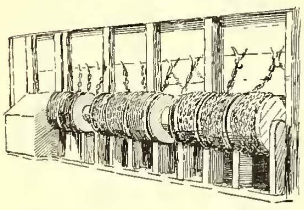


FIG. 6.—CHAIN REELS.

In the blacksmith shop are found many labor saving devices, a number of which are illustrated in this connection. The equipment of the shop consists of eight forges, two steam hammers, one of which is a Bradley hammer, and two furnaces. One of these has a removable back so that quite long pieces may be heated. The furnaces are fitted with a blast and serve for heating a number of small parts quickly and cheaply. Some of the forges have a brick fire arch or an arch of firebrick held in place by an iron backing and provided with a ring to facilitate handling them. These are placed over a fire, assist in keeping in the heat and avoid the necessity of forming a coke arch. For extra large forgings however a coke arch is formed (Fig. 8).


FIG. 7.—BRICK FIRE ARCH.

The principal labor saving implements of the blacksmith shop are the different bending tools and swedges, some of which are illustrated in this connection.

Fig. 9 illustrates a bending tool which is placed above the anvil and in which four bends can be made at one heat. In this flat iron 1½ ins. × 1½ ins. can be bent, and round iron up to 1¼ ins. One of the levers is handled by the helper and the other by the blacksmith. The different shapes that can be formed of this tool are shown in the same connection. It will be readily seen that a large number of pieces can be turned out in a day in a tool of this kind.

Fig. 10 is a link tool for bending coupling links up to ⅝ in. square. This tool is placed on the anvil and is pivoted at the point marked P. The handle then clamps the iron after which the entire tool is moved around the pivot and the link formed.

Fig. 11 is an S-hook tool for bending S-hooks cold, and will bend from ¼ in. up to $\frac{7}{16}$ in. in diameter.

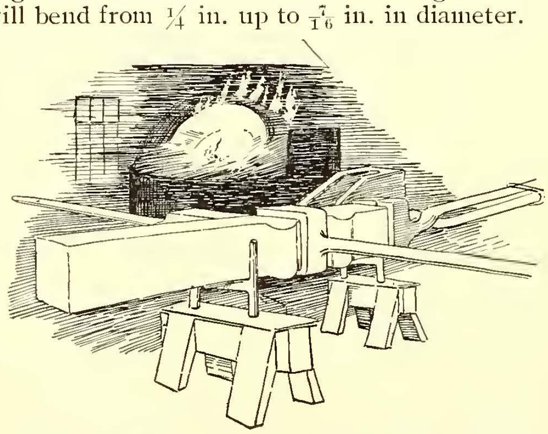


FIG. 8,—COKE FIRE ARCH FOR HEAVY FORGINGS.

Fig. 13 is an adjustable bending tool for links and hooks of all sizes. The roller as noted may be shifted for any desired diameter.

Fig. 12 is an adjustable bending tool for making rings, links, etc., of any diameter. It can be adjusted with the set screw shown in the illustration.

Figs. 14 and 15 show a spring swedge for use with the steam hammer. This is swiveled on a post or pedestal and can be swung off the die when not in use and when it is necessary to use the hammer for other purposes. This tool is employed for swedgings of all descriptions and for making crotch irons. As will be noted the swedge is provided with a spiral spring between the parts which serves to lift the upper part free from the iron as the hammer head rises.

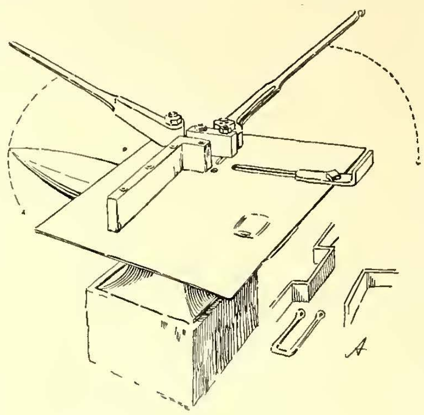


FIG. 9.—BENDING TOOL.

A large number of tools of similar design for lighter work are also provided, and were nearly all designed by Fred Steen, foreman of the blacksmith shop.

Another interesting feature of the foreman's work is that of a sketch book in which he makes a pen sketch of every new piece of work that comes to the shop, in which the dimensions are given and the quality and dimension of the iron from which the piece is to be forged, and which will be readily understood from Fig. 16 which shows an exact reproduction (half size) of two of the pages of this sketch book. These records serve very valuable references, for should the stock of a piece be exhausted and a new order come in, the drawing and dimensions and the proper method and size to be cut off are readily referred to, as there is an index to the book. This saves a great deal of labor in re-sketching the piece, and the foreman can turn over the book to one of the blacksmiths who is able to make the piece without further supervision.

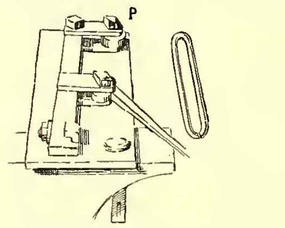


FIG. 10.—COUPLING LINK TOOL.

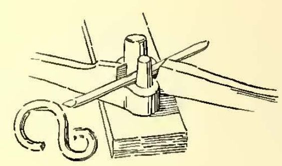


FIG. 11.—S-HOOK TOOL.

There are many other interesting features of the shop, but as these are common to most shops they will not be noted in this connection.

The tin and burnishing shop are on the second floor of the main building and have some interesting features. Oxydized brass is used for all car trimmings, and when old cars are overhauled for repairs the brass work is all cleaned and put through an oxydixing process. For cleaning the old metal the parts are introduced to a bath of hot lye and from this into a water bath. They are then taken to the buffing room for polishing. When returned to the oxydizing room they are placed in a solution of muriatic acid, arsenic and chloride of iron. The latter is made by the mixture of muriatic acid with anvil scales which are obtained from the blacksmith shop. A weak solution of nitric acid is also added to the oxydizing mixture. When the material is removed from the bath it is the color of a black oxide. It is then sent to the buffing room and is spotted on the buffing wheel in irregular or antique forms according to the taste of the operator. It is then given a coat of lacquer and baked in a furnace which

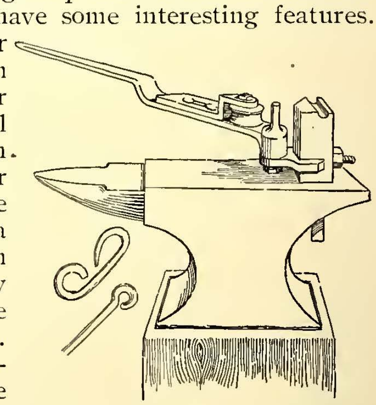


FIG. 12—ADJUSTABLE BENDING TOOL FOR HOOKS AND LINKS.

is heated by steam to a temperature of 120 degs. Rough brasses and such as are not to be oxydized are cleaned by being dipped in a solution of nitric and sulphuric acid.

Fig. 17 shows a cable reel in position with about 300 ft. of the rope hung on from the reel and coiled at the top. This arrangement provides for readily running out the first section of the rope into the splicing room ready to be spliced on to the old rope when a new rope is to be run in. This avoids the necessity of getting a large number of men together in a hurry to help turn the reel. A small engine with proper shafting is provided from which, by means of sprocket chains, the cable reels are operated for winding up or transferring cables. The long ropes are shipped on two reels to facilitate the handling, but when placed in position for stringing in the conduit the entire rope is run upon one reel.

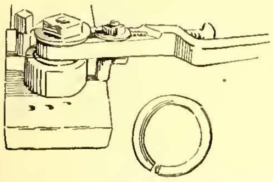


FIG. 13.—BENDING TOOL FOR RINGS AND LINKS.

Ten old trail cars have recently been remodeled into low deck motors for winter service. A special feature in the new construction of these motors is that they have solid windows, the glass being set without sash. The edges of the glass are held in place by rubber channels and a space of 1/4 in. is left all around between the rubber and the framing. This arrangement prevents the rattling of the glass, and although these cars have now been in service about four months, there has been no breakage from the strain or jarring of the cars. Ventilation is secured through the deck lights.

The company has recently equipped five of its track sprinklers with single Westinghouse No. 3 motors. These sprinklers are mounted on a wooden truck with 4 in. X 7 in. sills. The framework which supports the sprinkler tank rests on eight round rubber springs, four on each side, the springs being 4 ins. X 2 ins. The springs are held in place by a wooden plug which is shorter than the thickness of the springs. The motor is suspended from a steel yoke which is attached to the sills. In some cases the suspension consists of wrought iron hangers attached to one of the cross sills. The cables are protected by a watertight trough and the motors by a canvas curtain which screens it from the spray of the sprinkler. One of these sprinkler tanks holds about 1300 gals., the rest are of 1500 gals. capacity. The trolley is supported by a bench or table on top of the tank and the controller is located on the floor of the truck which extends beyond the tank.

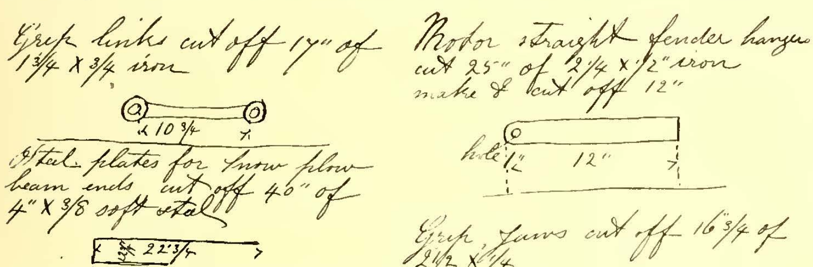


FIG. 16.—FAC-SIMILES OF PAGES FROM FOREMAN'S SKETCH BOOK.

In the woodworking department a very ingenious tool is employed for making dowels so that the grain of the wood will be the same as the surrounding parts of the hole that is to be plugged. (See Fig. 18.) Those dowels are chiefly employed for plugging the countersunk holes of screws used in paneling or for holding strips of any kind. The tool is a pipe with regular saw teeth cut into the end. It is operated in a boring machine and the dowels are sawn as shown in the illustration. Both sides of the block are cut when the plug is sawn through endwise and the dowels come out completed, of any size and of smooth and uniform surface. They may also be cut tapering if desired.

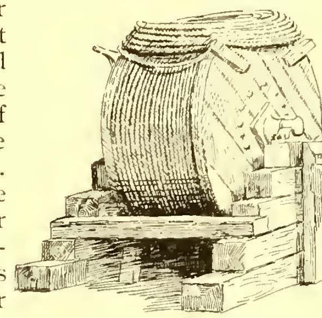


FIG. 17.—CABLE REEL.

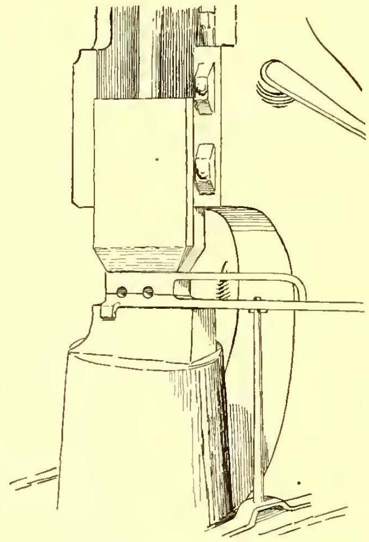


FIG. 14.—SPRING SWEDGE AND STEAM HAMMER.

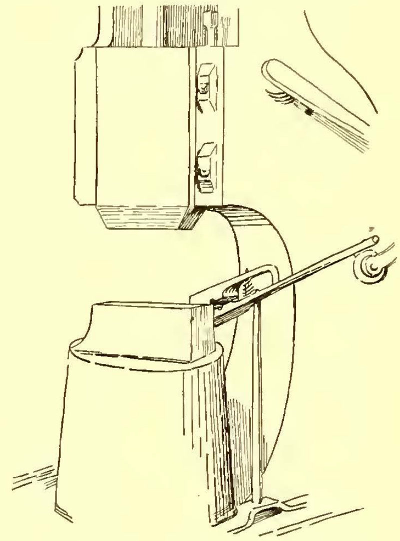


FIG. 15.—SWEDGE TURNED BACK FROM DIE.

In placing the dowels over the countersunk screws (Fig. 19) care is taken not to drive the dowel against the head of the screw, but an air space of one-sixteenth inch or more is left, or the dowels are cut with a concave surface at the end so that they do not touch the screw. This prevents them from being forced out of place by the expansion or contraction of the metal of the screw, so that after being painted it is never possible to detect the position of the dowels as they do not work loose after being glued in place.

FIGS. 18 AND 19.—METHOD OF CUTTING DOWELS AND COVERING COUNTERSUNK SCREWS.

THE Board of Health of New York City has passed a regulation forbidding passengers in the surface or elevated cars spitting on the floor. Notices to this effect have been posted in all the cars of the city.

Power Distribution for Electric Railroads.

By LOUIS BELL, Ph. D.

V.—Direct Feeding Systems.

By direct feeding is meant the supply of current to the working system of controlling from a central station, without any intermediary apparatus. It is the system employed on most present electric street railroads, save a few of the largest size. It is ordinarily used on interurban lines and would be universally applied were there not many cases in which the distribution of power from a single station becomes uneconomical at any practicable voltage on account of the great distances involved.

Nearly all interurban lines, and especially the systems which are likely to result from the conversion of steam into electric lines, can be best operated by other means which will be described in subsequent chapters. Indeed a careful examination of very many existing electric railways will disclose the fact that direct feeding is being worked far beyond its proper limits of application and is the cause of serious pecuniary loss, both in interest on a huge investment in copper and in power needlessly lost on the line.

Direct feeding however is properly applied in most instances, and must be ultimately applied as the distributing system almost universally, since even where substations are employed the lines proceeding from them are a case of direct feeding and must be treated as such.

Electric railway feeding systems are akin in principle to those employed in simple cases of distribution for lighting, and yet in practice differ from them very radically in certain particulars. Railway feeders are not generally designed to preserve uniform voltage within the area fed, but to hold the voltage, admittedly variable, within certain rather wide, but fixed limits. Lighting feeders must be designed with reference to a load varying in the same area from time to time, but units closely confined to that area; railway feeders must be so designed as to meet not only a load variable in amount from second to second, but shifting from place to place obedient to causes that follow no definite law. On the other hand not only are railway feeders absolved from the necessity of holding the voltage closely uniform, but by virtue of this they can the more easily be arranged to meet extreme shifting of the load.

In early electric railways the trolley wire proper was rather small and the feeding was often relatively quite as complex as that in large modern systems.

The conditions which must be met in planning a direct feeding system are roughly as follows:

1. The maximum fall in voltage at any point in the system under all working conditions must not exceed a fixed amount.

2. The average drop throughout the system under normal conditions must equal a certain predetermined amount.

3. The feeders must be so connected that accidents to the working conductors shall interfere with traffic to as small an extent as possible.

To meet these various conditions a large number of

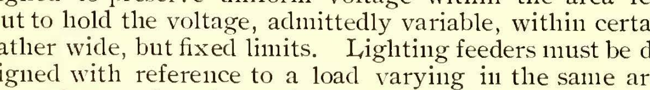


FIG. 34.

arrangements of feeders have been devised, many of which are in extensive use. The following are some of the most usual, which have stood the test of experience.

1. The so-called ladder system shown in Fig. 34. Here one pole of the dynamo is earthed as usual and the other is connected to the trolley wire C D, and also to the feeder A B. These are connected at intervals of a few hundred feet by subfeeders *a*, *b*, *c*, *d*, *e*, *f*, etc., which are generally hardly more than tie wires uniting the principal feeder to the trolley wire. This arrangement was very common in early electric roads. It made possible the use of a very slender trolley wire merely large enough to carry conveniently the current for cars running between the subfeeders, and made the system tolerably free from interruption by accidents to the trolley wire, which from its small size was rather prone to break. Both the trolley wire and the principal feeder are continuous and of uniform cross section. This continuity is useful in case of the crowding of cars at one or more points on the line since it brings to the rescue the full conductivity of the system. It is bad however in case of short circuits in that the main fuse at the station is quite likely to blow and stop every car on the line.

As a real feeding system it hardly deserves the name, since electrically it is nothing more than a continuous working conductor of uniform area. The properties of such a conductor have already been fully considered in Chap. 1. The only additional fact that has to be taken into account in the ladder system is the limited conductivity

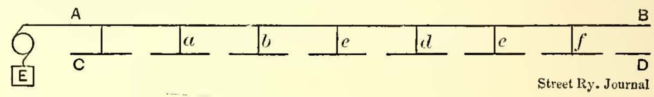


FIG. 35.

of the trolley wire between the subfeeders. The drop in voltage at a car located at any point is practically the drop in the principal feeder up to that point plus the drop in the trolley wire from the car to the nearest subfeeders which are virtually in parallel, inasmuch as current flows into the trolley in both directions along the trolley wire.

2. A system similar in some respects to Fig. 34 is shown in Fig. 35. Here there is as before a principal feeder A B. The trolley wire C D is not however continuous, but is broken by insulating joints into separate sections of approximately equal length each with its own subfeeder *a*, *b*, *c*, etc. The added conductivity of the continuous trolley wire is, of course, sacrificed by this arrangement. Both the trolley and feeder are generally of unifom area throughout their respective lengths and the system is electrically, to all intents and purposes, a uniform linear conductor save for the abrupt change in conductivity in passing from the principal feeder to any subfeeder and its section of trolley wire. As regards a load at any point the total drop is that in the principal feeder up to the subfeeder controlling the section in question plus the drop in the subfeeder and the trolley wire up to the load.

The advantage gained by cutting the trolley wire into short, independent sections is a certain amount of immunity from breakdowns. The subfeeders *a*, *b*, *c*, etc., are usually provided with fuses or switches or both, so that while in case of a break in the trolley wire the cars on the adjacent sections are not deprived of current any more than in the ladder system, there is no longer the danger of stopping traffic by blowing fuses at the station, since the subfeeder fuse immediately acts to stop an excessive flow of current. In addition, in case of fire or flood affecting any part of the system, the disturbed region can be very promptly isolated by opening the circuit at the subfeeders. In cities where fires are of frequent occurrence such an arrangement is highly necessary, although it is generally desirable to use a far more complete feeding system in connection with it. Both the arrangements just shown are entirely without special provisions for holding up the voltage at distant parts of the line, depending practically on the conductivity of the principal feeder.

3. A true feeding system corresponding in a general way with Fig. 34 is shown in Fig. 36. Here A B is the trolley wire while in multiple with it are feed wires tapped into the trolley wire at *a*, *b* and *c*. These feeders are generally quite independent of each other up to their respective junctions with the trolley wire. A load at any point, as *d*, receives its current in both directions through the trolley wire, which in turn draws current from the adjacent. The conductivity available at the load *d* is that of the trolley wire from A to *d*, reinforced by the feeders *a* and *b*; in parallel with that of the trolley wire section from *d* to *c* and the feeder *c*. With the arrangement of Fig. 36 it is quite possible to hold the voltage fairly uniform by giv-

ing sufficient area to the longer feeders. As a matter of convenience, to avoid the undue multiplication of wires, the distances A *a*, *a b*, etc., between feeders are made considerably longer than in the ladder system: hence the trolley wire is generally larger. Of course, it must be large enough to avoid excessive drop in the sections *b d* and *c d* when load is applied at *d*. As a rule the distances A *a*, *a b*, etc., are several thousand feet except where the traffic is very heavy. With No. 0 or No. 00 trolley wire the distance named is not generally excessive. As compared with the ladder distribution this one has the great advantage of giv-

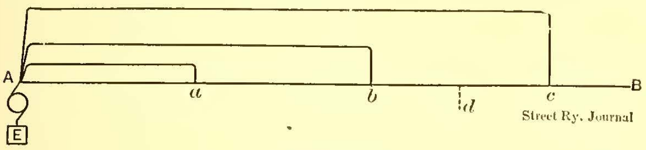


FIG. 36.

ing a fairly uniform voltage, and can be more readily arranged to handle abnormal loads at distant parts of the line. It has also the same convenient property of giving current to each car from two directions so as to minimize the effect of breaks in the trolley wire. It is however exposed to trouble in case of serious short circuits, and is inconvenient in the matter of cutting out portions to execute considerable changes in wiring or to avert accident.

4. An obvious modification of the arrangement just mentioned is that shown in Fig. 37. This bears the same relation to (3) that (2) does to (1). It shares with (3) the advantage of maintaining fairly constant voltage under normal conditions, though it is somewhat at a disadvantage in case of a heavy load on a distant section, since that section must depend on its own feeder alone without assist-

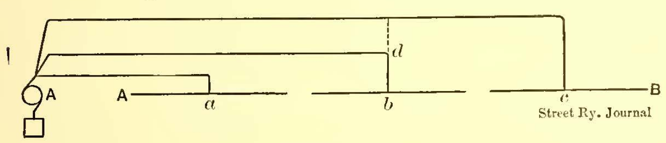


FIG. 37.

ance from adjacent sections. The feeders *a*, *b*, *c*, etc., are provided with individual switches and cut-outs at the station so that if a short circuit occurs nothing worse can happen than the temporary disabling of that particular section, while if necessity demands any section can be promptly cut out of circuit in case of fire along the line or any other sufficient cause. (4) is very well adapted for use on long lines with fairly regular traffic. Like (3) it requires a rather heavy trolley wire for the best results. A load at any point is supplied by the feeder for that section in series with the trolley wire, between the load and the feeder junction, so that the drop under any given conditions is very readily computed.

In both (3) and (4) it is sometimes convenient to tie two or more feeders together, as shown by the dotted line

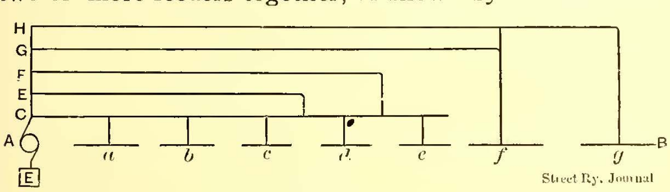


FIG. 38.

at *d* (Fig. 37). This procedure reinforces the conductivity with reference to the section thus connected, as *b*, and while it will lower the voltage of sections beyond the link, is very useful when a particular section is exposed to severe loads from grades or massing of cars, particularly since such linking can be applied at any time that the service may require it.

In very many cases it is advantageous to install a composite feeding system which can be made in a considerable measure to unite the advantages of those already described. A very useful combination is that shown in Fig. 38.

Here the trolley wire, A B, is cut into sections of varying length, short where considerable danger of interruption of service exists, long where longer sections can be more conveniently utilized. C is a principal feeder as in the ladder system connected at *a* and *b* to a continuous trolley line, and at *c*, *d* and *e* to trolley sections. This principal feeder is reinforced by feeders E and F to equalize the voltage more perfectly in the region of dense traffic, while the independent feeeders, G and H, supply the long isolated sections, *f* and *g*. G and H are moreover linked at *f* if the conditions of service require. Fig. 38 represents the actual arrangement of an extensive feeding system much more closely than any of the simpler arrangements shown. As a matter of fact such a complex system is generally the outgrowth of the conditions which develop in service rather than the result of deliberate forethought. Nevertheless, good engineering often demands the adoption of such apparently complex methods.

In general, independent feeders are necessary to preserve good working pressure in outlying districts where comparatively independent lines are worked, while in regions of dense traffic the tendency is to link together the principal feeders of neighboring lines into a network reinforced by special feeders wherever necessary. The trolley wire is sectionalized only in so far as danger from fires and electrical troubles require. Although a continuous trolley wire is now far less necessary than formerly on account of improved methods of construction, on the other hand an extensive subdivision into sections hinders the full use of all the copper installed and increases the danger of local stoppage of traffic. On any railway system, street or other, continuity of service is of the first importance, both by reason of the direct loss from suspension of traffic and the indirect, but far more serious, loss of public confidence and goodwill.

Consequently it is often advisable to take chances in order to keep running, and linking feeders and trolley into a continuous system to drive through a time of short circuit if possible rather than shut down part of the system. The present tendency is to make the various sections of feeders and trolley wire separable rather than separate, so that they can be cut apart when absolutely necessary, but not long before that crisis.

Long lines, interurban and the like, may often be best treated indirectly through substations, but when direct feeding is employed, it is ordinarily best to use a very substantial trolley wire, not smaller than No. 00, installed in separable but not disconnected sections, and supplied with current by separate feeders, which may be linked if local conditions require. If large power units are to be employed, requiring large currents, it is better to use a very large trolley wire than to install a principal feeder, since with large currents the larger the contact surface of the working conductor the better, and the conductivity of the trolley wire can be relieved if insufficient by connecting each section to its feeder in several places instead of one. There is no reason however why, on large work such as is found in converting steam roads to electric, the working conductor may not have a cross section equivalent to No. 0000 wire or more which enables comparatively long sections between feeders to be employed with advantage. For example, suppose a No. 0000 trolley wire carrying a current of 200 amperes per section received equally from the two adjacent feeders. This condition would be met by a train requiring one hundred kilowatts to drive and located midway between two feeders. Allowing no more than two per cent loss, i. e., about ten volts in the trolley wire between feeder junction and load and substituting the above values in the fundamental equation $c.\ m. = \frac{11\ C\ L}{V}$, the distance between feeders should be about 4000 ft. Inasmuch as the average drop produced by the moving train, with a maximum of two per cent midway between feeders, would be but one per cent, it would generally be advisable to increase this amount. Allowing an *average* drop of two per cent in the trolley wire, i. e., a maximum of four per cent, the proper distance between feeders would be virtually doubled, rising to about 8000 ft.—a mile and a half.

For long roads, then, one may use with advantage such an arrangement of feeders as is shown in Fig. 39.

Here a continuous heavy trolley wire is divided into sections of, say, a mile to a mile and a half in length, each with a junction to the feeding system. This, as shown, consists of three main feeders, each supplying two sections of trolley wire. The number of these main feeders and the number of sections each supplies is regulated by convenience and local conditions, as is too the length of each section. The sketch (Fig. 39) shows merely the principle, which is well suited to roads up to a dozen miles in length fed from somewhere near the middle. Such roads are apt to require rather large units of loads, due to well loaded trains and high speed, but the number of trains to be oper-

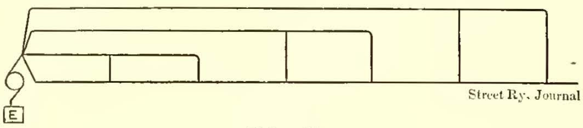


FIG. 39.

ated at any one time is usually small. A rather nice question sometimes arises as to the relative cross section of copper to be put in the trolley wire and in the feeders. In the large work that we are just now considering, the trolley wire must be in any event large enough to give sufficient contact with the trolley. And this is apt to indicate about as large a working conductor as can conveniently and securely be supported. Therefore the feeders will be relatively smaller than in ordinary street railway practice, and it is not advantageous to separate permanently the sections of trolley wire, thus throwing away the conductivity of its large cross section. Whenever double tracks are used it goes quite without saying that the whole system of conductors should be united, each trolley wire serving as a feeder to the other.

Occasionally, too, on single track roads with frequent turnouts two trolley wires are strung ten or twelve inches apart, each to accommodate the cars running in one direction, so as to entirely avoid overhead switches of any kind. This arrangement is shown in Fig. 40, and while it is not now very widely used, it is exceedingly convenient in certain cases. In Fig. 40 the track at a turnout is shown by the solid lines and the two trolley wires by dotted lines. The trolley wire, A B, would naturally be used by cars running from right to left as indicated by the arrow, while C D would be used by cars running from left to right. Each car keeps to its own trolley wire throughout the track, unless it is necessary to change over in backing around a turnout. This double trolley device enables long extensions to be handled without feeders.

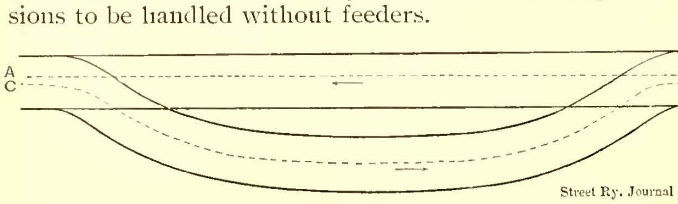


FIG. 40.

Before passing to the actual computation of a trolley and feeder system, we must go back to our two fundamental propositions and inquire into the permissible maximum drop and what we mean by average drop.

Suppose that ten per cent average drop has been decided upon in a given case,—What is really meant by this? There has been considerable confusion on this point. Are we to understand that this average drop is that determined from the effect of the maximum working load throughout the system, or is it the average loss on the parts of the system considered separately irrespective of their relative amounts. Is it the drop produced by the average load or the average of the drops produced by the simultaneous loads at some particular time?

To reduce the matter to a common basis with other cases of the electrical transmission of energy, we are at liberty to put but one interpretation upon average drop. By it we should mean in every case that a certain specified proportion of the energy delivered to the line during a particular period is to be lost in the transmission. On this basis we can design the system for conditions of maximum economy, knowing approximately the probable cost of energy per kilowatt hour and the price of copper. Starting with this definition, we can then intelligently work out the relation of this average energy loss to the loss in volts at the various parts of the system. It is necessary however to bear in mind, first, that the same conditions of economy with respect to loss in transmission do not necessarily hold for all parts of a given system, and second, the question of economy in transmission is quite subordinate to that of successful operation.

As regards the former consideration, the average energy delivered to an electric railway system is a very different thing from either the maximum energy or the average energy during the hours of heavy load. The load factor, i. e., the ratio between average and maximum output on a railway system is generally rather unsatisfactory, as has already been indicated. It ranges in general from .3 to .6, varying greatly with the size of the system, the character of the service and the habits of the people who ride. In cities many interesting facts appear from the load curve of an electric railway—the movements of workingmen, the crowd of shoppers going downtown in the forenoon, the migration in the early afternoon, the homegoing at six and the theatre crowd an hour and a half later. All

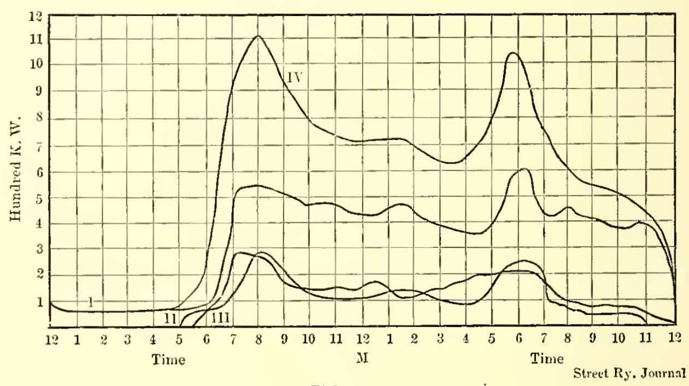


FIG. 41.

these factors of load operate with varying force, not only in different places, but in different parts of the same system. The changes from day to day are considerable, but on the whole the same line preserves its character remarkably well. The result of a varying load factor is a necessary limitation in the permissible loss of energy. For if we have a load factor of .3, the average loss of energy, whatever economy of transmission may indicate cannot be so great as to cause at maximum load a drop in voltage sufficient to interfere with the proper operation of the cars. If we write for the maximum permissible drop, V, v for the drop corresponding to the loss of energy for greatest economy of transmission, for the load factor, L, and for the drop assumed, V^1, we have the following in equality which sets a limit of drop which must not be exceeded

$$V^1 < L\,V$$

Very fortunately it usually happens that

$$v < L\,V$$

So that there is no special difficulty in making $V^1 = v$. But it is not safe to assume this happy condition of things without some investigation. It may be true of one part of the system and not of another. It is necessary therefore to look into the various parts separately in laying out any considerable system. Fig. 41 shows three load curves which may be supposed to be from three parts of the same system, together with the summation curve of the three from which the total load factor would be determined. I may be taken as the load curve of a main urban system, while curves II and III will serve for branches. IV is the summation curve of the whole. The load factor of this final curve is very evidently worse than that of the main line, curve I, since heavy loads in morning and evening on branches II and III raise the morning and evening maximum values on IV. The load factor of II is hardly better than .3 while that of I is nearly .6. Consequently we have far less latitude in planning the conductors for this branch than in case of the main line, being always confronted by a high maximum to be taken care of. The load factor however does not fully represent the precautions that have to be taken. It shows, to be sure, the normal maxima, but it does not include the effect of shifting load.

This is really a very serious matter in making the plans for a conducting system and the probabilities of the case need to be carefully weighed. A base ball park, for instance, located far out on a branch line means trouble unless it be taken into account. It means that now and then, not only all the regular cars on the line, but all the extras that can be spared, will be massed at near the distant end of the branch and brought in heavily loaded and all together. It is the same effect that would be obtained from a steep grade, except that it is only occasional. The amount of such an extra load may be sufficient to double the ordinary maximum load and that in the most disadvantageous way, i. e., at the end of the line. From what has been said it is sufficiently evident that laying out the conductors for a large system is more a matter of acute judgment than of exact theory.

The reason for this is that there are no data sufficient to justify a general theory based upon them. The value of the load on an electric railway is so uncertain, whether for any stated time or during any interval, and so uncertain in position as well as amount, that the success of any calculation depends almost wholly on the skill with which the data are assumed.

Street Railway Rolling Stock.

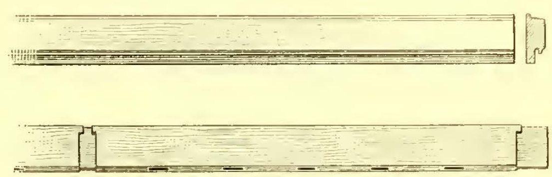
By W. E. PARTRIDGE.

VII.—Belts, Rails and Plates.

The belts or rails of a car are the longitudinal members by which the frame is united into a continuous whole. The first, counting from the floor, passes the whole length of the car on the line where the concave and convex panels unite. The next above is the window rail, and its upper surface usually forms the window sill. Above this comes the window panel or letterboard, as it was termed when it was sufficiently broad to receive a sign. In modern cars it is called the window rail and is, as its name indicates, a rail and not a panel. Above this, and sometimes forming an almost integral portion of it, is the belt or plate which unites the heads of the posts, and at the same time forms the lower member of the roof. The rail or head piece over the door deserves to be taken into the category of rails, but sometimes this is a single heavy piece of whitewood, and at others a rather complex piece of framing. In one case it is a rail, in another case it is a frame.

The accompanying figures show a set of rails from an ordinary box car. Fig. 1 shows the front and end view or cross section and Fig. 2 the back of the window rail. The length shown in the engraving is that of a single panel. The upper edge of the rail is beveled to allow the water to flow away, and at the inside corner is a bead to prevent the water from being blown under the window into the car. The form shown, that used by the J. G. Brill Company, possesses one feature not ordinarily found, though the value is undoubted. This is a rabbet or groove on the outer side of the under face into which the upper edge of the convex panel goes. The projecting lip on the window rail entirely covers the edge of the panel, and the joint is consequently perfectly protected from water or dampness. This is a feature which is worthy of attention, since it entirely excludes water from a point where it can do the greatest damage if it once finds entrance. In the practice of a large number of builders, and of all of the most careful, this rail is mortised into the corner posts. As a means for connecting the different members of the frame, the mortise is far in advance of any method of halving or locking which has been introduced. In fact a mortise and draw pin in combination with white lead to exclude the moisture gives one of the strongest and most durable connections between two pieces of timber at right angles to each other which has yet been devised.

As will be seen at the left hand end of engraving (Fig. 2) the window rail is halved on the post and on its under side is mortised to take the strainers which support the panels, in this case five in number. This rail secures the post very firmly and is or always should be made of a single piece of selected ash. This rule holds good in regard to the practice of the best makers, and for cars up to twenty feet in length. The Jackson & Sharp Company makes a valuable modification of the window rail which is worthy of more extensive introduction. In the cars of this company the rail is widened horizontally so as to admit of a small mortise to receive the projecting end of the outside window strip. The window strip forms a part of the post as shown in Fig. 9, and when the rail is put in position it is wedged



FIGS. 1 AND 2.—WINDOW RAIL, BACK AND FRONT.

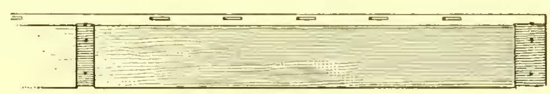
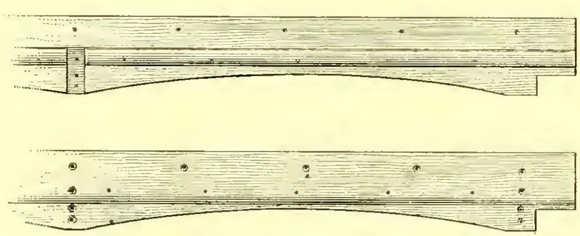
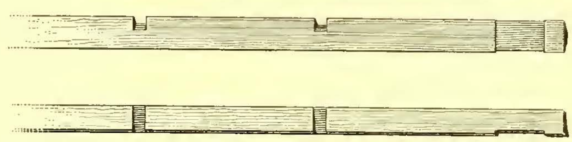


FIG. 3.—BELT RAIL.



FIGS. 4 AND 5.—WINDOW PANEL AND RAIL.



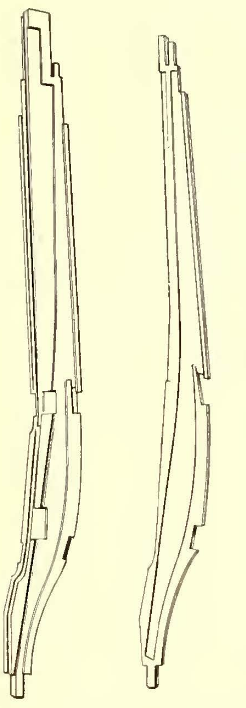
FIGS. 6 AND 7.—SIDE AND TOP OF PLATE.

upward into place. In this way it secures a more firm hold upon the post, and at the same time is prevented from being driven off by accidental violence or by the window coming down upon an accumulation of ice and so bursting the end of the strip out. This breaking of the strip is a very common occurrence and the post is weakened by such an accident. The increased thickness of this form of rail is sufficient to add considerable to its strength.

Fig. 3 shows the belt or concave rail. This is usually thinner on one edge than on the other so as to conform to the curved outline of the car. Occasionally the post is deeply notched to receive it. Although the posts are of ample size at the point where they receive this rail, they should not be cut to a greater depth than is necessary for this purpose. The upper edge of the belt rail is notched to receive the strainers from the window panel. As shown in Fig. 5 the lower strainers which are mortised into the sill are invariably screwed upon the inside of the rail where its lower edge is barely a quarter of an inch in thickness. The union of window and belt rail by means of the strainers constitutes one of the critical points in car building. Good workmanship here, well made mortises and tight fitting tenons properly driven home and pinned are among the essential features of a durable car. The fitting of these rails upon the posts and their union with the corner posts is equally essential.

In the East the belt rail is almost always of yellow pine. A few makers have used Douglas fir, and in the West the belt is occasionally made from ash.

Fig. 4 shows the inside and Fig. 5 the outside of a window panel and rail worked out of a solid piece. This union of the panels, the window head and the supporting rail in one is a very desirable feature. It substitutes a piece of wood of considerable cross section for a number of small and loosely jointed pieces and enables



FIGS. 8 AND 9.—POSTS.

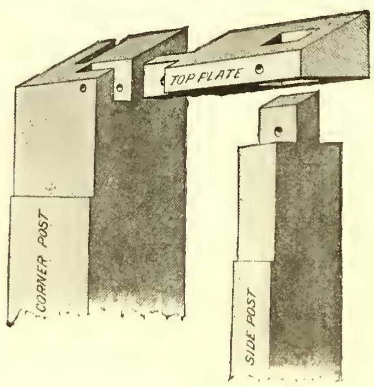


FIG. 10. PLATE AND POST JOINT.

the halving upon the posts to be of considerable advantage. The engraving shows the number of screws employed, and their location.

It has been a common practice in the East to use a single thin strip of wood for a window panel secured in place by wood screws only. In cars built in this way these panels usually split or cut off the screws, showing that there is a considerable amount of strain concentrated at the tops of the posts and that more wood and a better method of fastening is needed.

Fig. 6 shows side and Fig. 7 top of one form of plate which is notched for the carlins. It is beveled on one edge to the curve of the roof, and halved upon the corner posts. Ordinarily, the plate should be mortised to receive the heads of the posts, and in this respect the practice of the Jackson & Sharp Company is exceedingly good. Each of the posts of this company, as shown in Figs. 8 and 9, has a sort of double tenon so that the plate obtains an exceedingly firm hold upon the post. The same system is observed at the corner posts and the result is that this construction may be expected to be of the most durable character.

Fig. 10 illustrates the method used by the Brownell Car Company for putting the plate upon the posts and uniting it with the corner posts. Here both tenons are drawbored and pinned. The joint thus made and filled with white lead is about as strong and durable as it is possible to obtain with wood. The value of the greater strength obtained by the use of glue is not equal to the advantage obtained by having these somewhat exposed joints thoroughly waterproof. Their exposure arises from the fact that breaks in the covering are liable to occur from accidents and may not always be discovered before damage is done.

The means of uniting posts and rails are as varied as can well be imagined, in fact, no two shops practice precisely the same system. In some establishments the joints of the plates and rails are all bedded in a thick white lead paste. Screws in the posts are used to finish the joint and prevent working. In other establishments the window rail is set in white lead, and the plate put on with fish glue. Another shop uses glue. The lines of the joint are carefully covered with white lead when the glue is dry and the whole is afterwards painted over. At least one establishment uses oil with a mere trace of white lead in it for filling these joints. Another practice is to employ common glue for all the rails and the plate and depend upon a good coating of paint for protection. The strainers are almost always driven into their rails with white lead in the mortises. This is probably, all things considered, the best practice. The joint is then filled with a cement of medium strength and water is excluded. Perhaps the advantage of this latter feature is worth more than the greater strength obtained by the use of glue.

In the fitting of the rails to posts and the strainers to the rails the most careful workmanship must be employed if the car is expected to be durable. Neither good material properly seasoned nor good design will give a durable car if the workmanship be inferior, while good workmanship has frequently saved a car of inferior design.

Sand Boxes and Flat Wheels.

In the Street Railway Journal for April, page 235, were published some figures in regard to the effect which the use of sand boxes had upon the wear of wheels. The information has since been brought down to Mar. 19, 1896, at which time the road using sand boxes had taken off 1422 wheels, of which 252 were so badly worn or skidded that they were broken up and replaced by new ones. The 1170 wheels remaining were reground and will be again placed in service.

The other company has a total equipment of 172 cars. It has entirely abandoned the use of sand boxes, using independent sand cars instead. These are operated over the entire length of the road whenever the rail is in condition to make sand necessary.

The ratio between the roads in the matter of equipment is, as nearly as possible, 1 to 3.6. Had the larger road been operated with as little wear upon its wheels as the smaller, the number of wheels to be reground would have been 29 instead of more than 1100. The number of wheels removed would have been 187 instead of over 1400.

New Open Cars for Broadway, New York.

The Metropolitan Street Railway Company has put a number of open cars in operation on its Broadway cable line. They are being run as smokers and seem to be very popular. The cars are of the ten bench type with folding steps and bars. The side panels are of malleable iron instead of wood. The ceilings are of birdseye maple with no decorations. This gives an extremely light appearance to the cars with excellent general effect, besides making the maintenance less expensive. Sterling registers and brakes are used.

One hundred cars have been ordered altogether. Fifty of these are from the J. G. Brill Company and are mounted on Brill trucks; the remaining fifty were built at the works of the John Stephenson Company, Ltd., and are mounted on Peckham trucks. The first fifty are fitted with Bushnell spring rattan seats, and the second fifty with spring rattan seats from Hale & Kilburn.

Novel Method of Stringing Trolley Wire.

A novel method of stringing trolley wire was recently used by the Sioux City Traction Company on a line lately completed from Covington to South Sioux City. The wire was live when strung, and as it was fastened in place in the hangers it was used to furnish current to the car to carry it to the next span wire.

The spool on the car on which the wire to be strung was wound, was placed in a wooden rack on wooden supports and arranged with a brake which was operated by a man standing just back of the spool. By means of this brake it was possible to keep the proper tension on the wire. The car was anchored every 1000 ft. and the work performed as easily as reeling a dead wire on the ground. A half a mile of wire was recently strung in half a day, and the company states that it expects to put up all its own lines hereafter in this way.

LETTERS AND HINTS FROM PRACTICAL MEN.

Correct Location of Trolley Wire on Spiral Curves.

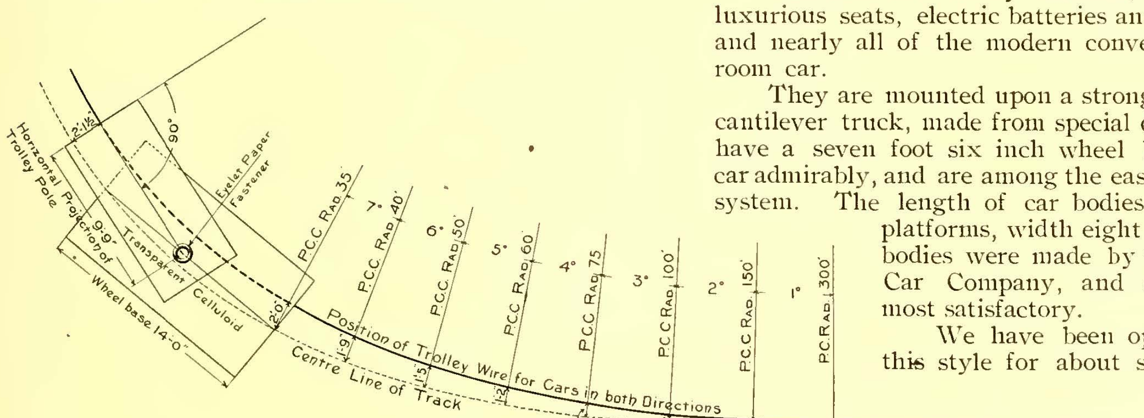
STEELTON, PA., June 6, 1896.

EDITORS STREET RAILWAY JOURNAL:

The method of locating the trolley wire on curves, given in the June issue of the STREET RAILWAY JOURNAL is only applicable to the use of simple curves, while modern practice tends towards using a true spiral curve of considerable length for the ends of all curves. For this portion of the curve, perhaps forty feet long or more, Mr. Foster's formula would not apply. The proper location can be easily found by the use of a template of the essential elements of the problem, i. e., the wheel base and the horizontal projection of the trolley pole.

Having a plan of the curve for which the location of trolley wire is desired to a scale of five feet to the inch or larger, take a piece of thin transparent celluloid and cut it to the length of the wheel base (on the same scale as the plan) and mark with a sharp point a line for the center line of the car and mark the center of the wheel base. Then cut another piece a little longer than the horizontal projection of the trolley pole. Mark a line on this at right angles to one end and mark the length of the horizontal projection of the trolley pole from this end. Then join the two pieces at the center of the wheel base and center of the trolley base, by an eyelet paper binder, loosely enough so that they may turn with some little friction.

Then, placing the template upon the plan of the curve so that the wheel base coincides with the center line of the curve and swinging the "trolley pole" until the square end is radial to the track curve, we can mark a point which will be approximately on the wire curve. Carrying this process through the spiral to the point where the offset becomes constant, we next sketch in the approximate location through the points just found. Going over this again, and making the "trolley pole" square with radial lines from this approximate location instead of those of the track curve, we can lay down the final location of the wire for cars to run in one direction. If cars are to run in both directions, the location should be found by taking an average of the curves located by the aid of the template.



METHOD OF LOCATING TROLLEY WIRE ON SPIRAL CURVES.

In the instance shown in the sketch there is from six to eight inches difference in the offsets for cars going in opposite directions.

Having plotted the wire curve on the plan, of course the offsets will be taken off by scale and used as circumstances may require.

This method can also be used for locating frogs over complicated switch work when the curves are compounded, in finding the proper position for the trolley wire in a car house door, and in other ways which will suggest themselves to the constructing engineer.

The time taken for the operation, having the plan and template in hand, should be trivial.

If the outer rail of the curve is elevated, the trolley wire should be set in towards the center of the curve an additional amount equal to

$$\frac{\text{Elevation} \times \text{height of trolley wire above rail}}{\text{Gauge}}$$

CHAS. A. ALDEN.

Twenty Foot, Single Truck, Center Aisle Car.

UTICA BELT LINE RAILROAD COMPANY.

UTICA, N. Y., May, 22, 1896.

EDITORS STREET RAILWAY JOURNAL;

The accompanying photograph shows one of our cross seated, straight sided aisle cars on a single truck. This car is giving excellent satisfaction, is sought after by

SINGLE TRUCK CENTER AISLE CAR

patrons of the road, especially ladies, and is considered a very desirable and taking car.

The cars are nicely finished, are capacious, have luxurious seats, electric batteries and bells, push buttons and nearly all of the modern conveniences of a drawing room car.

They are mounted upon a strong, extra size Peckham cantilever truck, made from special design. These trucks have a seven foot six inch wheel base, and sustain the car admirably, and are among the easiest riding cars on our system. The length of car bodies is twenty feet over platforms, width eight feet two inches. The bodies were made by the Jackson & Sharp Car Company, and are in every respect most satisfactory.

We have been operating some cars of this style for about six months, both for city and suburban travel. The seating capacity is greater then in our standard eighteen foot six inch car bodies, but, of course, the total carrying capacity is not so great. We do not experience any trouble in maintaining schedule time with this car. There are five richly upholstered cross seats on each side of the aisle and also two end seats, running lengthwise of the car at either end. This arrangement of seats gives a seating capacity of twenty-eight, and also forms an open space at each end, and facilitates loading and unloading passengers.

J. W. BOYLE, President.

The Resistance of Cast Welded Rail Joints.

LAKE ONTARIO & RIVERSIDE RAILWAY COMPANY.
OSWEGO, N. Y., June 17, 1896.
EDITORS STREET RAILWAY JOURNAL:

On page 354 of your June number I find in an article by Dr. Louis Bell, a statement which, if uncorrected, will cause many railways needless annoyance and loss. In this very able essay upon rail returns the cast weld joint is referred to as producing a continuous rail of ample conductivity. It is very evident that the doctor has not had time or opportunity to measure the electrical loss with heavy currents through these joints, both when new and after some months underground. Had this been done we should have received an entirely different report from this accurate observer. It was my good fortune to take part in some tests of the cast weld joint at the Edison laboratory over a year ago. From 100 to 1500 amperes were passed through each joint and the drop measured with a Weston millivoltmeter. When new the conductivity of this joint on a sixty pound rail was merely that of a single No.0000 copper wire. After two months' burial in street soil, the tests were carefully repeated and the conductivity was found to have dropped below that of a No. 00 copper wire.

It is needless to say that the conductivity of the rail is nearly equal to that of one million of circular mils of copper. Mechanically the joint is fine. Its performance on light rail with heavy cars in Newark and Orange, N. J., has been magnificent. But it was found absolutely necessary to bond it. I am informed that several thousands of these joints have made good mechanical records in Chicago, but here also they required heavy bonds. The reasons for this are not hard to find. The joint is *not* a weld, for if it were it would show the same defects exhibited by electrically welded rails.

It is very evident that when a small amount of molten iron is poured around a steel rail, the latter will expand and occupy more than its normal amount of space. It will remain enlarged until long after the cast iron has set, when it will resume its former size and leave a small, but appreciable clearance between surfaces of rails and joint. It is evidently this clearance which makes the joint a mechanical success, for it is sufficient to allow for expansion and contraction, and yet not enough to allow movement from passing cars.

Were this not so, how could this small amount of cast iron withstand the tremendous strain due to temperature variation which, as is well known, has pulled apart steel girder rails weighing ninety pounds to the yard? Any one familiar with the difficulty of making a good electrical joint by pouring molten copper around a copper cable, will smile when told that high conductivity can be had between molten iron and a large steel rail. Even though the surface of the rail should be filed bright, the heat from the melted iron and the steam from the mould would cover it with a coating of iron oxide before the cast iron could enclose it. F. H. TIDMAN, General Manager.

WEST CHICAGO STREET RAILROAD COMPANY.
CHICAGO, June 15, 1896.
EDITORS STREET RAILWAY JOURNAL:

We have three sections of track, the rails of which are cast welded. We use no bond and have no trouble electrically whatever. F. L. FULLER, Superintendent.

BROOKLYN HEIGHTS RAILROAD COMPANY.
June 25, 1896.
EDITORS STREET RAILWAY JOURNAL:

From one Falk joint which I have tested, I should not think it necessary to bond in addition, except, of course, under and around special work and cross bonds, which we put in as usual.

I expect to have another sample joint made to test, and may then be able to furnish you with data, but I have not positively decided whether to publish results or not. Although the resistance of the joint is greater than I expected, it is extremely low and better than any I have seen. J. T. WHITTLESEY, Chief Engineer.

CASS AVENUE & FAIR GROUNDS RAILWAY COMPANY.
ST. LOUIS, June 19, 1896.
EDITORS STREET RAILWAY JOURNAL:

Our experience, and all the tests which we have made, satisfy us that bonding a cast welded track is unnecessary. This is especially the case if it is new track, and the welding is carefully done.

We have ordered more delicate instruments for the purpose of making further tests, and will be glad to let you know the results. We have one piece of track of ten miles cast welded. It has not an ounce of copper or other wire, or bonding of any kind in it.

ROBERT MCCULLOCH.

CHICAGO CITY RAILWAY COMPANY.
CHICAGO, June 18, 1896.
EDITORS STREET RAILWAY JOURNAL:

I enclose herewith report to me by G. W. Knox, our electrical engineer, on subject of conductivity of Falk cast welded joint, in answer to your request for same.

M. K. BOWEN, Superintendent.

REPORT OF MR. KNOX.

All of the joints which have been so situated that a test could be made upon them, I have found without the least appreciable drop across their parts, but where these tests were made there was a comparatively light volume of current flowing.

In making a strict bridge resistance test with, I suppose, every joint cast, there will be shown to be absolutely no resistance in the joint, but to run a reasonably heavy volume of current through the joints, taking them collectively, I believe among some of them there will be found a considerable amount of resistance, for this reason : in casting this joint there is no absolute certainty of the casting being perfect, as I have frequently noticed castings which broke (by being pulled in two with contraction of rail) were but a shell, the inside being completely honeycombed with blow holes through the casting process, and too, I have noticed at these joints the rail pulling back or slipping out of the joints, showing that there is not in all cases an amalgamation between rail and joint metal. This I do not believe will occur with one per cent, and even less, of the joints cast, but one imperfect joint, as regards conductivity, in the circuit, of course, destroys the efficiency of the whole circuit.

In making a close examination of a cross section of one of the cast welded joints a seam will be found between the rail and metal of the joint; looking into this seam with a microscope you will notice small particles of rust or burnt iron scales. Where the metal of the joint does come in contact with the rail it is irregular, or in saw tooth fashion; this is caused by the metal cooling upon striking the rail, which is comparatively cold when the cast is made.

It is easy to understand how these "saw teeth" tissues may be destroyed, *as a conductor for the current*, by the rail constantly working upon them and breaking them down during the expansion and contraction of rail, or the jar or hammer blow effect of car wheels; and again, the burning up of these tissues by the passage of heavy currents across them.

These seams between rail and joint may be considerably increased or diminished according to the honesty of the workmen in cleaning the rust off the rail before the cast is made; and even with a new rail the blue scale coating the rail, formed at the time of rolling, will act as a barrier to the uniting of joint metal to rail.

In considering these cast joints as poor conductors in the rail return circuit, I am, in most, taking the extremely bad joints as examples, but as said before, one bad joint or part in the circuit destroys the efficiency of the circuit, and until we are able to practically apply, say, the X ray, to every cast welded joint employed as a conductor in a circuit and see in just what condition the rail, to metal of joint, is in, we are taking too great chances in using the joint as a conductor, more especially with heavy currents, such as are employed with a road having heavy traffic.

I will say, though, I believe it would be safe to count on the cast welded joint as a conductor where the volume of current is not liable to be excessive, say, twenty to thirty amperes per joint. It will, of course, be possible to "shove through" these, even bad joints, many times more than the amount of current given, if so desired, but it is going to be accomplished at the expense of the coal pile.

In conclusion I will say, if a road thinks of counting on the cast weld joint as a conductor to any extent, it will pay to make careful tests with every joint. An engineer in testing for drop across the joint should be sure to send the maximum amount of current the joint is expected to carry, through such joint.

[Signed] G. W. KNOX,
Electrical Engineer.

A Way to Reduce Pipe Vibration.

KANSAS CITY, June 5, 1896.

EDITORS STREET RAILWAY JOURNAL:

I notice in your June number, p. 359, J. Mahony of the Montreal Park & Island Railway Company asks for my opinion as to a matter of piping.

While the sketch furnished is not sufficiently complete in plan to enable me to write as one concerned, I think the following may possibly account for the trouble.

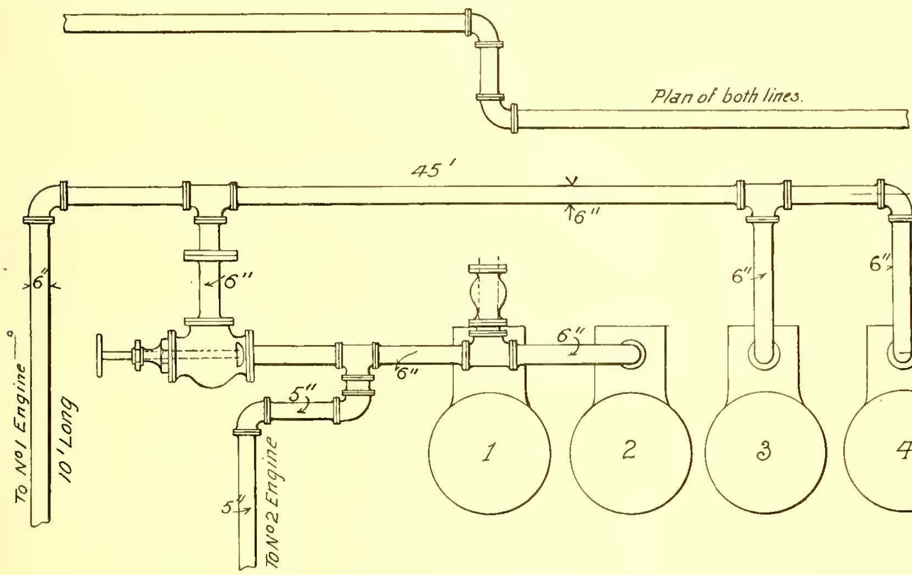


DIAGRAM OF PIPING.

Referring to the sketch, it will be observed that considerable piping is between the angle valve and boiler No. 2 and between the angle valve and engine No. 2. When the angle valve is open, No. 2 boiler is cut out by a valve presumably above it and No. 2 engine cut out at the throttle. These pipes form a part of the steam space. When the steam valve of No. 1 engine opens the steam pressure drops, and then rises as the steam valve closes. This, of course, causes a pulsation. These pulsations affect the angle valve first, and owing to the distance the effect has to travel to the valve over No. 2 boiler, there is probably an appreciable interval between the instant at which the pulsation acts on the angle valve in one direction and on the pipe over No. 2 boiler in the other. The result tends, of course, to produce a vibration in the pipe. If the natural time of vibration of the pipe should bear a certain relation to these pulsations the effect would be cumulative. When the angle valve is closed the conditions are removed and the vibration ceases.

The leaking of the screw joints and flange after the angle valve is closed is no doubt due to the contraction of the pipe between No. 2 boiler and the angle valve. The fact that such leaking does not begin until the leg begins to fill with water does not indicate that the water has anything to do with it, further than to show that the piping has fallen in temperature. This suggests that the length of pipe between the elbow above boiler No. 2 and the boiler connection is too short.

Should Nos. 1 and 2 boilers be connected to the forty-five foot length in a manner similar to Nos. 3 and 4, and the steam pipe for No. 2 engine be taken from the same line, the trouble would probably disappear. Whether this is practicable cannot be determined from the data at hand, but if not, it is not improbable that some plan as effective and perhaps more simple may be suggested by Mr. Mahony's thorough familiarity with the plant.

R. J. MCCARTY.

Transition Curves for Street Railways.

PHILADELPHIA, PA., June 20, 1896.

EDITORS STREET RAILWAY JOURNAL:

A discussion on "Transition Curves" having at length appeared, I will add a word in support of my paper in last September's Journal.

The practice of flattening the ends of sharp curves is now general, and the object of that pioneer article was to bring out opinions on the best way of doing it. It was there argued that so exact a curve as a parabola is not necessary or practicable; and that a curve of two or three radii, with chord lengths of each equal to the wheel base of the car, furnishes a simple but complete transition. Mr. Mohler in last month's letter on the subject takes exceptions to this recommendation, asserting that nothing but a cubical parabola is good engineering.

The initial radius was chosen at about one hundred feet for the sake of uniformity. More than half our short radius curves lead from switches, and it is not possible to make a good switch design for longer radii. Other things being equal, it is then desirable to make curve ends alike thus avoiding a multiplicity of standards. That a curve of this radius rides smoothly at city speeds we know by experience. It also satisfies the requirement that the transition curve should be short.

The statement that a car on a curve rotates about its own center (roughly speaking) is not in error, nor is it so loose as would appear from Mr. Mohler's figure. His argument applies only at the tangent point and the discrepancy there would not be so alarming if the overhang were shown in its true proportion. A fault there however would by no means invalidate the reasoning, since the angle of the car changes as desired, whether or not the rotation is about the car's center.

Mr. Mohler's conclusion that long chords and abrupt changes of radii should be avoided in good engineering is rather sweeping. A street car's motion is guided by two points, and it is the relative change of position of these points which accomplishes the transition. Then, simply if the front and rear wheels are held on curves of different radii, that change will occur. It is not necessary that the path of each wheel, separately, should be a spiral.

The conclusions and recommendations of the article of last September were based especially on practicability. It is not believed that the actual conditions warrant such refinement as the cubic parabola or its equivalent, the spiral. Mr. Mohler's curve has an off-set of one-half an inch in six feet. Now in nine cases out of ten a street corner cannot be surveyed to this accuracy (½ in. in 50 ft.). It is very difficult to bend a heavy section with the nicety that this calls for; and it is extremely unusual for trackmen to lay a curve so exactly. Even if the curve should be in the ground exactly true, the car would not get the full benefit of it, because firstly, the wheel gauge is tighter than the track gauge, by at least one-quarter of an inch, so that wheels may not take the curves just at the tangent point; secondly, owing to the uncertain speed, unevenness of track. particularly over special pieces, and to the elastic connection of car body to truck, the motion of the car would destroy the fine effect of any curve.

A true spiral is very useful on high speed lines, especially where the outer rail is elevated, but for street railway special work its value is questionable.

JAMES A. EMERY.

Attractions For Pleasure Resorts.

THE ALTOONA & LOGAN VALLEY ELECTRIC RAILWAY COMPANY.

ALTOONA, PA., June 13, 1896.

EDITORS STREET RAILWAY JOURNAL:

Our experience has convinced us that pleasure travel is very greatly stimulated and increased by maintaining a park. On our Hollidaysburg division we have located Lakemont Park, comprising 95 acres of woodland and 11½ of water. The grounds have been laid out in part in walks and roadways, planted in shrubbery and trees. We have two large greenhouses in which are propagated our bedding plants, and employ a landscape gardener with four or five men to keep the grounds in the very best order and make them as attractive as possible.

In the way of amusements, we have a carrousel, swings and a summer theatre and casino. In the latter, music is furnished every afternoon and two evenings in the week, Sundays excepted. No admission is charged to the grounds or casino.

On the lake we have an electric launch and row boats, which are well patronized in the summer season. In the winter we have skating on the lake. It requires very little care to keep our electric launch in good condition. It is operated by electricity charged from our feed wire along the electric road. The man who has charge of the row boats also has charge of the launch.

JOHN LLOYD, President.

Conductorless Cars.

THE CITIZENS' ELECTRIC RAILWAY, LIGHT & POWER COMPANY.

MANSFIELD, O., May 21, 1896.

EDITORS STREET RAILWAY JOURNAL:

I noticed an article in your May issue by Superintendent Walker, of Sioux City, on "Operating Electric Cars Without Conductors." We run all our cars in the winter season with one man to the car.

The motorman is furnished with tickets and change, the change being put up in envelopes to facilitate making change. The motorman is required to "ring up" a fare on his register as soon as a passenger enters the car, and that reminds the passenger that he is expected to pay his fare as soon as he enters the car. This system makes it easier for the motorman to keep track of his fares.

Regarding accidents, I do not think we have more than roads running conductors. On roads where the gross earnings do not average more than eight or ten cents per car mile, the system of one man to the car is the thing, as the wages paid conductors would amount to about one-fifth of the earnings per car mile.

ARTHUR J. HAYCOX,
Superintendent.

High Speed on the Lorain-Cleveland Electric Line.

THE LORAIN STREET RAILWAY COMPANY.

LORAIN, O., June 6, 1896.

EDITORS STREET RAILWAY JOURNAL:

In your last issue you refer to a run recently made by one of our cars of a mile in 1 min. 35 sec. We have done even better than that; 1.30 and 1.28 is often made, and on one occasion I got a record of 1.26¼, with a stop watch. We are running sixteen foot cars, two "type C" steel motors. The car with the record of 1.26¼ had thirty-two passengers.

W. H. PELTON.

New Sand Car.

The Third Avenue Railroad Company, of New York, has recently built at its shops the sand car shown in the accompanying engraving (Fig. 2). In front of each wheel is a scraper shown in detail in Fig. 1. This can be raised and lowered from the platform by means of the gear and segmental rack shown, within limits determined by a set-screw which is set lower as the metal strips with which the scraper is fitted wear out. The end is hinged and fitted with a spring so that it will turn back, instead of breaking in case an immovable object is struck. Between the wheels of the car are two rotary brushes each independently driven by sprocket chains from the axles. The journals carrying the brush are so arranged that any stretch of the chain can be easily taken up. The brush sweeps straight ahead, the debris being thrown to one side by means of a sheet metal fender, so that under no circumstances can the brush sweep on to the next track or spatter passers-by. The height of the brush is also regulated from the platform.

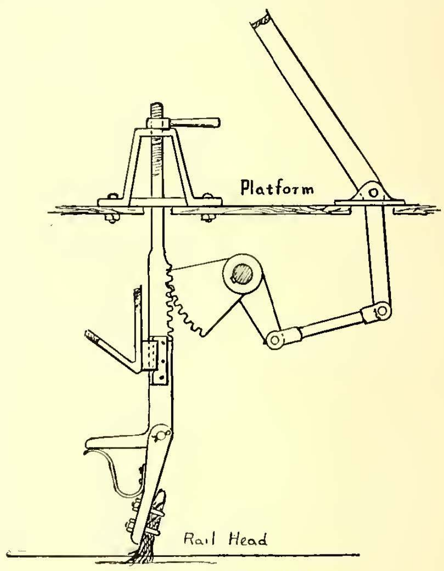


FIG. 1.—SCRAPER.

FIG. 2.—NEW SAND CAR—THIRD AVENUE RAILWAY, NEW YORK.

The car is fitted with four hoppers, and sand is admitted in the rear of the rotary brush so that it is deposited on a perfectly clean track. The hoppers are provided with valves so that the flow of sand can be regulated to suit the condition of the track. The car has the usual grip, brake levers, etc., and measures eighteen feet over all.

Mileage, Long Distance Riding and Transfer Systems in American Cities.

The following information bearing upon the question of how much a passenger on the street railway systems of the larger American cities receives for his money has been obtained through correspondence with the managers of the principal systems in those cities. The total track mileage of the entire city system, the longest distance which any passenger can ride on payment of five cents or by transfer without charge or at reduced rates, and the general transfer privileges accorded in the city are given below in detail. All populations are for the census year of 1890:

CHICAGO, ILL.—Population served, 1,099,850. Total track mileage, 760. On the lines of the Chicago City Railway Company, the longest distance for a single fare (including two transfers) is fifteen miles. No extra charge is made for transfers. On the east and west lines transfers are given only on payment of cash fare. On north and south lines a transfer is given free on payment of either cash fare or transfer.

PHILADELPHIA, PA.—Population served, 1,046,964. Total track mileage, 462. The longest ride for a single five cent fare is about 11¾ miles. "Exchange tickets" are sold at eight cents each, and on these a passenger may ride about 16½ miles.

BROOKLYN, N. Y.—Population served, 838,547. Total track mileage, 393. On the surface lines of the largest system the longest ride which can be taken is eighteen miles, involving two changes of cars with free transfers.

BOSTON, MASS.—Combined population served by the principal system is 678,000. Total track mileage, 275. The longest distances for a single five cent fare without change of cars are 6.3, 6.9 and 8.2 miles. By the use of free transfers a passenger can travel 8.1, 9.1 and 9.9 miles. Upon an eight cent check a passenger may travel 14.2 miles. Changes of routes now in contemplation will considerably increase these distances.

ST. LOUIS, MO.—Population served, 451,770. Total track mileage, 335. The longest ride for a single five cent fare is about fifteen miles. Free transfers are given by each system for its own lines, but transfer privileges are not interchanged. Transfers are not given on transfers as a rule, but on a crowded day a passenger may ride indefinitely. The fares are five cents for adults and two and a half cents for children under twelve years of age.

JERSEY CITY, N. J.—Total population of Jersey City, Hoboken and Newark served by one system is 388,481. Total track mileage, 175. The longest ride on a straightaway run without transfer is 8.25 miles. Transfers are given to some points, but in no case will the combined ride much exceed the figure named.

SAN FRANCISCO, CAL.—Population served, 298,997. Total track mileage, 269. The longest ride for a single fare (with two transfers) is eleven to twelve miles. Transfers are given without charge on lines of the principal system.

MINNEAPOLIS, MINN.—The combined population of Minneapolis and St. Paul is 297,894. Total track mileage 222. The longest ride for a single five cent fare is 12.94 miles. There are a large number of lines on which a passenger can ride over eleven miles including transfers. For a ten cent fare a passenger can go from any point in Minneapolis to any point in St. Paul, and by this arrangement can ride between twenty-three and twenty-four miles over a large combination of routes.

CINCINNATI, O.—Population served, 296,908. Total track mileage, 263. The longest ride for a single five cent fare is 13.44 miles. One transfer only is given without extra charge.

CLEVELAND, O.—Population served, 261,353. Total track mileage, 269. The longest ride for a single fare with free transfer privileges is ten miles. A large proportion of those using transfers ride six miles.

BUFFALO, N. Y.—Population served, 255,664. Total track mileage, 143. The longest ride for a single five cent fare is 13¾ miles. No extra charge is made for transfers.

LYNN, MASS.—Total population served by the interurban system of the Lynn & Boston Railroad Company is approximately 250,000. The total track mileage of the system is 153. Passengers can ride about six miles for five cents, and longer distances over the system on a rising scale of charges.

NEW ORLEANS, LA.—Population served, 242,039. Total track mileage, 169. The longest ride on a single five cent fare is seven miles and a fraction. Transfers wherever issued are given without extra charge.

WASHINGTON, D. C.—Population served (District of Columbia), 230,392. Total track mileage, 138. The longest ride for a single fare is 9½ miles. Cash fares are five cents and tickets are six for twenty-five cents. Transfers are given free.

DETROIT, MICH.—Population served, 205,876. Total track mileage, 202. The longest ride for a single fare is ten miles. Cash fares are five cents each and tickets eight for twenty-five cents. Free transfers are given by each company for its own lines, but transfers are not interchanged.

MILWAUKEE, WIS.—Population served, 204,468. Total track mileage, 159. The longest ride for a single five cent fare is nine miles. Transfers are given without charge on a liberal system.

KANSAS CITY, MO.—Population served (including Kansas City, Kan.) 171,032. Total track mileage, 142. The longest ride for a single five cent fare is 11.02 miles. There are eight other routes varying from 9.02 miles to 11 miles. Transfer privileges are given without extra charge.

LOUISVILLE, KY.—Population served, 161,129. Total track mileage, 150. The longest ride for a single fare is nine miles. There are several others from seven to eight miles in length. About eighty-five different transfers are given by the company without extra charge, and a passenger may, as a matter of fact, ride indefinitely if he so choose.

ROCHESTER, N. Y.—Population served, 133,896. Total track mileage, 93. The longest ride for a single five cent fare, including transfers, is about nine miles. There is a universal transfer system, and transfers are given without extra charge.

DENVER, COL.—Population served, 106,713. Total track mileage, 212. The longest ride for a single five cent fare, including transfers, is about 11½ miles. No extra charge is made for transfers.

INDIANAPOLIS, IND.—Population served, 105,436. Total track mileage, 107. The longest ride for a single fare including free transfers is eleven miles.

COLUMBUS, O.—Population served, 88,150. Total track mileage 97. The longest ride for a single five cent fare including one transfer is nine miles. Tickets good for a single line ride are sold at six for twenty-five cents and twenty-five for $1. No transfers are given on tickets, but are given without extra charge when a five cent cash fare is paid.

NEW HAVEN, CONN.—Population served, 86,045. Total track mileage, 80. The longest ride for a single fare is 5½ miles. There are four principal companies which do not exchange transfers with each other, but transfers are given by each company on its own lines without extra charge.

TOLEDO, O.—Population served, 81,434. Total track mileage, 113. The longest ride given to a passenger for a single fare, including free transfers, is within a fraction of twelve miles. No transfer charges of any kind are made by the principal system.

PATERSON, N. J.—Population served, 78,347. Total track mileage, 91. The longest ride for a five cent fare is 8.1 miles, this being from the extreme limits of Paterson to the extreme limits of Passaic, and transfers are issued without charge over the entire system.

LOWELL, MASS.—Total population (exclusive of suburbs), 77,696. Total track mileage, 60. The longest ride for a single five cent fare is five miles, this being to suburban points. On these lines no transfer privileges are given within the city limits.

FALL RIVER, MASS.—Population served, 74,398. Total track mileage, 27. The longest ride for a single five cent fare is 6⅛ miles. Transfers are given without extra charge.

MEMPHIS, TENN.—Population served, 64,495. Total track mileage, 62. The longest ride for a single five cent fare, including transfer, is eight miles.

DAYTON, O.—Population served, 61,220. Total track mileage, 53. The longest ride for a single fare is eight miles. Cash fares are five cents; tickets, six for twenty-five cents, twenty-five for $1. A passenger has a right to a transfer to any line in the city without extra fare.

TROY, N. Y.—Population served, 60,956. Total track mileage, 40. The longest ride, including free transfers, is about eight miles. No extra charge is made for transfers.

GRAND RAPIDS, MICH.—Population served, 60,278. Total track mileage, 50. The longest ride for a single fare is eight miles. The cash fare is five cents, and tickets are sold at six for twenty-five cents. No extra charge is made for transfers.

CAMDEN, N. J.—Population served, 58,313. Total track mileage, 54. The Camden, Gloucester & Woodbury Railway Company carries passengers between Camden and Woodbury, 8½ miles, for three tickets, purchased at stated places and at the rate of thirty for $1. There is no transfer system.

TRENTON, N. J.—Population served, 57,458. Total track mileage, 37. The longest ride for a single five cent fare is about 5½ miles.

LINCOLN, NEB.—Population served, 55,154. Total track mileage, 55. The longest ride for a single fare including transfers is 11.36 miles. No extra charge is made for transfers.

CHARLESTON, S. C.—Population served, 54,955. Total track mileage, 30. The longest ride given by the Enterprise Railroad Company (horse railway system) for a single five cent fare is four miles, for a double fare eight miles.

ST. JOSEPH, MO.—Population served, 52,324. Total track mileage, 33. The longest ride for a single five cent fare, including one free transfer, is six miles.

LOS ANGELES, CAL.—Population served, 50,395. Total track mileage, 176. The longest ride for a single fare, including transfers, is 7½ miles.

DES MOINES, IA.—Population served, 50,093. Total track mileage, 38. The longest ride for a single five cent fare and transfer is eight miles. Transfers are given without extra charge.

LEGAL NOTES AND COMMENTS.*

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

OF THE NEW YORK BAR.

Justice Between the Poor Man and Woman and the Rich Corporation.

Recently in one of our large cities the president of a street car line was at his office when the report was received of an accident to a woman who had been run over by a car. The president, contrary to his custom, remained at the office and not only read the reports of the various impartial witnesses to the occurrence, but actually saw them and questioned them. They were all reputable citizens, some five of six in number. The facts stated by them wholly exculpated the employes of the road from any negligence, and showed the accident to be wholly the fault of the woman herself.

The president was amazed to find that his Loss Department advised a settlement for a considerable amount. Having paid little attention to this department of the company's business, he felt that something was wrong and he disregarded the advice and ordered the case to be vigorously defended. Experienced counsel were specially employed, and the president attended the trial himself. Practically the only witness for the plaintiff was the plaintiff herself; her twelve year old child, who was with her and saw the whole occurrence, was not put upon the stand. Notwithstanding this the jury gave a large verdict for the plaintiff, wholly disregarding the evidence of the impartial witnesses for the defendant.

Facts like these are not at all astonishing to any one who has been connected either as counsel or otherwise with the accident department of a street railroad company or with the defense of actions on insurance policies where they have been obtained by fraud, but they must surprise any one who is not familiar with the facts.

Juries refuse to obey the charge of the Court that the mere fact of an accident is not even *prima facie* evidence of negligence, and they practically lay down a law for themselves, to the effect that an accident conclusively gives the plaintiff, if poor, or especially if a woman or a child, a right to recover something, and if a few jurors are more intelligent and conscientious than the rest, they are won over by a proposition for a compromise verdict. Hence the advice of the Loss Department in the case just refered to was, probably, good advice from a practical business standpoint.

There seems to be no remedy save in the adoption of means by which the average intelligence of the jury panel may be raised. But even this proposition receives a serious setback when we find that even judges upon the bench, with all the training and experience that that implies, fall into the same error and have to be rebuked and overruled by appellate tribunals.

A remarkable instance of this is a recent case in a United States Circuit Court. There the action was on an insurance policy on the life of one who disappeared about a year before the commencement of the suit, and to succeed in the suit it was necessary for the alleged widow and child, who were the plaintiffs, to prove that the husband and father was dead.

The Insurance Company excepted to those portions of the judge's charge which are quoted below. The trial resulted in a verdict for the plaintiffs. We quote from the opinion of the Circuit Court of Appeals, which reversed the judgment and ordered a new trial. "In opening "his charge to the jury the Court below said: 'Wherever "'women or children are connected with the case, I make "'it a rule to say as little as possible to the jury when the "'matter is finally submitted to them for their considera- "'tion, because I have frequently found that my sympathies "'would get the better of my judgment. So I have found "'it advisable, as a rule, to say as little as possible to the "'jury, so that they might take a full and fair view of the "'duties they are called upon to perform.' At the close of "his charge, the Court below said: 'Now, gentlemen of "'the jury, I try to close my eyes, as well as I can, to the "'fact that a woman and child have any interest whatever "'in the result of a controversy when it is brought into "'court. I cannot always do it. I don't suppose you can. "'It is not expected. If a man can do that, he is no better "'than a brute. He is as bad as the heathen is supposed "'to be, and worse than the horse thief is thought to be. "'If he could close his eyes to that fact, lose all sense of "'decency and self-respect, he would not be fit for a juror. "'But, so far as it is possible for you to do that, you do so, "'and decide the case precisely as you would if it was "'between man and man or between a woman and a woman. "'Of course, neither one has any greater or more extensive "'rights than the other, but both must be tried according "'to the same rule; both must be adjudged by the same "'law, so far as it is possible for human ingenuity to do it, "'And what I have said to you in reference to myself I ask "'you to do on behalf of your own selves. Take the case "'and decide it according to the testimony, and according "'to the weight of the testimony, as it has been presented "'to you for consideration, and then let your verdict speak "'for itself.'"

"In our system the trial by jury, the province and "duty of the presiding judge is to fix the attention "of the jury upon the issues on trial, and upon the evi- "dence that is material to their determination, to guard "them against the consideration of irrelevant and in- "competent testimony, and against the influence of sym- "pathy, passion, or prejudice, and to secure a fair and "impartial trial of the issues presented. The main issue "which this jury was trying was whether or not the in- "sured had died before these actions were commenced. "The consideration of what party or parties would be "benefited or damaged by the determination of that issue "in one way or the other was utterly irrelevant to this "question. It could not tend in any way to assist in cor- "rectly deciding it. It was worse than irrelevant and im- "material. It was positively pernicious. The natural and "inevitable effect of its consideration was to excite the "sympathies and to warp the judgment of the jurors, as "it evidently did those of the judge; and to produce a de- "cision founded, not upon the evidence as to the life or "death of the insured, but upon a consideration of the "question whether or not the insurance companies could "afford to lose the amounts of these policies better than the "woman and child could afford to do without them. The "charge of the Court was an open invitation to the jury to "substitute the latter question for the former, and to per- "mit its determination to control their verdict. It not "only invited, but it taught them so to do, both by precept "and example, for the judge himself devoted this very forci- "ble portion of his charge to the consideration of this very "question. The influence of the presiding judge in a jury "trial can hardly be overestimated. His learning, his abil- "ity, his long experience in the trial of causes, and the rule "that his view of the law must control, combined to com- "mand for him the respect of the jury, and to enable him "often, by a word or a look, to lead them to a decision of "a doubtful case. Juries are none too anxious to divest

*Communications relating to this department may be addressed to the editors, No. 45 Wall Street, New York.

"themselves of passion, prejudice and sympathy, and "courts cannot be too diligent in guarding themselves and "their juries against their influence. The portion of the "charge under consideration is its own condemnation. "Nothing that we can say will make its fatal error more "glaring and apparent than its perusal."

Where such mistakes are made by trial judges what may be expected from juries?

USE OF ROAD—DAMAGES.

PENNSYLVANIA.—In an action for damages for taking a right of way and constructing a railroad across a tract of land used for farm purposes, and across which no streets were opened, it is error to admit in evidence a street plan of the borough in which the land is situate, prepared after the location of the railroad, and not completed or approved by the borough authorities till after completion of the railroad, and showing streets across the land; the measure of damages being the difference in value of the whole property before and after the construction of the railroad, and its value before the injury being shown by the actual condition thereof at the time condemnation proceedings were begun.—(Walker v. South Chester R. Co., 34 At. Rep. 560.)

PENNSYLVANIA.—Compensation for use and occupation, which a railroad is required, by Act May 14, 1889, § 17, to pay for entering on and using a turnpike for its tracks, is not measured by the mere additional expense in keeping the turnpike in repair by reason of the presence of the tracks, but by the depreciation in value of the property as a whole, resulting from the occupation and use, and caused by the presence of the tracks and cars; not including, however, loss of tolls by reason of the improved facilities for travel furnished by the railroad.—(Allentown, El. Turnpike Co. v. L. V. Traction Co., 34 At. Rep. 565.)

DEDICATION.

PENNSYLVANIA.—The fact that a railroad company allowed the public to make a short cut between two avenues over one of its lots was insufficient to show a dedication, though allowed for the necessary length of time, where the lot was fenced, and during that period had been constantly used by the company for its own purposes.—(Frankford Pass. Ry. v. Philadelphia, 34 At. Rep. 577.)

INJUNCTION.

PENNSYLVANIA.—Proceedings under a decree awarding a preliminary injunction restraining defendant railroad from interfering with construction of plaintiff's track over defendant's road at grade, the right to which is denied by defendant, will, on appeal from the decree, be restrained till final hearing, the crossing not having been actually completed under the decree.—(Chester Traction Co. v. P. W. & B. R. Co., 34 At. Rep. 619.)

PENNSYLVANIA.—Where a plaintiff, seeking an injunction to prevent an electric railway company from building its line on his land, failed to show affirmatively that the proposed road would be on his land, it was proper to dissolve a preliminary injunction.—(Thouron v. Schuylkill El. Ry. Co., 34 At. 601.)

LIABILITY FOR NEGLIGENCE.

NEW YORK.—In an action for personal injuries it appeared that the horse car on which plaintiff was riding was preceded by a wagon being driven along the car tracks, and loaded with a few boards, which projected two feet beyond the end of the wagon; that the wagon attempted to turn into a side street, which was crowded with vehicles, one of which was coming towards the wagon on a steep down grade on a line intersecting the course the wagon was required to take in turning off the track; that the driver of the car, instead of waiting a moment to see if the wagon would be cut off in the attempt to leave the track, and forced back down the steep grade, tried to pass, as soon as the wagon cleared the track and that while doing so the wagon backed, causing one of the projecting boards to pass through the stanchion between the first and second windows of the car and strike plaintiff. *Held*, that a finding that the driver was negligent was warranted.—(O'Malley v. Met. St. Ry. Co., 38 N. Y. Supp. 456.)

WISCONSIN.—In an action against an electric railway company for personal injury, it appeared that plaintiff, employed by an electric light company, while climbing a pole to remove an electric light, came in contact with a span wire supporting defendant's trolley wire and the iron post to which the span wire was fastened, receiving an electric shock which threw him to the ground; that the trolley wire was suspended from the span by a bell insulator, and the span wire supplied with a circuit brake, interposed between the trolley and the post; that the plaintiff was experienced, and knew all the dangers connected with the trolley and span wires. *Held*, insufficient to show that defendant's negligence was the proximate cause of plaintiff's injury.—(Huber v. La Crosse City Ry. Co., 66 N. W. Rep. 708.)

U. S. COURT.—The evidence showed that the car had no sand box to sand the track and enable the brake to work effectively; that none of the defendant's cars had sand boxes, but that defendant, at certain seasons of the year, not including that at which the accident happened, caused the track to be sanded by sending out a special car to scatter the sand, which defendant claimed to be a better method. The Court charged the jury that the only question was whether the car had proper appliances for stopping it; that the defendant was not bound to provide the very best appliances, but to provide what is reasonable, and such as a prudent man would provide; and left it to the jury to determine whether the car had reasonable appliances for stopping, or there was a lack of what it really ought to have had, which prevented its being stopped, and caused the accident. *Held*, no error.—(Atlantic Ave. R. Co. v. Van Dyke, 72 Fed. Rep. 458.)

PENNSYLVANIA.—Plaintiff, without indicating his intention to the conductor or driver, attempted to board defendant's street car at the front platform, while it was standing still to let off a passenger. The conductor was standing on the ground, at the rear, facing the front, and could have seen plaintiff. He knew plaintiff well, and knew that he usually took the car. The driver knew plaintiff, but was not looking to see if any one was to get on, and started up his horses; plaintiff was thrown to the ground and injured. *Held*, that a nonsuit was warranted.

The fact that defendant's cars were not provided with fenders to prevent objects from getting under the wheels does not constitute negligence.—(Pitcher v. People's St. Ry. Co., 34 At. Rep. 567.)

PENNSYLVANIA.—Where a motorman saw a child standing in the street, away from the track, in time to stop the car before reaching it, without anything in its attitude to indicate that it was about to cross the track, and the child, when the car was within ten feet of it, started to cross, and was run over notwithstanding the effort of the motorman to stop the car as soon as he saw the child start towards the track, the company was not liable.—(Fisherman v. Neversink Mountain R. Co., 34 At. Rep. 119.)

OHIO.—It is not always negligence per se for one about to cross a steam or street railroad to fail to stop, look and listen, but the care required is simply ordinary care; and whether or not it is negligence to fail to stop, look and listen is a question of fact under the circumstances of the particular case.—(Weiser v. Broadway & N. St. Ry. Co., 10 Ohio Cir. Ct. R. 14.)

ILLINOIS.—One is not, as a matter of law, guilty of contributory negligence in boarding an electric car while in motion.

The doctrine of comparative negligence has been abolished in Illinois.—(Cicero & P. St. Ry. Co. v. Meixner, 43 N. E. Rep. 823.)

CHARTERS, FRANCHISES, ORDINANCES.

PENNSYLVANIA.—A passenger railway within the limits of Fairmount Park, Philadelphia, is not a "street passenger railway," so as to render Act Apr. 14, 1868, which authorizes the park commissioners, independently of city authorities, to license the building of passenger railways within the park, a violation of Const. art. 17, § 9, prohibiting the building of any "street passenger railway" within the limits of any city, borough or township without the consent of the local authorities—(City of Philadelphia v. McManes, 34 At. Rep. 331.)

NEW JERSEY.—If sidings or turnouts are provided for in the ordinance granting a street railway company permission to lay tracks, then only such as are so provided for can be constructed, and any extension of those provided for, or connection between them, would be illegal; and if the manner of construction be substantially changed, then the railway company can be dealt with as if no right of construction or operation had ever been granted at all, and the unlawful construction can be removed as an obstruction, without judicial intervention, by the summary action of the municipal authorities having the control and regulation of the streets.

Where a street railway company has in good faith constructed its tracks, sidings and turnouts upon a street, by virtue of an ordinance under which it claims it had the right to construct in the manner adopted, and such construction was made without objection by the municipal authorities, before an ordinance can be enacted which determines adversely the right of such construction on the part of the company, and provides for a summary removal of its tracks, turnouts or sidings, notice must be given to the company and an opportunity for a hearing be afforded.—(Cape May, D. B. & S. P. R. Co. v City of Cape May 34 At. Rep. 397.)

OHIO.—Rev. St. § 850, providing that the clerk shall keep a complete record of the proceedings of the Board of County Commissioners; and § 878, providing that it shall be essential to the validity of any contract entered into by County Commissioners or order made by them that the same has been assented to at a regular or special session thereof, and entered in the minutes of their proceedings, do not require that the permission of the Commissioners to the occupancy of a street by a street railroad company shall be entered in the journal of the Board.—(Nearing v. Toledo Electric St. Ry. Co., 9 Ohio Cir. Ct. R. 596.)

MICHIGAN.—City of Lansing Ordinance No. 61 (granting a street railway company the franchise to lay its tracks upon the street), by section 15, provides that the railway company, in constructing its tracks, shall pave between the tracks with the same material as that adjoining said tracks; and, if the city provides for paving or repairing any street, the company shall use within the railway tracks the same material, and keep the same in good repair. *Held*, that the company is bound to repave between the tracks, in case a street is repaved with different material, with the material used in the new pavement.

Mandamus will lie to compel a street railway company to pave the street between its tracks as required by the ordinance granting it the franchise to lay the tracks upon the street.—(City of Lansing v. Lansing City Elec. Ry. Co., 66 N. W. Rep. 949.)

STREET RAILWAY JOURNAL

JULY, 1896.

PUBLISHED MONTHLY BY

THE STREET RAILWAY PUBLISHING COMPANY,

HAVEMEYER BUILDING,

26 CORTLANDT STREET, NEW YORK.

WESTERN OFFICE:

MONADNOCK BLOCK, CHICAGO, ILL.

EUROPEAN OFFICE:

39 VICTORIA STREET, WESTMINSTER, LONDON, ENGLAND.

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 / £1 5s 0 / 31 fr

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

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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.

WE commence in this number a series of statistical papers bearing upon the street railway industry in America. The first of these papers will be devoted to the operating statistics of a large proportion of the street railway mileage of the country; the second paper to the statistics of capitalization of American street railway properties; and in subsequent papers the combined capitalization and operating statistics of groups of cities of the same size will be presented in such a way as to permit of interesting and valuable comparisons. From the statistics given in the article in this issue it appears that in the year 1893 the gross receipts and income applicable to dividends of 127 street railway corporations reached high water mark, being greater than in both previous and subsequent years up to the present time. The latest reports, however, show a decided improvement over those of one year ago in gross receipts, earnings from operation and net income, and it is to be hoped that this rate of increase will be kept up for the financial year ending in 1896 and thereafter, with the steady growth of urban population and the expected improvement in business and manufacturing conditions.

WE think it desirable to suggest to street railway managers that letters or telegrams received by them from newspapers and city officials in different parts of the country asking for information about various details of street railway operation should be answered, not hastily or carelessly, but with due regard to the way in which this information may possibly be used. It should be remembered that newspapers do not ordinarily seek unbiased information, but are anxious to obtain that which will bolster up opinions already expressed in their editorial columns and to which they are therefore committed. They often use, therefore, only such information as suits their purposes. Moreover, it is impossible for laymen in street railway matters to easily understand the differences in conditions which make a transfer system, for example, possible in one city and very difficult to establish in another, and a brief or carelessly worded reply may do an immense amount of harm to local street railway interests. An illustration of the danger of the indiscriminate answering of requests for information is found in the results of a recent circular telegram sent by a Boston paper to a large number of the street railway managers of the country inquiring about their experience with transfer systems in their respective cities. The paper published what purported to be all answers to these telegrams, but, as a matter of fact, it omitted several which were sent and which were distinctly unfavorable to the transfer system, printing only those which served to strengthen its own position. There is no way of preventing this, we presume, but it is certainly a thing which no honorably conducted paper would condescend to do; and the probability of having one's views misquoted or garbled, especially when opinions are given in brief, should lead street railway men to think twice before complying with requests of this kind.

PERHAPS the most severe test of the ability of a mechanical engineer who is engaged to design an electric railway power plant is his arrangement of the auxiliary appliances and the piping system. He has to lay out his plant so as (a) to avoid unnecessary length of piping, (b) to secure a duplication sufficient to keep the plant in regular operation no matter what accidents may happen to individual parts, (c) to avoid difficulty with joints and escaping steam due to expansion, contraction and other causes, (d) to make every portion of the plant easy of access so as to provide for constant inspection and occasional repair, and (e) to do this all at minimum first cost. One of the chief requisites of a power station is absolute continuity of operation, and the necessity of duplicating such parts of the plant as are most liable to accident and whose temporary disuse would otherwise paralyze the service is apparent. In times past, engineers have adopted several widely different methods of duplication. Those most generally employed involve the constant use of one complete feeding system, and the holding of another in reserve to be used only in case of accident to the first. This means large pipe diameter in each system and consequent heavy first cost, and may easily mean that the reserve system will be out of order when the necessity for its use is most urgent. On another page of this issue, Mr. Davis, in a carefully prepared article describing the different methods of piping which have been employed in electric railway work, has recommended one which certainly seems to possess a number of advantages. The plan proposed involves the employment of two systems of pipes whose combined sectional area is equivalent to the area of a single main capable of operating the entire plant in the most economical manner. These duplicate systems are used together and continuously—in parallel, as it were. If one system should break down it is immediately cut out and repaired and, during the short period usually necessary for such repairs, the pressure on the boilers is raised a sufficient amount to make it possible to still deliver steam to the engines through the second system at the same pressure as before, though, of course, with a considerably greater temporary loss in the piping. In other words, Mr. Davis believes, and with reason, that a small reduction in the efficiency of the piping system, occurring at rare intervals and only for a day or two at a time, involves far less money loss than the constant loss of interest upon the much larger investment necessary with duplicate systems each of which is capable of running the entire plant at all times. Several plants have been piped on this system and are understood to be working with entire satisfaction and excellent economy.

THE question as to whether it is or is not necessary to specially bond electric or cast welded track joints is one which it is not at all easy to solve, for the reason that so much depends upon the mechanical perfection of the joint made in each particular case. In the letters given on another page from a number of street railway managers who are using cast welded joints, it is seen that there is a decided difference of opinion on this subject. It would appear that in many of these joints a portion of the metal of the rail itself is fused so as to make a union amounting practically to a complete weld between the molten metal of the joint and rail. In some cases, however—probably where the rail surfaces are not cleaned with sufficient thoroughness—the joint surfaces are honeycombed so that the "weld" is not complete. It does not, of course, follow from this that the joint, considered purely from the point of view of its service in the track, is poor, but it may quite possibly be true that the joint is not electrically good without auxiliary bonding. It has been noticed also in one or two cases by those using the cast welded joint that the electrical conductivity seems to deteriorate with the length of service, this being very possibly due to the jarring apart of the joint surfaces to an extent unappreciable as far as the strength of the joint is concerned, but of some importance as regards electrical conductivity. It is not an easy matter to test these joints to determine whether or not bonding is necessary, since it is impossible to completely insulate a long stretch of track so as to accurately measure the loss in voltage due to the passage of a heavy current, while the loss at each joint, even when the latter is comparatively poor electrically, should be so exceedingly small as to be difficult of measurement. The best way of determining track resistance is, as we have before pointed out, to measure the fall in potential between the ground bus bar at the station and any point on the track system, by means of a test wire strung upon the poles on every street throughout the system, and in this way defective lengths of track or even defective joints can usually be found.

DURING the last three years probably more patents have been granted in this country for street car fenders than for any other invention. They cover devices of all kinds, sizes and degrees of practicability and are of such number and variety that among street railway men a new fender has come to be regarded in somewhat the same light as a new car coupler by steam railroad managers. Just how many fenders have been put on the market it is impossible to say, but a good idea of the large number can be obtained from the following incident: some time ago a street railway manager stated in an interview, which was published in one of the daily papers of his city, that his company was on the lookout for a good fender. The interview was copied by a good many papers throughout the country, and within three months, it is said, 4000 different fenders were offered him. The manager, in self defense, was finally obliged to put up a notice on his doors, "No More Fenders Wanted." While the subject has its humorous side, and while many, if not most, of the devices are utterly absurd in conception and construction, the fact that so much attention has been given to fenders by the general public shows that there is a universal feeling that safety guards of some kind are necessary for electric cars in cities. At first this idea was not generally accepted by street railway managers, and quite a number still believe that fenders are not only not necessary, but often harmful. On the other hand, it is undeniable that they are being adopted in most of the large cities as well as in many of the smaller towns, and we are inclined to think that all managers operating cars in crowded streets will do well, even if not believing that fenders are of much positive value, to disarm possible popular criticism by the employment of a safety device of the latest and most approved pattern. Another interesting and somewhat remarkable fact in connection with fenders is that in spite of the enormous number of the fenders patented, but a comparatively small number of types have been adopted to any considerable extent. This might be understood in the case cited of a steam railroad coupler where uniformity of equipment is desirable, but with fenders a different type could be used on each road, or even on each car, without seriously affecting the efficiency of the service. The fact that there are less than half a dozen makes which have become generally known seems to show that in spite of the many patents granted for fenders, these few combine all the requisites.

Cheapness of Municipal Transportation in America.

IN view of the occasional agitation of the question of reducing fares on our street railway systems we have sought information as to the longest rides given for a five cent fare in American cities above 50,000 inhabitants, and as to the regulation of transfers within those cities. The results of our inquiries are found in some detail on another page, while here we wish to call attention to a little table containing some figures upon the street railway systems of cities above 100,000 inhabitants which are significant and interesting to an unusual degree.

In the first place, the size of the systems as shown in the third column commands attention. The city of Chicago, for example, contains as much track as would reach from New York to Cincinnati, while the length of line would reach from New York to Rochester—a very respectable size for even a steam railroad system. Large mileage in a street railway system necessarily means a widely ramified network of lines, and indicates a far greater convenience to the public than would be the case with a smaller system in the same city. It also means, or may easily mean in many cases, that the street railway corporations of a city, taken as a whole, may be operating more mileage than would really yield them the greatest percentage of profit upon the investment. Corporations are not always philanthropic, but they are, when prosperous, almost always more generous and more far sighted in their treatment of the public and in their plans for the future than is the case when they are ground down to the lowest possible margin of profit or compelled to fear too much the effect of possible contingencies.

CITY.	Approximate Population. 1890.	Track Mileage.	Longest ride for 5 cent cash fare, miles.	Transportation rate per mile.
New York, N. Y.	1,851,060	458	12.5	.0400
Chicago, Ill.	1,100,000	760	15	.0033
Philadelphia, Pa.	1,047,000	462	11.75	.0043
Brooklyn, N. Y.	839,000	393	18	.0028
Boston, Mass.	678,000	275	9.9	.0051
St. Louis Mo.	452,000	335	15	.0033
Jersey City-Newark, N. J.	388,000	175	8.25	.0060
San Francisco, Cal.	299,000	269	12	.0041
Minneapolis-St. Paul, Minn.	298,000	222	12.94	.0039
Cincinnati, O	297,000	263	13.44	.0037
Cleveland, O.	261,000	269	10	.0050
Buffalo, N. Y.	256,000	143	13.75	.0036
Lynn, Mass	250,000	153	6	.0083
New Orleans, La,	242,000	169	7	.0071
Washington, D. C	230,000	138	9.5	.0053
Detroit, Mich.	206,000	202	10	.0050
Milwaukee, Wis.	204,000	159	9	.0056
Kansas City, Mo.	171,000	142	11.2	.0045
Louisville, Ky.	161,000	150	9	.0056
Rochester, N. Y.	124,000	93	9	.0056
Denver, Col.	107,000	212	11.5	.0043
Indianapolis, Ind.	105,000	107	11	.0046

In the fourth column will be found the longest rides which can be taken for a five cent fare on the different city systems by a passenger desiring to get from one point to another by the shortest possible route. On several of these systems the transfers are so arranged that a passenger can ride indefinitely, if he so desire, but the longest legitimate rides, so to speak, are those given in the table. The figures in column five will, we imagine, strike our foreign friends with amazement as showing how wonderfully cheap is municipal transportation in America. A penny (two cents) for the first mile, and a half-penny per mile thereafter is the usual English charge for horse car transportation on the generally short routes of their principal cities. Here in our larger cities a passenger may ride at one-quarter penny per mile or less, and ride at much greater speed and in comparative luxury and ease. It is not too much to say that American street railways afford the cheapest transportation in the world—and yet it is sought in some cities to bring down rates even lower.

We have recently commented at some length upon the tremendous advantages which have accrued to the American public from the policy of liberal street railway franchises which has usually been adopted by our municipalities, in comparison with the restrictive policy common abroad, and nothing further need be said upon this point here except that a reversal of this American policy would be in the highest degree unwise, and its effects would never be tolerated by the American public. Foreign cities are beautiful and most attractive as places of residence and enjoyment for the rich, but the living conditions for the poor—alas, the poor must live as they may.

The longest ride possible in our cities of 50,000 inhabitants and above varies from about eight miles in the smaller cities to from twelve to eighteen miles in the larger, this variation being, of course, due to local conditions. In all but a few cases these longest rides can be had at a single five cent fare, there being but three or four cities in which double fares or special, higher rate transfer checks are issued. In fact, we have been much surprised to see how universal is now the custom of issuing free transfers to all parts of a company's system. Only nine cities out of thirty-eight from whom we have heard refuse this, and in several of these latter there are genuine reasons for such refusal. For example, a passenger can ride in any part of St. Paul or in any part of Minneapolis for a five cent fare. The same company, however, controls a line from St. Paul to Minneapolis, and for a ten cent fare will carry a passenger from any point in St. Paul to any point in Minneapolis, so that he may ride for twenty-four miles for ten cents. Before the advent of electricity the steam railroad running between St. Paul and Minneapolis carried passengers between its own stations in the said cities for thirty cents each way, and ran trains not oftener than once in thirty minutes instead of once in seven minutes, as by the electric lines at present.

In Philadelphia the consolidation of three great systems has made it exceedingly difficult to arrange transfers properly without a strong probability of their abuse, and while free transfers are given upon many lines, an eight cent fare is charged on some of the longest routes—from fifteen to eighteen miles. In Boston the conditions are somewhat the same, the West End Company having a number of long lines extending far into the suburbs, but even there reductions are constantly being made in the direction of a general five cent basis.

Altogether it does not seem just or reasonable to demand further concessions from the street railway companies in most of our cities. The public is being served by them as no other public in the world is served, and is getting more for its money than would ever have been thought possible until the advent of electricity. Enormous investments have been made, and are still being made, with a view to better service of the public. Dividends are being withheld from the stockholders in a large number of cases, and turned back into the property. A few men have undoubtedly made large profits from the manipulation of franchises and in the building up of the street railway systems, but the great body of security holders is surely not receiving unusual or extortionate profits.

J. C. MONAGHAN, U. S. Consul at Chemnitz, Germany, in a recent report to the State Department, states that experiments are being made on the street railway system of Dresden, Germany, with accumulators and the conduit system. The system is now being operated by overhead wires.

THE Birmingham (Ala.) Railway & Light Company put in service May 1 the first electric car on its East Lake line, which was formerly operated by steam dummies. The operation of the car was made the occasion of a celebration by the railway company and prominent citizens of Birmingham, and the opening was in every sense a success. The inauguration of electricity on this line is the forerunner of the equipment of other lines which the company will change over as rapidly as possible.

CONSTRUCTION

Steam Piping for Electric Railway Power Plants.

By Geo. H. Davis, M.E.

The requirements of electric railway service are such that managers and engineers are anxious to make use of every improvement in power plant design which will insure the greatest reliability. Definite and complete plans for the auxiliary equipment of stations had their origin with the electric railway, and designs for this work are the result of a most careful study of all the thermo-dynamic and mechanical conditions entering into a steam installation.

Although given types of engines and boilers are modified to suit local conditions, yet in general a given design is repeated in plants while each power plant is a special design suited to special conditions.

The steam installation may be divided into two parts. (1) Engines and boilers as received from the manufacturer. (2) Auxiliary fittings, including the remainder of the steam, water and furnace equipment.

There are two general layouts for power plants which are best. Where land can be obtained at moderate cost a cross connected, one story plant should be installed. Where land is extremely expensive the boiler room should be placed over the engine room, still maintaining the cross connection. Hence in the accompanying sketches the various styles of high pressure piping are compared with each other in a cross connected layout.

The following live steam piping systems may be used:

1. Single pipe without a main, extending directly

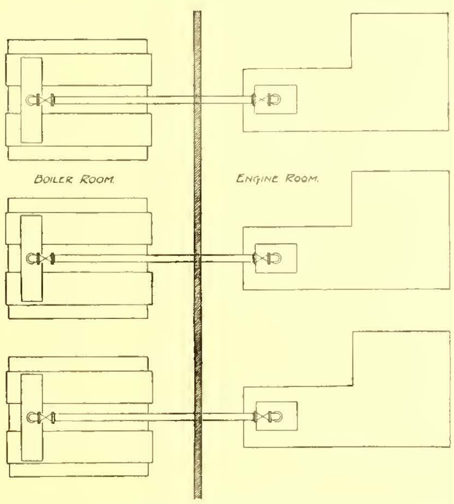


FIG. 1.—SINGLE PIPING WITHOUT MAIN.

from a boiler or battery of boilers to one engine. (Fig. 1.)

2. Duplicate piping without mains. (Fig. 2.)

3. Single piping from boilers to engines through one small continuous main.

4. Single piping from boilers to engines through one large main, the main being divided into sections. (Fig. 3.)

5. Single piping in circuit around engine room, the pipe being divided into sections. (Fig. 4.)

6. Double piping, one small main and one large main with small and large leaders to each boiler and each engine. (Fig. 5.)

7. Duplicate piping, two large mains of equal cross section divided into sections with two equal leaders to each engine and each boiler, one-half the system to be used at one time.

8. Duplicate piping, two small mains of equal cross section divided into sections with two equal small leaders to each engine and each boiler, the *entire system being in constant use.* (Fig. 6.)

With reference to the relative merits of these systems it may be said that much depends on special conditions.

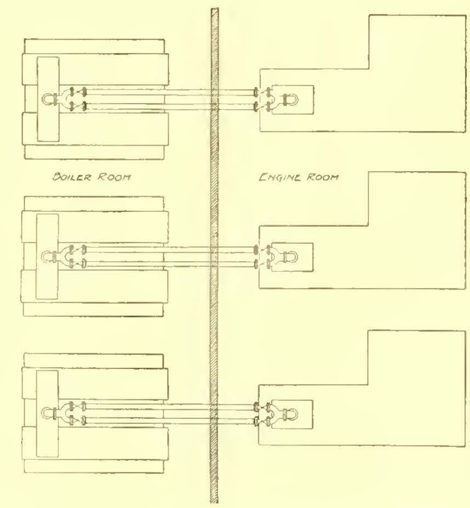


FIG. 2.—DUPLICATE PIPING WITHOUT MAIN.

No system is reliable or practical unless the pipe, fittings, gaskets, valves, etc., are of the best quality obtainable, designed exactly for the use intended, and erected by skillful and conscientious mechanics. A brief general description of the most common steam piping layouts is as follows:

Systems Nos. 1 and 2 as shown in Figs. 1 and 2 represent single and duplicate pipes connecting each individual engine and boiler and making the unit a separate plant. This style of duplication was the one first in general use for small plants. Although the steam fitting is much cheapened and simplified in this layout the number of engines and boilers required for the best results is increased, since if an engine is disabled its boiler is also thrown out of use and *vice versa.*

System No. 3 is the same as No. 1, except that a small main or by-pass is introduced connecting the various units.

System No. 4 (Fig. 3) is one modern method employed in the single piping of power stations. It consists of a main extending the full length of the boiler room and of sufficient size to allow of the use of any boiler with any engine in the plant or any combination of engines and boilers that may be required. The main is also divided into sections by intermediate valves, thus cutting out sections with their leaders that are not in use. In this way the heat losses due to radiation and convection are materially reduced. The boilers and engines are connected with the main through single leaders of suitable capacity with valves as shown.

The single system depends for its reliability entirely upon the quality of the material and workmanship used in its installation. So long as no part of the piping is disabled any combination of engines and boilers can be made. However, unless an excessive number of valves are used, a slight defect in gaskets and fittings may cause the shutdown of a considerable portion of the plant. If an engineer is sufficiently vigilant a first class single system may be run for years through night repairs without a single stoppage from defects in piping. Still the extra cost of an engineer of this character would more than pay the interest on the additional cost of a more reliable system, and the cost of the required number of extra large valves, to obtain the ordinary results of duplicate piping in the single system, would pay for duplication in smaller pipe sizes.

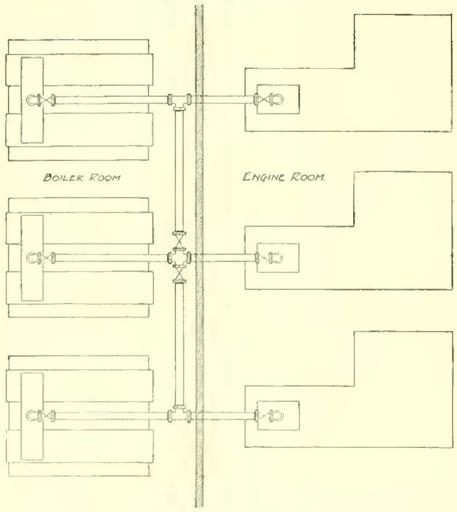


FIG. 3.—SINGLE PIPING WITH MAIN.

System No. 5 (Fig. 4) is usually installed as shown with a single large main making a circuit of the power plant, extending from the boiler room over one or two batteries of boilers into the engine room, entirely around the same and back to connect with the starting point. Leaders to the engines and valve divisions are as shown. Each engine and boiler is attached to a separate section of the main. As the main is in sections any disabled part can be repaired by disconnecting one section and one engine. This system is particularly adapted to plants where vertical engines are installed, the mains being placed on the side walls of the building at the level of the throttle valves of the engines.

System No. 6 (Fig. 5) is a complete double piping layout consisting of one large main with large leaders to boilers and engines and one small main with small leaders. The small main with its leaders are intended to stand idle, except in case of accident to the other half of the system. The small main and leaders are made sufficiently large to run the plant to its capacity during repairs, with a drop of from fifteen per cent to twenty per cent in the steam pressure.

System No. 7 is the full duplicate system of line steam piping consisting of two mains with their individual leaders, each of which is sufficiently large to run the entire plant at the most economical drop of steam pressure from the boilers to the engines, i. e., each main is the same size as the one main in the single system. The mains are divided into sections, and the duplication extends from the nozzles of the boilers to the throttle valves of the engines. Only one half of this system of piping is used at a time. This method originated with the first very large railway plants, but has such serious objections that it is now seldom installed.

System No. 8 (Fig. 6) shows in plan and elevation the location of pipes and fittings for a layout of the small duplicate system. The piping is installed entirely in duplicate. The two mains are located on brick piers in the basement of the engine room, and are equal in size. The combined cross sectional area of the mains is equal to the cross sectional area of the single main described in system No. 4, and one-half the cross sectional area of mains in system No. 7, assuming the three systems to be applied to the same plant. This is true also of leaders from mains to engines and mains to boilers. The mains are divided into sections, as shown, to insure greater reliability and to reduce, as much as possible, heat losses in any section of live steam pipes not in use.

Both pipes in any duplicate part are used all the time. If one becomes disabled the other is forced during the interval of repair.

Commencing with the special dry pipes or that portion of the boiler leaders inside of the boiler drums, a connection is made at the rear end of the boilers at the boiler nozzles, and from this point each of the leaders in duplicate extends directly across to the party wall. From this point, with a wrought iron bend with a radius of six diameters, the leaders extend down, and with a similar bend through the party wall, join each of the two mains located on piers in the engine room basement. At the entrance of the mains a copper expansion piece is placed. From the mains the engine leaders extend directly to the cast iron Ys and to the throttle valves of the engines. Gate valves are placed as shown. The mains are the lowest part of the system, except the individual drip pipes situated under the mains.

By placing the mains in this position many advantages are gained: (1) Valves may be placed at the nozzles of the boilers, as shown, without obtaining a water leg which would be the case if a boiler were cut out and the mains were situated above the boilers. This is also true of leaders to the engines. (2) Placing mains in the basement of the engine room on substantial brick piers with expansion rollers furnishes a perfect support separate from the building walls. (3) The system makes the shortest possible connection between boilers and engines, as will be seen from the elevation (Fig. 6). (4) The engineer has easy and quick access to all valves and fittings, which in case of emergency is a most practical advantage. (5) Repairs and erection of piping are materially reduced in cost of labor. (6) Condensation is less in a basement than in an open boiler room. (7) The drip system for the live steam pipes is much simplified, the gravity drips being omitted entirely. (8) The mains, being only five feet or six feet

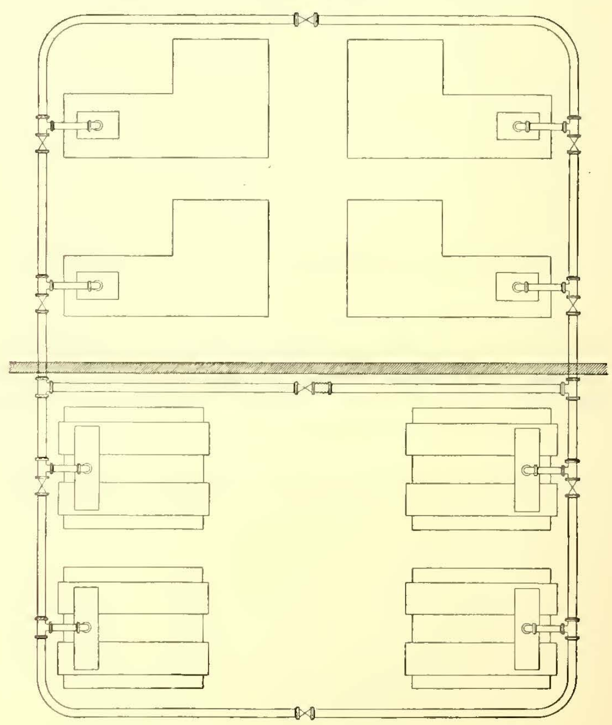


FIG. 4.—CIRCUIT FORM OF SINGLE PIPING.

from the throttle valves, form a storage receptacle for steam at this point, thus making it unnecessary to install steam separators. Steam enters the top of the mains and is delivered from the top, and in this way the steam passes through a separating process.

Placing boiler leaders for nearly half their length in the drums of boilers has particular advantages, since it steam jackets that portion of the leaders, leaves clear space or head room above the boilers and avoids one right angle bend.

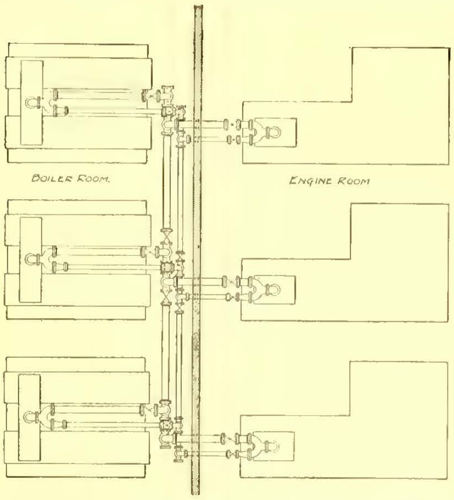


FIG. 5.—DUPLICATE PIPING WITH LARGE AND SMALL MAINS.

DUPLICATION OF PIPING.

The duplication of steam piping under the present methods of construction is an extremely desirable thing in railway or lighting plants if it can be made to accomplish the objects for which it is intended. It is customary to "duplicate" engine and boiler installations, in small plants one hundred per cent, in medium sized plants fifty per cent, and in all larger plants at least twenty-five per cent. In records of repairs in railway plants it has been found that about seventy-five per cent of such repairs are chargeable to the auxiliary equipment, i. e., the equipment not including engines and boilers.

The weakest parts of a pipe line, as in a railway track, are the joints. Gaskets of themselves cost very little, but the labor and stoppage of plant involved in their renewal are extremely expensive.

If a piping system including valves and fittings could be made entirely of wrought iron or steel electrically welded at joints and connections, making the whole system one integral piece, then a duplication would be unnecessary, since pipes deteriorate only from rust and are not burned out as with boiler tubes, or worn out as with moving parts of an engine.

Assuming that a system is erected of the strongest character now used, say, of XX pipe, heavy male and female flanges, with long threaded surfaces and pipe thoroughly peened into flange, and gaskets of both metal and composition installed at each joint, the structure as a whole is unreliable as compared with other parts of steam installation.

Until a more permanent piping system can be erected than is now possible, some form of duplication is absolutely necessary.

The full sized duplication (system 7) has many disadvantages, among which are its first cost which is nearly eighty per cent more than the single system and nearly seventy per cent more than the small duplicate system. In the large system of duplication only one-half the system is in use at one time. The valves of the other half always leak sufficient steam to keep the idle half of the system up to nearly boiler pressure, and in this way twice the amount of superficial live steam area is exposed for condensation due to convection and radiation of heat. This amounts to about seventy B. T. U. per square foot per hour, where one inch of asbestos and one inch of hair felt are used in covering the pipes. Then the drips of the idle main have to be left open to the atmosphere to avoid a complete filling of the main with water, and in this way the losses due to the leakage of large valves become enormous. Again the repairs to gaskets and fittings of large pipes cost fifty per cent more than in pipes one-half their area. Finally in most plants installed with the large duplicate system the chief engineer has allowed one main to be used for six months or a year at a time, and when an accident does occur and the idle main is required the valves are so thoroughly seated, due to rust or impurities carried over in the steam, that they are immovable, and thus the very object of the system is defeated.

These faults in a lesser degree are found in a system where one small main and one large one are installed as described in system No. 6 (Fig. 5). In this system the small main is never intended for use except when the large main is disabled. As designed the mains cannot be changed, consequently the valves of the small main are sure to become seated, and the double system becomes useless for the purpose intended.

The only fault that may be found with the single system (No. 4) if the best material and workmanship are employed in its erection is to a certain extent its unreliability. It becomes at once the weakest part of the steam plant, since boilers, engines, condensers, etc., are nearly always in duplication and of much more substantial construction. The rupture of one gasket is sure to throw one boiler or engine out of use, and this usually occurs at a time when the full capacity of the plant is required. Again the repairs to a single system are most difficult and expensive, since most stations are stopped for only three or four hours at night.

With reference to system No. 5, in which the main makes a circuit of the engine and boiler rooms, it may be said that the first cost is the same as for the large duplicate system No. 7. The latter costs about eighty per cent more than the single system and seventy per cent more than the small duplicate system No. 8. In system No. 5 the valve seating mentioned in systems No. 6 and No. 7 is avoided, since some part of both sides of the plant are presumably in frequent use. The drop in steam pressure is more than in any other system, due to the great length of mains required. The condensation is large, due to the fact that there is a greater superficial area exposed in this system than in any other. It also forms a particularly bad layout for future extensions, since any extension of building in the line of a main places boilers and engines farther apart.

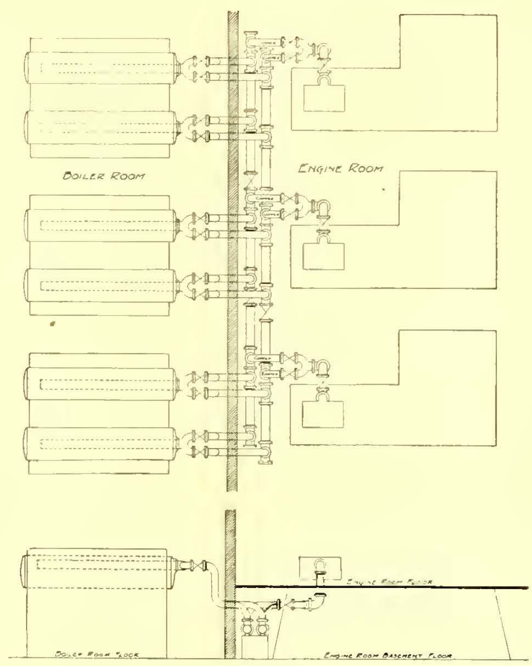


FIG. 6.—DUPLICATE PIPING WITH EQUAL SIZED MAINS IN CONSTANT USE—PLAN AND ELEVATION.

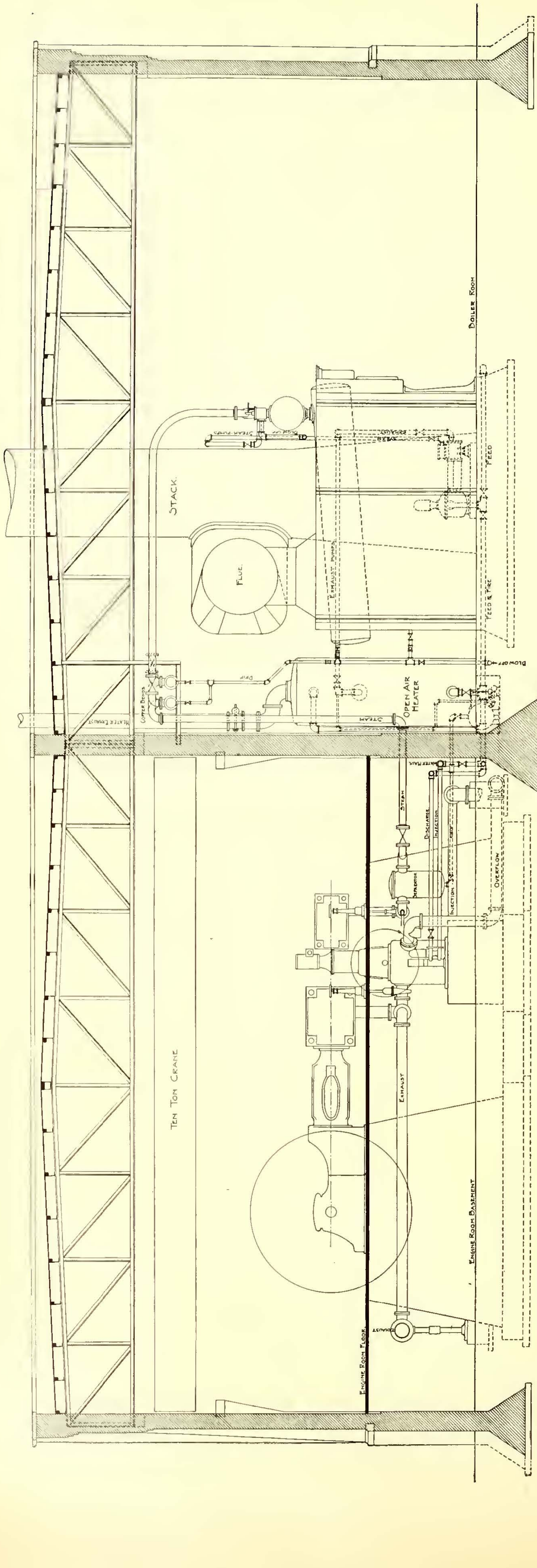


FIG. 7.—CROSS SECTION OF POWER STATION OF THE ORLEANS RAILROAD, SHOWING PIPING.

Ford & Bacon, Engineers.

The advantages of the small duplicate system No. 8 are as follows:

(1) Its low first cost which is only ten per cent more than that of the single system. (2) Its reliability. (3) Its economy of operation. (4) Its adjustability and convenience in repairs.

With reference to the reliability of this system it may be said that it reduces the chance of crippling the service of the piping plant just fifty per cent. All gate valves are in use and open all the time, thus preventing their being seated. In this way a pipe or main may be thrown out at any time and the load transferred to the other side without stoppage or delay. The drop in steam pressure when one side alone is used can be quickly made up at the boilers by increasing their pressure.

So far as economy is concerned this system has only forty per cent greater superficial area than the single system and thirty per cent less than the large duplicate system, and, as previously explained, the drips from each side of this system are pump-returned to the boilers with the same drip. In this way the outdoor discharge of the leakage through valves not in use as in the large duplicate system is avoided. The other advantages in the way of economy are due principally to the style of layout as shown in Fig. 6. The connections are short and compact, and the piping is in the best position to avoid friction and condensation losses.

The first cost of the various systems which have been described has been carefully computed, and the percentages given below are from estimates furnished by a prominent steam fitting contractor. All systems were calculated for the same plant, i. e., the same size and number of engines and boilers and the same layout. They were based on exactly the same quality of material and workmanship and all accessories which would belong to each system to make it complete.

System No. 4	costs	100	per cent (single system.)
" " 5	"	180	" (mains making circuit of engine room.)
" " 6	"	130	" (one small and one large main.)
" " 7	"	180	" (large duplicate system.)
" " 8	"	110	" (small duplicate system.

In any installation of machines the designer should make his work (1) reliable, i. e., perfect in operation; (2) the installation should have a low first cost; (3) the installation should be economical in operation, and (4) it should be simple, sensible and ornamental. System No. 8 has all these characteristics.

STEAM FITTING INSTALLATION FOR THE ORLEANS RAILROAD, NEW ORLEANS, LA.

A practical example of system No. 8 is shown in Figs. 7, 8 and 9, which are the complete working drawings of the plant of the Orleans Railroad Company, of New Orleans, La., a general description of which was published in the STREET RAILWAY JOURNAL, for April, 1896.

Before the final arrangements for the purchase of the building site for this plant were completed, the general arrangement of steam fitting was carefully planned and the location of all the parts of the plant was determined with reference to the best arrangement of the auxiliary equipment. The latter includes the following:

1. The high pressure live steam system.

2. The condensing and exhaust steam system including two 12 in. × 20 in. Allis vertical condensers.

3. The feedwater and purifying system, including two 7 in. × 4½ in. × 10 in. duplex pumps, open air feedwater heaters and purifiers and artesian well connections.

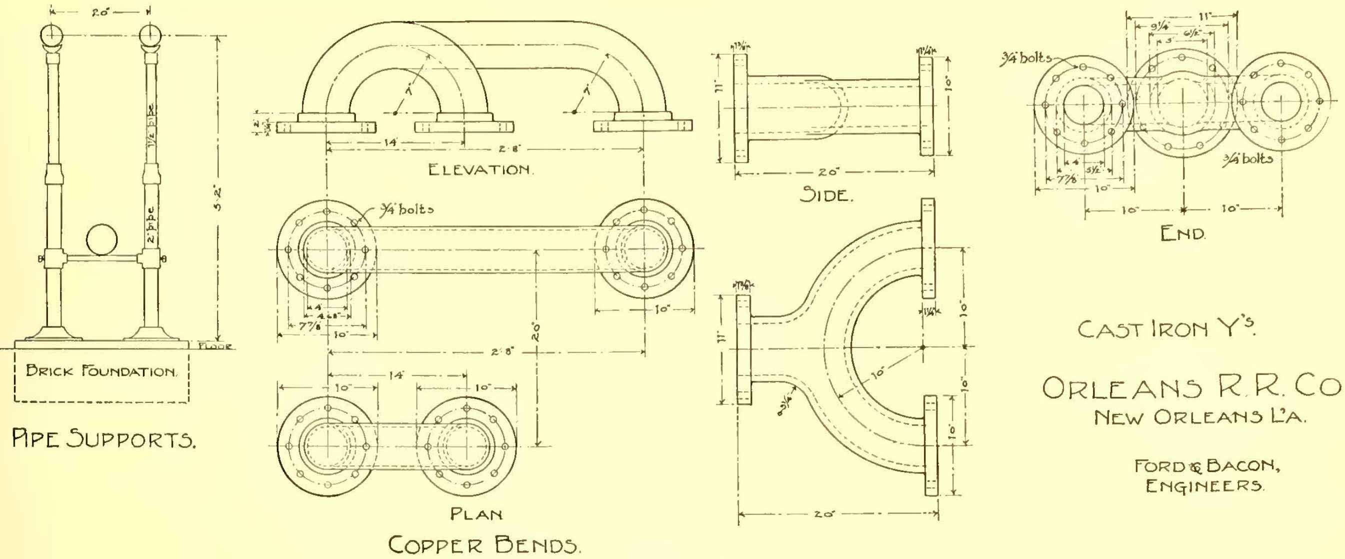


FIG. 8.—DETAILS OF PIPING—ORLEANS RAILROAD.

4. The drip and blow-off system, including one duplex pump and tank.

5. Water piping system for fire protection.

6. Flue, stack and furnace connections.

8. Pipe and flue coverings, painting and finishing of the equipment complete.

The high pressure live steam piping commences with a cast iron Y at the nozzle of the cross drums of the Heine boilers and extends in duplicate with wrought iron bends over the flue to the mains, which are situated along party wall on a level with the top of the flue. From these mains the duplication extends through copper expansion bends down and under the engine room floor to steam separators at the throttle valves of engines.

Chapman gate valves are placed in the mains, dividing them into sections, so that engine No. 1 and boiler No. 1 or engine No. 2 and boiler No. 2 may be used without the admission of live steam into the part of the system not in service. The entire high pressure system with all valves, unions, fittings and connections is of such dimensions and quality as to stand without leakage 160 lbs. per square inch live steam pressure and in a preliminary test to stand 240 lbs. per square inch hydraulic pressure. The pipe is of the best American lap welded charcoal iron of extra heavy pattern. Flange unions and gate valves are used in all pipes greater than two inches in diameter and flanges are in general like the Chapman standard for high pressure steam fitting carefully lathe faced. Rainbow packing with cement is used at all joints. As is shown in detail drawing (Fig. 8) the flanges are unusually thick at the threaded surface, and all pipe ends are carefully and thoroughly peened into flanges.

In pipes smaller than two inches Jenkins high pressure globe valves are used. The supports for steam mains are channel iron, built up hangers suspended from roof trusses and party wall. Other supports consist of brick piers with single or double yoke, adjustable pipe stands as shown in Fig. 8. The live steam piping is very completely shown in Figs. 10, 11 and 12. In Fig. 10 is shown the two duplicate engine leaders commencing with the two horizontal gate valves near the separators and extending on pipe supports back through the party wall. Figs. 11 and 12 illustrate the full boiler room live steam piping, including mains, engine and boiler leaders.

The condensing and exhaust steam system commencing with the low pressure cylinders of each engine, extends to individual Allis engine condensers. At the latter the exhaust may pass through a relief valve into individual leads to the main twelve inch open air exhaust which is in front of engines and terminates above the roof with large muffler condensing exhaust head. The open air exhaust is of standard wrought iron in the interior of the building and the interior of pipe is thoroughly painted and oiled. The exterior portion is of heavy spiral, riveted, galvanized iron.

The injection and overflow pipes are of heavy flanged cast iron with Chapman low pressure gate valves located as shown in Figs. 7 and 9. Condensing water is taken from artesian wells in the rear of the building and from the navigation canal in front and by the arrangement of the injection pipe with by-pass as shown in Figs. 9, 11 and 12 both canal and well water may be used at the same time for either or both condensers. The well water has a constant temperature of 70 degs. F. throughout the year while the canal water varies from 40 degs. F. in winter to 85 degs. F. in summer.

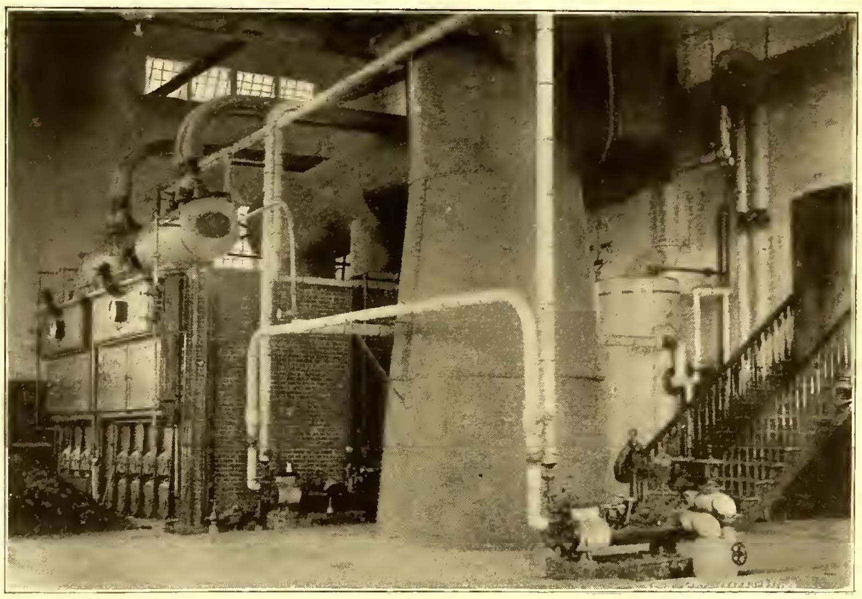


FIG. 10.—INTERIOR OF BOILER ROOM, ORLEANS RAILROAD, SHOWING LEADERS FEED PUMP AND PIPING, STACK STUB, ETC.

The overflow pipes are placed under the basement floor and discharge into street gutters from which water passes to the Orleans drainage canal two blocks in the rear of building. The discharge was placed as it is because there is almost no current in the drainage canal, and by discharging the overflow in the same general locality as the injection is received would materially raise the temperature of the injection above normal.

The feedwater and purifying systems begin with the two sources of supply, the artesian wells and the navigation canal. A water main is placed parallel with the party wall as shown and joined with the injection at each end of

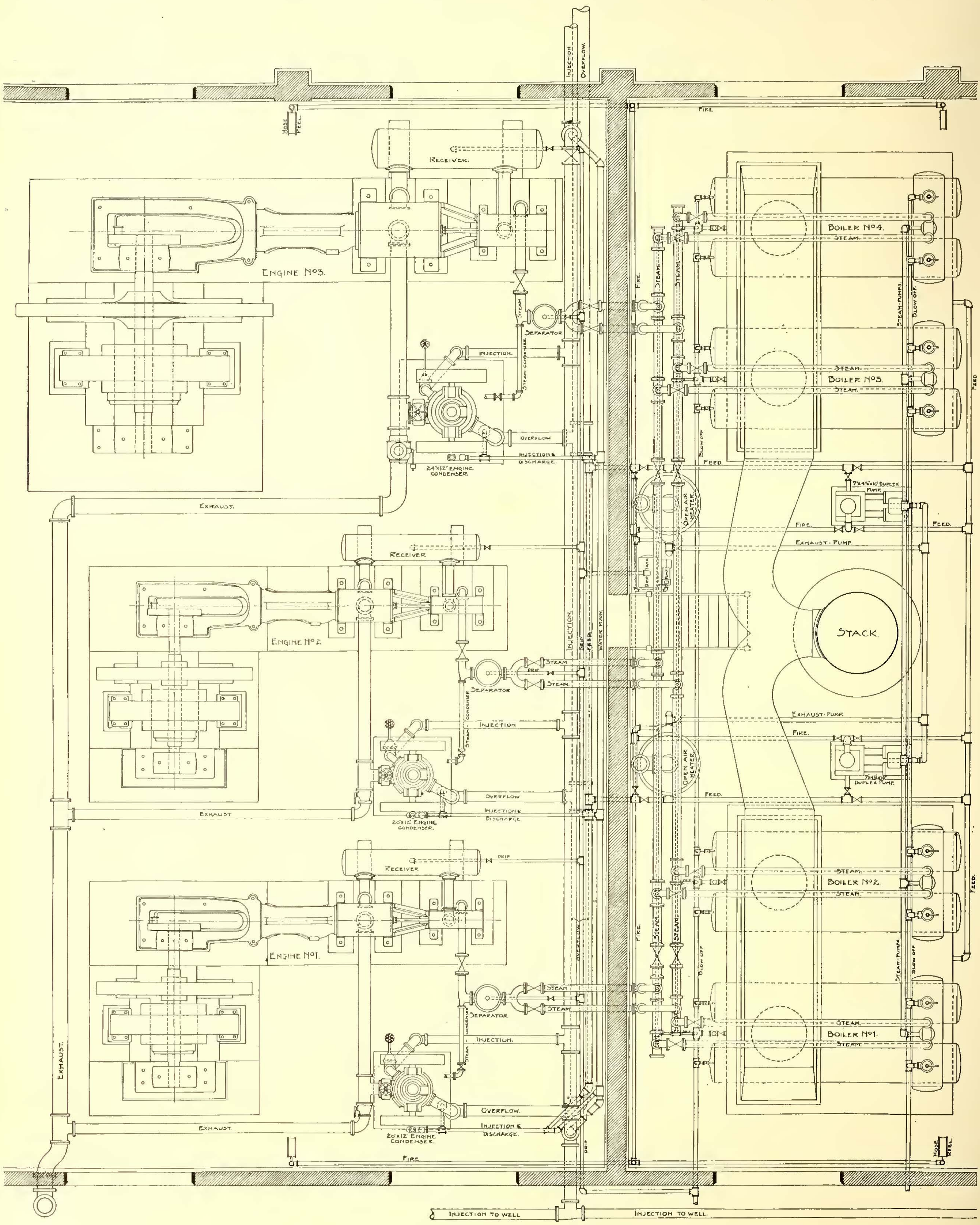


FIG. 9.—PLAN OF POWER STATION—ORLEANS RAILROAD.

the engine room basement and outside of the main gate injection valves. Each of the duplex feed pumps and each of the condenser feed pumps are joined to the water main. The condenser feed pumps take water from either the discharge hot wells of the condenser or from the water main and discharge into the open air heaters. The duplex pumps take water from the heaters and discharge into boilers.

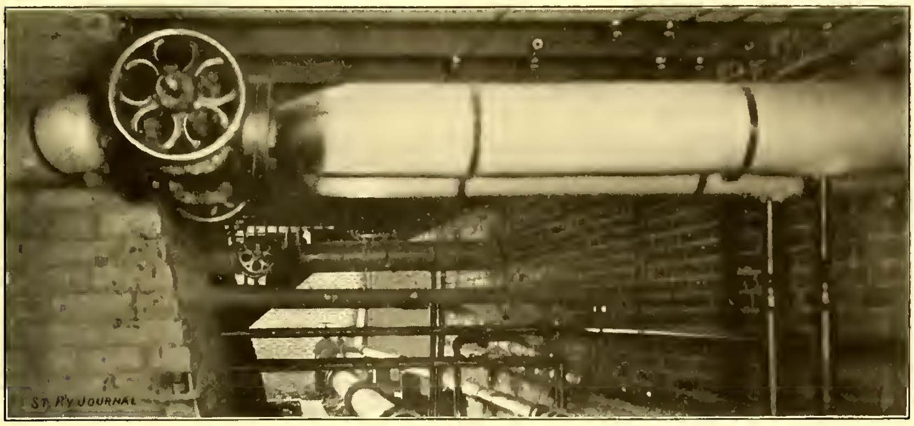


FIG. 11.—ENGINE ROOM BASEMENT, SHOWING DUPLICATE LEADERS TO ENGINES, HOT WATER, DRIP AND INJECTION PIPING AND WATER MAINS.

The arrangement of piping is such that either condenser feed pump or duplex pump may be used to feed boilers with either condenser discharge water or cold water, and so that either duplex pump will supply either hot or cold water to either boiler.

After careful consideration it was decided not to install primary heaters in this compound condensing plant, as the saving effected by them would not pay the interest on their original cost, besides introducing an extra number of joints in the connection between the low pressure cylinders and condensers which would greatly increase the chances for air leaks and defective vacuum.

The open air heaters and purifiers are of the vertical type designed to eliminate carbonate impurities. These heaters are installed with by-pass connections and extra plates.

Discharge water from condenser is usually used for feedwater. This at 110 degs. is discharged into open air heaters where the temperature is raised to 150 degs. by the exhaust from pumps alone. A live steam connection is made with these heaters so that by throttling the exhaust from the heaters the temperature may be raised to 200 degs. F. This however is never used since the impurities of feedwater do not require it. The condensers exhaust directly into their own vacuum which, of course, for all engine condensers with economical valve gear is the most economical use of this steam. This also much simplifies the piping.

Figs. 10 and 12 illustrate these heaters and general water piping in boiler room. The artesian well connections are located as shown on the plans and are continuous from injection pipe to bottom of strainer in the 750 ft. wells. At the top of the well there is a by-pass which takes the natural flow of water from the well to the street gutter when the plant is not in operation or the well is not in use. These wells become clogged with sand immediately after the natural flow is stopped.

The drip and blow-off system is carefully shown in plan and elevation of piping and also in Figs. 10, 11 and 12. In each main a drip connection is placed at the entrance of each leader from the boilers, and the drips are returned by gravity to the boilers or may be discharged into the blow-off tank in the rear of building. All drips from the live steam jackets of receivers, steam separators at engines, etc., are returned by gravity to an automatic drip pump and tank and from this point are forced into the boilers or allowed by gravity to discharge into blow-off tank. All check valves in this system are of the Platt & Cady pattern brass bodies.

The water piping for fire protection extends from each of the duplex pumps to the roof at each end of the party wall and also at each end of engine and boiler rooms as shown.

The piping installation has in connection a station gauge board in the engine room upon which are placed in nickel finish and nickel piping

1 Crosby steam gauge, ten inch dial,
1 " recording steam gauge, ten inch dial,
1 " vacuum gauge, ten inch dial.

The individual gaugeboards with each engine have in place

1 Crosby steam gauge, ten inch dial,
1 Crosby vacuum " ten inch dial,
1 Receiver " ten inch dial.

Also in connection with piping are installed one medium size "Perfection" steam oil purifier, one Pittsburgh alarm water column and one Spencer damper regulator. Thermometers and cups are installed throughout the entire piping installation.

Live steam piping, including headers, leaders, drips, steam cylinders, etc., is covered in standard sections and forms with one inch layer of asbesto-sponge and one inch layer of hair felt. Outside of the hair felt is placed a cover of ducking bound in position with brass bands and terminated at ends of pipe, joining fittings and valves with the Ainsworth patent sleeve.

All hot water pipes are covered with a one inch layer of asbesto-sponge. The covering is an extremely neat and workmanlike installation as shown in the engravings.

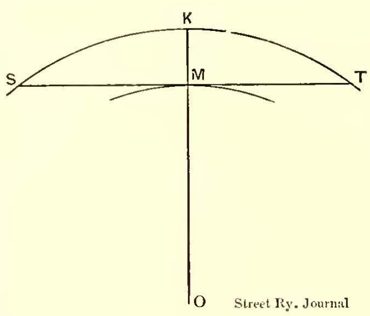
FIG. 12.—REAR OF BOILERS, SHOWING MAINS, LEADERS, HEATER, DRIP TANK AND FLUE.

Among the special characteristics of this piping installation are its simplicity and absolute reliability. It has now been in operation seven months and has proven most satisfactory under almost every condition of service. As previously mentioned, the greatest care was exercised in its design and installation, and the operation of the plant has been carefully watched by engineers and railway officials interested in the best and most practical designs for railway construction.

The Correct Location of the Trolley Wire on Curves.—Part II.

BY S. L. FOSTER.

The formula for the correct location of the trolley wire on curves, given in the last issue of the STREET RAILWAY JOURNAL, applies to cases where the radius of the curve is known either from the track being in place and the data recent or from a line of stakes to which it is possible to work. Where the trolley wire is to be put up over old existing tracks of which there are no records, its proper position can be more readily obtained than by first determining the radii of the curves and then figuring from that data.



In the engraving.

O K = radius of center line of track curve.

O M = radius of properly located trolley curve.

O K — O M = M K = distance inside the center of track the trolley wire curve should be.

This distance, M K, is the versed sine of chord, S T. The problem is to get a simple expression for the length of chord, S T, in terms of the known quantities, D (wheel base), L (length of trolley pole) and H (height of trolley wheel above trolley base), and we have a common chord length for all curves, the versed sine of which chord will always be the distance inside the center of the track curve the properly located trolley curve should be.

The length of a chord can easily be shown to be

$$C = 2\sqrt{\text{versin}\,(2\,R - \text{versin})}\,.\;.\;.\;.\;.\;.\;.\;(9)$$

Here C = S T, versin = M K, R = O K and

$$S\,T = 2\sqrt{M\,K\,(2\,O\,K - M\,K)}\;.\;.\;.\;.\;.\;(10)$$

We have already shown that

$$M\,K = R - \sqrt{R^2 - \left(\frac{D}{2}\right)^2 - L^2 + H^2}\;.\;.\;.\;.\;.\;.\;(5)$$

Substituting in equation (10) for M K its value as given in (5), using for R its equivalent O K, and for $\left[\left(\frac{D}{2}\right)^2 + L^2 - H^2\right]$ the letter K, we get S T=

$$2\sqrt{\left[O\,K - \sqrt{O\,K^2 - K}\right]\left[2\,O\,K - (O\,K - \sqrt{O\,K^2 - K})\right]}\;(11)$$

$$= 2\sqrt{(O\,K - \sqrt{O\,K^2 - K})\;(O\,K + \sqrt{O\,K^2 - K}}\,.\;(12)$$

$$= 2\sqrt{K}\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;.\;(13)$$

We thus have an expression for the chord length that is independent of the radius of the curve and depends only on the value of the constant quantities,

D = length of usual wheel base,

L = length of trolley pole,

H = distance between trolley wire and car roof,

and a convenient length is obtained that can be given the line foreman and from which he can locate the trolley wire correctly in all cases, except where the track is not in place, when the location must be obtained from formula (7)

$$M\,K = R - \sqrt{R^2 - K}.$$

As the radii of the inner and outer rails of a track curve differ, greater accuracy would be obtained by taking the average length of the versed sine of chord when applied to both inner and outer rail.

Experiments With Compressed Air on Lenox Avenue, New York.

The announcement was made last month that the Metropolitan Street Railway Company, of New York, would install on its Lenox Avenue system during the first part of July ten compressed air motor cars built at the plant of the American Wheelock Engine Company, Worcester, Mass. The trial with compressed air is in the nature of an experiment to determine whether this motive power is desirable for use on the many crosstown lines of the company, and does not indicate that the electric conduit system which has been in operation on the Lenox Avenue line during the past year has been unsatisfactory. The problem of the best motive power to use on its horse car lines, now aggregating about 150 miles in length, is an important one, and the policy of the company as outlined by the managers is to spare no effort to determine the best possible substitute on these lines for animal power.

The compressed air motors, it is claimed, will employ some novel principles which will eliminate to a large extent, if not entirely, many of the defects which have appeared inherent to the employment of this power in the past. The company which will manufacture these motors is said to be a particularly strong one both in financial resources and engineering ability, and includes among its corps of engineers, J. H. Hoadley, of Hoadley Brothers, New York, and Walter H. Knight, formerly chief engineer of the General Electric Company, and now chief engineer of the new air power company.

Structural Steel Flywheel at Albany.

One of the new steel flywheels installed in the power station of the Albany (N. Y.) Railway was described by Thos. E. Murray in a paper recently read before the American Society of Mechanical Engineers.

The former cast iron wheel which it replaced and which was twenty feet in diameter by fifty inches face, and weighed 50,000 lbs. burst, causing considerable damage. It was connected to a 20 in. × 36 in × 48 in. tandem compound engine and was belted to a forty-eight inch pulley located on a 500 k. w. generator.

Running under normal conditions this engine made seventy-two revolutions per minute. At the time of the accident, the speed of the engine (according to statements given at the time, and from computations made from the distances that portions of the wheel were thrown) was far beyond the conditions of every day practice.

Mr. Murray does not attempt to state the cause of the accident, or the acceleration in speed, but his faith in cast iron flywheels was considerably shaken, aud to replace the broken wheel he naturally looked for something better and of different material, which would stand the very high rate of speed and have a greater factor of safety, and at the same time, locate the weight in the wheel where the best results would be accomplished.

As some balance wheels had been constructed of structural steel with good results, Mr. Murray looked for a belted wheel of the same material, but was unable to locate any which had been built, and accordingly designed a wheel as per the accompanying engraving, and an order was placed for two wheels with Harry E. Campbell of the Albany Construction Works. The wheel was not designed to run at seventy-two revolutions per minute; or at any stated factor of safety, but the construction was of the strongest possible at a moderate cost, Certain parts of the wheel are much stronger than others, as, for instance, the hub and disks which take the place of the arms or spokes.

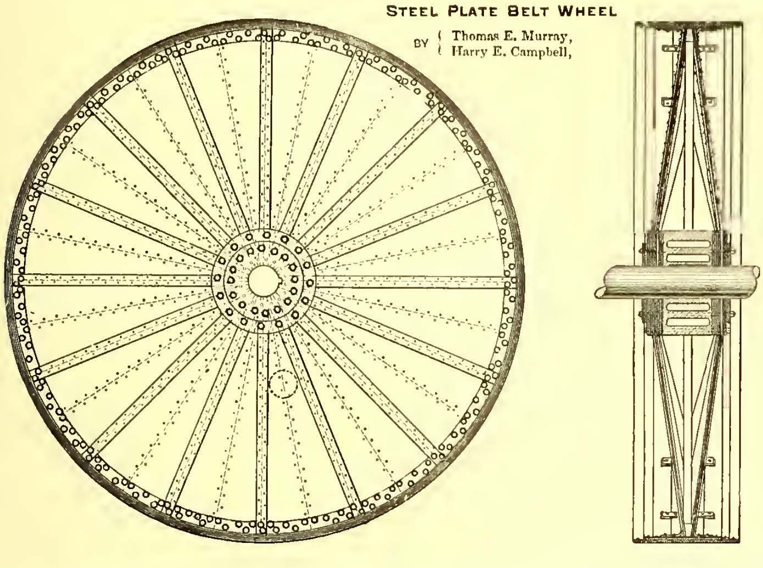
The steel was of a grade known as "shell steel," open hearth process and of 60,000 lbs. tensile strength, and great care was used to have grain, in the direction in which the plates were rolled, placed in position so as to give the greatest strength. All rivets used were Burden's best, and were of two sizes, namely, 1¼ ins. and ¾ in. in diameter.

The hub is described as follows: six ¾ in. disks were sheared 36 ins. in diameter and fourteen 48 ins. in diameter and these plates together with the cast iron separator or spider 23 ins. long by 48 ins. in diameter composed the hub, and were assembled as follows: two sets, composed of three 36 in. and three 48 in. disks each, were drilled for thirty-two countersunk rivets and after being securely clamped to tight joints, were riveted together, making two hub sections for the outer part of wheel hub, each 4½ ins. thick, and these were bored to a "driving fit" to shaft, two sets of four disks each were secured together and bored in the same manner for inside sections of hub, giving a steel bearing on shaft of 15 ins. The casting or spider, weighing 2700 lbs., was bored to a close fit and placed on shaft. This casting was faced on ends and cored for thirty-two 15/16 in. hub bolts and provision made for keys. The four steel hub sections were next clamped together and bored for the thirty-two steel bolts. The two sections, 48 ins. × 3 ins. were driven on the shaft, one against each end of the spider and one of the 36 in. × 48 in. × 4½ in. started on each end of shaft and driven past bearings, after which the shaft was set in position in bearing. Each part of hub was faced to right angles with bore.

Two dished webs were formed 19 ft. 6¾ ins. in diameter, each composed of two layers of ¼ in. plate, and each layer having sixteen sections, making sixty-four plates in all. These plates were drilled

STEEL PLATE BELT WHEEL

BY { Thomas E. Murray, Harry E. Campbell,



so as to have all joints broken. Said rivet holes were 3 ins. on centers, staggered, and four lines of holes running lengthways of plate. The small ends of plates were heated and bent on a form to right angle to shaft, and each drilled for two 1 5/16 hub bolts. The rim ends of plates were drilled for two lines of rivets and in such a manner as to properly secure segments of 6 in. × 6 in. × ½ in. angle irons. These plates were next connected between inside and outside hub steel plates, sections forming two complete dished disks which were 2 ins. apart at rim, and 29 ins. apart at hub. Thirty-two 5 in. × ¾ in. steel bars were fitted one over each outside joint of disk plates with hub end bent, and rim ends formed two right angles with center of wheel or parallel with shaft. This end was bent to secure rim in connection with angles, and were each drilled for two 1¼ in. rivets. Great care was used in making these bends, and sharp angles were avoided. All bars were drilled from a template. After the bars and plates were assembled in position, with temporary bolts, the hub was bolted together with bolts passing entirely through hub and disks and drawn close and firmly together, each bolt passing through two bars, four plates, and all parts of hub. Between the outer edges of disks a cast iron filler ring was placed and all bolted temporarily together. As all parts were drilled to templates, the work proved true and in line. The riveting was done from the outside with one man inside holding on and taking the hot rivets through a manhole left for that purpose.

The manner of constructing rim was as follows: eight 32 in. × ½ in. plates were rolled to form a circle, and riveted to, and with joints over the 5 in. × ¾ in. bars. Over these plates another layer of 40 in. × ⅝ in. plates, in sixteen parts, was placed with joints broken over the first layer. The 6 in. × 6 in. × ½ in. angle irons were next formed and securely riveted and bolted to disks, and also through both rim plates, with countersunk rivets. The ⅝ in. × ½ in. plates were also riveted together, rivets 4 in. centers. Another layer of ⅝ in. plate, 50 ins. wide, was next riveted on. This was also cold rolled, and the last or face sheet, 50 in. × ⅞ in., was rolled hot and riveted on. The countersink of last sheet was almost its full thickness; sixty-four 1¼ in. rivets were driven through the 5 in. × ¾ in. bars, and all rim plates connecting all plates and disks. The wheel was then keyed to shaft with two cast steel keys, one driven from each side of hub, and without turning or facing the wheel in any way, the belt was put on and the wheel put to work. The belt remained in center of wheel and has been running two months. There are three points in the diameter of wheel which buckles in plate, due to heating, raised 3/16 in. out of true, but the balance of wheel is practically true and in line with shaft. The wheel will be turned later. The weight of wheel is 57,930 lbs., distributed as follows:

Rim	32,000 lbs.
Disks	16,400 "
Hub	9,530 "

In calculating the strength of this wheel it is not necessary to begin at the hub and figure out every part as in a cast iron arm wheel. It is enough to know its strength at the weakest point, which is undoubtedly the outer layer of rim plates, as those plates must leave the wheel before any other part could give way.

Each of these plates weigh 590 lbs. and the direct centrifugal force on each plate, tending to hurl it off the wheel is, according to Haswell's formula:

$$F = W\frac{n^2 d}{5217} = \frac{590 \times 72^2 \times 20}{5217} = 11{,}725 \text{ lbs. nearly.}$$

But these plates are held in position by rivets having a total area of 20.75 sq. ins., which at a strain of 15,000 lbs. per sq. in. would carry 311,250 lbs.

$$\text{Then the factor of safety } \frac{11{,}726}{311{,}250} = 26 \text{ nearly.}$$

Mr. Murray states that he regards the advice of making the disks or webs dished on the same principle as a bicyle wheel, as the most important feature of this wheel, and believes it could be applied with success to broad-faced wheels for mill work by using double pairs of disks and also to balance wheels, such as are used with direct connected engine for the generation of electric light or power.

A New Line in Ohio.

The Dayton Traction Company has recently completed an electric railway connecting Dayton to Miamisburg, the total length with turnouts and double tracks being 12½ miles. The rails are 60 lb. section, six-hole double angle joints are used, provided with ¾ in. bolts, nut locks and washers. 2500 ties 6 in. × 6 in. × 7 ft. are laid per mile and the road bed thoroughly tamped and packed with gravel and stone under and between the ties.

The overhead electrical line from the city of Dayton to Miamisburg is standard wrought iron bracket construction with wooden poles. In the city of Dayton and Miamisburg cross suspension construction is employed, iron poles being used. All line material is of the General Electric make and the feeders are carried along the entire length of the line with feeding-in points every 1000 ft.

The car barn and power station have been erected at a point midway between the two termini and so situated as to facilitate the receipt of coal. It is in close proximity to water of excellent quality and sufficient quantity for steam making and condensing. The station buildings are of brick and steel. The roofs of both power house and car barn are of corrugated iron and that of the power house is lined with hard wood making same moisture proof. The power station is 80 ft. × 50 ft. and the interior is divided by means of a fire-proof wall.

The boiler room contains a battery of three boilers, each 18 ft. × 72 in. in diameter and containing seventy-two 4 in. tubes. They are of the best quality flange steel, triple riveted and designed to carry a working pressure of 125 lbs. per square inch. The stack is of steel, 60 in. in diameter and carried 102 ft. above the grate service of the boilers. It has an ornamental top and ladder. There are two 18 in. × 42 in. Hamilton Corliss condensing engines which are mounted upon 7 ft. brick foundations and drive two General Electric 200 k. w. multipolar generators, either couple sufficient to operate the load in its entirety, so that the plant consists of two duplicate units thus guaranteeing the greatest regularity of service. The switchboard is of the panel type and built entirely of slate and steel.

The car house, which is 75 ft. × 105 ft., is also fireproof and contains every convenience for repairs and handling cars, including two pits each 65 ft. in length. The repair shop is at the side of the car house and upon the opposite side are two offices, one for the general superintendent and the other for motormen and conductors.

The motor cars are of modern design and similar in appearance to standard steam railroad cars. They are thirty-five feet long, vestibuled at both ends, eight feet wide and mounted upon double trucks having all wheels thirty-three inches in diameter. They are straight sided with steam car roofs. The interior finish is of extra quality and of hard wood. The windows are large and double. The seats have special wide arm rests and are fitted with springs and upholstered in cane. There is a center aisle and the car seats in all thirty-six passengers. Each car is lighted with ten 10 c. p. lamps.

A combination baggage and express car used is similar in external appearance to the motor car, but has two compartments, one for passengers and the other for the carrying of baggage and express matter.

The trail cars are thirty-four feet in length with center aisle and seat forty-four passengers. The trailers are lighted in the same manner as the motor cars.

The motor cars are equipped with two 50 h. p. General Electric motors each. All work has been done by and under the direct supervision of Stern & Silverman, to whom we are indebted for the particulars given.

A Railroad Publication.

The Brooklyn Heights Railroad Company has adopted a novel method of advertising its transportation facilities and excursions by publishing monthly an attractive paper for distribution in Brooklyn and New York. It is entitled "The Trolley," and the first number is tastefully illustrated and very readable.

SCIENCE · ENGINEERING · INVENTION

New Swivel Truck.

The accompanying engravings show a new type of swivel truck for double truck cars, brought out by the J. G. Brill Co. and entitled the Brill "No. 27" truck. It embodies a number of radical departures from the usual form of swivel truck, as will be seen from the following description.

The truck may be characterized as one with a wrought iron frame, having jaws forged on, with solid extension pieces, T-iron end pieces, angle iron jaw straps and angle iron transoms with the spring plank formed of two Z-pieces filled with wood. The equalizers are a part of the spring plank, carry the swing bolster, and take their load in the center, they are in turn carried by links and move with the swing motion. Eight-inch journal box springs, nest spirals in the links, and quadruplet or triplet elliptics on the equalizer and spring plank furnish the vertical elasticity.

The form and peculiarities of the truck frame are shown in Figs. 1 and 2. The frame is a forging and the wheel pieces of a form somewhat like that which is so effective in locomotive practice. To a bar of ample stiffness jaws are forged at the proper points. From the outermost jaw at each end, extension pieces are carried, to which T- iron end pieces are bolted. On the wheel pieces between the jaws, and as close to them as may be practicable, suitable lugs are forged for carrying the spring links. Upon the inside of these wheel pieces, when made of steel castings, as is the company's practice for electric service, brackets are cast to take the angle iron transoms; when the frame is forged, corner brackets are used. For passenger service this frame is completed by iron safety beams and angle iron tie rods for connecting the jaws.

The strains upon the truck frame for a given weight of car and load are much less than in the ordinary construction. The swing links come close to the pedestals, relieving the wheel pieces from a large part of the strain which comes upon them when the load is carried by the transoms. Other things being equal, therefore, the truck may be kept square with a less strain on the frame.

One of the novel and most ingenious features of the truck is found in the equalizers. These are straight, forged bars, carried by spring links, or stirrups, upon their ends. At the centers they are solidly connected with the spring plank. The equalizer, spring plank and swing bolster move together in the side motion. The construction of the equalizer enables it to perform all that is possible for such a member. An ordinary equalizing bar is so in name only; it slightly reduces the motion of the wheels. In rare cases the movement of the body may be as small as three-quarters that of the journal, but this is all that can be expected. With this equalizer all is accomplished that an equalizer can do theoretically, which is twice that of the ordinary form. This makes the motion of the car body one-half as great as that of the wheel.

Fig. 3 shows the construction of new spring link. It consists of a cast steel stirrup, in which there is space for an eight-inch spiral. A follower is placed on top of the spring, and an eye bolt is screwed into it. The eye takes the end of the equalizing bar, which prevents the bolt unscrewing.

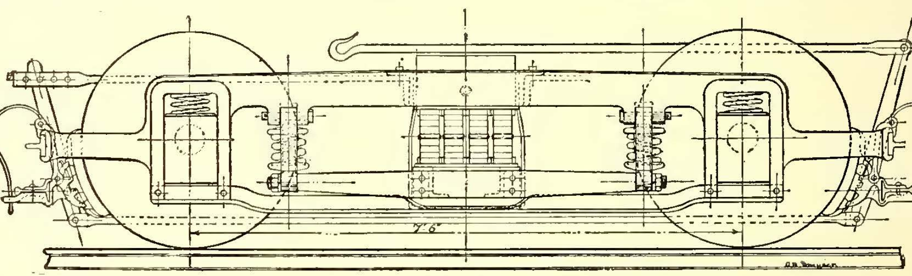


FIG. 1.—SIDE ELEVATION—NEW SWIVEL TRUCK.

The spring links are a novel feature of construction. They differ from the ordinary link in position, action and in possessing elasticity. While they perform all the functions of the common swing link, they also cushion the side motion. These springs are double action spirals of the draw and recoil type. They are so placed that the motion of the journal is doubly cushioned before it reaches the equalizer itself. Their location as shown is one which brings them in line with the centers of the journals, giving a very wide base for swing motion.

There are three sets of springs in the trucks placed in series. The weight rests on each set.

There are double journal springs resting on the tops of the boxes. They also cushion the rapid motion of the truck frame before it reaches the equalizer, making this motion much more safe than in the usual form. Next above this in the order of load carrying come the springs in the links and finally the elliptics.

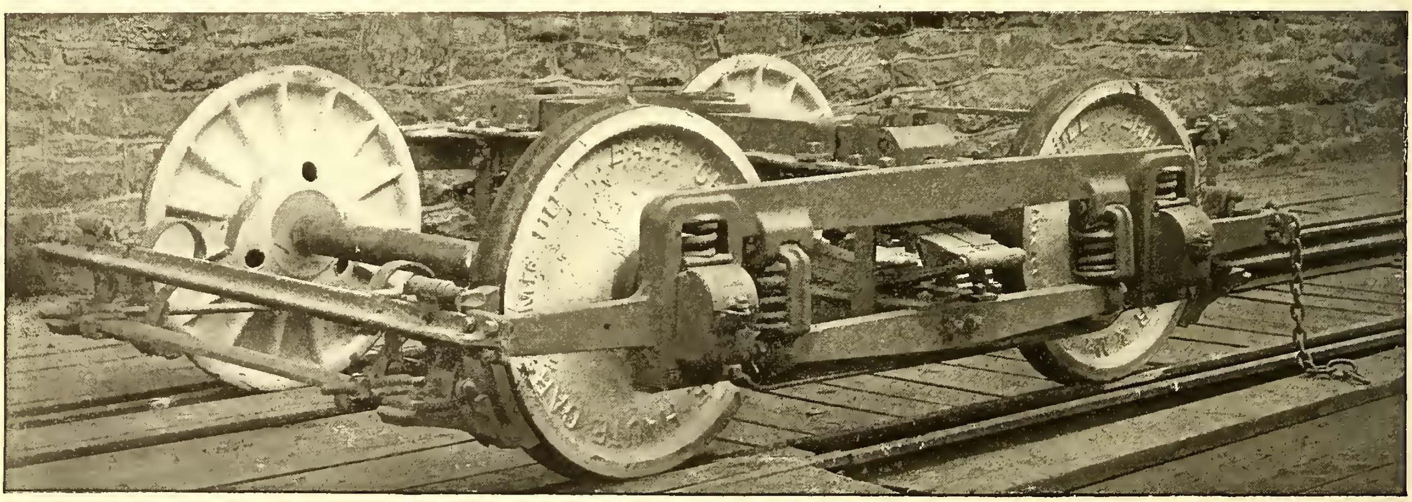


FIG. 2.—VIEW OF NEW SWIVEL TRUCK NO. 27.

Among the important claims made for the truck are remarkable smoothness in running, reduction of noise, jar and pounding of track while in operation, reduction of the weight on the axles unsupported by springs, cushioning of side motion by the spring links. The danger of jumping the track on curves is also, it is claimed, practically eliminated, because the springs of the swinging links yield and prevent the blow which with the ordinary type of link comes with full force when the bolster strikes the wheel piece.

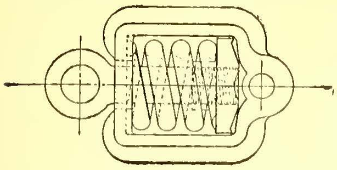


FIG. 3.—SPRING LINK.

The first trial with this type of truck was on an interurban electric railway of twenty-five miles length. Here, at an unusual speed for such service and in spite of very narrow treads, and shallow flanges, and curves with thirty-five feet radius, the adherance to the rails has been perfect.

Diamond Frame Trucks.

The accompanying engravings show the two latest forms of trucks manufactured by the Diamond Truck & Car Gear Company. The side frame from which the truck takes its name, is a true bridge truss with both tension and compression end members, and of such form so as to give a long spring support with correspondingly short wheel base.

An absence from teetering, is claimed, is one of the principal features of the Diamond truck and is accomplished by supporting the loads of the car body, at the ends of the triangle of the side frames, by specially constructed elliptic springs, which are also supplemented by a spiral tension spring, at the extreme end of the side frame members. The load is supported in the middle by two spiral springs, which are seated on malleable castings near the ends of the center triangles.

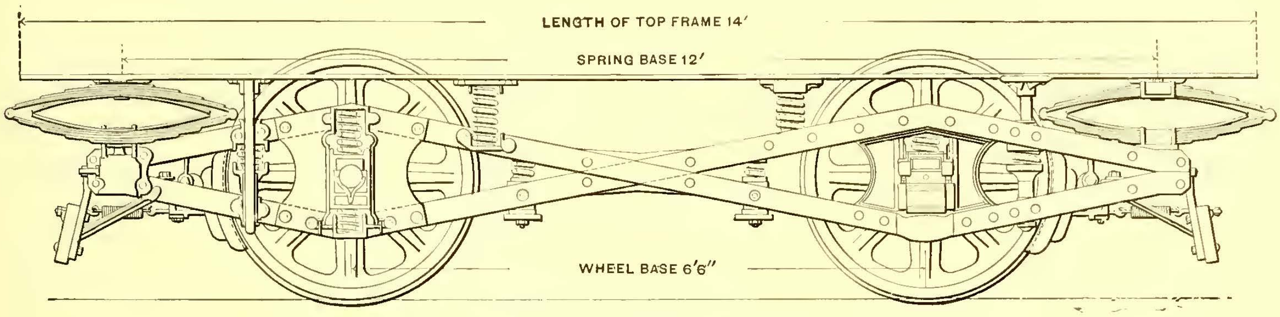


FIG. 1.—SIDE ELEVATION OF TRUCK NO. 3.

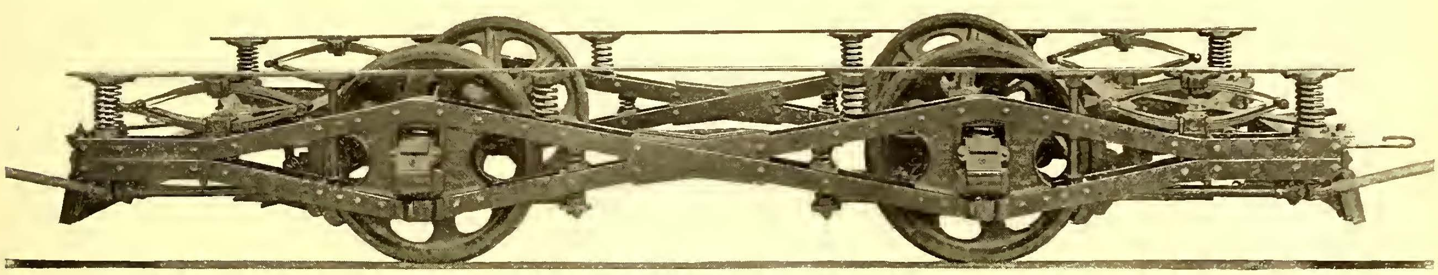
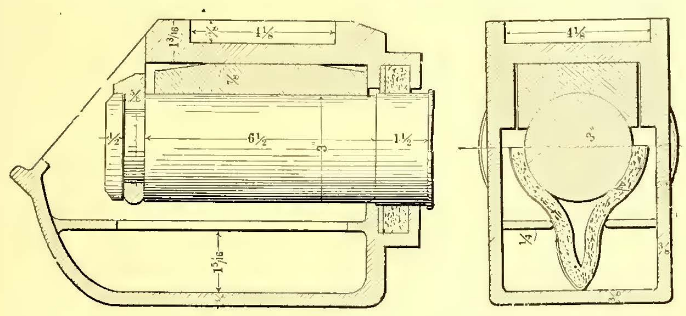


FIG. 2.—SIDE VIEW OF TRUCK NO. 5.

A double steel side frame member starts from the extreme end of the truck, passes over the apex of the adjacent pedestal, and crossing a precisely similar return member, terminates at the base of the adjacent pedestal. A malleable iron wheel piece serves to transmit the stress to a short diagonal member extending upward to the end of the truck. This malleable casting also confines the bearing in the pedestal by the compression of the under helical spring against the bottom of the axle box (Fig. 5). The loads often being very severe at the ends of the truck, especially on a poor or uneven road bed, they are not only supported below, but are as well suspended from above.



FIGS. 3 AND 4.—SIDE AND CROSS SECTIONS OF BOX.

The cross stay or center bracing of each diamond, is done by the placing of the malleable pedestal within the area and firmly riveting the side frame members to it. This pedestal also provides a vertical guide for the axle boxes.

On top of the axle box is mounted a compound helical spring which carries the lighter loads, being sufficiently aided by the inner or auxillary spring as the load increases (Fig. 3). Under the axle box and seated on the malleable iron wheel piece, is a single coil spring, which is adjusted by compression against the journal box by the fastening of this wheel piece in position, which is accomplished by the tightening of two bolts, attached to the under part of the pedestal. This under spring not only prevents the noises and jar of the box against the pedestal, but serves to arrest the tendency of the side frames to oscillate, when the car body is not heavily loaded. If one end of the truck frame should attempt to rise by a sudden change of position of weight in the car, this spring by its pressure against the under side of the box, will further compress and at once check this objectionable motion.

To prevent any lateral or side motion plunger bolts are used. These bolts are screwed into malleable castings attached to the top frame and pass thence through other castings located between the upper and lower members of the side frames, the castings being held in place by hot driven bridge rivets. An end plunger bolt is also used on the extreme ends of the side frame. This bolt passes down through the end spiral spring, carrying with it a specially shaped nut or spring seat upon which rests a short but powerful helical spring. If the car should have a tendency to oscillate or teter relatively to the side frame, one of these end plunger bolts would rise and compress this lower tension spring against the under part of the side frame end casting, thus completely checking the oscillation.

The axle box is of an improved pattern, especially adapted to the yoke in which it slides, and with it oil or grease may be used. A thrust end plate fits in a groove at the end of the axle and slides in

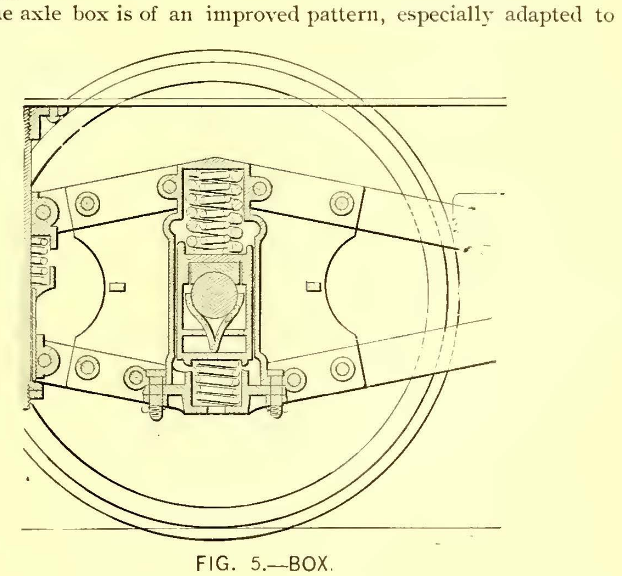


FIG. 5.—BOX.

a similar grove cast in the sides of the box itself. This thrust plate is made of bronze and limits the side play so prevalent with other trucks. At the rear of the box is a cast compartment in which a tough felt ring is placed, tightly fitting to the axle bearing. This most effectually excludes all dust and dirt from the main bearing. By simply removing the two tension bolts, the wheel piece above referred to is easily removed, the compression under box spring coming with it, thus releasing the axle from its pedestal.

Another very important feature of the Diamond truck, is the rigid cross bracing which the side frames have relative to each other. This end cross bracing prevents the side frames from getting out of square, which heretofore has been such an objectionable feature of many trucks, causing excessive wear on wheel flanges, and also requiring considerably more power to run the car when the truck frame was out of alignment. It also prevents the racking strains on the car body.

The Diamond Truck & Car Gear Company is now manufacturing two styles of trucks. No. 5 has a spring base of from sixteen feet to seventeen feet, and is intended for long and heavy cars, while truck No. 3 has a spring base of from twelve feet to thirteen feet, and is adapted to short light cars. On truck No. 5 an extension truss is used, if desired.

New Cars for Mt. Clemens, Mich.

The Rapid Railway Company of Mt.Clemens, Mich., has recently put in service a number of new interurban cars, built at the works of the Barney & Smith Car Company. The closed motor cars are 31 ft. 5½ ins. long over the body, 41 ft. long over all, and 8 ft. 6 ins. wide over the sheathing. Both ends are vestibuled with doors on each side of the vestibule. The roof and hood are of the regular steam car pattern. The side windows are double upper and lower light, the upper light being embossed glass. The outside is sheathed with narrow siding straight up and down in the regular passenger car style.

Fig. 1 is an interior view from which it will be seen that the car is seated with rattan covered reversible seats of the Wheeler Walkover pattern. Each car is equipped with four section tables. The end doors of the cars are the regular steam car pattern, having two lights of glass, the upper light to drop for ventilation. The windows are equipped with tapestry curtains on spring rollers and with automatic fixtures in the bottom. The cars are fitted with basket racks at convenient locations along the basket board, the ceiling is birdseye maple veneer handsomely decorated. The inside finish of the car is cherry. The cars are heated with hot water circulating pipes from a Baker heater, which is on the front platform inside the vestibule. One of the features is the trap door over the step inside on each platform. When the vestibule doors are closed the trap doors can be let down, forming a solid and safe floor over the entire vestibule in a similar manner to the most improved vestibules in use on steam railroad cars.

Figs. 2 and 3 show a convertible open and closed summer and winter car. This car is 31 ft. 6¾ ins. long over the body, 39 ft. 10 ins. long over the nose pieces and 8 ft. 6 ins. wide over the sheathing. The car is of the same general design as the vestibuled closed motor car, except that the side windows are in one large light, the cars having open platforms with folding gates at each side instead of the vestibule. The seats are slatted, of the Wheeler Walkover pattern and with spindle backs. The inside finish is ash and cherry with birdseye maple veneer headlining handsomely decorated.

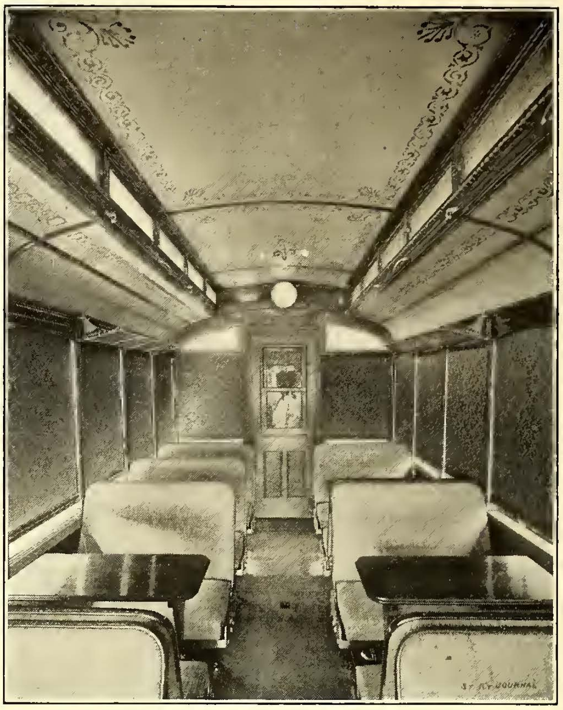


FIG. 1.—INTERIOR OF CLOSED CAR.

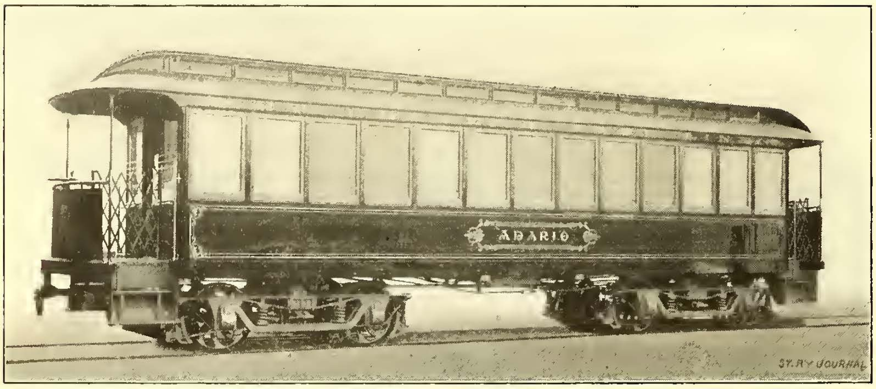


FIG. 2.—COMBINATION CAR CLOSED.

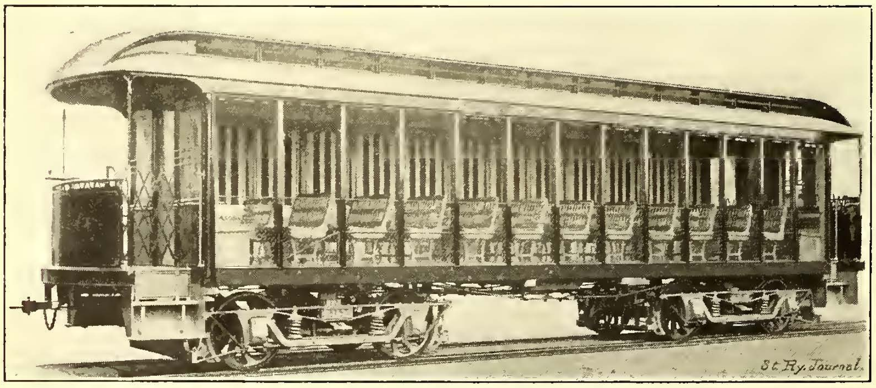


FIG 3.—COMBINATION CAR OPEN.

In converting the car to its summer use, the glass sashes in the windows and the solid wood panels below the windows are removed, and in place of the latter are put wire screen guards as shown in the engraving. So perfect is this convertible feature said to be worked out in all its details that when the car is complete in its winter arrangement it would be impossible for a person, not knowing that it was a convertible car, to detect but that this was its permanent arrangement. The wood panels so perfectly fit into their places that that they are absolutely water and storm proof.

All of these cars are mounted on the standard Barney & Smith class "F" interurban motor trucks, the cars being equipped with the Hunt air brake. All sills of the cars are heavily plated with steel which makes them very substantial indeed. The exterior of the cars is painted a bright vermilion color and lettered and ornamented in gold, which gives a very striking appearance

Tests on the Strength of Rails.

Some interesting tests of steel rails, made under the direction of the Austrian railroad authorities, are given by Julius Meyer, C. E., in a recent issue of the *Railroad Gazette*, and prove that a steel rail is far from homogeneous throughout. One trial made was with small test pieces cut from the top and middle of the head, from the web and from the middle of the base, at points at different distances from the end. The comparative results are thus stated. Test bars.

(*a*) from top of rail, have less strength, but greater elongation.

(*b*) from center of head, have greater strength, but less elongation.

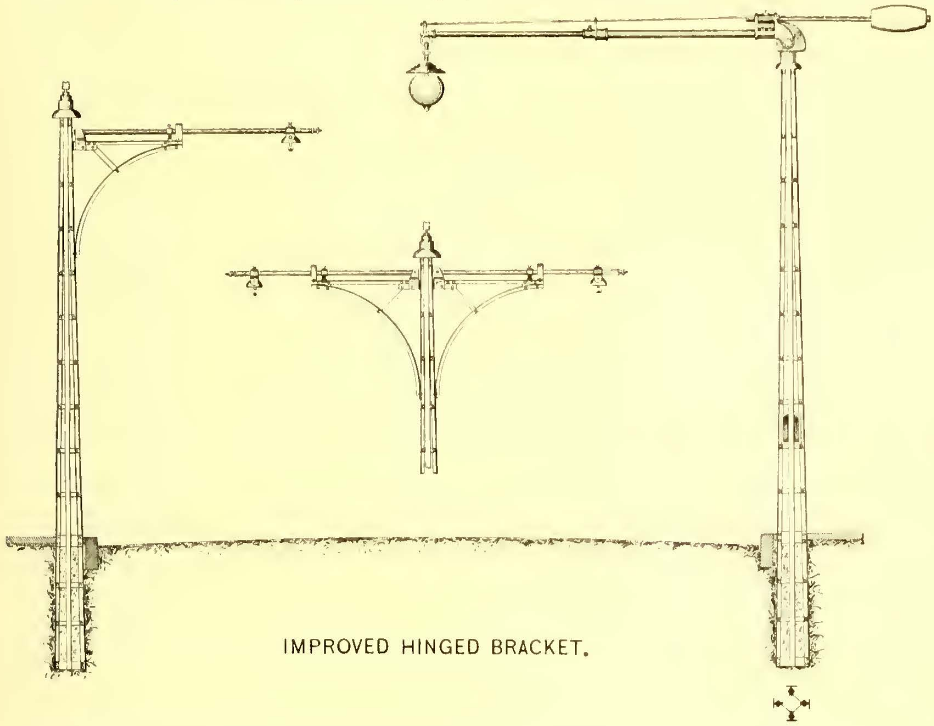
(*c*) from the web, have greater strength, greater elongation.

(*d*) from the base, less strength, greater elongation.

Another series of tests proved furthermore, that the strength is pretty even all over the section near that rail end which is rolled from the lower end of the ingot, but that the differences increase as the other end is approached. The tests seem to disprove the theory of the rolling process increasing the density of the material near the surface of the rail.

Improved Hinged Bracket.

In stringing a trolley wire there is always a certain amount of slack or sag in the wire between the points of suspension. When the trolley wheel is midway between any two points of suspension it is at an elevation higher than at the points of suspension. The result is that if the points of suspension are rigid, as in all fixed brackets or those that are substantially rigid, the trolley in passing from the mid-span to the bracket and from the bracket to the next mid-span, is subject to sudden changes of elevation. The increased pressure on the trolley pole springs, as the wheel approaches the fixed point of suspension, is suddenly released as the point of suspension is passed. The wheel passes from a downward to a short horizontal course on the fixed insulator and makes a sudden change to an upward course as the insulator is passed. This must necessarily cause a certain jarring or concussion of wire, insulator, car and all connecting parts.



IMPROVED HINGED BRACKET.

The L. S. Pfouts improved patent device or hinged bracket, which is manufactured by the Wrought Iron Bridge Company, and illustrated herewith, is designed so as to overcome this trouble which, it is claimed, not only causes damage to the construction, but also occasionally makes the trolley wheel leave the trolley wire, to the delay of traffic.

As the trolley wheel passes the mid-span the bracket arm in front, in the pole illustrated, begins to rise and attains its maximum elevation as the wheel passes under it, being restored to its normal position when the wheel arrives at the middle of the next span. By this gradual raising and lowering all hammering and destruction of the overhead construction is said to be done away with, and the trolley remains continuously in contact with the wire. In other words all the advantages of the span wire system are retained without its defects or its increased expenses. In fact it is said the Pfouts hinged bracket is more flexible than the span wire, inasmuch as the weight of the wire is in a measure counterbalanced and if so desired, can be entirely counterbalanced.

In addition to the bracket here illustrated, the manufacturers of it make various other styles, as the patent hinged feature may readily be incorporated into a more ornamental bracket to suit the taste of the purchaser.

Street Railway Aid Association in New Orleans.

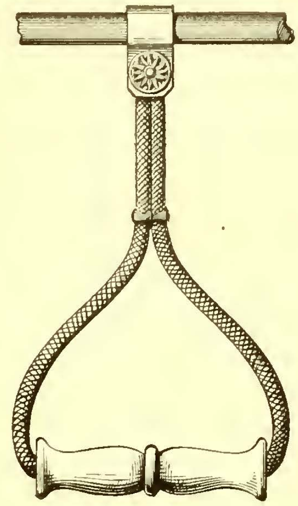
One of the most prosperous of the recent employes' aid associations was organized Mar. 26, 1896, by the employes of the New Orleans Traction Company. For total disability the association pays $1 a day for six months, and fifty cents a day for the next six months, after which the benefits cease. In the event of death the association pays to the family a sum equal to fifty cents from each member in good standing at the time of death. With a membership of 700 in good standing, this insures $350. It pays $50 on the death of the wife of a member or the mother of an unmarried member, and $25 on the death of a child under fourteen years, and furnishes free medicine and minor surgical attendance to the family of every member.

The dues are $1 initiation and fifty cents a month, and assessments of fifty cents are made on each member in case of a death, and twenty-five cents for the wife or mother of a member, but no assessments are made as long as there is a surplus over $1000 sufficient to pay the death benefits.

The Traction Company has agreed to contribute $1000 a year.

Novel Car Strap Handle.

The accompanying engraving shows a novel device designed as a substitute for the ordinary hand strap. It consists of a round handle of maple, rosewood finish, supported by a cord held to the supporting rod by a leathern loop. While as strong or stronger than the ordinary form of strap, its weight is only three ounces.

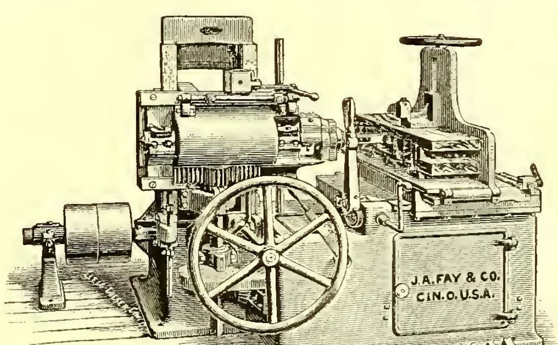


NOVEL CAR STRAP.

The advantages of the handle are apparent. The polished glassy finish of the handle always keeps it clean and attractive. It is also easier to grasp than the ordinary strap. It is manufactured by the Sanitary Car Strap Handle Company, and has been adopted by the Dry Dock, East Broadway & Battery Railway, of New York, and other roads.

Improved Automatic Hollow Chisel Mortising and Boring Machine.

The machine here illustrated, manufactured by J. A. Fay & Company, is intended for mortising all kinds of heavy timbers used in car and bridge construction of all classes, either in hard or soft woods. It is a powerful and compact machine, is automatic in its operation, and works with great rapidity. When once set and started, the machine will make any number of mortises without change. It is operated by the reciprocation of a square hollow chisel having an auger revolving in its center, the chisel squaring the hole produced by the auger. The superiority of this method of



MORTISING AND BORING MACHINE.

mortising is apparent from the fact that the mortise is left in a completed condition, no cleaning out being required, and a mortise of any length can be made by continuously cutting one hole after another on the same line. The reciprocation of the chisel is automatic, and the work produced very rapidly by the ease with which the movements and adjustments can be made by the operator.

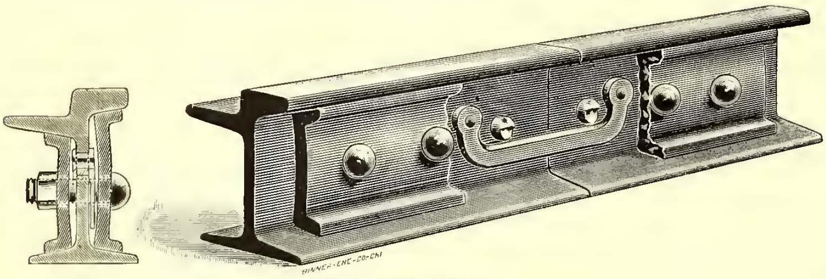
The bed supporting the timbers is massive, and has adjustments for carrying it to and from the chisel for different thicknesses of material and depths of mortises. It remains at one height, and is movable endwise to produce the varying lengths of mortises. There is a clamping arrangement for holding material in position, stops for gauging the lengths of mortises, and for using templates in producing duplicate mortises.

The chisel frame and auger spindle are carried on a heavy vertical column which is connected to the base on which the bed for the timber is placed. It has a vertical movement on the column to allow the position of the chisel to be varied up or down according to the desired position of the mortise. The reciprocating motion of the chisel frame is produced by a reversing friction and gearing which operates in a rack on the chisel frame, the driving force coming very near the point of resistance of the chisel.

New Rail Bond.

The Rieth Electric Company has brought out a new rail bond which is illustrated herewith. This bond is formed strictly in one piece and is claimed to be of pure ingot copper. It makes direct contact with the metal of the rail, no pins, sleeves or channel pins being used.

As will be noticed, the bond has large contact area at its connecting points and is connected to the rail by the use of a special tool which expands the end of the bond in the web of the rail. The

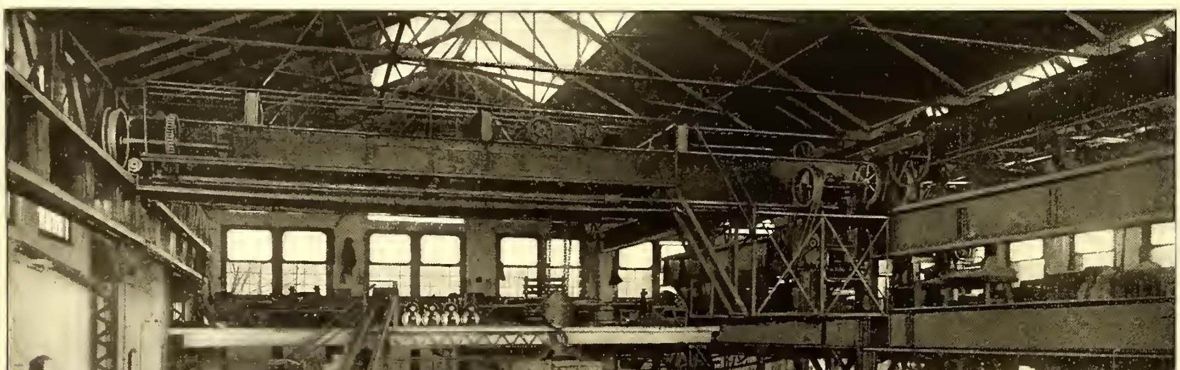


NEW RAIL BOND.

outer end of the bond is also expanded and upset so as to make a perfect and permanent watertight connection, this insuring the best possible electrical contact. The bond is intended to be used under joint plates.

Extensive Machine Works.

The tools of the Bullard Machine Company are well known among machinists for their high grade and superior construction. They have been generally adopted among the manufacturers of electrical apparatus, and to a considerable extent also in electric railway repair shops. The works are located at Bridgeport, Conn., close to the tracks of the New York, New Haven & Hartford Railroad. An interior view of the portion of the factory of the company including the erection department is shown in the accompanying engraving.

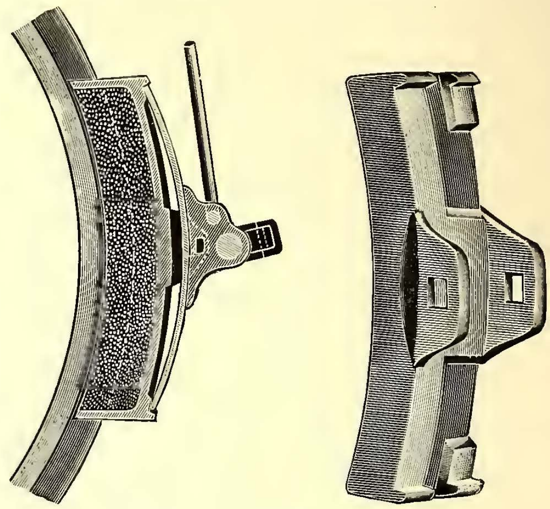


INTERIOR OF ERECTING SHOP.

The business was established in 1880 by E. P. Bullard, who is now president of the company. Attention has been given at the works exclusively to a line of lathes, turret machines and boring and turning mills. The latter have been widely adopted as they have been found superior to lathes for face plate work. Among the patrons of the company is the General Electric Company which has in use a number of boring and turning mills as well as other tools.

New Brake Shoes and Connections.

An invention which appears to possess merit and will undoubtedly prove of value is the new Kinzer brake shoe and brake shoe connections manufactured by the Kinzer & Jones Manufacturing Company. One of the principal features of this invention is the flat spring attachment which takes the brake pressure instead of the pressure being exerted on the shoe direct. The illustration (Fig. 1) shows a sectional view of the Kinzer composition filled shoe with the spring attached. This spring acts as an adjuster or equalizer between the shoe and the brake head. The manufacturers claim that by the use of this arrangement the maximum braking pressure is obtained



FIGS. 1 AND 2.—BRAKE SHOES.

without locking or skidding the wheels, and that to slide the wheels is simply impossible. A car can be brought to a quick stop by a steady continuous pressure without jerking or jarring. Fig. 2 is an outside view of shoe with spring and connections detached.

The company makes both cast iron shoes and composition shoes, the latter consisting of a cast iron shell as shown in Fig. 1, the shell being filled with a patented composition packed in the shells under heavy pressure and then baked at a high temperature. This composition forms an extremely solid mass and produces the maximum per cent of friction with the minimum amount of wear on shoe and wheel. All parts are made interchangeable and the shoes and connections are made to fit any style of brake beam, and can be readily put on. The Pittsburgh Traction Company, of Pittsburgh, has made a record of 4476 miles with the Kinzer composition shoes and connections, whereas the average records made previously with cast iron shoes and heads was 1650 miles. The shoe, it is also claimed, wears the wheel much less than one of cast iron.

SUPERINTENDENT HAWKEN, of the Rockland, Thomaston & Camden Street Railway, has completed the new extension to the town of Thomaston, Me., the first car, decorated with U. S. flags and bunting, and with a band of music on board, running June 16. This piece of road is considered one of the best in the state, and was pushed to completion in a very few days. The same company has also completed this season a new electric line from Main Street, Rockland, to Tillson Wharf.

THE Canton & Massillon Street Railway Company, of Canton, O., will probably extend its lines to Navarre this summer.

Third Rail Experiments at Nantasket, Mass.

The second step toward the operation of its main lines by electricity was made June 26 by the New York, New Haven & Hartford Railroad Company in the extension of the electrical equipment of the Nantasket Beach line as far as East Weymouth, 3½ miles along the main line of the South Shore branch of the Plymouth division, of which J. C. Sanborn is superintendent.

In determining upon this extension the overhead trolley system in use on the Nantasket Beach branch was abandoned and the third rail method of contact adopted as the most readily adaptable to ordinary railroad requirements. This is the first time in the history of railroads that the main line of a surface steam railroad has been operated by electricity taken from a conductor laid upon the ground, as the Nantasket branch inaugurated just twelve months ago was the first steam road in the world to which electricity was solely employed as the motive power.

While the third rail system for electric roads is not new, it being in use on the West Side and Lake Street Elevated Railways in Chicago, the rail being set outside the track, this is the first instance of a third rail being laid upon the permanent way of a trunk steam road, between the rails of the service track. All the preliminary work was carried out at the Schenectady Works of the General Electric Company.

The current for the third rail section is brought from power house No. 1 on the Nantasket line, over two insulated feeders of copper cable laid along the tops of the poles which carry the overhead wires of the Nantasket line. At the Nantasket Junction station the feeders are dropped to the ground, and each is connected to its own third rail.

The third rail is of peculiar shape, the end view resembling a flattened A. It is laid midway between the two service rails of each track. Each section of third rail is thirty feet long, and weighs ninety-three pounds to the yard. It is supported by three ash blocks to each section, the blocks being let into the ties. Before use these blocks are boiled in vacuum pans with a tar compound and thus each pore is filled with insulating and preservative material. The insulation is almost perfect. The continuity of the third rail circuit is secured by attaching each end of one rail to that of the next by means of two heavy copper bonds. The line between Nantasket Junction and East Weymouth is absolutely distinct electrically from that between the first named stations and Pemberton. It is fed by its own feeders and is provided with its own automatic safety appliances which, in case of carelessness or accident to the third rail section enter into action and cut all electricity off from it, rendering it nothing more than a peculiarly laid stretch of track.

The current is taken from the third rail by two sliding shoes hung loosely from the car, one suspended between the axles of each truck immediately under the king pin by two links which allow it to slide easily over the top of the third rail and make perfect contact with it all the time. The current is brought to the motors through the controllers and circuit breakers and returns to the track rails by the wheels. The continuity of the return circuit is secured by using a short thick bond of copper cable to join together the ends of each pair of track rails, the ends of the bond being fastened into the flange of the rail. The distance between each of the two shoes on the car is thirty-three feet. No third rail is laid at the crossings, the circuit continuing between the broken end by means of lead covered cables. At those crossings which are less than thirty feet wide, one of the shoes is always in contact. At wider ones the impetus of the moving car brings the shoes into contact again before the car can come to rest.

The baggage cars in use last year, each of which was equipped with four motors, have been abandoned, and the large sixteen-bench open cars are alone employed as motor cars or locomotives. Sixteen of these cars will be put into service, each equipped with two G. E. 2000 motors, two series parallel controllers, two automatic circuit breakers, and an air pump and motor for the compressed air whistle and brakes. The air pump combination is automatic in its action. As soon as the pressure in the main air tank falls below ninety pounds to the square inch a small knife switch is closed by a spring, and the motor starts. The switch is forced open by the air pressure as soon as that in the tank reaches the normal.

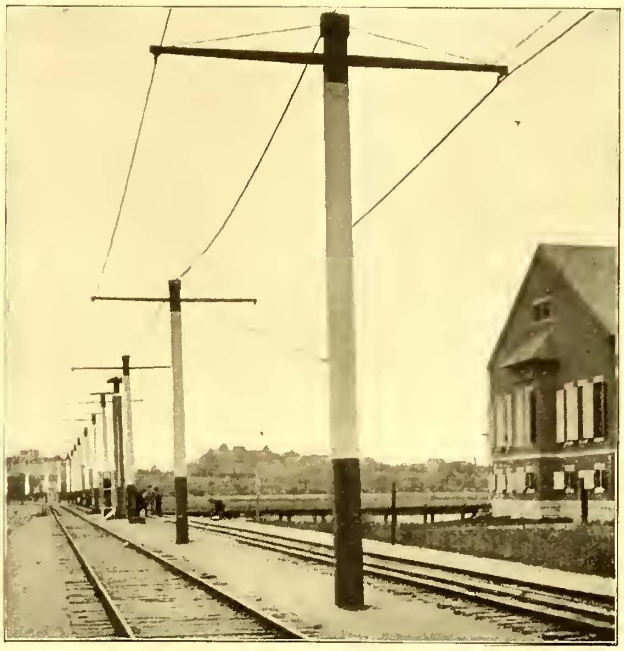


FIG. 1.—TRACK WITH OVERHEAD AND THIRD RAIL CONSTRUCTION.

The cars leave Pemberton and run with the overhead system as far as Nantasket Junction. The trolley is then pulled down and hooked and the shoe strikes the third rail, the passengers being unaware of the change in the method of contact. The regular schedule of the electric trains between Pemberton and East Weymouth has been in force since June 14, but owing to the incompletion of the third rail section the trains have been hauled from Nantasket Junction to East Weymouth, 3½ miles, by two steam locomotives. A good idea of the advantage of electricity as a motive power compared with steam may be gathered from the fact that the two locomotives burn each four tons of coal per day, while not more than four tons per day burned in the power house serve to generate sufficient power to operate the whole seven miles of line between Pemberton and Nantasket Junction by electricity. The construction of the section has been carried out under the supervision of Col. N. H. Heft.

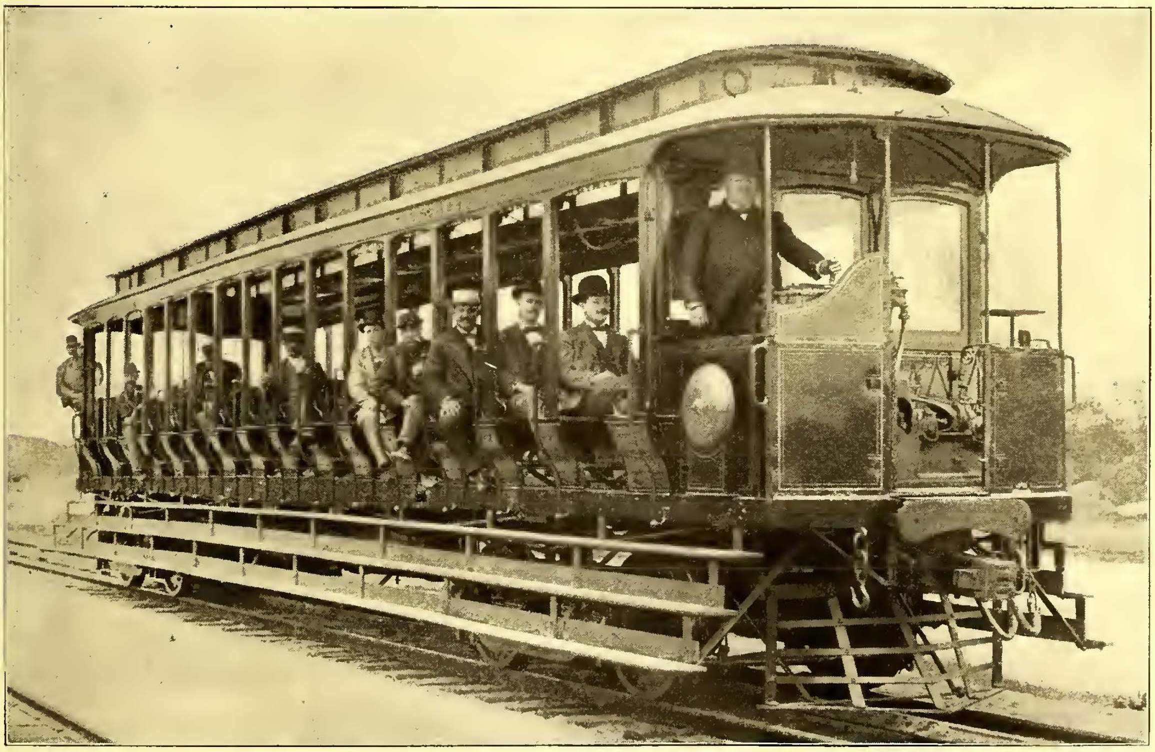


FIG. 2.—CAR OPERATING ON THIRD RAIL SYSTEM—NANTASKET.

A party consisting of President Clark, Vice-President Kendrick and nearly all the prominent officials and superintendents of the New York, New Haven & Hartford Railroad, together with Mayor Frank E. Clark, of Bridgeport, Conn., W. J. Clark, general manager of the railway department of the General Electric Company, and a number of officials of that company, boarded the large motor car at Pemberton, June 26, and ran with the trolley as far as Nantasket Junction. The track on which the third rail was laid was clear, and the motor ran easily from the trolley system to the third rail system of contact without stop, the trolley being merely pulled down and hooked. This was the first motor car run by electricity over the third rail and the success of its operation fully justified the belief of Colonel Heft and the General Electric officials in the feasibility of the system.

The car sped along without any difficulty or accident whatsoever; crossings were passed and the shoe struck the third rail again imperceptibly. Near West Hingham is a crossing some 1200 ft. wide; added impetus was given to the motor car and this crossing was passed without difficulty. On the tangent on the West Hingham side of East Weymouth, the motorman threw over the handle of the controller and it was estimated that a speed of seventy to eighty miles an hours was attained. On arrival at East Weymouth, the car was switched over and the return trip was made from East Weymouth to Pemberton in about eleven minutes, the distance being about 10½ miles.

President Clark, of the New York, New Haven & Hartford Railroad, and the other officials expressed full satisfaction with the success that attended the first trip made by a steam railroad car over a steam railroad track by means of electricity, although when Colonel Heft closed the switch which threw the electricity for the first time into the third rail, considerable doubt existed in the minds, not only of the president, but in those of the other officials as well.

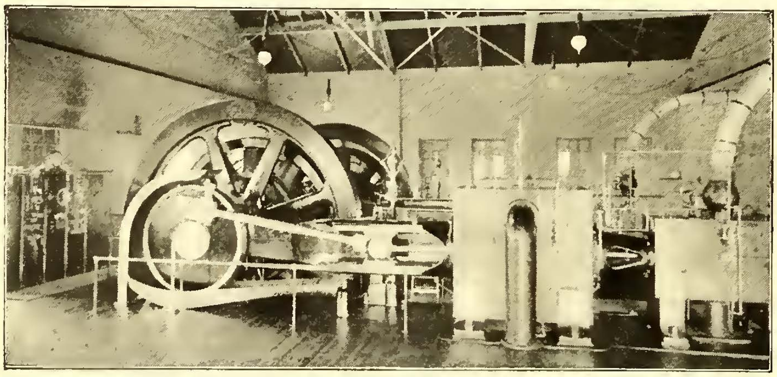


FIG. 3.—INTERIOR OF STATION.

Should the operation of this road prove successful, it is probable that the third rail system will be extended as far as Braintree, a station ten miles out of Boston, and if the success of the new method, under the ordinary condition of constant travel, fulfills all expectations, suburban service throughout the country will probably undergo a change.

Paper and Cloth as Insulators.

Some interesting experiments upon the subject of the insulating qualities of paper and cloth under different conditions of temperature were described in a recent paper by G. F. Sever, A. Monell and C. L. Perry before the American Institute of Electrical Engineers. The following general conclusions, as the result of the experiment, were drawn;

That paper is a better insulation and withstands increase in temperature much better than cloth (shellac and varnish were not used in any of the experiments), oiled paper or oiled cloth.

That paper and cloth have a maximum resistance when first heated at about 75 degs. C., and are not injured mechanically under 180 degs. C.

That the point of maximum resistance for paper and cloth (in this case 75 degs. C.) depends on the rapidity with which the temperature is increased.

That all give a high resistance after cooling, but have little mechanical strength.

Compressed Air Motors on 125th St., New York.

The announcement was made last month that the Third Avenue Railroad Company, of New York, would make a test this summer on its 125th Street line, of two compressed air motors built by the General Compressed Air Company. One of these cars has just been completed at Rome, N. Y., and is shown in the accompanying engraving. It measures twenty-eight feet over all and weighs about 18,000 lbs. with mechanism. The air is stored under a pressure of 2000 lbs. per square inch in reservoirs, sixteen in number, carried on the truck and having a total capacity of fifty-one cubic feet.

COMPRESSED AIR CAR.

The motor mechanism consists of two simple link motion, reciprocating engines with cylinders 7 ins. dia. × 14 ins. stroke, with valves cutting off at from one-tenth to one-sixth, and applying the power by connecting and parallel rods direct to the crank pins of the drive wheels. The latter are twenty-six inches in diameter, with wheel base of 7½ ft.

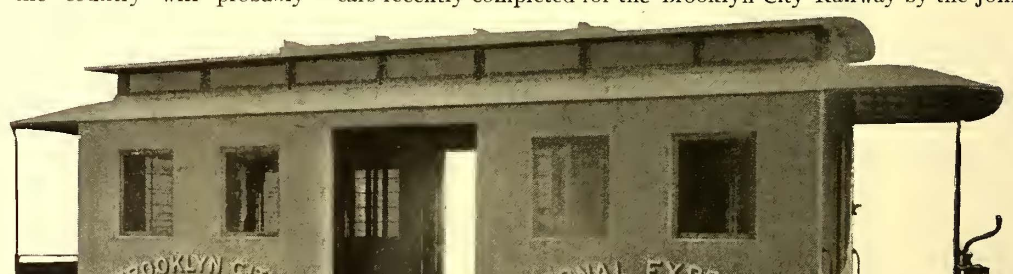
In operation the full reservoir pressure is not used, but it is lowered to 150 lbs. per square inch by a reducing valve. After leaving the reducing valve the air is heated to between 200 and 300 degs. by being passed through a hot water cylinder carried on the car, the object being to obtain more work from the air and also to avoid the production of extremely low temperatures in the air cylinder which would otherwise result from the expansion of the air.

The hot water tank is seven feet long and eighteen inches diameter and is charged at the power station before starting out. It is jacketed with non-conducting material to prevent external radiation.

The car is also equipped with air brakes.

Electric Express Car in Brooklyn.

The accompanying illustration shows one of the new express cars recently completed for the Brooklyn City Railway by the John Stephenson Company, Ltd. A general plan of the express service contemplated by this company was published in the last issue of the STREET RAILWAY JOURNAL. The company proposes to engage quite extensively in this business and before long to be able to have from three to five collections and deliveries in all parts of the city.



ELECTRIC EXPRESS CAR—BROOKLYN.

The Manufacture of Electric Railway Apparatus.

In the May issue of the STREET RAILWAY JOURNAL the annual report of the General Electric Company was summarized and discussed in detail, from a financial point of view, and taken in that light it certainly repays most careful analysis. There are to be found however in the details of the department reports some interesting facts and figures that have for the most part been passed unnoticed by the various critics who have looked the statement over. The facts and figures referred to are those embodied in the reports of the first and third vice-presidents, and relate to the physical condition of the company and the scope of its engineering work. The value of these statements lies in the deductions that may be drawn from them as to the relative importance of various branches of electrical work at the present time and the probable direction in which the greatest progress is to be made in the future.

A consideration of the General Electric Company as a manufacturing concern is of special interest owing to the history of its growth and the number of different enterprises and varying lines of electrical work that have gradually been brought together under one organization. In this connection the accompanying illustrations, showing the general arrangement of the company's three great plants at Schenectady, Lynn and Harrison, may not be without interest as they show in detail the main characteristics of the works in a form not heretofore published.

An interesting feature of the concern, and one not generally understood, is the inclusion under one management of a group of practically independent lines of detail work for the production of many of the supplies used in the manufacture of the larger electrical apparatus which forms the basis of the company's business. The excellence of such supplies must of necessity enter largely into the quality of the products which include them and it cannot fail to be of advantage to the manufacturer to be thus relieved from the necessity of reliance upon outside sources of supply. Most of these special departments, including the porcelain works, the tube works, the wire, cable, and insulating departments, etc., are located at Schenectady, which brings them under the direct supervision of the company's engineers.

The Lynn plant is given over to the manufacture of transformers, meters, railway motors, small railway generators, arc dynamos and lamps, small alternators, fan motors and some general supplies. The Harrison plant is devoted exclusively to the production of incandescent lamps. Every other product of the company comes from Schenectady and all the principal offices are located there.

In the organization of the company there are three main departments, the sales department, the treasury and accounting department, and the engineering and production department, the first, second and third vice-presidents respectively being the heads of these departments.

The company's present working force comprises nearly 7000 skilled workmen, of whom about 3500 are at the Schenectady works, 2500 at the Lynn works and 1000 at the Harrison works. The company's total business for the year amounted to $13,315,000 toward which the 509,000 h. p. in generators and motors which were produced and shipped, contributed of course, most largely.

A finer, more energetic and more thoroughly effective organization than that which President Coffin has formed as the result of an experience in this field extending over the past sixteen years has perhaps never before been seen in any industry in this country. Mr. Coffin is himself a man of rare administrative ability and a seemingly tireless worker. He comprehends a knotty problem instantly and decides it frequently at the moment. He has the faculty of accurately judging character, and the company's heads of departments are men of the highest intelligence who are able to take a broad grasp of affairs so as to build for the future in cases where the mere interest of the moment might point to opposite and narrower decisions. In the company's service is a corps of trained engineers which has no equal in any business enterprise in this country and by means of which the company has always been able to be early in the field with new appliances and developments in the art of electrical engineering.

Much emphasis is laid in the report on the railway installations made by the company upon the Baltimore & Ohio Railroad, the Nantasket Beach branch of the New York New Haven & Hartford Railroad, the Metropolitan West Side Elevated Railroad, of Chicago, and to the power transmission plants at Sacramento and Fresno, Cal., Portland, Ore. and Pachuca, Mex. There can be no question that authentic data such as is embodied in these statements coming from the largest existing concern devoted to the manufacture of electric power and lighting apparatus furnishes a more practical guide as to the drift of the business and the lines of work undergoing most rapid development than can be as readily gained from other sources.

The lighting department, moreover, cannot be passed by without a word, for the entire plant at Harrison, as has been said, covering 179,502 sq. ft. of floor area and employing in the vicinity of 1000 hands, is given over entirely to the manufacture of incandescent lamps. During the past year nearly 6,000,000 lamps were made and shipped, certainly a comfortable business in itself, but these facts only give greater emphasis to the wonderful growth of other branches of the industry.

The sales department reports 8800 street railway motors sold during the year. At the ruling prices of such equipments this means a business of over $3,000,000 or about twenty-three per cent of the total business of the company. The addition of the generators and other supplies sold for railway purposes would probably double this percentage, making a total little short of half the entire sales for the year. The cumulative effect of such an output is self evident and its effect in this case is indicated by the statement of the third vice-president, who says that "the manufacturing costs have continued to decrease, large reductions having taken place more especially in railway apparatus which we have made in large quantities."

Reduction in factory costs means also, of course, reductions in the price at which the apparatus may be profitably sold and this in turn has brought into existence many electric railway systems which would not warrant the investment necessary to equip them at the rates charged for station, line and car apparatus a few years ago. That this has reacted to further swell the volume of the company's business there can be no doubt. Additional buildings are now being added to the principal works at Schenectady to relieve the present difficulties of production and for this it is safe to say the railway business is largely responsible. In fact it is probably not unreasonable to assert that the company's later growth has been chiefly due to the rapid development of electric traction, and what is true of this company in this respect is undoubtedly true in general of the whole industry. Practically all the more important electric manufacturing enterprises that have appeared and disappeared during recent years have come into existence to compete with the older concern for the railway business and the relative importance of such enterprises may be taken as proportional to the degree of success attained in this competition. The railway business was at the bottom of the early combinations of the Thomson-Houston Company with the Bentley-Knight and Van Depoele interests and of the Edison with the Sprague Company.

The chief bone of contention in the bitter struggle between the Thomson-Houston and the Edison General Electric Companies who formed by their consolidation in 1892 the present General Electric Company, was the railway business. It is not proposed to belittle or underestimate the importance of the electric lighting industry, but it is certainly a fact that its rate of growth under present methods appears to be fixed, and to some extent limited. It is probable that electric traction will, in the future, divide honors with undertakings for the long distance transmission of energy, but it cannot be denied on the other hand, that with the perfection of alternating current apparatus applied to such transmission the scope of electric traction has been and will be enormously increased. Heretofore the chief market has been through the establishment of more or less limited systems in and about localized centers of population. Of course, all of the more important franchises have been taken up and it has been frequently asserted that the field for this class of electric traction was practically filled. On the contrary, however, the demand has been constantly increasing up to the present time and is larger now than ever, as shown by the production figures already referred to. This is due largely to the development of suburban districts following the introduction of means of rapid transit, and the consequent needs for further extension. Much apparatus has also been absorbed through the displacement of old equipments by more modern designs, and this process of change must continue to be, for some time to come, a considerable source of business for the manufacturers quite apart from new lines or extensions.

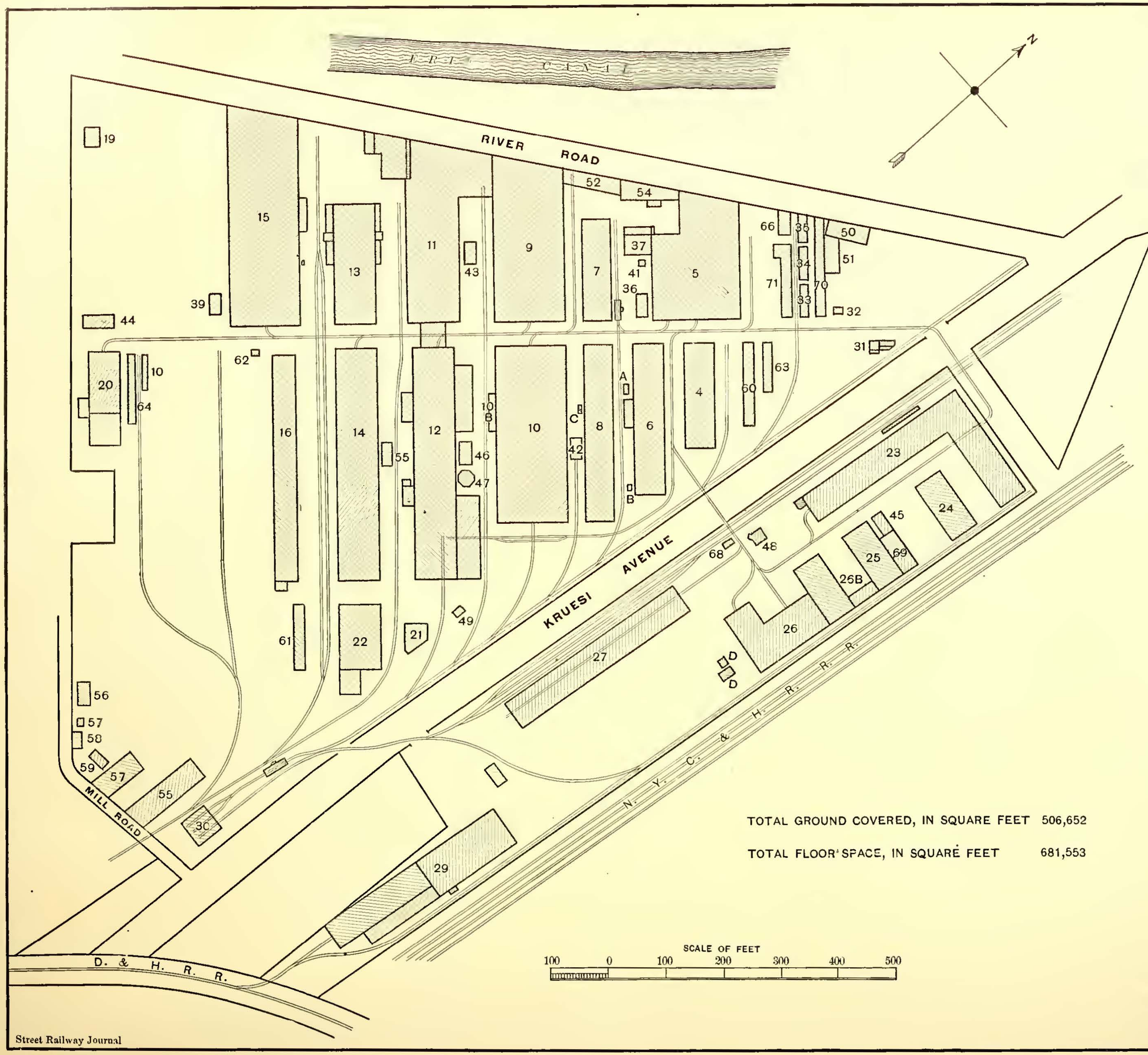
There are in operation to-day in this country alone nearly 45,000 electric railway motors of which only about sixty per cent are of the most modern form. Although much of the remainder is made up of perfectly serviceable apparatus, as far as the mere running of cars is concerned, all of this equipment must for economy's sake be soon replaced, as with the lower prices and higher efficiencies of modern machinery few roads can afford to operate the older types.

The development of the art abroad will undoubtedly furnish in the near future a market of considerable importance to American manufacturers. Electric traction has already been established upon a secure footing in Europe, especially in Germany and elsewhere upon the Continent, and what has been done recently in Great Britain, upon such representative installations as Bristol and Dublin, has gone far to remove the well rooted prejudices against electric traction by means of the overhead trolley and has opened the eyes of many of the local governments to the possible advantages to accrue from an extension of the system and the conversion of existing horse lines to electricity.

A strong preference for home made products undoubtedly exists abroad as is the case in this country, but if these products cannot be purchased from local producers in the same degree of excellence as American apparatus and for practically the same cost, the preference is greatly affected and importations are naturally taken into consideration.

The experience in electric traction gained in the United States during the past few years and the large amounts of electric railway apparatus that have been manufactured have had the effect not only of improving the design and efficiency of such machinery, but of reducing the cost of its production. It is therefore probable that European purchasers for some time to come will find it to their financial advantage to import motors, generators and other special supplies for the equipment of electric roads rather than make themselves the vehicle of experiment for native manufacturers who must of necessity pass through certain stages of development before they can produce high class apparatus in any considerable volume.

In its growth electric traction is following the lines through which steam railroading developed. First came the local systems, then the interconnection and re-interconnection of groups of such systems and finally the main lines were established. The present outlook for new electric railway work in this country would seem in general to be in the second stage of the process, that is to say in "interconnecting" or "interurban" lines, When this field has been exhausted the exact analogy of progress will end, for if by that time



GROUND PLAN

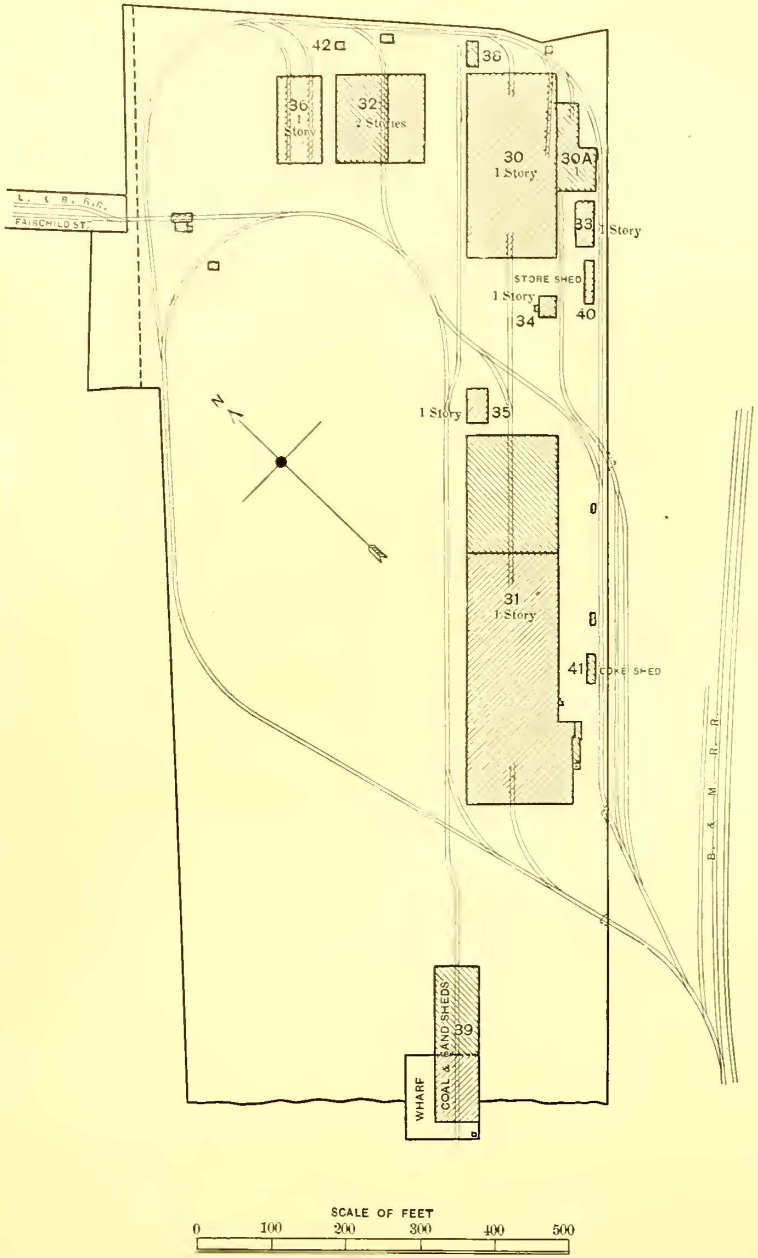
GENERAL ELECTRIC COMPANY.

SCHENECTADY WORKS.

Total Ground Area, 43.21 Acres.

	BUILDINGS.	Ground Covered Sq. Ft.	Floor Space Sq. Ft.
1			
2			
3			
4	* Carpenter and Pattern Shop	9.464	27,046
5	* Iron Foundry	29,710	27,078
6	* Office and Vaults	14,552	46,350
7	* Brass Foundry	9,200	8,278
8	* Machine, Forge and Tin Shop	15,606	14.376
C	Shed between 8 and 10.	120	120
9	* Machine Shop	34,038	31,000
10	* Machine Shop	37,332	35,000
10 B	Storage Shed for Copper	650	650
11	Machine Shop	34,440	48,746
11 B	* Pump House and Reservoir	4,424	3,906
12	* Testing and Shipping	34,317	31,242
13	* Power Station	17,812	13,827
14	* Wire Shop	28,944	54,500
15	* Siemens Cable and Armature Department	45,140	47.215
15 B	† Storage for Tools	720	720
16	† Store House	15,680	15,680
17			
18			
19	† Standardizing Laboratory	936	936
20	* Armature Disc Department	8,610	8,000
21	* Gas House	1,600	1.450
22	* Compound and Cable Shop	8,208	7,480
23	* Electric Supply Dept	25,383	69,500
24	* Press Shop	5,966	5,317
25	* Dip., Jap. & Annealing Shop	5,966	5,317
26	* Porcelain Factory	18,114	32.6[illegible]3
26 B	* Boiler House	983	850
D	† Stables	659	659
27	† Store House	18,642	17,838
28			
29	* Tube Works	23,114	23,406
30	* Locomotive House	2,500	2,500
31	† Gate House	590	590
32	† Hose House	164	154
33	† Foundry Supplies	968	968
34	† " "	968	968
35	† " "	768	768
36	† Wash House	800	800
37	† Coal and Coke House	1,872	1,872
38			
39	† Wash House	740	740
40	† " "	740	740
41	* Foundry Supply	484	484
42	† Wash House	800	800
43	† " "	740	740
44	† Store House	1,188	1,188
45	† Wash House	800	800
46	† " "	820	820
47	† Chem. Laboratory and Water Tower	756	2,285
48	† Gate House	455	455
49	† Hose House	154	154
50	† Stable	2,359	2,359
51	† Shed	1,787	1,787
52	† Shed	2,675	2,675
53	† Wash House	780	780
54	* Core Shop	1,627	1,627
55	† Store House	5,600	11,200
56	† Smithy	880	880
57	† Oil-Paper Shop	3,042	6,084
58	† Shed	540	540
59	† Paint Shop	576	576
60	† Store House	2,880	2,880
61	† " "	2,280	2,280
62	† Hose House	154	154
63	† Lumber House	1,562	1,562
64	† Shed for Disc, Iron and Coal	1.464	1,464
65	† Hose House	154	154
66	† Core Sand Shed	840	840
67	† Coal Shed	160	160
68	† Charcoal Shed	299	299
69	† Japanning and Smithy	2,072	2,072
A	† Coal Shed	180	160
B	† Pipe Storage	136	136
70	† Sand Shed	3,237	3,237

* Denotes Brick Buildings. † Denotes Wood Buildings.

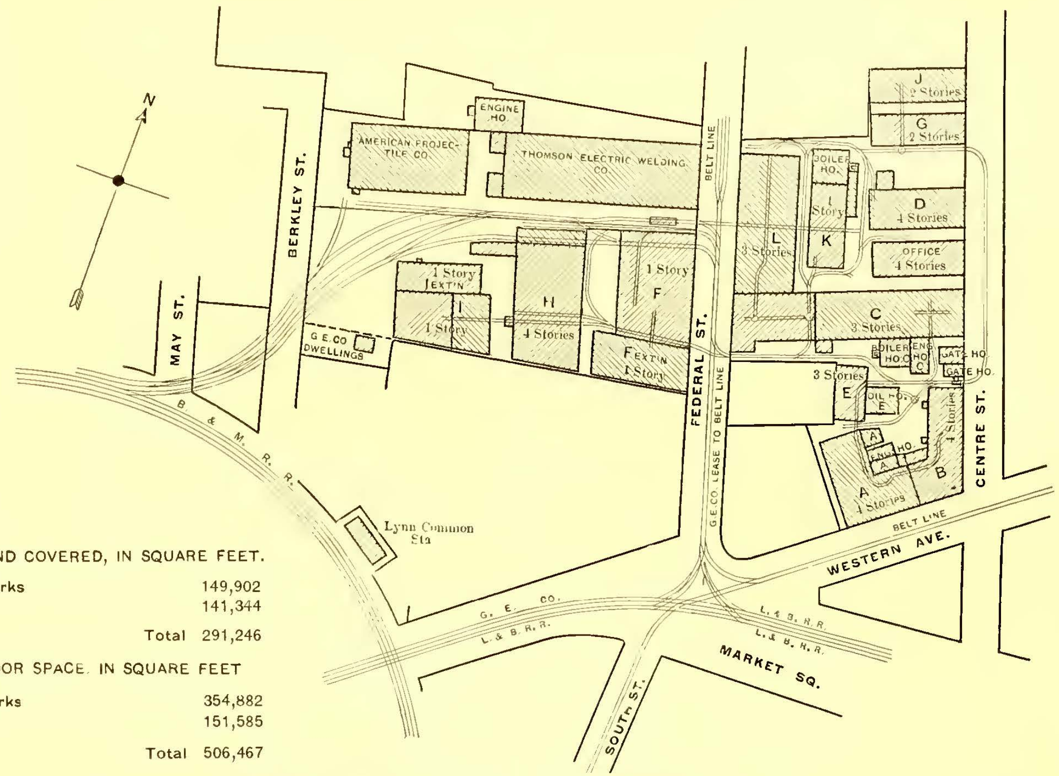


TOTAL GROUND COVERED, IN SQUARE FEET.

West Lynn Works	149,902
River Works	141,344
Total	291,246

TOTAL FLOOR SPACE, IN SQUARE FEET

West Lynn Works	354,882
River Works	151,585
Total	506,467



GROUND PLAN

GENERAL ELECTRIC COMPANY.

RIVER WORKS.

Total Ground Area, 20.4 Acres.

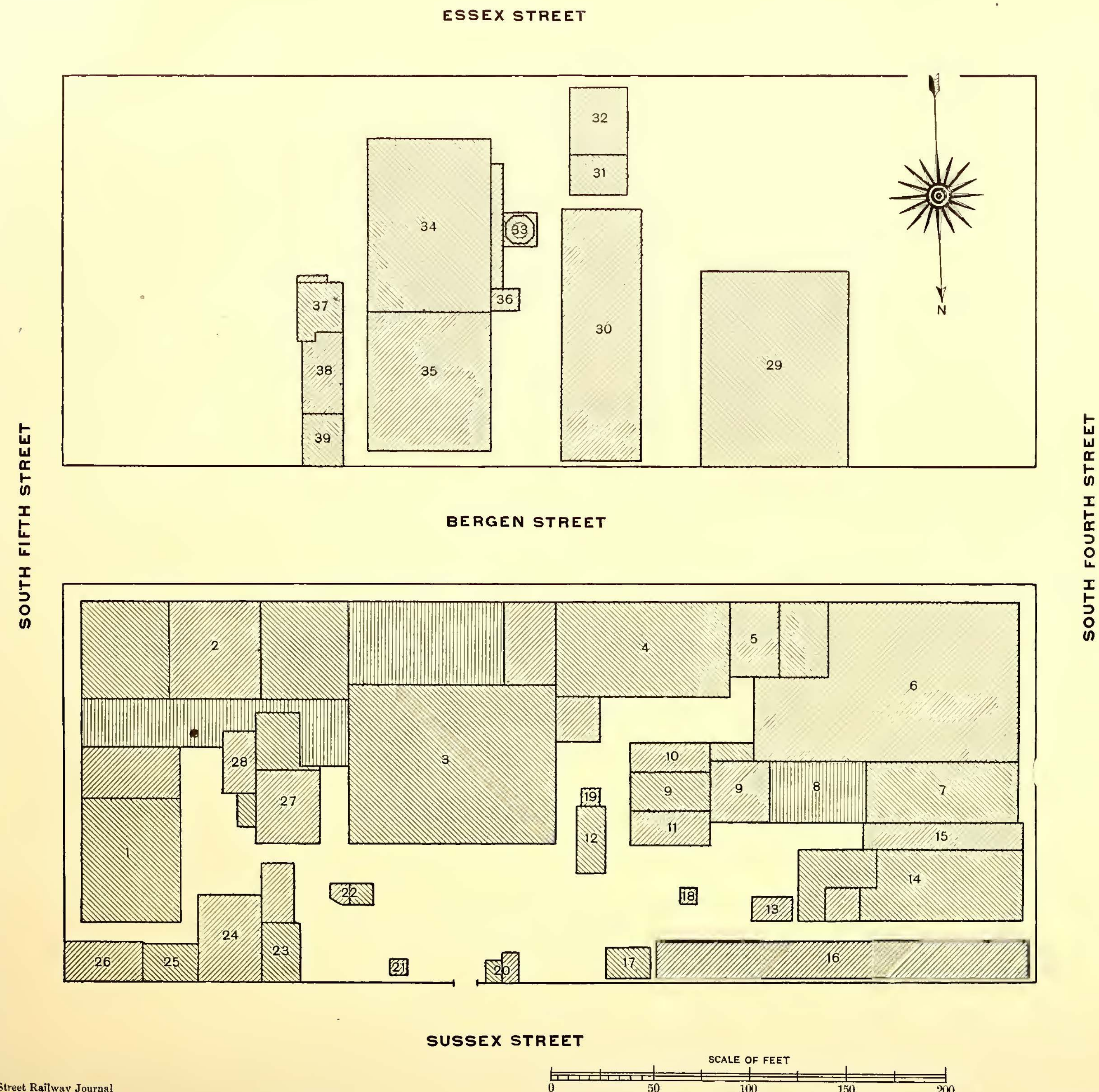
	BUILDINGS.	Ground Cov'red Sq. Ft.	Floor Space Sq. Ft.
30	* Steel Foundry........	30,990	30,000
30 A	† Cleaning Shed........	5,100	5,100
31	* Iron Foundry and Machine Shop....	64,890	63,155
32	* Press and Tool Shop, Carpenter and Pattern Shop...........	14,882	27,848
33	Gas House............	1,612	1,612
34	† Office	720	720
35	† Boiler House..........	1,276	1,276
36	† Store House	7,200	7,200
37	† Gate House...........	140	140
38	† Store House..........	648	648
39	† Coal and Sand Shed..	12,410	12,410
40	† Store Shed...........	840	840
41	† Coke Shed...........	480	480
42	† Iron-Balling Shed....	156	156

NOTE.—† Denotes Wood Buildings.
* Denotes Brick Buildings.

WEST LYNN WORKS.

Total Ground Area, 5.54 Acres.

	BUILDINGS.	Ground Cov'red Sq. Ft.	Floor Space Sq. Ft.
A	* Machine Shop........	9,948	36,712
A	* Boiler House.........	835	809
A	* Engine House........	602	550
B	* Machine Shop.........	8,365	28,020
B	* Boiler House.........	550	465
B	* Gate House...........	1,494	2,502
C	* Machine Shop.........	20,803	58,614
C	* Boiler House.........	1,521	1,444
C	* Engine House	1,300	1,176
	Office.	5,969	22,928
D	* Machine Shop	6,870	25,804
E	* Carpenter and Paint Shop...............	2,920	7,773
E	* Oil House............	1,530	2,892
F	† Car Shop.............	13,761	13,761
F	† Machine, Forge and Smith-Shop	7,800	7,800
G	† Machine Shop.........	5,376	10,752
H	* Machine Shop and Shipping............	16,560	61,626
I	† Brass Foundry........	9,024	9,024
I	† Box Factory	4,480	4,480
J	† Machine Shop.........	6,630	13,260
K	* Testing and Boiler House..............	8,780	8,245
L	* Machine Shop.........	14,784	36,245



Street Railway Journal

GROUND PLAN
GENERAL ELECTRIC CO.
Harrison Works. Harrison, N. J.

Brick or Wood	B'ld-ing.	Floor	DEPARTMENT.	Ground Covered Sq. Feet	Floor Space. Sq. Feet
B	1	1	Crescent Shipping	4638	4638
		2	Socketing		4638
		3	Storage		4638
		4	Crescent Clamping		4638
B	2	1	Photometer	6974	2225
		1	Wire Lamp		4749
		2	Socketing		6974
		3	Lamp Exhausting		6974
		4	Tubulated Bulb Storage		6974
B	3	1	Shipping and Stock	13029	12633
		2	Cleaning and Wrapping		8598
		2	Office and Vaults		4827
		3	Glass Working		13029
B	4	1	Bulb Storage	3910	3910
		2	Stem Inspecting and Storage		3910
		3	Breakage		3910
		4	Clamping		3910
B	5	1	Bulb Washing and Preparing	1868	1868
		2	Breakage		1868
W	6		Bulb & Tube Receiving & Storage	9809	9809
B	7		Carbonizing	2433	2433
B	8		Carbon Forming and Assorting	1550	1550
B	9		Receiving & General Supplies	1721	1721
B	10		Wiring	532	532
B	11		Chemical Laboratory	684	684
W	12		Gasoline Tank House	744	744
W	13		Coffee House	281	281
W	14		Fibre	4252	2954
	14		Experimental Laboratory		306
	14		" and Life Testing		992
W	15		Fibre Winding	1000	1000
B	16		Carbon Treating	3700	3700
W	17		Oil Storage	371	371
W	18		Hose House	64	64
W	19		Hose House	64	64
W	20		Gate House	192	192
W	21		Hose House	64	64
W	22		Pump House	240	240
B	23	1	Lunch Room	1052	1052
		2	Lamp Storage		442
		2	Bulb Coloring		610
		3	Decorative Designing		1052
B	24	1	Sign Exhibiting and Storage	1518	1518
		2	Wiring		1518
B	25	1	Storage	529	529
		2	Machine Shop		529
B	26	1	Office	800	800
		2	Machine Shop		800
B	27		Barrel Storage	1244	1244
B	28		Blower House	496	496
W	29		Lamp Storage	7413	7413
W	30	1	Carpenter Shop	5200	5200
		2	Machine Shop		5200
		3	Crescent Lamp Storage		5200
B	31		Fire Pump House	580	580
W	32		Reservoir	1522	1522
B	33		Chimney	240	
B	34		Boiler House	4625	4625
B	35		Engine and Dynamo Room	4375	4375
B	36		Blacksmith Shop	179	179
W	37		Storage	660	660
W	38		Storage	850	850
W	39		Storage	496	496

Total Ground Covered........... 89,899 sq. ft.
Total Floor Space................179,502 sq. ft.
Total Ground Area............... 2.06 acres.

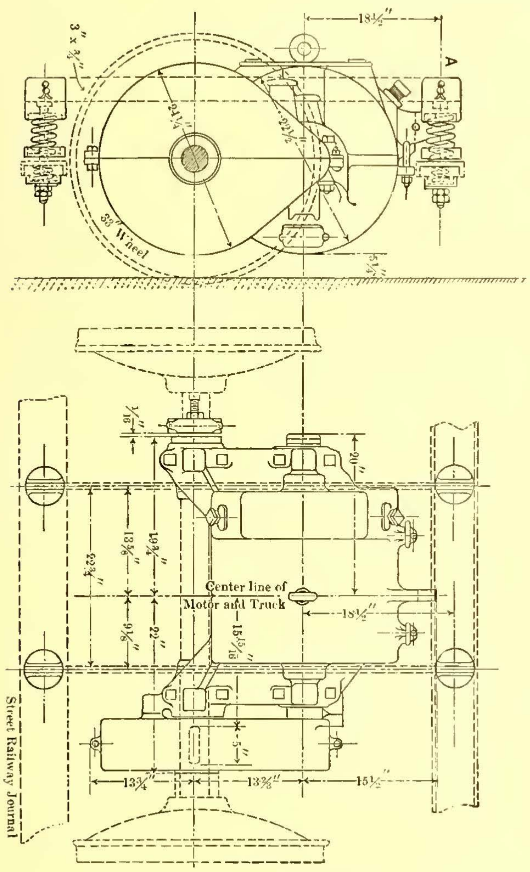
long distance electric railroading is practically and economically possible. as in all probability it will be for passenger service, the steam locomotive must give way to electricity on through lines already existing.

It is probable, of course, that some little time must elapse before the consummation of all that is now deemed possible in this field, but be that as it may, there is every reason to believe that in the immediate future, at least, the railway branch of the electrical industry will continue to hold its own as a prime factor in the situation.

New Motor.

An additional motor equipment for fifty cars was recently purchased by the Chicago City Railway Company from the Westinghouse Company, of a partially new design as illustrated herewith. It is a steel motor possessing superior strength and magnetic qualities, while it weighs only 1836 lbs., and is known as the Westinghouse No. 12 B steel motor. The general shape of the frame of this new motor is cylindrical, there being no excessive sharp projections to cause magnetic leakage. The distribution of the metal in the field cores and frame, as well as the proportions of the windings are such as to provide a complete electrical balance. The two parts of the case are machine fitted, thus eliminating air gaps in the magnetic circuit and rendering the case dust and water proof. The axle and armature bearings are provided with under wick oil feeds and the grease cups have a by-pass channel for oil; this is drilled through a body of metal left in one corner of the cup. There are also some special features in the bearing shells and thrust collars.

The specifications for a pair of these motors required that they should have a drawbar pull of 1820 lbs. running continually at ten miles an hour for two hours with a temperature of not more than 150 degs. F. above surrounding atmosphere, using not more than 101 amperes of current, and at the conclusion of a two hours' continuous



NO. 12 B STEEL MOTOR.

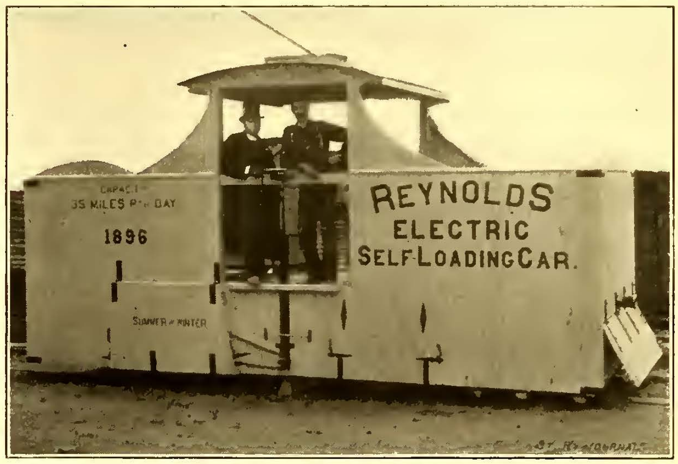
run the temperature of the commutator should not exceed 250 degs., while they should be free from injurious sparking. The field coils were required to stand a breaking down test of 5000 volts of direct current from the copper of the coils, and the armature to stand a test of 2500 volts alternating while a resistance of not less than one megohm measured from the copper conductors to the motors when cold. The gears and pinions are of steel with cut teeth. Any electrical or mechanical defects that might develop within sixty days of service the contractors were required to make good.

A NEW electric railway in Hingham, Mass, was put in operation June 22. The line connects with that of the Quincy & Boston Street Railway Company and also with the Hanover & Norwell Electric Railway, now nearly completed. It operates twenty-one cars manufactured by Jackson & Sharp, mounted on Peckham trucks and equipped with G. E. 800 motors. The road was installed by the firm of Tucker, Anthony & Company.

Street Cleaning by Electricity.

There has been turned out of the car works of the Rathbun Company, of Deseronto, Ont., recently, an electric self loading car for street cleaning, the invention of A. Jackson Reynolds to whom U. S. patents for the device were granted June 23, 1896. The car is twenty-two feet in length, and is fitted with the usual trolley equipment. The brakes, motors, etc., are all situated above the wheels and axles, so as not to impede the full action of the brush.

The car works on much the same principle as a carpet sweeper, and discharges the dust into a receptacle in the body of the car, and, it is claimed, will pick up thirty-eight cart loads without stopping. The broom, which is fastened to solid heavy axles, is so arranged that it always fills the case in which it is contained, a simple device changing the size of the latter to suit the changes made by the wear of material. The broom acts as well one way as another, steel deflectors being so arranged that it can be run backward without any change of machinery. The action may be reversed instantly, so as to throw the dust one way or the other as may be desired. The broom may be extended so as to cover the whole street outside the car track if



ELECTRIC SELF-LOADING CAR.

necessary. For removing snow the car may be constructed as long or wide as may be required.

For dumping purposes the floor is constructed in sections. The car can be unloaded in thirty seconds, one man doing the whole work by a lever. The inventor claims that this car will not only sweep the dust from the streets, but convey it outside the city, thus saving the labor of hundreds of men and horses. In operation the cars can be used to clean the whole street, except a narrow strip at each side from which the dirt is swept towards the tracks by the usual horse brooms.

According to the superintendent of the Montreal Street Railway, the car illustrated, which has been in operation on that line for a short time, can clean fifty miles of street a day and its work has been so satisfactory that the company is building a second car from designs supplied by Mr. Reynolds.

Work at a Large Car Factory.

The J. G. Brill Company has just finished boring a well which is 378 ft. deep. Water is raised from it by a pneumatic pump of the Waring-Prindle type. The well yields eighty or ninety gallons per minute. The company has now a water supply sufficient for its whole works. An electric transfer table with gipsy heads, etc., for moving and transferring cars has also been recently installed. This, in connection with the new incline for loading cars upon freight cars greatly increases the ease of handling work. The incline can be adjusted to suit any height of flat car. By its use loading becomes as easy as pushing a car up an incline. Cars can be loaded at the rate of one in eleven minutes.

The company is now putting in about a mile of track with overhead work, etc., and is taking in about six acres of ground into the yard. This space is needed for storage, etc. The company has just shipped 150 ten-bench open cars to the Nassau Electric Railway of Brooklyn. These cars are thirty-feet long and are in what is known as the No. 1 finish. They are in a light yellow (Oxford ochre) with aluminum leaf letters.

Fifteen cars have also just been shipped to the Buffalo & Niagara Falls Railway. They are twenty-nine feet long, eight feet wide and seat forty persons. They are fitted with cross seats and have two compartments, one for smokers and one for regular passengers. These cars are mounted on the new Perfection truck "No. 27" which has recently made such a reputation for easy riding for itself. The cars are fitted with vestibule ends.

Twenty-eight cars have just been completed for the Akron, Bedford & Cleveland Railway. They are thirty-two feet long, eight feet five inches wide and seat forty-four passengers. They also have the "No. 27" Perfection truck. The seats are transverse and are upholstered in plush. They have one round end vestibule solid on one side with folding doors on the other.

STREET · RAILWAY · NEWS

A Unique Strike and Boycott, With Its Results and Lessons.

By C. B. Fairchild.

On the morning of May 4, the car men and some other employes of the Milwaukee Electric Railway & Light Company went on a strike. New men were imported from other cities, and on the 11th of the month the company was running the full quota of cars. In fact quite a number of cars were run on the first day of the strike and every day following except on the two Sundays the 10th and 17th, when at the request of the Mayor no attempt was made to run cars. During the first few days of the strike there was considerable rioting. Cars were stoned, the motormen assaulted, streets were blocked by disabled wagons and in some places tracks were torn up, and trolley wires cut. For several days cars were run under police protection, the city police force being largely increased by the addition of deputies. As soon as the strikers saw that they were likely to be defeated they instituted a boycott, and called upon all their sympathizers to refrain from riding on the cars. In this they were highly successful, as they started opposition bus lines in all parts of the city, pressing into service almost every type of vehicle and importing a number of hotel carry-alls from neighboring towns. The men who managed the busses were promised $5 a day by the local union, but this promise did not materialize. A uniform fare of five cents took a passenger to any part of the city, the routes being designated on the sides of the vehicles. By threats, gross misrepresentation and playing upon race prejudices, they succeeded in turning away the patronage almost entirely from the cars. The receipts of the company for some days were not more than $150.

The company from the first refused to accede to the demands of the strikers, although the officers received all committees of the strikers and their sympathizers and stood ready to take back any of the men as fast as vacancies might occur. The Common Council of the city almost to a man sided with the strikers, and did everything in their power to embarrass and annoy the company. The Mayor and Chief of Police however stood by the company and made every effort to protect the patrons and prevent the destruction of the cars and the property of the company. The associations of merchants and trades people took a hand, and so powerful was the surveillance, inquisition and spotting that even the friends of the company were paralyzed with fear and threatened social ostracism, so that they remained at home or patronized the busses.

The published reasons for the strike were the refusal of the company to yield to the demands of the men for an increase of pay from nineteen to twenty cents per hour and for some minor changes in the method of making the runs. The prime cause however was from another quarter, it being the move on the part of certain labor leaders to force the company into a recognition of the labor union. The company knew from the first that a large number of the men were satisfied with their wages. The strike was ordered and managed from the first by W. D. Mahon of the Amalgamated Association of Street Railway Employes. Mr. Mahon after failing in an effort to institute a strike in Philadelphia and Buffalo, took up his abode in Milwaukee some days before the strike was ordered and remained six weeks.

The officers of the company were not entirely unprepared for the strike, for there were indications of it for some time previous. The general manager was away in New York and returned to the to the city in response to a telegram, a few days before the strike was instituted. When, however, it was evident that a strike was imminent, the necessary preliminary arrangements to meet it were made in Chicago and elsewhere, especially for housing and feeding the new employes. A caterer was engaged and arrangements were made with Thiel's detective agency of Chicago to supply men promptly both for the places made vacant by the strikers and for special deputies. Agents were sent to neighboring cities with authority to engage new men promptly as soon as the signal should be given. The wisdom of these precautions was soon manifest, for no sooner was the strike declared at four o'clock on the morning of May 4, than word was sent to the various agents and the first trains from the neighboring cities brought new men to fill the various positions.

Edward R. Swett, a well known hotel man of Chicago, now of Lake Harbor Hotel, Muskegon, Mich., who had been engaged as caterer, embarked on the first boat from Chicago and landed in Milwaukee with fifty colored cooks, a number of gas and coal ranges, cooking utensils, table, furniture and provisions for feeding 1200 men; also canvas cots and blankets for the same number. The lofts and vacant rooms in each of the seven car houses were utilized for dormitories, kitchens and dining rooms. Temporary tables and seats were provided by the company, and seven hotels were soon in full blast. The new men while not on duty were obliged to remain in the stations under police protection. The merchants would not sell them or the company provisions and no one would entertain the new men or sell them anything. It was not that there were not those who would have been humane to have done so, but they were intimidated and afraid of being boycotted by the strikers and their friends for an indefinite period. One or two boarding houses that undertook to entertain some of the men were set upon by the strikers, the inmates maltreated and the fronts disfigured by ink and paint. The new men were fed and housed at the expense of the company in addition to their regular pay, the contract price with the caterer being $1.50 per day per man. The meals were served from 4:30 to 1:30 next morning and the menu was very satisfactory to the men. Sanitary arrangements were provided and as each squad usually had a barber among the number, the men made out to get along very comfortably indeed. Tin plates and cups took the place of china for table furniture, but as they were kept scoured and scrupulously clean, the men did not complain. The superintendent and his assistants made a careful inspection of the quarters every day and to this was due the acceptableness of the arrangements. New men were imported from Chicago, Minneapolis, Grand Rapids, Mich., Cleveland, Buffalo, St. Louis and Galena. The street car managers in nearly all of these cities responded cheerfully to the company's call for help and assisted the agents in selecting good men. In some cases the extra lists were turned over to the agents and they were told to take any of the men who would go. In only one instance did a manager refuse aid or encouragement. The men engaged by the agents were furnished transportation to Milwaukee. About six hundred men were imported by the company and about as many more came on of their own accord and applied for work, and a splendid class of men they were. When the selections were finally made the company found that they had a brighter, more gentlemanly and more efficient class of men than formerly. It was noticed however that there was a marked difference in the ability of the men from different cities, due to the training they had received in the previous service. Among the best class of men chosen, those from Grand Rapids made an especially good impression. That city furnished quite a large quota of new men, some leaving the service of the Grand Rapids company to go to Milwaukee, glad to accept nineteen cents an hour in the place of only fourteen paid in the former city.

Had it not been for the boycott the company would have been the gainers by the strike. Even now it will count as a gain in the long run, for the management will be independent of labor unions and other restraining influences. The attitude of the company towards the strikers was commendable from the first. No sooner was the strike declared than the company gave the men an offer for twenty-four hours to return to work and submit their grievances to an arbitrating committee. This the men declined. On the Thursday following a committee of five from the Board of Aldermen, together with a like number from the Merchant's Association, and a committee of strikers waited on the officers of the company to see if a settlement of the difficulties could not be effected. They made no proposition, but the company offered to take back 500 of the old men at the former rates, giving preference to men with families. The men offered to all return to work at old rates, but the company refused to engage them. On Monday, the 11th, at the request of the Mayor, the State Board of Arbitration investigated the matter and made a report. The company proposed to the Board to take back 350 of the men. The Board of Arbitration reported that the strike was ill-advised and unwarranted, and recommended that the men make terms with the company and get back to work as soon as possible.

A committee of Republican politicians and office holders then waited on the company. They made no proposition, but the company through them offered to take back one-third of the men giving preference to the men longest in the employ of the company. A citizen's committee was then formed and it was proposed to raise a fund and deport the new men and so make room for the old men, With this proposition the company refused to have anything to do. Next a committee of retail merchants began work to induce the strikers to modify their demands and as a result the strikers proposed to all come back and work with the new men, the force to be divided into three shifts and each to work one-third time. This the company refused as they were unwilling to employ 900 men to do the work of 300, nor were they willing to break contract with the new men, for the proposition would reduce their pay from $60 to $20 per month. Again the company renewed its offer to take back one-third of the old men.

At this stage Samuel Gompers appeared upon the scene and by his counsel the strikers all proposed to return to work with the new men and work on shifts, two of eight hours and one of four hours. This the company could not accept as it was under contract with the new men to give them work for ten hours a day at nineteen cents, and the proposition would reduce all wages to $1.26½ per day, and the company would not ask men to work for for such low wages. Again the company proposed to take 300 men and guarantee pay for eight hours a day, work or no work. Mr. Gompers replied that he would rather have the men beg from door to door, and after a few days he left the city.

Nearly every organized society in the city even to the singing societies and some of the churches sided with the strikers and helped to enforce the boycott. Merchants who patronized the street cars were boycotted and in turn boycotted anyone who rode on the cars. Druggists refused to sell soda water or cigars to anyone seen to leave a street car and enter their stores. Even the Mayor after issuing his proclamation was refused meat by his butcher.

Race prejudice figured largely in the strike. All sorts of absurd statements were hatched up and quoted as coming from some of the officers. For instance, it was commonly reported that Manager Wyman had said that "he had whipped the Irish in a New York strike and he would whip the Dutch in Milwaukee". Many wore cards in their hats bearing the words "The Dutch will walk". A prominent German of the city in a public address is reported to have demanded "to know whether the Germans present are ready to concede that the whole Germandom of the city is to be ruled by two Yankees (Payne and Wyman). We Germans are from old famed for our courage; already in the year A. D. 91 Hermann the Cheruscan showed the world the courage of the Teutons as he chased the Romans out of his country, and now shall we let ourselves be dominated by the Yankees? Surely, if this happens, I will, by means of the telegraph, request the emperors of Germany and Austria to call home their former subjects because they have become cowards."

It is seldom that street car managers with a strike on their hands are called upon to stand up under so much pressure and personal abuse as were the three men who engineered the affairs of the company during this severe ordeal. They certainly can lay claim to having "good big back bones". They were threatened with personal violence and even death, by numerous letters, but through it all declared that they were not afraid, while the merchants and others seemed paralyzed with fear. The new men were a courageous lot and stood up bravely under the threats and odium heaped upon them. The addition of 1000 such men must be a great gain to a city. Fortunately there were very few accidents during the time of the strike, the new men being unusually careful.

The company supplied the new men with badges and stem winding Elgin watches, these being purchased in quantities at a very low figure. New hat badges were ordered, those for the conductors being plated in gold, and for the motormen in silver, and perforated for the numbers. Even numbers were used on conductors' badges and odd on the badges of motormen. After a month's time the men were required to fill out application blanks and undergo a surgeon's examination and the regular examination by the superintendent. New hats and uniforms were ordered, and at the end of a month the business was going on as if nothing had occurred.

The hostile attitude of the public that made the strike and boycott possible was based upon two charges made against the company, one that two years ago the company declined to sell twenty-five tickets for a dollar, a practice that had previously been for some time in vogue. The principal cause however was a matter regarding taxes. Some two years ago the city assessor discovered that the franchises held by the company were very valuable, and proceeded to fix a tax rate at an estimated valuation of $3,000,000, thus increasing the annual taxes to the sum of $65,000. The company showed that it was not making money and was about to go into bankruptcy, but the levy was made and the company had to go to the courts for redress, and was successful, when the judge pointed out a way that a reasonable increase of the taxes might be arranged. Other as absurd schemes were proposed, when the company took the matter before the State Legislature, and a bill was passed taxing all street railway companies in the state on their gross receipts, in lieu of real estate and other taxes. By this arrangement the company paid bout $1000 a year over former assessments, the amount being for 1895 $22,303.94 as against $21,300.69 for 1894. Had the demand of the assessor been for a fifty per cent increase of annual taxes the company would not have objected, but when the proposition came for an increase of 400 per cent it was obliged to act in self defence.

The socialistic element in the city sided with the strikers against the corporation, and howled for a revocation of the company's franchise and for municipal control of the railway and lighting interests.

That this strike, like all others, was ill advised is patent on the face of it. The old men are out and are now glad to get on the extra list, the company making no objection to their filing their applications, having given out that they hold no prejudice against them. The inflow of new men shows that the labor market is overstocked and men enough could have been found at a few days' notice to man twice the cars were such a thing desirable. The manager states that he finds it easier, or rather, finds a larger number of men skilled in the handling of the controller and brake of an electric car, than could be found to man a horse car properly.

No one can object to the desires and efforts of the so-called laboring classes to better their condition. They would not be true to their native instincts did they not make the efforts. They have rights and should dare to maintain them, but their methods are decidedly wrong. If men of this class would spend the same amount of energy in the direction of their own personal unfoldment, and in perfecting their organizations along the lines of mutual helpfulness, and cease to entertain a spirit of prejudice, antagonism or revenge against their employers or against corporations in general, they would soon find and receive aid or encouragement, or at least would nullify the alleged oppression of which they complain.

Strikes have a lesson for employers as well as employes and it is time for the former to recognize that there is a possible method of training or teaching (for strikes are born of ignorance) that will elevate the laboring classes, making them efficient and trustworthy and help them to see that the interests of the employer and employes are mutual, when what is now spent for detection, inspection and strike expenses and losses can better be paid as additional wages.

Opening of the Lake Street Elevated Road.

The Lake Street Elevated Railway, in Chicago, the second to be operated exclusively by electricity, was opened for traffic last month, the experimental runs which had been made previously having proved entirely successful. The road is one of the Yerkes interests, and runs west from the vicinity of the Masonic Temple for a distance of some 6½ miles in double track. The electrical current is, for the present, taken from the stations of the North Street Chicago Railway Company.

The electricity is carried by the side of the service track upon a third rail just outside the guard timbers. This rail is supported by pillar insulators set every six feet, and is protected by two planks set on edge. This provision is made to prevent accident from any carelessness, and it will be impossible for the workmen to lay any metal on third rail and track at once, while it will eliminate any chance of shock. The current returns by the track rails and structure, and the greatest care has been exercised to have the return circuit as perfect as possible to prevent leakage. The feeders, of copper cables, are carried on insulators at the side of the third rail and boxed over.

The motor cars are about the same size as those on the Manhattan Railway. They are the rebuilt cars formerly used with steam locomotives on the Lake Street Elevated. Each train will consist of three or four ordinary cars and one motor car at the head. The motorman's cab is at the front right hand corner of each motor car, and contains the controller for turning the current into or out of the motors; an automatic circuit breaker, which protects the motors from any sudden rush of current; the air brake levers and an electrically driven pump for the compressed air, which starts automatically when the pressure in the tanks runs down.

The electrical equipment of each car is the same as that which the General Electric Company put on all the motor cars of the Nantasket Beach branch af the New York, New Haven & Hartford Railroad and the West Side Elevated Railroad, also of Chicago, and in addition to the apparatus in the cab, consists of two G. E. 2000 motors (125 h. p. each), both motors being mounted on the forward truck.

New Track Switch.

An electric track switch operated from the car has been in use for the last eleven months on the lines of the North Hudson County Railway Company, of Hoboken, N. J., with excellent results. It was installed by W. C. Wood, of the New York Switch & Crossing Company.

The operating mechanism consists of two powerful horseshoe magnets in an hermetically sealed iron box in the middle of the track and connected with the switch tongue by a lever moved by an armature between the two magnets. An automatic locking and unlocking circuit changer is provided which holds the circuit of the operating magnet closed until the car has passed the switch, and which then reverses and changes the circuit to the opposite magnet to be ready on the approach of the next car. The magnets are of low resistance and one terminal is grounded while the other is connected with a short insulated section of track in front of the switch. Every car passing along this insulated section with the current on throws the switch, but if the motorman sees that the switch is already in the right direction he coasts or travels by momentum over the switch.

Device for Measuring Bond Resistance.

A device for locating defective track rail joints on electric railways has recently been devised by John C. Henry, the well known electrical engineer, now residing in Denver, Colo. Mr. Henry uses a specially designed differential ammeter, containing two coils so arranged that one end of each is connected with one rail, and the other ends can be connected with rails at equal distances in front and in the rear. When a current is passed through both circuits the magnet coils in each oppose each other. In case of a defective joint the instrument becomes unbalanced, and the needle will indicate the defect in the direction it assumes and also the extent of the defect. By means of the instrument an electrician, with the assistance of two boys, can readily test and mark all of the defective joints in several miles of track in a day's time while the cars are running.

Removal of Large Truck Works.

On June 25, President Edgar Peckham, of the Peckham Motor Truck & Wheel Company, purchased at a referee's sale, the Perry Stove Works, which are situated on Van Rensselaer Island, Albany. The works were built in 1889, and are comparatively new. The plant includes over five acres of land and consists of several well constructed buildings, chief among which are the main building, 71 ft. × 203 ft., foundry 129 ft. × 281 ft., and three large store houses; besides there is a fine residence and numerous stables. The plant is illuminated by electric light, heated by steam and equipped with automatic sprinklers in case of fire. There is also one 250 h.p. engine and another of 50 h. p. The shipping facilities are unsurpassed. Goods can be shipped from the works directly on the boat to New York, also on the West Shore, New York Central and Delaware and Hudson Railroads, and by short connection on the Erie.

Owing to the large and rapidly increasing business of the Peckham Company Mr. Peckham has been considering for some time the acquirement of larger and more commodious quarters. In a recent interview Mr. Peckham stated that while for a number of reasons he should dislike to move his works from Kingston, he had practically decided to do so. In a week or so, Mr. Peckham said, he would look over the new works and would then definitely decide.

The popularity of the Peckham trucks has been marvelous. Today the trucks are not only used all over the United States, but in Japan, Brazil, Australia, France, Ireland, England and other foreign countries. Over 5000 Peckham trucks are now running on cable and electric roads in Greater New York, while over 1000 are in use in Philadelphia. Besides the four different kinds of Peckham trucks—Excelsior, Standard, Extra Long and Double—the concern is now constructing and furnishing storage battery trucks and special trucks for compressed air and mining work. Since the first of the year the concern has turned out 1300 trucks, being as many as was made all last year, and before the year closes considerably over 2000 trucks will be constructed. The daily output now averages eleven trucks a day, and during May 280 trucks were built. From 125 to 130 hands are engaged at a pay roll amounting to nearly $1300 per week. Last year over $10,000 worth of new machinery was placed in the factory.

The concern is now rushed with orders and working night and day. Peckham trucks are constantly growing in popularity and the company reports the following orders for June: Union Traction Company, Philadelphia, Pa.; Metropolitan Street Railway Company, New York City; Lynn & Boston Railroad Company, Lynn, Mass.; Worcester Construction Company, Brookfield, Mass.; Bristol Belt Line Railroad Company, Bristol, Tenn.; Hagerstown Traction Company, Hagerstown, Md.; Metropolitan Railroad Company, Washington, D. C.; Butte Consolidated Railway Company, Butte, Mont.; Steinway Railway Company, Long Island City, N. Y.; Oswego Street Railway Company, Oswego, N. Y.; Bradford Electric Street Railway Company, Bradford, Pa.; American Wheelock Engine Company, Worcester, Mass.; Plattsburgh Traction Company, Plattsburgh, N. Y., Baltimore City Passenger Railway Company, Baltimore, Md.; Kingston City Railroad Company, Kingston, N. Y.; Bergen County Traction Company, Fort Lee, N. J.; Georgetown & Tennallytown Railway Company, Georgetown, D. C.; Ryder Compressed Air Motor Company, San Francisco, Cal.; Clinton & Leominster Railway Company, Leominster, Mass.; Calumet Electric Railway Company, Chicago, Ill.; Coney Island & Brooklyn Railroad Company, Brooklyn, N. Y.; Mobile & Spring Hill Railway Company, Mobile, Ala., Hingham Street Railway Company, Hingham, Mass.; Worcester Suburban Street Railway Company, Worcester, Mass.; Wakefield & Stoneham Street Railway Company, Wakefield; Mass.; North Woburn Street Railway Company, Woburn, Mass.; Woburn & Reading Street Railway Company, Woburn, Mass.; Somerset Traction Company, Skowhegan, Me.; General Construction Company, Derry, N. H.; Bangor, Orono & Oldtown Railway Company, Bangor, Me.; Braintree & Weymouth Street Railway Company, Braintree, Mass.; Woonsocket Street Railway Company, Woonsocket, R. I.; Passaic & Newark Electric Traction Company, Passaic N. J.; Dublin Tramway Company, Dublin, Ireland; Consolidated Traction Company, Jersey City, N. J.

Personals.

Mr. Albert Strauss, treasurer of the Standard Air Brake Company, was married June 9 to Miss L. M. Lord.

Mr. F. H. Tidman has been appointed manager of the Lake Ontario & Riverside Railway Company, of Oswego, N. Y.

F. P. Fish, General Counsel, and J. P. Ord, Second Vice-President of the General Electric Company, sailed for Europe on June 27, on the steamship "La Bretagne."

Mr. S. Dana Greene, of the General Electric Company, was married June 25, to Miss Chandler, daughter of Rear-Admiral Chandler, of the United States Navy.

Mr. E. W. Sherman, former superintendent of the North Chicago Street Railway Company, has connected himself with the Broderick & Bascom Rope Company, of St. Louis, Mo.

Mr. Walter E. Harrington has severed his connection with the Cutter Electrical & Manufacturing Company and has been appointed general manager for the Consolidated Electric Railway interests in Camden, N. J., and vicinity.

Mr. Edward J. Wessels, general manager of the Standard Air Brake Company, sailed for Europe on the steamship "Spree" on June 30. Mr. Wessels will go abroad on business connected with his company which has sold a large number of brakes abroad, especially in Germany

Commodore George W. Melville, the well known authority upon steam engineering, received last month the degree of Doctor of Engineering from the faculty and trustees of Stevens Institute. This is only the second time in the history of the institute that this degree has been conferred.

Mr. Richard S. Jerome, who was formerly traveling salesman for the Central Electric Company, with whom he spent four years, and who afterwards was connected with the American Heating Corporation, of Boston, has been engaged by the Gold Car Heating Company to sell its products on the road.

Mr. Edward Guy Waters, who for the past three years has been manager of the Pittsburgh office of the General Electric Company, has been transferred to the New York office of that company. Mr. Waters will remain in the railroad department of the company in which he has made a very successful record.

Mr. H. P. Hirsch has been appointed Eastern representative of the McGuire Manufacturing Company, with headquarters at 26 Cortlandt Street, New York. Mr. Hirsch has been engaged in newspaper work for a number of years in Chicago where he has achieved an excellent reputation as an energetic and up-to-date journalist.

Mr. J. A. Hanna who for a long time has represented the McGuire Manufacturing Company in the East, has formed a business connection with the Peckham Motor Truck & Wheel Company. Mr. Hanna is one of the best known and most popular men in the trade and carries the best wishes of his friends in his new position.

Mr. George H. Baker, formerly editor-in-chief of the *National Locomotive and Car Builder*, will commence in July the publication of a new monthly magazine devoted to railroad interests. Mr. Baker has had long experience as a railroad engineer and master mechanic and the prospectus for the first number of this new magazine shows that it will contain matter of practical value to steam railroad managers and engineers.

Mr. Armand Requier sailed last month for London in the interests of the Westinghouse Electric & Manufacturing Company, and will install an electric railway in Rouen, his home. Mr. Requier is a native of France and has been connected with the Westinghouse Company for a number of years, during which he has installed a number of railway and other electrical plants. He has just returned via San Francisco from Guatemala, where he had charge of the installation of an electric power transmission plant using Westinghouse apparatus.

Mr. Garret A. Hobart, who was nominated for vice-president last month by the Republican party, is president of the Paterson, (N. J.) Railway Company, and takes an active interest in its management. In spite of his many other engagements he finds time to devote a great deal of his attention to this property, and its present efficient condition is largely due to his personal efforts. Mr. Hobart was born June 3, 1844, at Long Branch, and was graduated from Rutgers College in 1863. He chose the law as a profession and soon secured success in this as in business and politics, serving as State Senator and in other responsible positions. For eleven years he was chairman of the Republican State Committee of New Jersey, and since 1884 has been a member of the Republican National Committee. He has remarkable executive ability and is president or director of a large number of corporations, engaged in transportation, banking or manufacturing. From his long business experience he is well fitted to act as presiding officer of the Senate.

GARRET A. HOBART.

Mr. W. H. Wilkinson has recently accepted the office of general manager of the Diamond Truck & Car Gear Company, whose truck for street railway service is well known. Mr. Wilkinson has had a long experience in railroad work, both steam and electric, and is well qualified to know the needs of railway service. For four years he acted as superintendent of motive power of the Meriden, Waterbury & Connecticut River Railroad, and later for the same number of years as superintendent of motive power of the Danbury & Norwalk Railroad Company. After leaving the service of this latter company he entered that of the Pennsylvania Railroad, with which he remained for ten years, engaged in the motive power department at Altoona of this extensive system. With the development of the electric railway interests Mr. Wilkinson decided to engage in that field, and accepted the position of superintendent at Kingston with the Peckham Motor Truck & Wheel Company. He is pushing and energetic and says that he intends to secure a large proportion of the orders for trucks which may be given during the coming season.

Mr. Louis J. Magee, manager of the Union Elektricitäts Gesellschaft (Union Electrical Company), of Berlin, Germany, has been making a four weeks' visit to this country, returning to Europe the latter part of May. Mr. Magee was born in Malden, Mass. After taking his degree at Wesleyan University, Middletown, Conn., he entered, in 1885, the works of the Thomson-Houston Electric Company, at Lynn. He carried out several electric lighting installations in New England and Florida, and then spent a year and a half in electrical work in Lima, Peru, in the interests of his company. From that time on, Mr. Magee's work has been chiefly with foreign countries. Seven and a half years ago he took charge of the European office of the Thomson-Houston Electric Company, at Hamburg—a position which brought him into connection with most of the European countries, and afforded wide opportunity for travel. Four years ago the German Company, of which Mr. Magee is manager, was organized for the manufacture and installation of electrical appliances chiefly on the basis of the experience of the General Electric Company.

LOUIS J. MAGEE.

This company has had great success especially in street railway work in Germany, Belgium and Austria. It is manufacturing street railway apparatus, meters and electrical apparatus for power transmission, but has devoted itself little to lighting work.

AMONG THE MANUFACTURERS.

McCarthy & Woodward, of Chicago, agents for the Wheeler Rail Joint Company, are now located at 1332 Monadnock Building.

The J. G. Brill Company, of Philadelphia, has discontinued its Western office. F. C. Randall, the Western sales agent, will travel from Philadelphia, taking in the Western states as heretofore.

J. Holt Gates has opened a storeroom at 311 Dearborn Street, Chicago. He will handle the C. & C. Electric Company's motors and dynamos and other good specialties in the electrical field.

The Pioneer Electric Works, of Chicago, are unusually busy on repair work. The company rewinds and repairs electrical machinery of every make and description and gives special attention to street railway work.

J. M. Atkinson & Company, of Chicago, report that the sales of the "horse shoe" rail bond lately brought out by them have greatly exceeded their expectations, the orders coming from some of the best and largest roads in the country.

Creaghead Engineering Company, of Cincinnati, reports a number of inquiries and orders for its flexible brackets and other line material. These orders come from quite every section of the country and reflect the popularity of these goods.

J. A. Fay & Company, of Cincinnati, have recently received an order from Alexandria, Va., for a complete planing mill outfit, consisting of a dimension planer, two flooring machines, an inside moulder, self feeding ripping saw, cutting-off saws, exhaust fans, engine and boiler.

The Standard Railway Supply Company, of Chicago, is now pleasantly located in the new Fisher Building, corner Dearborn and Van Buren Streets. The company is handling a full line of the R. D. Nuttall Company's products; bronze and brass car trimmings and standard electric railway material generally. The company reports business as very satisfactory.

George Cradock & Company, of Wakefield, England, write us that they have discharged their United States representative, T. A. Wigham, and that they are now desirous of appointing agents in different parts of the United States for the various centers, not only for their street railway cables, but also for mining ropes, which form a very large and extensive portion of their business.

The Berlin Iron Bridge Company, of East Berlin, Conn., has a contract for furnishing steel trusses for the new building which is to be erected by the Holyoke Gas Company, of Holyoke, Mass. The building is fifty feet wide and sixty feet long. Roof trusses are entirely of steel, and the covering is slate. No woodwork or inflammable material will be used anywhere in the construction.

The Oshkosh Logging Tool Company, of Oshkosh, Wis., is one of the most extensive manufacturers in the world of tools adapted to street railway, electric lighting, telegraph and telephone line construction, embracing pay-out and take-up reels and such other tools as are necessary for handling and putting up poles, wire, etc. The company has a reputation for good tools and reports a very satisfactory business.

The Sunbeam Incandescent Lamp Company, of Chicago, has removed its offices to suite 1509-10-11 Monadnock Block. These rooms have been fitted up especially for the use of the Sunbeam Company and the other lines Mr. Terry is connected with, namely, the Lakon transformers, the I. T. E. circuit breakers and the C-S switches. The rooms are handsomely fitted up and very complete and convenient.

The Brown Hoisting & Conveying Machine Company has just sold to E. D. Smith & Co., contractors, two standard ten-ton locomotive cranes, to be used on the work of extending the wheel pits of the Niagara Falls Power Company to accommodate seven more 5000 h. p. turbines. The cranes will be fitted with extra large drums to take the great length of rope that will be required in hoisting out of the wheel pits.

The Crane Company, of Chicago, Ill., has just published two very handsome panels 22 ins. × 13½ ins., one representing one of the Crane 24 in., high pressure gate valves weighing 6200 lbs., and a small child in the background; the other, one of the Crane patent metallic disk valves held by a bright looking machinist about five years of age. The engravings are very handsome and make an attractive ornament for the wall.

The Snow Steam Pump Works, of Buffalo, N. Y., have published a very handsome pamphlet descriptive of their pumps for water works. The left hand page contains cleverly written and tastefully illustrated matter relating to different applications of Snow pumps to water service, and the right hand page a handsome half tone engraving of different pumps. Altogether the pamphlet is one of the handsomest which has ever reached this office.

The Falk Manufacturing Company, of Milwaukee, Wis., has recently added to the list of roads using the Falk cast welded joints the following: Brooklyn City & Newtown Railroad Company, Brooklyn, N. Y., Brooklyn Heights Railway Company, Brooklyn, N. Y.; Milwaukee Electric Railway & Light Company, Milwaukee, Wis.; Lindell Railway Company, St. Louis, Mo.; Missouri Railroad Company, St. Louis, Mo.; Capital Traction Company, Washington, D. C.

F. E. Marsland, of New York, is doing an excellent business in the supply of enameled iron signs. These are supplied by him in any quantity and in any color or combination of colors. They are especially adapted for street railway use and can either be carried on a car or employed as station or street signs. The advantages of enameled signs for these purposes are that they are attractive, durable and easily cleaned. They will withstand the effects of weather in all climates and will practically last a lifetime.

The Broderick & Bascom Rope Company, of St. Louis, Mo., tendered at its works a reception to the members of the American Society of Mechanical Engineers, during the recent meeting of that society in St. Louis. Each member was also presented a piece of wire rope handsomely mounted, as a paperweight. In recognition of the courtesies of the Broderick & Bascom Company, the society passed a set of resolutions thanking the company for its action and for the opportunity of studying the methods of manufacturing wire ropes.

The American Electrical Works, of Providence, R. I., whose originality in advertising lines is well known, have sent a reminder to their friends that the Fourth of July is near. This memento of Independence Day is a wooden and pasteboard gun, alleged to be a facsimile of the original gun which Johnny was told to get. The American Electrical Works recommend their friends to watch the bull's eye when they shoot the gun and also to remember that the best bare and insulated wires can be purchased at their works in Providence.

The Standard Air Brake Company, of New York, received June 15 still another order from Australia for brakes. This makes the fifth order received by the Standard Air Brake Company from that country, and as it calls for thirty-one outfits is the best kind of testimonial that the former equipments have been most satisfactory. The company's extensive European business has compelled the general manager of the company, Edward J. Wessels, to make another trip to Europe during the past month and the outlook for brakes is most encouraging.

The Diamond Truck & Car Gear Company, of Kingston, N. Y., will hereafter have its principal office in the Havemeyer Building, New York City, and the works will remain as before at Kingston. The company has been reorganized and among those interested as stockholders or directors are A. N. Brady, of Albany; W. F. Sheehan, of Troy; Hon. Chas. N. Preston, president of the Equitable Securities Company and John E. Searles, president of the Western National Bank and secretary and treasurer of the American Sugar Company. W. H. Wilkinson is superintendent of the works.

The Universal Filter Company, of Philadelphia, Pa., reports an increasing demand for its oil filter. The device, including the filtering material, can be easily cleaned without removing the oil from the filter or the filtering material from the chamber, and this important point is one of the chief advantages of the device. The company builds filters in three sizes with a capacity of two barrels, fifty gallons, and twenty-five gallons. It is now in use in a number of plants including that of the Hestonville, Mantua & Fairmount Passenger Railway Company of Philadelphia and the new Philadelphia Bourse, where it is giving good results.

The International Register Company, of Chicago, has been very busy all the spring, getting out orders for its numeral stationary register. This machine was put on the market last year after more than a year spent in perfecting and trying it, and there are now a large number of them in service in all parts of the country from which there has been no complaint. These machines have superior wearing qualities and are guaranteed for five years. The aluminum dials give them a fine appearance in the car, and do not tarnish or crack. As the dial is the most prominent part of a register, it is quite an advantage to have one that always looks like new.

The Bates Machine Company, of Joliet, Ill., builder of the Bates-Corliss engine, etc., is crowded with work to the full capacity of its shops. In fact the works have been running day and night for the past sixteen months. Late shipments and orders now in hand are as follows: Missouri, Kansas, Mississippi, Illinois, Indiana, Kentucky, Ohio, Michigan, New Jersey, Virginia, Mexico, South Africa and Japan. These orders all range from 100 h. p. to 500 h. p. and are all for Corliss engines with the Bates valve gear. The company is now manufacturing the improved feedwater heater, purifier, oil separator, etc., under the Cookson patents, and reports great success with it.

The Milwaukee Electric Railway & Light Company has lately been putting in some new track on Oakland Avenue, Milwaukee, using heavy T rail sixty feet in length. The joints were cast welded by the Falk Manufacturing Company. Owing to a pressure of other work by the street railway company, this piece of track was left from ten days to two weeks after the joints were made, the rails being exposed throughout from the tread to the base for the whole length of the track during this time, the days being excessively warm and the nights cool, and yet the track remained in perfect alignment and condition, a photograph of the same showing the track as straight as an arrow.

The Standard Air-Brake Company, of New York, has recently received a handsome testimonial to the value of its brakes from the Akron, Bedford & Cleveland Railroad Company. This railroad company installed in the early part of 1896 ten air brakes of another make, and soon after, at the request of the Standard Air-Brake Company allowed it to equip one of its cars with brakes. As a result of the competitive test of the two systems an order has been given to the Standard Air-Brake Company for the equipment of all the new cars of the A. B. & C. road. As these cars make as high as forty-eight miles per hour and as the grades at one point of the line are over thirteen per cent, the importance of the order is at once appreciated.

J. A. Fay & Company, of Cincinnati, O. manufacturers of wood working machinery recently received a very large order from Yokohama, Japan. During the recent contest with the Chinese the Japanese saw a large railroad shop fitted out by J. A. Fay & Company many years ago. The Chinese had made very little use of it, but the Japanese instead of taking the old plant down and transporting it to Japan, came to the United States and bought a somewhat similar though more complete outfit for their government railroad shops. This is the largest order ever given by them for an outfit of wood working machinery, and it has attracted much attention, as these shops are intended to be the finest in the East, if not in the world.

The Mica Insulator Company, of New York, has for distribution to railway managers a sample of its style B flexible micanite plate designed as an insulator for armature slots, armature bodies, field magnet coils, etc. Its extreme flexibility will allow it to be bent in any position desired. It is furnished in sheets 36 ins. × 36 ins. and of any thickness desired from .01 in. up. The company states that the demand for micanite specialties is on the increase both in America and in Europe, and that the company's London and Schenectady factories are kept very busy filling orders. The forms in which the company furnishes micanite are of large variety and for all the common uses to which the material can be put. The company has also a large trade in Empire cloth, linen and paper, and in mica for electrical uses, either cut or uncut.

The H. W. Johns Manufacturing Company, of New York, has published a new catalogue of standard size with its former catalogues and descriptive of the many electrical appliances manufactured by it. A number of new devices are illustrated, prominent among which the reader will notice the H. W. J. electric car heater. In this the resistance wire is first wound with asbestos thread and then woven into cloth with an asbestos warp. A piece of cloth containing a certain quantity of wire is fastened by fireproof insulating cement to a sheet of asbestos millboard, which forms its support. The whole is then enclosed in a neat covering of perforated steel plate. The steel covering is then japanned with an insulating compound. The heaters are controlled by a patented knife switch, which can be adjusted to give three different degrees of heat.

The Electrical Mutual Casualty Insurance Company, of Scranton, Pa., reports that it is meeting with pronounced success in its organization of street railway managers—for the purpose of caring for the accident losses of their respective roads. Over forty-five roads have joined and as many more are applicants or have signified their desire to join as soon as their present insurance expires. A skilled legal board has been organized, together with adjusters and detectives, and every means taken to promptly ascertain the assured's liability in all accidents of a serious nature. By avoiding litigation if possible by prompt settlement, it is the association's desire to cultivate a better public feeling toward the assured in their respective localities. The organization promises to be a successful feature of thorough and conservative street railway management.

The Deane Steam Pump Company, of Holyoke, Mass., has published a small pamphlet giving the report of the superintendent of the Andover (Mass.) Water Works on the performance of the steam pump used in the Water Works station. The records show that the duty has been developed in every-day work. This duty averages about 133,000,000 ft. lbs. per one hundred pounds coal for short runs of about six hours. In a nine hour run a duty above 137,000,000 has been obtained. The superintendent adds, "one great feature is the ease with which the pump is operated. I am more than well pleased with the pump. Its operation exceeds my anticipations." It should also be stated that a premium of $25 per 100,000,000 ft. lbs. above 125,000,000 was offered to the pump manufacturers, and that this premium was won and amounted to $97.50.

The Ohio Brass Company, of Mansfield, O., reports numerous orders recently for the Wood's flexible pole brackets, which it is manufacturing exclusively under letters patent. The amount of these sales so far this year has far exceeded that for all of last year, which of course is highly satisfactory. The selection of this style of flexible pole bracket by the engineers of some of the leading roads in the country after making a thorough investigation, and in some cases an exhaustive trial of the different kinds now on the market, would seem to indicate that they are meeting with widespread favor and approval. The Ohio Brass Company has recently distributed to the trade a very neat descriptive circular, setting forth the merits of the styles A and B brackets, which will, no doubt, prove interesting to any who contemplate erecting bracket construction in the near future.

The Berlin Iron Bridge Company, of East Berlin, Conn., has secured a contract for a steel rolling building, 103 ft. × 112 ft., from the Pennsylvania Bolt & Nut Company, of Lebanon, Pa. The building will have a steel frame, and roof and sides will be of corrugated iron. The same company has also received an order from the Glens Falls Paper Company, of Glens Falls, N. Y., for the trusses of a new building which this company is now erecting. The new works of this company will consist of a machine room 67 ft. × 217 ft., a machine room 52 ft. × 167 ft., a finishing room 50 ft. × 100 ft. and two boiler houses of somewhat smaller dimensions. On all these new buildings the company will place roofs supported by steel trusses. This form of construction is especially adapted for factories devoted to the manufacture of paper, and wherever new buildings are put up, or old ones remodeled, steel is almost invariably used.

The Loando Hard Rubber Company, of Boonton, N. J., is manufacturing of the best hard rubber a full line of trolley hangers, single and double pull-off insulators and strain insulators. The rubber is moulded in a single piece upon the bolt and is suspended by sheet metal parts of brass or steel, as desired, instead of castings. The insulators are the invention of John J. Green, and their particular advantages are superior insulation and light weight combined with ornamental appearance and ample strength. The hangers weigh only ten to twelve ounces. The insulating bell of hard rubber has a double skirt to increase the surface distance and prevent leakage. The appearance of the insulators encased in polished lacquered brass or steel is striking, while the merits of the best hard rubber as insulation are undeniable. The difference in cost between heavy castings and the light metal used enables the company, it is claimed, to use a high quality of rubber at prices as low as other makes.

The Standwood Manufacturing Company, of Chicago, supplied all of the steel steps of the cars used in Minneapolis and St. Paul, described in the June issue of the STREET RAILWAY JOURNAL and the officers of the company speak of them in the highest terms. It is also probable that the small number of accidents on the cars of this company, to which reference was made in our last issue is in a considerable measure due to the use of these steps, as owing to their construction slipping upon them is almost impossible. The new universal sanitary street car of the Dry Dock, East Broadway & Battery Railroad, described in the June issue of the STREET RAILWAY JOURNAL, is also equipped with these steps, a fact which was not mentioned in the article last month. The Dry Dock Company in the construction of this car was anxious to make it a model and chose the best which the market afforded, so that Stanwood steps became a necessity. The steps are meeting with continued favor in all parts of the country and are regarded by many managers as essential to the proper equipment of their cars.

Eugene Munsell & Company, of New York and Chicago, miners and importers of mica, are enjoying an excellent trade in India mica, of which they make a specialty, being direct importers from the mines, and employing a large force in selecting the mica, They are in a position to furnish it cut to size and stamped to any shape or pattern for electrical insulation. They have just issued a neat price list, which is being mailed to the trade, and offer to send samples and quotations to the electrical trade on application. L. W. Kingsley, secretary of the company, sailed June 3, on the steamship "St. Louis," for a trip abroad, where he will spend considerable time sight seeing as well as looking after the affairs of the company in Europe. The company's business is largely increasing in foreign countries. This is largely due to the high grade of insulation "Micanite" now being furnished the manufacturers of electrical machinery of the European countries, at the newly equipped factory, at Stoke Newington, London. At these works upwards of one hundred hands are given employment. The company's London office is at No. 12 Camomile Street.

Tke Cutter Electrical & Manufacturing Company has been having excellent results in the sale of its automatic magnetic circuit breakers. The underwriters of the cities of New York, Chicago, Boston and Philadelphia have approved them, and the old, unreliable, improper methods practiced in the matter of circuit protection will soon become a thing of the past. As is usually the case in all inventions and improvements, the "thing" or feature is some little modification or development which is apparent at first glance, and which seemingly, should have been thought of before. The letters "I. T. E." in brief represent the salient features of the automatic magnetic circuit breakers, viz.: "I. T. E." means Inverse Time Element, and represent the basic principle entering into the construction of the device. That is, a circuit protected by this circuit breaker is opened in less and less time as the circuit approaches nearer and nearer a short circuit. The circuit breakers are made for switchboards, railways, light and power, motors, house service and storage batteries, in direct and alternating circuits. The catalogue recently issued by the company will repay careful reading and will be sent, upon application, to all interested in this subject.

Crafts & Insertel, is the title of the enterprising firm now acting as sales agents for the Walker Company in the city of New York. The firm has its headquarters in the Postal Telegraph Building, New York, and has already secured a number of important orders for Walker apparatus within its territory. One of the most important of these is for the generating apparatus for the Brooklyn Bridge railway a contract which has already been mentioned in these columns. This was secured in the face of large competition and is certainly very much to the credit of the gentlemen who secured the order. The personnel of the firm is a strong one. S. D. Crafts was formerly with the New York Wood Vulcanizing Company and is well posted in railway matters and affairs. Mr. Issertel is a practical electrical engineer and for a number of years previous to joining the Walker Company was connected with the H. W. Johns Manufacturing Company. In this capacity he gave special attention to the railway business of that company and is fully conversant with the electrical problems confronting the street railway manager. The outlook for business by the Walker Company in New York and vicinity seems very hopeful in the hands of this firm.

Clarence Whitman & Company, of New York, the manufacturers of Pantasote, the well known waterproof curtain material, report an increasing demand for this product. Pantasote forms an important feature of the equipment of the "Universal Sanitary Street Car" described in the June issue of the STREET RAILWAY JOURNAL, p. 360, a fact which was omitted by mistake in the description last month. Pantasote being thoroughly waterproof adds very largely to the comfort of the passenger. In fact, it is the use of Pantasote that makes a car of this design practical; that is, the passenger having but a single seat near the window at his disposal, is unable to move away from the side of the car. In bad weather such a car without a waterproof curtain would be decidedly unpopular. All of the street railway systems in New York, as well as those in many other cities, might well give more attention to the important matter of curtains. Brooklyn is far ahead of many cities in this respect, as there are at least one hundred cars there furnished with the Pantasote curtains. The Metropolitan Street Railway Company, of New York, has lately furnished one car on its Tenth Avenue line with this material as a test and so far the result is highly satisfactory. The Pantasote curtains are on some 500 cars of the New York Central system and are used by most of the large steam and electric systems through the country.

The Wells Light Manufacturing Company, of New York, of which Edward Robinson is sole proprietor, is doing an excellent business in the manufacture and sale of the Wells light. This portable kerosene light has achieved a very wide use, especially on railroads during track laying and repairs generally, on wrecking cars and other places where a strong portable light is desired. The light is produced by passing kerosene oil through a heated burner where it is generated into gas. The gas burns in a large powerful flame which needs no protection and will stand any weather. The oil is kept under about twenty-five pounds pressure, and a few strokes of the pump every few hours is all that is required to renew this pressure. An idea of the small weight of the light can be had from the statement that the apparatus for producing 800 c. p. flame sufficient to burn for five hours weighs, when full, but seventy-five pounds, and when empty forty-five pounds, and can be refilled while burning without danger of putting out the light. The 2000 c. p. lamp, capable of burning fourteen hours weighs 245 lbs. when full, and but 110 lbs. when empty. The burner can, of course, be used for heating as well as for illumination, if desired. Wells lights have been used by the principal railway companies, both steam and street railway, and the company has letters of testimonial from prominent contractors, engineers and operating companies.

Otto Goetze, of New York, reports an increasing demand in this country among street railway companies for mannocitin. This is a slushing compound which has been extensively used for a number of years in Europe by railways and factories of all kinds, and which is endorsed and used by a number of well known firms in this country. It is composed of greases and volatile oils. On application, the oils evaporate, and there remains a thin air-tight film which tightly adheres to the metal and forms the coating which absolutely and permanently protects the metal against rust and corrosion. As this film is transparent, the compound can be used to great advantage on engines and machinery in power houses, or in stock, as it does not spoil the appearance of the metal. The mannocitin coating affords protection against salt air, salt water, dampness, gases and fumes of muriatic acid and ammonia, and consequently will be found of great utility for machinery exposed to any of the above agents. For instance, in power houses located near the seashore or in damp places, or on machinery that is shipped long distances. The compound is easily applied and has the advantage of being quickly removed, and thereby saving time. It contains no acid and remains absolutely neutral. One application is all that is required, as the mannocitin coating will protect the metal as long as the coating is allowed to remain on.

Trade Catalogues.

CATALOGUE. Published by the Snow Steam Pump Works, Buffalo, N. Y. Forty-four pages. Illustrated.

PRICE LIST NO. 10. Published by the Phosphor Bronze Smelting Company, Philadelphia, Pa. Twenty pages.

A PERFECT PASSENGER TRUCK. Published by the J. G. Brill Company, Philadelphia, Pa. Eight pages. Illustrated.

HYDRAULIC MACHINERY. Published by the Pennsylvania Iron Works Company, Philadelphia, Pa. Fifty-five pages. Illustrated,

ELECTRICAL MATERIALS. Published by the H. W. Johns Manufacturing Company, New York. Thirty-two pages. Illustrated.

CALENDAR AND CIRCULAR. Published by the Goulds Manufacturing Company, Seneca Falls, N. Y. Eight pages. Illustrated.

INDESTRUCTIBLE STEEL CARS AND STEEL UNDER FRAMES. Published by the Universal Construction Company, Chicago, Ill. Forty-two pages. Illustrated.

THE I. T. E. AUTOMATIC CIRCUIT BREAKER. Catalogue 14. Published by the Cutter Electric & Manufacturing Company, Philadelphia, Pa. Sixteen pages. Illustrated.

REPORT OF TEST OF DEANE STEAM PUMP IN ANDOVER PUMPING PLANT, ANDOVER, MASS. Published by the Deane Steam Pump Company, Holyoke, Mass. Eight pages. Illustrated.

List of Street Railway Patents.

U. S. PATENTS ISSUED MAY 19, 1896, TO JUNE 9, 1896, INCLUSIVE.

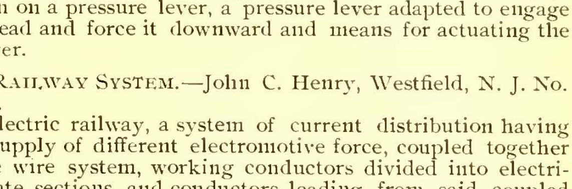
MAY 19.

BRAKE FOR STREET CARS.—J. Morrison, Detroit, Mich. No. 560,226.

A hanging brake head suspended by diverging links each of which is provided with an elongated eye at its end, and engages with a pin on the car frame and by converging links that engage with the pin on a pressure lever, a pressure lever adapted to engage the brake head and force it downward and means for actuating the pressure lever.

ELECTRIC RAILWAY SYSTEM.—John C. Henry, Westfield, N. J. No. 560,265.

In an electric railway, a system of current distribution having sources of supply of different electromotive force, coupled together in the three wire system, working conductors divided into electrically separate sections, and conductors leading from said coupled sources of supply to different sections of the road, and arranged so that one predetermined section is connected with one side of a three wire system, another section connected with the other side of the three wire system, and a third section that may be connected with either side or in series with both sides as desired. It is claimed for this system that all of the economical advantages of the three wire system are obtained. In addition to this the motors may be much more economically controlled, as three changes of speed are within reach, without throttling or current wasting devices. The main



PAT. NO. 560,265.

scheme is to supply the road with current at different voltages, as the local conditions may require; for instance, in the congested districts where the cars must run slow and where high potentials and double overhead wires are prohibited, the motors receive current at 400 volts. On the up grades, the single trolley wire may be supplied at 600 volts, while in the suburbs, where double overhead wires are not objectionable, and the rail connection would be, the voltage would be constant at 1000, which could be changed at will by the motorman to 600 or 400 on the motors, but in no case would the potential between the overhead wires and the track rails be greater than 600 volts.

ELECTRIC RAILWAY.—N. Leidgen, Milwaukee, Wis. No. 560,269.
A trolley wire supporting device for railways, comprising a hanger having curved sides for receiving the ends of the wire sections, said sides terminating in upwardly inclined cam surfaces and weighted eccentrics pivoted to said hanger for clamping the ends of the wires against said curved sides.

CAR FENDER.—J. H. Leightner, Cincinnati, O. No. 560,270.
An automatic scoop shaped car fender or guard suspended wholly from an elevated support and provided with rigid longitudinally slotted shackles, together with fixed hangers that traverse said slots.

CAR FENDER.—A. Iske, Lancaster, Pa. No. 560,317.
A pivotally mounted fender having its ends on opposite sides of its pivotal point each provided with means to receive and hold an obstruction on the track, said ends being arranged when said fender is rocked on its pivot to be alternately lowered adjacent to the track in position to receive an obstruction thereon.

CAR FENDER.—S. A. Kneedler, Philadelphia, Pa. No. 560,318.

CAR FENDER.—Wm. T. Donohue, New York, N. Y. No. 560,482.

CAR BRAKE.—Jas. Ford, Johnstown, Pa. No. 560,488

ELECTRIC RAILWAY.—Robt. Lundell, Brooklyn, N. Y. No. 560,513.
In an electric railway a system of permanent or continuous interconnections between electromagnetic switches and sectional trolley-conductors, the arrangement being such that each electromagnetic switch is given a certain time allowance to close before it is called upon to transmit the propelling current no matter which way the car or train be moving.

MAY 26.

CONTROLLER FOR ELECTRIC CARS.—E. A. Sperry, Cleveland, O. No. 560,658.
A controller cylinder, a switch for reversing the armature connections, a rocking device arranged to actuate said reversing switch, a connecting rod arranged to be actuated by the cylinder and means for engaging said rod with and disengaging it from the rocking device.

ELECTRIC RAILWAY.—H. Brandenburg, Chicago, Ill. No. 560,678.
Consists of a slotted tubular conductor, a trolley having a beaded plate, and a sleeve carrying a multiplicity of contacts mounted on said bead.

ELECTRIC RAILWAY.—E. H. Johnson, New York, N. Y. No. 560,721.
A method of disconnecting a sectional trolley conductor from circuit with a current main or lead, when the circuit connections between said conductor and main are due to leaking currents; which consists in conveying the leaking currents around the switching mechanism and thereby causing said switching mechanism to assume its normal or open position.

ELECTRIC BRAKE.—Wm. P. Potter, Schenectady, N. Y. No. 560,751.

CONDUIT ELECTRIC RAILWAY.—W. Lobach, Chicago, Ill. No. 560,807.
A conduit, an insulating liquid heavier than the water contained therein, an electric conductor immersed in said liquid, and a contact device carried upon the car and adapted to make contact with said conductor.

CURRENT COLLECTOR FOR ELECTRIC RAILWAYS.—A. N. Connett, Washington, D. C.
A traveling contact or current collector for electric railways, comprising a hanger, oppositely disposed contact shoes, an interposed toggle and a spring connection between the toggle and hanger.

CAR FENDER AND SAFETY ATTACHMENT.—A. O. Cunningham, New Orleans. No. 560,843.

CAR FENDER.—M. Fernandez, Los Angeles, Cal. No. 560,849.

CURRENT COLLECTOR FOR ELECTRIC RAILWAYS—A. S. Connett, Washington, D. C. No. No. 560,894.
A contact or current collector for electric railways, comprising insulated contact shoes, a hanger from which the shoes are pivotally suspended, and springs interposed between the shoes and hanger, and adapted to move both laterally and longitudinally.

CAR FENDER.—F. J. Hopkins, Newark, N. J. No. 560,902.

ELECTRIC RAILWAY.—W. H. Jordan, Brooklyn, N. Y. No. 520,903.

ELEVATED ELECTRIC RAILWAY.—J. H. McGurty, Jersey City, N. J. No. 560,917.

CAR FENDER.—H. A. Webster, Haverhill, Mass. No. 560,953.

CAR FENDER.—S. D. Wright, New York. No. 560,959.

ELECTRIC RAILWAY SYSTEM.—N. J. Halpine, U.S. Navy. No. 560,988.

CAR FENDER.—F. W. Nye, Cincinnati, O. No. 561,061.

JUNE 2.

TROLLEY SWITCH.—Moses Rangey, Schenectady, N. Y. No. 561,128.

CAR FENDER.—Peter Best, Elizabeth, N. J. No. 561,155.

CAR FENDER.—F. J. Graf, New York, N. Y. No. 561,163.

TROLLEY STAND.—F. N. Kelsey, New Haven, Conn. No. 561,168.

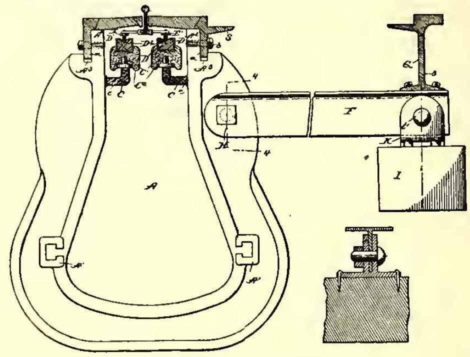
CAR FENDER.—H. D. Gardy, Chester, Pa. No. 561,218.
Consists of a frame carrying a netting, a coil spring having its ends attached to the rear of the frame and a series of radial wires leading from the coil spring to the frame whereby an inclosure is formed above the netting.

ELECTRIC CAR.—J. C. Henry, Westfield, N. J. No. 561,224.
Consists of two driving axles having suitable cranks, a motor mounted on and between said axles by a non-yielding support, a crank operated by the motor shaft and rigid connecting bar hung by rigid or non-yielding support on the three cranks.

ELECTRIC CAR.—J. C. Henry, Westfield, N. J. No. 561,225.
Consists of a motor, an air brake system, including an air pump and means under the control of the operator for connecting said motor operatively with either the car axle or the air pump or both.

CAR FENDER.—J. W. Swartz, Philadelphia, Pa. No. 561,293.
A fender having mounted thereon the angular cradle which is formed of members united as one at the angle of the cradle and having a shaft at said angle connected therewith and means directly on said shaft and the frame of the fender for locking said cradle.

ELECTRIC RAILWAY.—Henry Brandenburg, Chicago, Ill. No. 561,307.
A conductor having the external insulating material or covering and a longitudinal uninsulated oil channel on the upper surface for the trolley contact.


PAT. NO. 561,307.

CAR BRAKE.—E. E. LaRose, Providence, R. I. No. 561,328.

POWER GEARING FOR ELECTRIC CARS.—E. A. Sperry, Cleveland, O. No. 561,354.

ELECTRIC LOCOMOTIVE.—W. P. Henszey, Philadelphia, Pa. No. 561,395.

CAR FENDER.—E. E. Higinbotham, Chicago, Ill. No. 561,397.

CAR BRAKE.—C. Matthews, Irwin, Pa. No. 561,414.
A car brake consisting of a brake shoe carrier and a brake shoe, means for operating the brake shoe vertically, and in combination a connection for tilting the brake shoe laterally.

STREET CAR MOTOR.—B. C. Pole, Washington, D. C. No. 561,433.

CAR BRAKE —J. U. Elwood, McKeesport, Pa. No. 561,502.

ELECTRIC CAR TRUCK.—J. Taylor, Troy, N. Y. No. 561,530.

JUNE 9.

STREET CAR MOTOR.—J. W. Dean, Springfield, O. No. 561,769.
Consists of a driving shaft adapted to rotate in one direction, two driven shafts connected thereto and adapted to rotate in opposite directions to each other, sprocket chains for connecting said driven shafts and the car axles together, and means for releasing either shaft from engagement with said driving shaft.

ELECTRIC RAILWAY.—W. M. Schlesinger, Philadelphia, Pa. No. 561,821.
An electrical conductor composed of superposed plates of copper and iron or steel of segmental form in cross section, with traveling brushes contacting with the steel or iron plate of the conductor.

ELECTRIC RAILWAY.—C. E. Stanley, Gallipolis, O. No. 561,830.

ARC INTERRUPTER FOR STREET CAR CONTROLLERS.—G. Valley, Cleveland, O. No. 561,838.
Comprises essentially an electro-magnet internal to the drum and having projections from its pole pieces extending through the drum in proximity to the contact pieces thereof.

REVERSING AND CUT-OUT SWITCH USED IN CARS.—G. Valley, Cleveland, O. No. 561,839.

CAR BRAKE.—D. L. Winters, Chicago, Ill. 561,845.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of twenty-five cents. Give date and number of patent desired. THE STREET RAILWAY PUBLISHING COMPANY HAVEMEYER BUILDING, NEW YORK.

FINANCE

American Street Railway Investments.

(1) *The Combined Operating Statistics of 211 Properties.*

From the reports presented in the STREET RAILWAY JOURNAL'S Financial Supplement, "American Street Railway Investments," it is possible to obtain a large amount of comparative statistical information regarding the history of the industry during the last four years and the general forces which have been at work in this field. In this and succeeding papers much of this information will be gathered together and commented upon briefly.

As there is no national board or commission armed with authority of any kind over the street railways of the country, there is a great diversity in the methods of bookkeeping and in the dates at which the books of the different companies are closed for their respective financial years. It is impossible therefore to combine a large number of reports of this character in such a way as to make a perfect statistical presentation of results, and all work in this street railway field is now, and will necessarily be for some years to come, at least, confined to a more or less close approximation to true results. The following discussion therefore should be read with a clear understanding of this fact, and deductions should not be more hastily drawn from the figures than are warranted by the character of the investigation.

The reports of 927 operating companies, 185 leased companies and 307 new corporations are contained in the manual above referred to. Ninety-six of these companies only present a complete report for the past four years, showing gross receipts, operating expenses and fixed charges; 127 companies (including the 96 mentioned) present complete reports for the past three years; 180 companies present complete reports for the past two years, and 215 companies present complete reports for the past year—i. e., for financial years ending at some time in 1895-6.

COMBINED OPERATING REPORT OF 96 AMERICAN COMPANIES FOR THE FOUR YEARS ENDING AT VARIOUS DATES IN 1895-6.

The 96 companies before referred to as presenting complete reports operate 2291 miles of electric railway track (single track basis), 321 miles of horse railway track, 147 miles of cable railway track, and 207 miles of miscellaneous track—a total of 2965 miles, representing between twenty and twenty-five per cent of the total track mileage of the country. These 96 companies are capitalized at $354,230,900, of which $178,002,945 is represented by capital stock and $176,227,-955 by funded debt. This capitalization is also very nearly twenty-five per cent of the total capitalization of American street railways, and amounts to about $119,000 per mile.

The following table shows the results of operation of these 96 companies during the past four years:

	1892.	1893.	1894.	1895.
Gross receipts	$49,698,486	$56,781,204	$52,842,721	$56,078,881
Operating expenses	31,419,697	34,592,118	33,190,992	34,373,403
Earnings from oper'n	18,278,789	22,189,086	19,651,729	21,705,478
Fixed charges	8,596,901	10,188,255	10,802,272	11,811,336
Net income	9,681,888	12,000,831	8,849,457	9,894,142
Per cent oper'g. exp. to gross receipts	63.2	60.9	64.7	61.3
Per cent fixed charges to gross receipts	17.3	17.9	20.4	21.1
Per cent net income to gross receipts	19.5	21.1	16.8	17.6
Per cent net income to capital stock	5.4	6.7	5.0	5.6

From this table it will be seen that the gross receipts of the 96 companies for financial years ending in 1893 show a sharp increase over those for 1892, that they fell off again in 1894, and have not fully recovered in 1895-6. It would seem, however, that there is again an upward movement, and it is probable from more recent information that this increase is continuing and that the 1896-7 report will show larger figures than ever before.

The percentage of operating expenses to gross receipts was largest in 1894 and is falling off again slightly at the present time, the 1895-6 figure being 61.3 per cent. This is certainly a low figure, and it is worthy of note that, as will be seen later, this figure is practically the same as that found in the combined reports of 215 companies for the last year.

The percentage of fixed charges to gross receipts shows a constant increase, the latest figure being 21.1 per cent. It would seem from this that these ninety-six companies are adding to their capital libabilities to some extent from year to year.

The percentage of net income to gross receipts, which was 19.5 and 21.1 per cent in 1892 and 1893 respectively, fell off sharply in 1894, and has since risen only slightly to 17.6 per cent. The percentage of net income to capital stock, which measures the possible dividend return upon the enterprises, was at a maximum at 6.7 per cent in 1893, at a minimum of 5 per cent in 1894, and has since risen to 5.6 per cent.

COMBINED OPERATING REPORT OF 127 AMERICAN COMPANIES FOR THE THREE YEARS ENDING AT VARIOUS DATES IN 1895-6.

In addition to the 96 properties which present complete reports for the four years as stated, 31 other properties present complete three year reports, and if these are combined with the reports of the last three years given for the 96 companies, we get a comparative three-year report of 127 companies.

These 127 properties comprise 3157 miles of electric railway track, 414 of horse railway track, 162 miles of cable railway track and 209 miles of miscellaneous track, a total of 3942 miles of track, equivalent to about thirty per cent of the total track mileage in America.

The capitalization of these 127 companies amounts to $433,945,-423, of which $217,656,211 is in capital stock, and $216,289,212 in funded debt. This capitalization is about 30 per cent of the total capitalization of American properties and amounts to $110,000 per mile of track. The combined operating report of the 127 companies is as follows:

	1893.	1894.	1895.
Gross receipts	$65,206,656	$61,105,088	$64,699,963
Operating expenses	40,086,630	38,202,056	39,388,133
Earnings from operation	25,120,026	22,903,032	25,311,830
Fixed charges	12,264,938	13,106,101	14,172,287
Net income	12,855,088	9,796,931	11,139,543

	1893.	1894.	1895.
Per cent operating expenses to gross receipts	61.5	62.5	60.9
" fixed charges to gross receipts	18.8	21.4	21.9
" net income to gross receipts	19.7	16.1	17.2
" " " " capital liabilities	5.9	4.5	5.1

We do not find in these figures any substantial difference in tendencies from those of the 96 companies previously cited. It will be seen however that the earnings from operation in 1895 were slightly greater than in 1893, due to a lowering in the percentage of operating expenses to gross receipts. The net income also in 1895 was more nearly equal to that of 1893 than was the case with the first group of companies. It is evident however that the addition of the 31 properties has had the effect of lowering the percentage return upon the capital liabilities.

COMBINED OPERATING REPORT OF 180 AMERICAN COMPANIES FOR THE TWO YEARS ENDING AT VARIOUS DATES IN 1895-6.

In addition to the 127 companies already grouped together there are 53 companies whose reports are given in full for the last two years, and if these reports are added to those of the 127 companies for the corresponding years, we get a complete operating report for 180 companies for the last two years. These 180 companies operate 3847 miles of electric railway track, 566 miles of horse railway track, 195 miles of cable railway track, and 234 miles of miscellaneous track, making a total of 4,842 miles of track, equivalent to about thirty-five per cent of the total street railway mileage of the country.

These 180 companies have combined capital liabilities of $550,-809,823, of which $279,559,711 is in capital stock and $271,250,112 in funded debt. This capitalization is equal to from thirty-five to forty per cent of the total capitalization of American street railways and to about $114,000 per mile.

The operating report of these 180 companies for the two year period is as follows:

	1894.	1895-6.
Gross receipts	$75,349,020	$80,110,651
Operating expenses	47,120,101	48,878,877
Earnings from operation	28,228,919	32,231,774
Fixed charges	18,146,346	19,989,818
Net income	10,082,573	11,241,956

	1894.	1895.
Per cent op. expenses to gross receipts	62.5	61.0
" " fixed charges to gross receipts	24.7	25.0
" " net income to gross receipts	13.4	14.0
" " net income to capital liabilities	3.6	4.0

We have in this report an increase in 1895 over 1894 of about six per cent in gross receipts, four per cent in operating expenses, fourteen per cent in earnings from operation, ten per cent in fixed charges and eleven per cent in net income applicable to dividends upon the stock. These 180 properties are evidently capitalized more heavily in proportion to their earning power than are the companies of the two groups previously investigated, for it appears that the percentage of net income to capital stock is but 3.6 per cent in 1894 and 4 per cent in 1895 showing, as has been indicated already, that the additions made to the number of companies under investigation have been with less prosperous companies and presumably those more recently put in operation in comparatively poorer territory.

COMBINED OPERATING REPORT OF 215 COMPANIES FOR THE LAST FINANCIAL YEARS ENDING IN 1895–6.

To the latest reports of the 180 companies just investigated are now added those for the corresponding year, of 35 additional companies, many of whom are new corporations recently commencing operation. These 215 companies operate 4291 miles of electric railway track, 611 miles of horse railway track, 277 miles of cable railway track and 243 miles of miscellaneous track, making a total of 5423 miles of track, equivalent to about forty per cent of the street railway mileage of the country. They have combined capital liabilities of $613,852,638, of which $319,117,576 is in capital stock and $294,735,062 is in funded debt. This capitalization is equivalent to nearly fifty per cent of the total capitalization of American street railway properties and to $113,000 per mile.

The combined operating report of these 215 companies is as follows:

	1895–6.
Gross receipts	$85,861,663
Operating expenses	52,421,918
Earnings from operation	33,439,745
Fixed charges	21,426,893
Net income	12,012,852

	1895–6.
Per cent op. exp. to gross receipts	61.1
" " fixed charges to gross receipts	24.0
" " net income to gross receipts	14.0
" " net income to capital liabilities	3.8

OTHER OPERATING REPORTS.

In addition to the groups already investigated, 26 companies present operating reports which cannot be grouped with those already given. It may be said however that these 26 companies add $49,470,350 to the capital liabilities; 538 miles to the track mileage; that their gross receipts amount to $4,981,277, and their net income to $1,198,456, equivalent to 4.6 per cent upon their combined capital stock.

We have, then, as a final result, the fact that about forty per cent of the street railway mileage of the country, bearing fifty per cent of its capital liabilities, report gross earnings amounting to about $90,000,000; operating expenses slightly over sixty-one per cent of the gross receipts; fixed charges of about twenty-four per cent of the gross receipts, and net income amounting to fourteen per cent of the gross receipts, equivalent to a return of slightly less than four per cent upon the capital liabilities.

A Bond Issue by the Johnson Company.

The Johnson Company has placed upon the market through the Guaranty Trust Company, of New York, an issue of $2,000,000 of first mortgage, twenty year, six per cent, gold bonds, of which $1,150,000 are now offered, $400,000 are already outstanding and $100,000 have been retired in accordance with the provisions of the sinking fund clause of the mortgage. The circular issued by the Guaranty Trust Company offering these bonds contains the following interesting report from Stephen Little, the company's expert accountant:

NEW YORK, Apr., 24, 1896.

WALTER G. OAKMAN, Esq., President,
Guaranty Trust Company, of New York.

DEAR SIR.—I have made a careful examination of the books and accounts of the Johnson Company, at Lorain, O., and herewith beg to enclose attested statement of its assets and liabilities of date of Dec. 31, 1895. I have examined with care the items of cost of plant

At Lorain, O.	$3,397,465.92
At Johnstown, Pa	1,401,615.08
Total	$4,799,081.00

and certify that the sum stated ($4,799,081.00) is the actual amount expended in the construction of said plants, and that the other items of real estate investments, inventory and current assets are the actual cost thereof as ascertained from the accounts of the company.

I have also examined the results of operation of the company for the past six years, and find that there was earned in these years, respectively, the following profits, gross and net, viz.:

Years.	Gross profits.	Less interest.	Net profits.
1890	$679,161.21	$36,383.25	$642,777.96
1891	533,255.82	32,926.28	500,329.54
1892	668,628.87	31,303.31	637,325.56
1893	364,520.14	29,626.94	334,893.20
1894	275,964.29	7,963.49	268,000.80
1895	578,372.97	102,032.12	476,340.85
Totals	$3,099,903.30		$2,859,667.91
Average per year	516,650.55		476,611.32

Yours truly,
(Signed) STEPHEN LITTLE.

The company is required to retire $100,000 per annum of these bonds, which may be called at 105 and accrued interest.

Denial of Consolidation Rumors.

Early in June a statement appeared in the columns of the Boston *Transcript* to the effect that a consolidation agreement was about being closed between the Walker Company and the General Electric Company. No details were given, but the inference was that the Walker opposition to the General Electric and Westinghouse Companies was to be "bought off." President Billings and Vice-President Short of the Walker Company authorize the most positive and absolute denial of any intention upon the part of the company to come to any understanding whatever with any of its rivals. The company prefers to be "independent" of all combinations and to conduct its business on manufacturing and not speculative lines.

President Billings states that the company's business is expanding enormously under the impetus given by the recent reorganization and that it is prepared to compete for all classes of railway, direct incandescent and arc lighting work, while within a short time the company will place upon the market a complete alternating system for lighting work and the long distance transmission of power.

The company is said to be considering the purchase from the General Electric Company of its Cleveland plant, formerly the factory of the Brush Electric Company, but no decision has yet been made. The New Haven factory is a busy place under the superintendence of Mr. Black, as it is here that the company's new controllers, arc lamps, and switchboards are being made, together with all of the general brass work formerly made in the Cleveland factory. The New Haven factory is now building what is said to be the largest switchboard in the world. This is one hundred feet long and is fitted up for the control of twelve 800 k. w. generators and forty feeder circuits. It is to be used in the new station of the Chicago City Railway Coompany, the dynamos for which were recently purchased of the Walker Company.

The company is bringing out a new trolley which involves principles which are a radical departure from present types and which are claimed to be decidedly superior to anything now in use. It has also arranged with Professor Rowland and Dr. Duncan of Johns Hopkins University to manufacture the wattmeter recently designed by them. It is evident that the company means to be foremost in every line of electrical work.

Stockholm Convention of the International Street Railway Association.

The eleventh annual convention of the International Street Railway Association will be held in Stockholm, Sweden, Aug. 25 to 29, 1896. The meeting will be held in the large Hall of the Artillery and Engineers' Academy. Half of each day, that is, from 8.30 A. M. to 12.30 P. M., will be devoted to the reading of papers on technical subjects and discussions of them. The afternoons will be spent in sightseeing and pleasure trips. Each evening the members will dine together at some hotel or restaurant and the official banquet tendered to the association by the principal street railway company of Stockholm will be held on the evening of Aug. 29. The programme of the papers to be read and the topics discussed was published in the STREET RAILWAY JOURNAL for July, 1895, p. 447.

The city of Stockholm is an extremely interesting one, and railway engineers who may visit Europe this summer wlil find it profitable to attend the meetings, to which foreign engineers are most cordially invited. The city was founded in the twelfth century and contains at present 270,000 inhabitants. The street railway service is carried on by two companies, the larger company, the Stockholms Nya Sporvägs Actie Bolag, has about eleven miles of track of which 3 ½ miles are double track. The cars are operated by horses of which the company owns 450. The second company, Stockholms Söder Sparvägs Actie Bolag owns about three miles of track, thirty-three horses and eight Rowan smokeless steam locomotives. Among the interesting sights of the city are the handsome Royal Palaces, one of which is now used as a portrait gallery and is one of the most famous in Europe. Upsala, the site of Sweden's oldest university and the famous cathedral, is situated seven miles from Stockholm.

TABLE OF OPERATING STATISTICS.

Notice.—These statistics are carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement, "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years.

Abbreviations.—The following abbreviations are used: * Including taxes. d. deficiency. m. months.

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
ALBANY, N. Y.						
The Albany Ry.	3 m., Dec. '94	122,382	85,240	37,142	22,579*	14,564
	3 " " '95	132,407	83,928	48,479	21,457*	27,022
	12 " " '94	461,918	298,972	162,947	92,592*	70,354
	12 " " '95	522,276	314,319	207,957	88,657*	119,300
ALTOONA, PA.						
The Altoona & Logan Valley Elec. Ry. Co.	12 m. Dec. '94	73,128	33,217	39,911	32,248*	7,663
	12 " " '95	83,292	41,158	42,135	33,564*	8,570
City Pass. Ry. Co. of Altoona	12 m. Dec. '94	50,303	40,302	10,000	4,300*	5,700
	12 " " '95	56,527	46,146	10,381	4,051*	6,330
BALTIMORE, MD.						
Baltimore Traction Co.	12 m., Dec. '94	1,012,319	623,040	389,279	359,243*	30,037
	12 " " '95	1,179,191	639,707	539,485	413,097*	126,387
City & Suburban Ry. Co.	12 " June '94	605,123	409,363	195,760		
	12 " " '95	751,720	546,970	204,750		
BATH, ME.						
Bath St. Ry. Co.	12 m. June '94	16,300	12,862	3,438	2,500	938
	12 " " '95	21,703	14,698	7,005	3,400	3,605
BAY CITY, MICH.						
Bay Cities Cons. Ry. Co.	12 m. Dec. '94	83,450	52,011	31,439	30,000	1,439
	12 " " '95	88,658	58,517	30,141	30,000	141
	1 " Mar. '95	6,121	3,920	2,201		
	1 " " '96	6,258	4,384	1,874		
	3 " " '95	17,464	12,188	5,276		
	3 " " '96	18,866	14,188	4,678		
BIDDEFORD, ME.						
Biddeford & Saco R R Co.	12 m. June '94	24,219	14,813	9,406	6,391*	3,016
	12 " " '95	24,287	12,186	12,101	5,915*	6,186
BINGHAMTON, N. Y.						
Binghamton R. R. Co.	12 m. Jan. '95	121,969	69,581	52,388	30,152*	22,237
	12 " " '96	128,972	73,345	55,628	35,459*	20,169
	1 " Mar. '95	8,372	5,615	2,757		
	1 " " '96	9,932	6,165	3,767		
	2 " " '95	15,415				
	2 " " '96	19 173				
BOSTON, MASS.						
West End St. Ry. Co.	12 m. Sept. '94	6,823,879	4807,088	2,016,796	725,064*	1291,732
	12 " " '95	7,746,171	5633,163	2,113,008	746,963*	1366,044
Lynn & Boston R. R. Co.; North Shore Traction Co.	12 m. Sept. '94	1,238,410	746,304	492,106	379,029*	113,077
	12 " " '95	1,381,389	784,392	59,997	391,681*	205,316
	1 " Feb. '95	76,851	59,450	17,401		
	1 " " '96	87,591	56,931	30,660		
	5 " " '95	448,646	313,125	135,521		
	5 " " '96	481,014	330,154	150,860		
BRIDGEPORT, CONN.						
Bridgeport Traction Co	12 m. Dec. '94	144,447				
	12 " " '95	298,883	151,697*	147,186	75,000	72,186
	1 " Mar. '95	20,227	14,321	5,906		
	1 " " '96	22,406	13,645	8,761		
	3 " " '95	55,669	41,259	14,401		
	3 " " '96	65,573	41,515	24,058		
BROCKTON, MASS.						
Brockton St. Ry. Co.	12 m. Sept. '94	214,370	143,511	70,859	70,974*	d 115
	12 " " '95	266,892	154,950	111,942	84,691*	27,251
	1 " Feb. '95	15,683	10,457			
	1 " " '96	19,970	12,632			
	5 " " '95	92,815	54,089			
	5 " " '96	106,798	70,939			
BROOKLYN, N. Y.						
Brooklyn Elev. R.R. Co	12 m. Dec. '94	1,730,848	1041,095		831,093*	d 141339
	12 " " '95	2,082,957	1158 219		859,447*	65,271
Brooklyn Traction Co.	1 m. Jan. '95	44,599	56,327	d 11,728		
	1 " " '96	82,796	52,236	30,560		
Atlantic Ave. R. R. Co.	12 m., Dec. '94	1,011,258	615,863	395,395	265,118	130,277
	12 " " '95	891,940	706,900	185,040	302,918	d 117877
Brooklyn, Bath & West End R. R. Co.	12 m June '94	111,605	86,717	24,888	39,718*	d14,830
	12 " " '95	130,928	79,394	51,535	61,150*	d9,616
Brooklyn City & Newtown R. R. Co.	12 m., Dec. '94	595,449	346,285	249,164	120,632*	128,532
	12 " " '95	598,691	372,554	226,137	127,647*	98,489
Brooklyn, Queens Co. & Sub. R. R. Co.	12 m. June '94	543,413	427,101	116,312	169,225*	d52,913
	12 " " '95	625,537	415,255	210,282	339,068	d 128786
	6 " Dec. '94	348,969	213,351	135,618	167,644*	d32,026
Brooklyn Heights R.R. Co.	6 " " '95	362,162	230,425	131,737	169,134	d37,396
	12 m., Dec. '94	3,509,016	2143,567	1,365,448	1468,553	d 103105
	12 " " '95	4,076,117	2682,614	1,393,504	2102,061	d 706758
Coney Island & Brooklyn R. R. Co.	12 m., Dec. '94	316,183	207,478	108,706	52,157*	56,549
	12 " " '95	383,367	236,547	146,820	52,861*	93,959
	1 " Feb. '95	24,418				
	1 " " '96	19,313				
	2 " " '95	51,242				
	2 " " '96	40,801				
Nassau Elec. R. R. Co.	3 m Dec. '95	82,140	59,904	22,236	20,286*	1,950
	6 " " '95	173,757	106,127	67,630	33,627*	34,003
BUFFALO, N. Y.						
Buffalo Ry. Co.	12 m., Dec. '94	1,536,284	856,631	67 ,653	468,917*	210,736
	12 " " '95	1,351,919	649,097	702,822	417,038*	285,783
CHICAGO, ILL.						
Chicago City Ry. Co.	12 m., Dec '94	4,264,618	2838,684*	1,425,934	207,878	1218,057
	12 " " '95	4,476,824	2807,726	1,669,098	300,389	1368,709
Chicago General Ry. Co	12 m., Dec, '95	82,082	64,334	17,748		
Lake St. Elev. Ry. Co.	12 m. Dec. '94	428,095	290,090	138,005		
	12 " " '95	517,301	319,606	197,695		
	1 " Jan. '95	44,670	28,180	16,490		
	1 " " '96	52,855	30,713	22,142		
No. Chicago R. R. Co.	12 m., Dec. '94	2,565,618	1347,326	1,218,292	465,648	752,644
	12 " " '95	2,780,487	1311,607	1,468,880	471,251	997,629
West Chicago R. R. Co	12 " " '94	4,181,237	2518,627	1,662,610	859,471	803,139
	12 " " '95	4,201,477	2267,195	1,934,282	902,016	1,032,266
Chicago & So. Side R. T. Co.	1 m., Mar. '95	70,013	47,113	22,900		
	1 " " '96	67,026	40,250	26,776		
	3 " " '95	193,073	140,694	52,379		
	3 " " '96	193,012	125,449	67,563		
CINCINNATI, O.						
Cinn. Newport & Cov. Ry. Co.	12 m., Dec. '94	497,950	370,606	127,344		
	12 " " '95	624,034	418,710	205,324		
	1 " Feb. '95	37,254	34,293	2,961		
	1 " " '96	42,702	33,917	8,885		
	2 " " '95	76 689	65,557	11,132		
	2 " " '96	89,402	68,399	21,003		
CLEVELAND, O.						
Cleveland Elec. Ry. Co.	1 m. Feb. '95	95,631	73,096	22,535		
	1 " " '96	118,977	82,781	36,196		
	2 " " '95	199,527	146,494	53,033		
	2 " " '96	244,384	167,551	76,833		
COLUMBUS, O.						
Columbus St. Ry. Co.	12 m., Dec. '94	566,811	269,362	297,449	176,648	120,801
	12 " " '95	629,995	311,594	318,401	183,506	134,895
	1 " Mar. '95	47,828	23,481	24,347		
	1 " " '96	50,896	25,743	25,154		
	3 " " '95	133,726	69,571	64,155		
	3 " " '96	148,507	78,549	69,958		
DENVER, COL.						
Denver Cons. Tramway Co.	12 m., Dec. '94	753,483	445,684	307,798	244,172*	63,625
	12 " " '95	716,039	441,283	274,756		
	1 " Feb. '95	48,001	30,485	17,516		
	1 " " '96	51,901	31,534	20,367		
	2 " " '95	103,697	66,380	37,317		
	2 " " '96	106,441	65,755	40,686		
DETROIT, MICH.						
Ft. Wayne & Belle Isle St Ry. Co.	6 m., June '95	116,945				
Citizens' St. Ry. Co.	6 m., June '95	386,575				
Rapid Ry. Co.	5½ m., Dec. '95	30,356	15,586	14,770	6,875	7,895
Detroit Ry.	3 m., Jan. '96	113,738	70,818	42,920		
DULUTH, MINN.						
Duluth St. Ry. Co.	12 m., Dec. '94	208,105	111,105	97,000		
	12 " " '95	213,229	95,329	117,900		
	1 " Feb. '95	15,712	8,833	6,879		
	1 " " '96	15,247	8,679	6,568		
	2 " " '95	31,415	19,161	12,254		
	2 " " '96	31,087	17,754	13,333		
FALL RIVER, MASS.						
Globe St. Ry. Co.	12 m., Sept. '94	248,106	147,352	100,754	75,284	25,470
	12 " " '95	269,786	159,090	110,696	76,479	34,217
FINDLAY, O.						
Findlay St. Ry. Co.	12 m. Dec. '95	29,798	20,308	9,490	7,415	2,075
FITCHBURG, MASS.						
Fitchburg & Leominster St. Ry. Co.	12 m., Sept. '94	89,260	61,416	27,845	7,209	20,636
	12 " " '95	110,275	74,103	36,172	7,017	29,155
GALVESTON, TEX.						
Galveston City R. R. Co.	12 m., Dec. '94	199,133	131,407*	67,726	50,000	17,76
	12 " " '95	216,271	141,080	75,191		
	1 " Feb. '95	12,449	8,741	3,708		
	1 " " '96	13,058	9,303	3,755		
	2 " " '95	27,010	18,602	8,408		
	2 " " '96	26,317	19,610	6,707		
GIRARDVILLE, PA.						
Schuylkill Traction Co.	12 m. Sept. '94	88,288	56,564	31,724	25,000	6,724
	12 " " '95	90,981	52,851	38,130	29,770*	8,360
	6 " Mar. '95	40,597	27,855	12,742		
	6 " " '96	46,157	26,758	19,399		
GREAT FALLS, MONT.						
Great Falls St. Ry. Co.	12 m., Dec. '94	26,431	24,905*	1,526		
	12 " " '95	26,650	28,126	d 1,476		
HAZLETON, PA.						
Lehigh Traction Co.	12 m., Dec. '94	97,202	50,605	46,597		
	12 " " '95	119,588	67,979	51,609	39,297	12,312
	1 " Mar. '95	8,941	5,837	3,104		
	1 " " '96	9,166	5,613	3,553		
	3 " " '95	24,273	16,527	7,746		
	3 " " '96	27,882	18,241	9,641		
HOBOKEN, N. J.						
No. Hudson Co. Ry. Co.	12 m., Dec. '94	818,280	611,482*	206,798		
	12 " " '95	871,273	619,830	251,443	246,649*	4,794
HOLYOKE, MASS.						
Holyoke St. Ry. Co.	12 m., Sept. '94	75,427	48,546	26,881	3,524*	23,356
	12 " " '95	112,547	69,627	42,920	20,058*	22,862
KANSAS CITY, MO.						
Metropolitan St. Ry. Co	1 m. Feb. '95	107,058	77,238	29 820		
	1 " " '96	124,935	82,620	42,315		
	9 " " '95	1,285,498	806,109	479,389		
	9 " " '96	1,343,367	782,447	560,920		
LAWRENCE, MASS.						
Lowell, Lawrence & Haverhill St. Ry. Co	12 m., Sept. '95	269,740	205,816	63,924	73,423*	d 8,498
	12 " " '96	403,530	262,935	140,595	84,081*	56,514
	1 " Feb. '95	20,475	18,548	1,927		
	1 " " '96	26,132	18,160	7,972		
	5 " " '95	114,947	93,012	21,935		
	5 " " '96	141,835	98,265	43,670		

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income.
LORAIN, O. Lorain St. Ry.	12 m., Dec. '95	80,176	46,092	34,084		
	1 " Mar. '95	6,337	3,254	3,083		
	1 " " '96	5,431	4,207	1,224		
	3 " " '95	15,861	10,940	4,921		
	3 " " '96	14,496	11,915	2,581		
LOUISVILLE, Ky. Louisville Ry. Co.	12 m., Dec. '94	1,176,790	633,206	543,584	355,799*	187,784
	12 " " '95	1,288,172	672,080	616,092	359,366*	256,726
LOWELL, MASS. Lowell & Suburban St. Ry. Co.	12 m. Sept. '94	277,029	179,409	97,620	66,624*	30,995
	12 " " '95	329,817	199,346	130,471	66,575*	63,896
MACON, GA. Macon Cons. St. Ry. Co.	12 m., Dec. '95	69,190	44,529	24,661	16,711*	7,951
MANCHESTER, N. H. Manchester St. Ry. Co.	12 m., June '94	81,627	76,906*	4,721	3,302	1,419
	12 " " '95	82,923	87,594	d 4,670		
MARSHALLTOWN, IA. Marshalltown Light, Power & Ry. Co.	12 m., Dec. '94	38,758	24,190*	14,568	7,650	6,918
	12 " " '95	40,757	24,307*	16,450	7,500	8,950
MINNEAPOLIS, MINN. Twin City R. T. Co.	12 m., Dec '94	2,003,679	1,044,548	959,131	738,961*	220,170
	12 " " '95	1,988,803	979,485	1,009,319	750,839*	258,479
	1 " Feb. '95	134,896	67,947	66,949		
	1 " " '96	145,061	69,383	75,678		
	2 " " '95	286,927	143,024	143,903		
	2 " " '96	303,974	144,585	159,389		
MONTGOMERY, ALA. Montgomery St. Ry. Co	12 m., Dec. '94	35,216	21,724	13,492		
	12 " " '95	50,645	27,915	22,730		
	1 " Feb. '95	2,825	1,794	1,031		
	1 " " '96	3,462	1,753	1,709		
	2 " " '95	6,330	3,958	2,372		
	2 " " '96	7,150	3,822	3,328		
MONTREAL, CAN. Montreal St. Ry. Co.	12 m., Sept. '94	897,838	628,454	269,384	55,363*	214,021
	12 " " '95	1,102,778	652,812	449,966	98,617	351,349
	1 " Mar. '95	78,638				
	1 " " '96	92,146				
	6 " " '95	462,431				
	6 " " '96	664,997				
NEWBURGH, N. Y. Newburgh Elec. Ry. Co.	12 m., Feb. '96	91,156	55,190*	35,966	26,458	9,507
NEWBURYPORT, MASS Haverhill & Amesbury St. Ry. Co.	12 m., Sept. '94	98,346	58,061	40,284	27,664*	12,621
	12 " " '95	104,853	65,936	38,917	28,223*	10,694
NEW HAVEN, CONN. New Haven St. Ry. Co	12 m., Dec. '94	126,183	69,517	56,666		
	12 " " '95	198,719	124,454	74,265		
	1 " Mar. '95	11,742				
	1 " " '96	12,679				
	3 " " '95	34,712				
	3 " " '96	39,988				
NEW LONDON, CONN. New London St. Ry. Co.	12 m., Sept. '94	49,899	29,150	20,749	6,423*	14,326
	12 " " '95	51,759	30,230	21,528	7,650*	13,878
NEW ORLEANS, LA. New Orleans Traction Co.	12 m., Nov. '94	951,528	620,508	331,020		
	12 " " '95	1,327,756	752,158	575,598		
	1 " Feb. '95	87,511	53,135	34,376		
	1 " " '96	*115,326	59,256	56,070		
	3 " " '95	280,236	162,286	117,950		
	3 " " '96	343,183	180,282	162,901		
NEWTON, MASS. Newton & Boston St. Ry. Co.	12 m., Sept. '94	33,478	25,262	8,216	7,677*	539
	12 " " '95	32,297	24,685	7,613	7,108*	504
Newtonville & Watertown St. Ry. Co.	12 m., Sept. '95	7,580	6,599	981	809*	172
NEW YORK, N. Y. Third Ave. R. R. Co.	12 m., Dec. '94	2,178,336	1,177,344	1,000,991	341,083*	659,909
	12 " " '95	2,355,154	1,456 782	1,198,372	328,917*	869,454
Metropolitan St. Ry. Co.	12 m., June '94	5,898,466	3,223,956	2,174,510	1,859,971*	314,539
	12 " " '95	5,772,260	3,183,210	2,589,050	2,016,889*	572,161
	6 " Dec. '94	2,885,101	1,632,245	1,252,856	963,046	289,810
	6 " " '95	3,613,850	1,832,246	1,781,604	1,155,620	625,984
Manhattan Ry. Co.	12 m., Dec. '94	9,953,840	5,446,029	4,507,811	2,674,049*	1,833,762
	12 " " '95	9,731,213	5,533,959	4,197,254	2,988,167*	1,209,087
Central Crosstown R. R. Co	12 m., Dec. '94	546,026	385,309	160,717	90,427*	70,291
	12 " " '95	547,491	379,523	167,968	101,526*	66,442
D. D., E. B. & Bat'y R. R. Co.	12 m., Dec. '94	691,861	465,236	226,626	171,423*	55,202
	12 " " '95	748,443	557,074	191,369	138,112*	53,256
Eighth Ave. R. R. Co.	12 m., Dec '94	768,064	565,927	202,138	95,545*	106,592
	12 " " '95	530,009	424,706	105,303	68,978*	36,324
42d St., Man & St. N. Ave. R. R. Co.	12 m., Dec. '94	645,130	517,445	127,685	122,804*	4,881
	12 " " '95	626,337	527,155	99,182	122,800*	d23,618
New York & Harlem R. R. Co.	12 m., Dec '94	1,106,017	670,970	435,047	37,524*	397,523
	12 " " '95	1,015,076	693,487	321,589	40,150*	281,439
Second Avenue R.R. Co	12 m., Dec. '94	987,923	755,395	232,529	140,078*	92,450
	12 " " '95	941,290	724,417	216,873	124,566*	92,308
Union Ry. Co.	12 m., Dec. '94	470,446	254,973	215,473	141,934*	73,539
	12 " " '95	457,457	280,435	177,022	127,287*	49,735
NORRISTOWN, PA., Schuylkill Val. Trac. Co	12 m., Dec. '95	50,752	36,580	14,172		
NO. ABINGTON, MASS. Rockland & Abington St. Ry. Co.	12 m., Sept. '94	52,762	38,836	13,926	5,282*	8,644
	12 " " '95	67,815	49,759	18,056	6,008*	12,048
NORTHAMPT'N, MASS. Northampton St. Ry. Co	12 m., Sept. '94	50,090	28,904	21,186	2,375*	18,811
	12 " " '95	83,504	46,240	37,264	3,131*	34,133

Company.	Period.	Gross Receipts.	Operating Expenses.	Earnings from Operation.	Fixed Charges.	Net Income
NORWALK, CONN. Norwalk Tramway Co.	12 m., Sept. '95	43,315	29,858	13,457		
NORWICH, CONN. Norwich St. Ry. Co.	12 m., Sept. '94	80,069	50,693	29,376	16,035*	13,341
	12 " " '95	85,210	53,454	31,756	17,400*	14,356
OAKLAND, CAL., Central Av. Ry. Co.	12 m., Oct. '94	32,668	26,781	5,887	1,852	4,035
	12 " " '95	30,808	26,148	4,660	3,785	875
Oakland Consol. St. Ry. Co.	12 m., Dec. '94	129,351	95 821	33,530	31,139*	2,390
	12 " " '95	125,485	94,115	31,370	25,140	6 230
ORANGE, N. J. Suburban Traction Co.	12 m., Dec. '94	42 502	42,938*	d 431		
	12 " " '95	52,000	56,000	d 4,000		
PATERSON, N. J., Paterson Ry. Co.	12 m., Dec. '94	243,921	157,520	86,401	88,597	2,196*
	12 " " '95	298,689	174,619	124,070	97,264	26,806
	1 " Mar. '95	19,452	13,474	5,978		
	1 " " '96	23,643	14,659	8,984		
	3 " " '95	54,848	37,880	16,968		
	3 " " '96	69,121	41,006	28,115		
PHILADELPHIA, PA., People's Traction Co.	12 m., June '94	1,044,159	673,479	370,680		
	12 " " '95	1,660,676	829,815	830,861		
Hestonville M. & F. P. Ry. Co.	12 m., Dec. '94	286,021	315,762	207,450	97,966	109,485
	12 " " '95	523,212				
Electric Traction Co.	12 m. June '94	1,900 606	1,120,026	780,580		
	12 " " '95	2,151,853	1,241,584	910,269		
PORT HURON, MICH. City Elec. Ry. Co.	12 m., Dec. '94	46,702	32,585	14,117		
	12 " " '95	52,848	34,771	18,076		
POUGHKEEPSIE, N. Y., Poughkeepsie City & Wappinger's Falls E. R. Co.	12 m., Dec. '95	93,557	60,257	33,300		
	1 " Mar. '96	5,448	4,198	1,250		
	3 " " '96	16,043	11,593	4,450		
ROCHESTER, N. Y., Rochester Ry. Co.	12 m., Dec. '94	782,520	448,304	334,216	269,045*	65,171
	12 " " '95	873,445	517,519	355,926	307,118*	48,808
ST. LOUIS, MO., National Ry. Co.	12 m., Dec. '94	1,353,136	776,582	576,554	337,684	238,870
	12 " " '95	1,403,957	821,315	582,642	366,587	216,055
SCRANTON, PA., Scranton Trac. Co.	12m., June '94	247,768	140,080	107,688	105,796*	1,892
	12 " " '95	270,700	142,278	128,422	119,858*	8,564
	1 " Mar. '95	20,919	11,889	9,030		
	1 " " '96	25,523	14,219	11,303		
	9 " " '95	194,781	119,599	75,182		
	9 " " '96	243,967	121,977	121,991		
SEATTLE, WASH., West St. & No. End Elec. Ry. Co.	12 m., Dec. '95	29,737	15,031	14,706		
SPRINGFIELD, MASS. Springfield St. Ry. Co.	12 m Sept. '94	373,903	252,269	121,634	18,210*	103,424
	12 " " '95	442,006	277.156	164,850	30,637*	134,213
SYRACUSE, N. Y., Syracuse Cons. St. Ry. Co.	12 m., Dec. '94	194,547	181,105	13,442	197*	13,244
	12 " " '95	164,626	178.072	d13,446	304*	d13,750
Syracuse St. R. R. Co.	12 m., Dec. '94	245,805	145,934	99,870	93,965*	5,905
TERRE HAUTE, IND. Terre Haute Elec. Ry Co.	1 m.. Dec. '94	8,354				
	1 " " '95	11,602	7,939	3,663		
	6 " " '94	60,336				
	6 " " '95	83,507	48,855	34,652		
TRENTON, N. J. Trenton Pass. Ry. Co.	12 m., Dec. '94	198,681				1,129
	12 " " '95	222,761				1,771
TORONTO, ONT., Toronto St. Ry. Co.	12 m., Dec. '94	958,371	517,708	440,663		
	12 " " '95	992,801	489,915	502,886		
	1 " Feb. '95	62,460	39,032	23,428		
	1 " " '96	72,468	42,740	30,728		
	2 " " '95	132,997	82,114	50,883		
	2 " " '96	147,845	85,878	61,967		
TROY, N. Y., Troy City Ry. Co.	12 m., Dec. '94	432,596	212,407	220,189	130,474	89,705
	12 " " '95	490,489	242,775	247,714	126,116*	121.598
UTICA, N. Y. Utica Belt Line St. R. R.	12 m., Dec. '94	149,105	90,754	58,351	29,844*	28,508
	12 " " '95	160.284	105,297	54,988	44.791*	10.197
WASHINGTON, D. C. Capital Traction Co.	12 m., Dec. '95	1,063.776	634,013	429.754		
WATERBURY, CONN., Waterbury Trac. Co.	12 m., Dec. '95	247,730	142,073	105.657		
	1 " Feb. '95	16,588				
	1 " " '96	19.282	11,265	8,017		
	2 " " '95	33,830				
	2 " " '96	40,738	23,401	17,337		
WHEELING, W. VA. Wheeling Ry. Co.	12 m., Dec '94	133,517	119,378	14,139		
	12 " " '95	150,094	88,552	61,542	32,248*	29,294
WILKESBARRE, PA., Wilkes Barre & Wyoming Val. Trac. Co.	12 m., Dec. '94	400,143	196 824	203,319	122,607*	80,711
	12 " " '95	451,941	209,600	242,341	134,215*	108,127
	1 " Mar. '95	30,557	15,223	15,334		
	1 " " '96	36,791	18,437	18,354		
	3 " " '95	81,992	47,987	34,005		
	3 " " '96	112,057	53,612	58,445		
WILLIAMSPORT, PA. Williamsport Pass. Ry. Co.	12 m., June '94	64,863	49,646	15,217	10,255	4,962
	12 " " '95	66,845	52,459	14,386	9,691	4,695
WORCESTER, MASS., Worcester Cons. St. Ry. Co.	12 m., Sept. '94	355,000	284,215	70,785	45,479	25,306
	12 " " '95	420,498	309,787	110,711	51,778	58,933
	1 " Feb. '95	25,947	23,466	2,481		
	1 " " '96	34,168	26,505	7,663		
	5 " " '95	150,823	118,226	32,597		
	5 " " '96	186,686	139,100	47,586		