Street Railway Journal

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THE STREET RAILWAYS OF DAYTON, OHIO

With the growth of population and enlargement of street railway facilities, the tendency in many cities, where there is more than one company, has been toward consolidation, thus effecting a reduction in operating expenses for all. The companies of Dayton, however, still maintain a separate existence. Although a city of only 80,000 inhabitants, it has three distinct companies operating three city systems, besides an interurban road to Hamilton and one now building to Eaton. Dayton is admitted by all visitors to be a most beautiful city; its streets throughout the business portion are paved with brick and asphalt, and

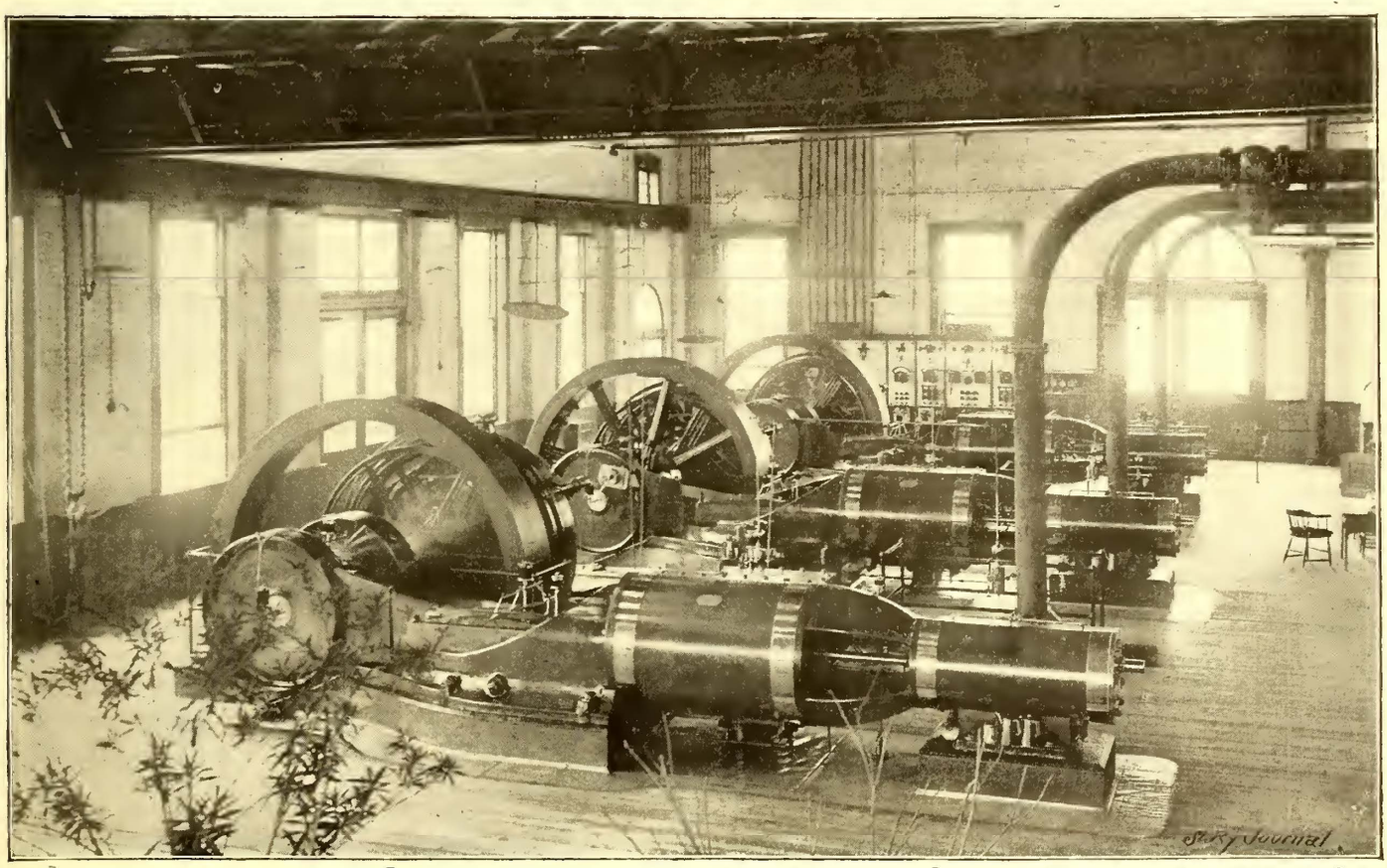


FIG. 1.—INTERIOR OF POWER STATION—CITIZENS' RAILWAY, DAYTON

are kept scrupulously clean. The cars of the street railway companies in no wise detract from the general "well kept" appearance; newly painted, polished to shining, and moving on tracks that are unexcelled.

All cars are run without conductors, the passenger deposits his fare in the box in the front end of the car, and in case of his refusal to do so when requested is liable to a fine, not to exceed ten dollars. The managements of the various roads believe that very few fares are lost even when the cars are crowded. On special days, when the crowding is excessive, the "extra" motormen are put on as conductors. There is not the public dislike of the street railway companies that prevail in some cities, and while there is an occasional agitation to compel the companies to put on conductors, the demand is not general, and the citizens on the whole are well satisfied with the service given.

Transfers are issued at four stations, located at the intersections of the different lines. At the time of paying his fare the passenger asks for a ticket, which, presented to the agent at the crossing of the line to which he wishes to change, secures a transfer to that line. The ticket received from the motorman states on its face that it is not a transfer, but is exchangeable for one; it also has a number corresponding to the one of the car from which it is issued, and, in order to be of value, must be presented to the transfer agent immediately upon the arrival of the car at the transfer station. This system relieves the motorman from the trouble of punching transfers.

For a time after the inauguration of the transfer system a strict account of the transfers was kept. At the end of a year the balance in favor of one road against the others was less than seventy-five dollars—much too small a sum to pay for the labor of keeping clearing-house accounts. The transfer merely represents a courtesy extended from one road to the others, and is not counted as receipts. The companies share equally in the expense of maintaining the

four transfer stations. Six rides are sold for a quarter, the tickets being in the shape of disks of celluloid about the size of a nickel, and having a hole through the center, like a Chinese coin. That the public takes advantage of the six-ride feature is shown by the large proportion of celluloid disks always lying in the fare box. Each road issues the tickets in a separate color, but a ticket from one is good on any other.

The franchises are mostly for twenty-five years, and no other compensation is asked than the building and repairing of the pavement between the tracks and one foot on either side.

Each company has its own power house, car barn and repair shops. The city lines comprise 56 miles of single track, and operate less than one hundred cars, so the saving which would be effected by a combination of the power house and repair shop equipment is obvious.

The power houses are in no case near the center of distribution, and in but one instance near enough to use the river water for condensing purposes. That of the People's Railway Company is the only one located on a railroad. This station is but a few blocks distant from the power station of the Citizens' Street Railway Company.

The White Line power house of the People's Street Railway Company was one of the first electric power stations in this country. There are two G. E. dynamos belted to Lane & Bodley and McIntosh & Seymour double engines. The Lane & Bodley engines were the first in-

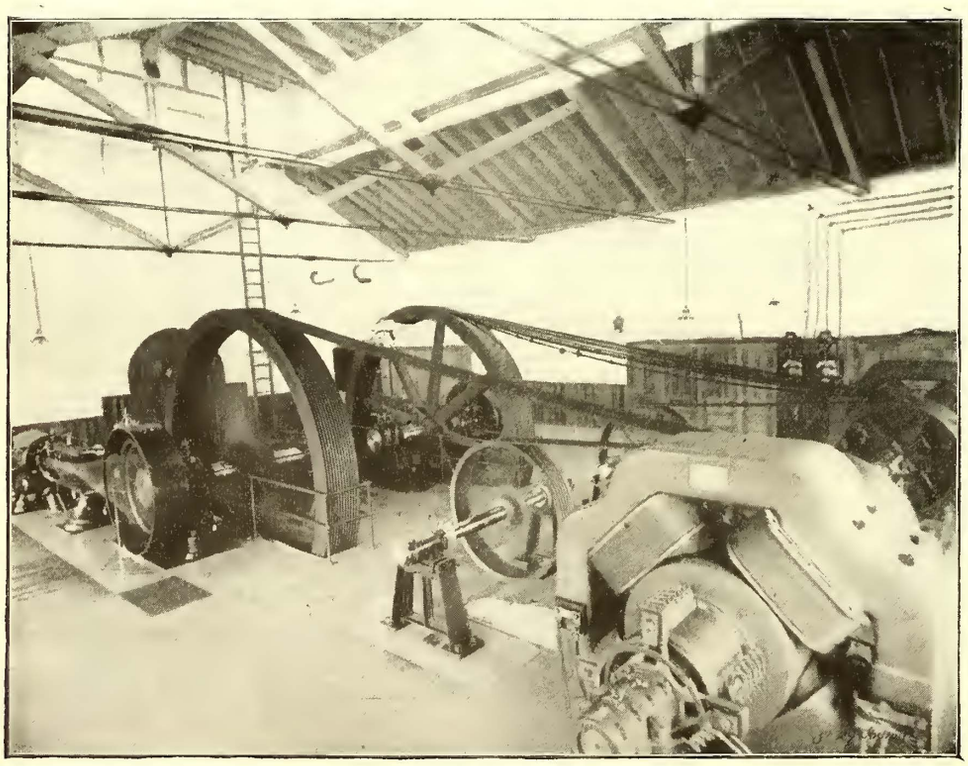


FIG. 2.—BROWN ST. STATION OF OAKWOOD STREET RAILWAY

stalled and have been running since 1889. In all that time they have given absolutely no trouble. A second McIntosh & Seymour engine of 1200 h.p. is direct connected to a G. E. generator. All three engines are connected to a 1000-h.p. Worthington condenser, maintaining a vacuum of 24 to 25 ins. The condensing and feed water comes from wells and is discharged in the city sewers. Five Brownell tubular boilers supply steam; some of these are very old and will be replaced soon.

The Brown Street station of the Oakwood Street Railway Company, Fig. 2, is equipped with two Minerva boilers, two American Wheelock engines of 400 h.p. each; rope connected to General Electric dynamos. The rope connection has the advantage of being noiseless, provides a more flexible connection, and slips less than a belt. C. E. Clark, the chief engineer, expressed himself as well pleased with the operation of the ropes. The rope is con-

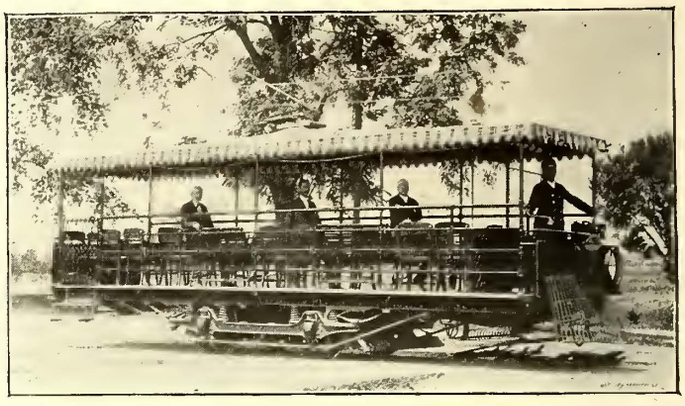


FIG. 3.—SUMMER PARTY CAR

tinuous and passes over a tension carriage similar to that used on a cable railway.

At the station of the Citizens' Railway, Fig. 1, there are three Buckeye engines, each of 500 h.p., direct connected to Siemens & Halske generators. The engines are tandem compound, the only ones of this type in the city. The boilers at this plant are of the Brownell tubular type. The first two stations burn natural gas and the last one coal.

The track construction on all the roads is extremely substantial; from 70 to 90 lb. girder rails are used; a layer of 6 ins. of gravel underlies a large part of the track work. Throughout the paved district the cars ride as smoothly as if the joints were welded. Iron poles, made by the Electric Railway Equipment Company, are used everywhere. As there are no conductors to care for the trolley very great pains has been taken in the construction of the overhead work, with the result that the trolley is seldom "off."

No better cars can be found than those running in Dayton, and few as handsome. Plush-covered upholstered seats are the rule. On the People's line all seats are set sideways, and the cars are turned from closed to open by removing the windows and panels on the sides. The front ends of all cars are vestibuled, according to Ohio law. All are electrically heated, and on the Oakwood line the front door is left open, in order to make it more comfortable for the motorman. A mirror tilted at an angle like that of a church organ enables the motorman to see his passengers safely on and off without turning around.

The People's line has a novel summer party car, Fig. 5. It has a canopy, roof, chairs and tables, a cooler for refreshments, and is, in fact, a modern summer garden on wheels. It rents for ten dollars per evening, and is very popular.

The cars, almost without exception, were made by the

Barney & Smith Car Company. A city ordinance requires the use of fenders; it is the popular opinion shared even by the managers of the roads that these have prevented many serious accidents. The Hunter fender has been in use since 1896, and is giving good satisfaction to both public and railway officials. A view of this fender is given in Fig. 3.

General Electric motors are quite generally used. The Barney & Smith and McGuire Mfg. Companies have furnished the majority of the trucks.

FIG. 4.—ELECTRIC ARC HEAD LIGHT.

The Dayton street railway companies have a total capitalization of $3,600,000, or more than $64,000 per mile.

INTERURBAN LINE TO HAMILTON.

The electric railway between Dayton and Hamilton is a splendid illustration of the interurban electric road of today. The line now in operation is 38½ miles long, with terminals at Hamilton and Dayton. The Dayton Traction Company operates that part lying between Dayton and Miamisburg, a distance of 11½ miles. From Miamisburg to Hamilton, 27 miles, the operating company is called the Cincinnati & Miami Valley Traction Company. The two companies are about to be consolidated, so will be considered as a whole.

The road starts from the Court House in the city of Dayton, having a population of 80,000, thence passes through Alexandersville, Carrollton, to Miamisburg, thence through Franklin, in Warren County, having a population of 5000, south through Middletown, having a population of 12,000; Trenton, population, 1000; Busenbark and Overpeck, population 500 each, to Hamilton, having a population of about 30,000.

The valley through which the lines passes is known as one of the richest valleys east of the Mississippi, the soil being extremely fertile, the principal ground products being tobacco, corn and wheat. The present terminus of the line at Hamilton is 20 miles north of Cincinnati, the projected terminus of the road, where it will be extended this coming summer.

It can hardly be said that this interurban road parallels the steam railroads, although from Dayton to Middletown it runs alongside of the Big Four, but at Middletown the latter diverges in a southeasterly direction to Cincinnati, whereas the electric line takes a southwesterly course to Hamilton, paralleling the Cincinnati, Hamilton & Dayton road from Middletown to Hamilton.

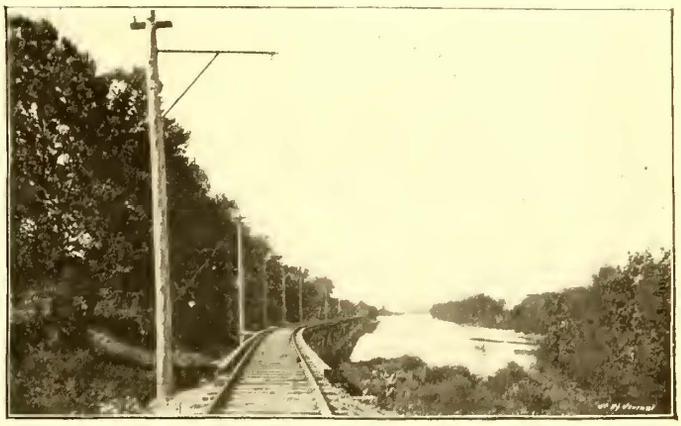


FIG. 5.—VIEW ON LINE OF MIAMI VALLEY TRACTION COMPANY

The frequency of cars between Dayton and Hamilton—every half hour from early in the morning till late at night—and the fact that the line traverses the principal streets of the several cities and towns, combined with the low rates of fare, has secured for it all the interurban travel along its route. This is so true that several local trains of the Cincinnati, Hamilton & Dayton and Big Four Railroad have been withdrawn. The cars make the 38 miles in the 135 minutes, including all stops, and the through fare is 50 cents.

The road is operated similar to steam roads. It has a train-despatching system, using telephones. It is equipped with a block signal system. Cars are provided with smoking compartments, toilet rooms, ice water and completely vestibuled.

The company has established its own ticket offices and agencies and waiting rooms in each and every town along the line. The style of tickets and the manner of keeping the accounts are similar in every respect to steam railroad systems. The company issues single and round trip, full fare and half fare tickets between all stations, school tickets, monthly commutation, and in all has 454 forms con-

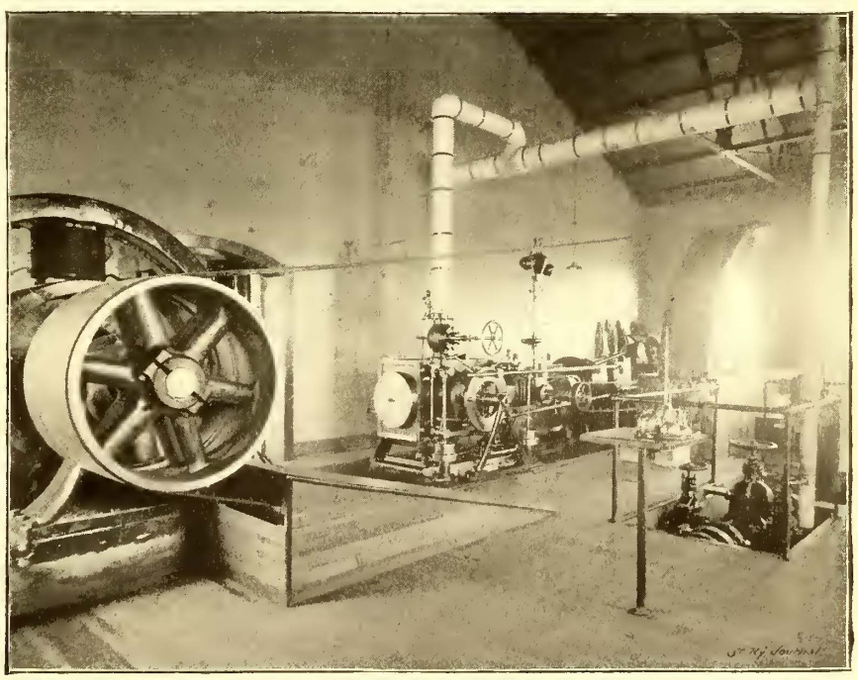
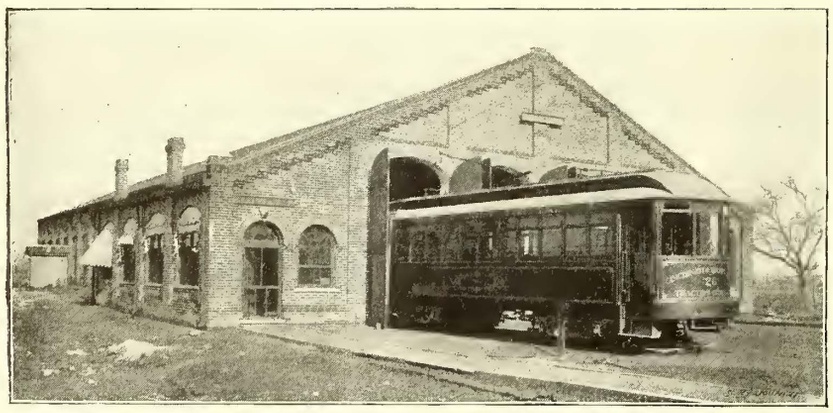
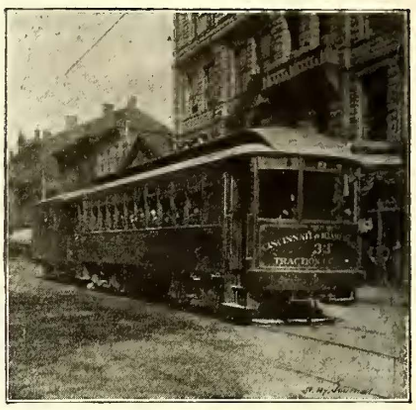


FIG. 6.—INTERIOR OF BUSENBARK STATION

stantly on sale. Baggage is checked and carried free, and the Wells & Fargo Express Company handles all the express business along the route.

Another peculiar fact which must be of interest to electric railway men is that while the C. H. & D. bitterly opposed the building of an electric road paralleling its own, its attitude has changed, and it is stated that it now proposes to make use of the interurban as a feeder, issuing





FIGS. 7 AND 8.—CAR HOUSE AND CARS—MIAMI VALLEY TRACTION COMPANY

interchangeable tickets and building a union depot where the lines cross.

Through the small towns and villages, and along the county highway a 60-lb. 4¼-in. T rail, with four-hole angle bars, rolled by the Carnegie Steel Company, is used. Through the larger towns and cities 70 and 90 lb. girder rails are used. The rails are laid on 5-in. × 7-in. × 7-ft.oak ties, 2500 to the mile. The tracks are bonded with Benedict & Burnham No. 00 rail bonds. The entire roadbed is ballasted with gravel, some of the fills being 20 ft. in depth.

Several large steel bridges have been erected by the Toledo Bridge Company and the Iron Substructure Company along the line over the Erie and Miami Canal and Miami River. For a distance of 3000 ft. south of Franklin the line runs between the Erie Canal and the Miami River, and has been built upon a very substantial trestle, and for secure anchorage many carloads of stone have been deposited between the bents.

In the cities iron-pole overhead construction is used, while outside of the city side construction is employed.

Two car houses are required for the storage of the cars, one 76 ft. × 105 ft., is located within six miles of Dayton, and the other having dimensions of 76 ft. × 185 ft., is at Trenton, Ohio, 9 miles from the southern terminus of the line. These car barns are of brick and steel and absolutely fireproof, and have offices at one side and a repair shop on the other side.

The cars are modern and similar in appearance to steam railroad cars, being 43 ft. in length, 8 ft. wide, and are mounted upon double trucks with wheels 33 ins. in dia. The cars have vestibules at both ends, are straight sided with steam car roofs, the interior finish is quartered oak and each is fitted with smoking compartment, as shown upon plan, double windows and wide arm rests. All cars have two rows of double Walkover seats arranged at right angles with the length of cars, and fitted with springs, upholstered in cane. Each is lighted with ten 16-c.p. lamps, the fixtures being made of special cast bronze. The smoking compartments are upholstered in leather and comfortably seat ten passengers. The cars have a total seating capacity of forty-one passengers. They are heated by Johns electric heaters.

Each car is equipped with two G. E. 57 motors (100 h.p. per car) with latest controllers at both ends of platform. All cars and trucks were made at the shops of the Barney & Smith Car Company's shops upon plans furnished by the engineers, and are mounted on the same company's trucks.

Three power stations are employed, one at Dwyer Station, on the line of the Dayton Traction Company, one at Franklin, Ohio, and one at Busenbark. They are so arranged that each power station feeds about 6½ miles in either direction. The buildings are 80 ft. × 50 ft., divided by fireproof wall. In each station there are two 225-k.w. General Electric multipolar belt generators, driven by two 18 × 42 Hamilton-Corliss condensing engines. The station voltage is 550. The belts are of the Bodifield make.

The boilers are of the horizontal return tubular type, 18 ft. long by 72 ins. in diameter, having seventy-two 4-in. tubes, and were furnished by the Rarig Engineering Company. Laidlaw, Dun & Gordon condensers are used.

Stilwell-Bierce & Smith-Vaile pumps, Garton-Daniels lightning arresters and Crane valves go to make up the remainder of the equipment of the power station.

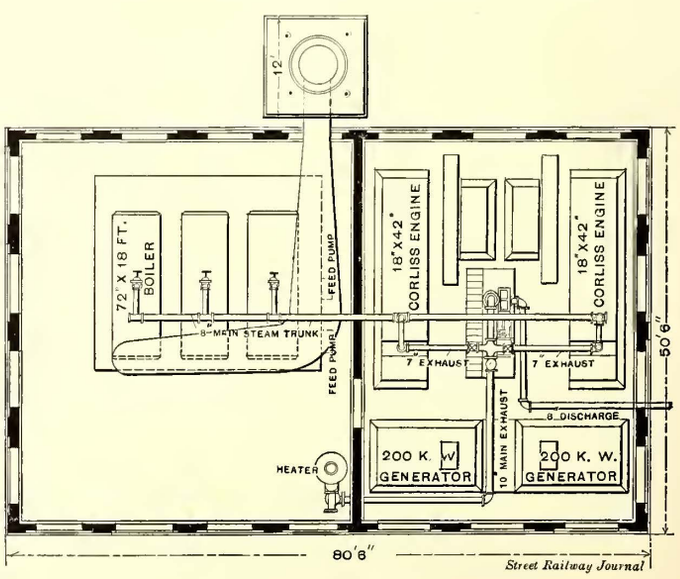


FIG. 9.—PLAN OF STATION AT BUSENBARK

The power plant in each station is sufficient to operate double the number of cars at present propelled, the original intention being to have a duplicate power plant in each station.

The line is equipped throughout with the block signal system. A signal box on each turnout, each containing five lamps; three of these are in circuit with two at the box two miles beyond at one direction, and two are in cir-

cuit with three at the box two miles in the other direction. The signal boxes are each arranged with a central partition, so that one group of lamps shines in one direction and the other group in the other direction.

The reason for using the five lamps in series instead of two is to cut down the voltage, the current being supplied from the trolley wire. Each box has two double pole switches, one in each circuit, by which the five lamps in each circuit—viz., three in one box and two in the next box—can be connected to either the trolley wire or to the ground. The operation of the system is then as follows: A motorman arriving at a signal box looks to see whether the lamps on the left of the box, which are the ones connected with those in the box ahead of him, are burning. If they are not it indicates that there is no car on the block, and he throws the double-pole switch in that lamp circuit so that the current will light the three lamps in that box and the two beyond, thus preventing a car entering the block from either end. Upon arriving at the end of the block he throws over the other double-pole switch in the lamp circuit, putting out the five lamps, but leaving, of course, both terminals of the lamp circuit connected either to the trolley wire or to the ground, i. e., in such a condition that another car entering the block in either direction can use the system by throwing one of the switches. As installed, the motorman can throw the signal switches without leaving the platform, but brings his car almost to a stop while doing so.

To increase the safety of operation at night, the cars are fitted with an electric arc light, invented by the general manager of the road, W. G. Wagenhals. The lamp is remarkable for its simplicity of construction, as well as the small amount of current required to run it. At a distance of half a mile it furnishes ample light for reading. It serves as a far better warning at crossings than could be given by a gong or whistle. In addition to this, it assures the motorman of the condition of the track for a full half-mile ahead. When an arc lamp has occasionally been replaced by an ordinary one, it has been impossible to make schedule time, the motorman being unwilling to push the car ahead at full speed. Should the signal system fail at any time, these lamps would give warning of the approaching collision long enough in advance to stop several times. A view of this headlight is given in Fig. 4.

At the two intersections with steam roads a derailing switch stands always open. In order to close this the conductor must first cross the steam road, and then hold the switch closed; when he releases the lever the switch flies open again of its own accord. At one of the intersections a Hall interlocking signal is installed. This locks the switch, making it impossible for the conductor to close it whenever a train on the steam road is within 2000 ft. of the crossing.

The operation of the entire system requires about ninety employes, who receive an average of 15 cents an hour. The cost of building, including all equipment, was about $13,000 per mile, or in round figures $500,000. The following is a report of the earnings of the two properties of the Dayton Traction Company and the Cincinnati & Miami Valley Traction Company for the five months ending Dec. 31, 1897:

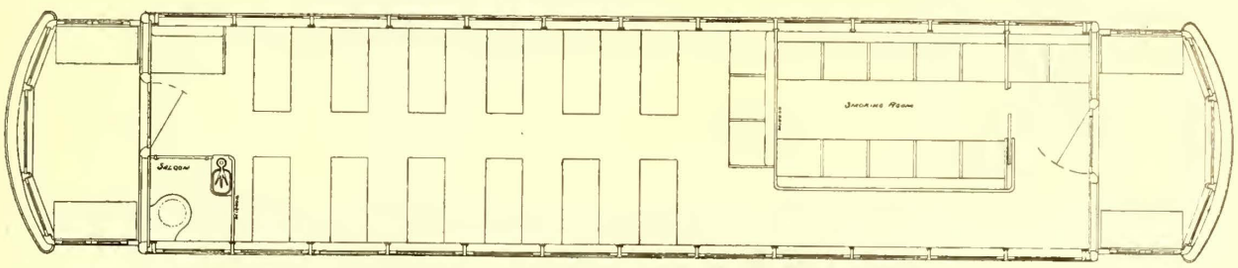


FIG 10.—PLAN OF CAR—MIAMI VALLEY TRACTION COMPANY

Number of passengers carried	553,929
Car mileage	404,027
Gross earnings	$61,358.06
Earnings per car mile	.152
Expenses per car mile	.0863

The entire work of design and construction of the cars, track, overhead work, buildings, power plant, etc., was furnished by Stern & Silverman and carried out to the complete satisfaction of the officers of the company. The same firm successfully financed the company's securities.

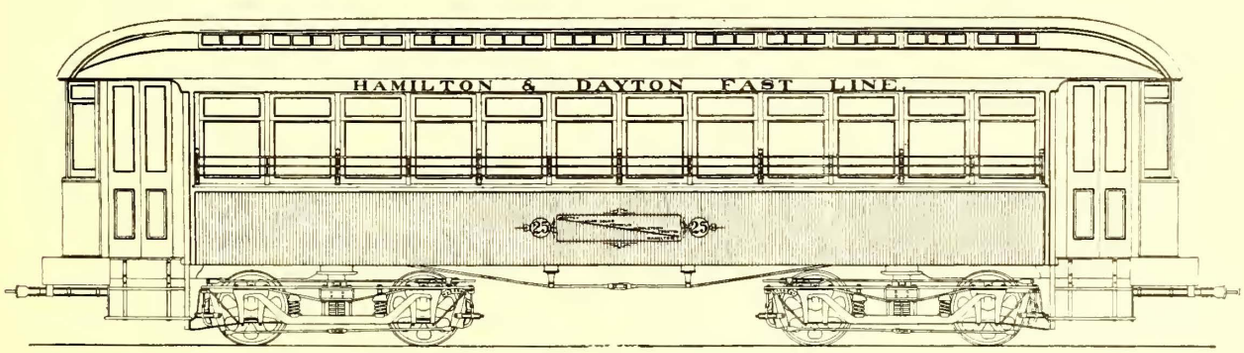


FIG. 11.—SIDE ELEVATION OF CAR—MIAMI VALLEY TRACTION COMPANY

DAYTON & WESTERN RAILROAD.

There is now building from Dayton to Eaton, Ohio, what promises to be one of the finest electric railways in this country. The road will run absolutely in a straight line, with the exception of one slight deflection near the Dayton end. It will be 24 miles long, touching between the cities mentioned the towns of West Alexandria, Johnsville, North Lebanon, Kingsville and the National Military Home. The total population adjacent to the route is 150,000 people. Within a short distance of the road on either side are a number of towns, which, it is expected, will offer considerable patronage.

Excursions to the Soldiers' Home will be one great source of traffic. Thousands of visitors go to the home throughout the summer months. Not only will the line carry its share of passengers from Dayton to the home, but it is expected that joint traffic arrangements will be made with the Cincinnati, Northern and Pan Handle railroads, whose lines are crossed at West Alexandria and Eaton. The fact that part of the trip would be over a fast electric line would add considerably to the attraction which the steam road could hold out to visitors at the Soldiers' Home.

The cost of building will be $23,000 per mile. As the right of way is comparatively level, these figures illustrate its substantial character.

The route will be along the public highway, except where curves in the highway compel leaving it to preserve a straight line. The highway bridges will in no case be used, but nineteen new steel bridges will be built. These will be of particularly heavy construction. Seventy-pound Johnson T rails, 62 ft. long, will be laid on oak ties. Washburn & Moen bonds and Ohio Brass Company's overhead material will be used.

The power house, located at West Alexandria and now partially built, will have a steel frame and will be 56 × 100 ft., the engine room being 56 × 84 ft. The equipment will include two Buckeye engines of 400 h.p. each, direct connected to Siemens & Halske generators, three Babcock & Wilcox boilers, built by the Aultman-Taylor Company, and Wheeler condensers.

The rolling stock will consist of six 42-ft. cars, built by Kuhlman & Company. These will be fitted with lavatories and equipped with Peckham trucks and airbrakes. The running time will be one hour and the maximum speed will be 30 miles an hour. The cars will be equipped with General Electric motors. The Chase Construction Company, of Detroit, are contractors for the entire work.

Fighting Snow in Portland, Me.

The severe snow storm which swept over the greater part of New England in the first part of February was one of the worst that has ever been experienced in this section. In many places all business was totally paralyzed

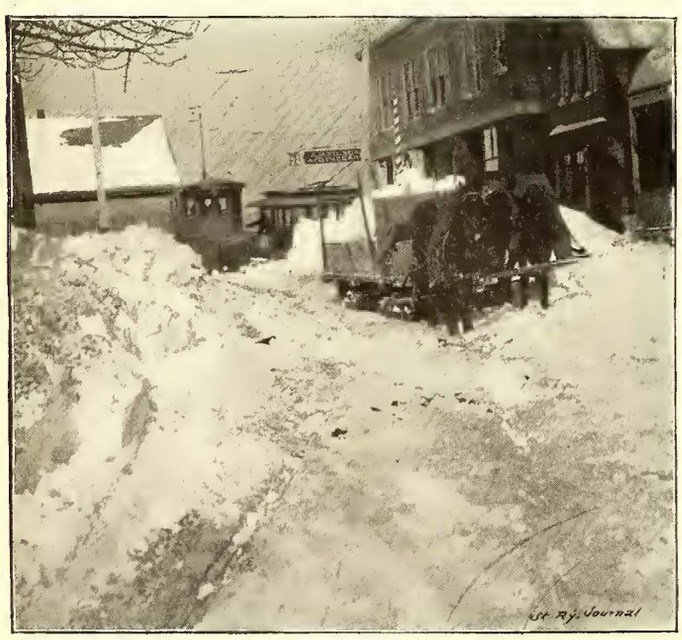


FIG. 2.—REMOVING SNOW—PORTLAND

for several days, the storm being particularly severe upon the street railway companies. The accompanying illustrations give a good idea of what the street railways in Portland, Me., had to contend with in order to resume operations. Fig. 1 is a view taken near Fort Preble, Me., on the line of the Portland & Cape Elizabeth Railway Company. This point is on a hill, and for a distance of about a block the snow was piled so high that it was possible for a man to reach the trolley wire from the top of

FIG. 1.—VIEW NEAR FORT PREBLE—PORTLAND

the drifts before the tracks were dug out. Fig. 2 shows a Taunton snow plough clearing the track for a car at the corner of Sawyer and Front streets in the village of South Portland, near Ferry Landing. The snow had been partially hauled away when this view was taken. Around the corner in the rear of the car the snow was drifted 12 ft. deep for a short distance. The plough was completely lost to view when going through the cut. On some of the higher elevations in the vicinity of Portland the snow was drifted against many of the houses, so that it was necessary for the occupants to leave their homes by the second-story windows.

Illinois Street Railway Association

In pursuance to a call by the president, the executive committee of the Illinois Street Railway Association met at Springfield, Ill., on Jan. 25, 1898. At this meeting a committee, consisting of W. H. Paterson, of Bloomington; W. F. Brennan, of Chicago, and C. K. Minary, of Springfield, was appointed to make arrangements for the general meeting of the Association, to be held next May. The secretary was requested to ask members to prepare papers for the next convention as follows: "On the operation of street railways in small cities," "On a system of collecting fares and checking up employes," "On the relation of the street railways and municipal corporations."

At this meeting of the executive committee a bill was presented by C. L. Bonney, of Chicago, which the Association will endeavor to have passed at the next session of the Illinois Legislature. This bill provides for the extension of the life of all street railway franchises in the state for a period of ninety-nine years.

Mr. Bonney was asked to prepare a paper upon the subject of his bill, the same to be read at the next meeting of the Association.

Electric Railway Motors

By GEO. T. HANCHETT.

VII—Armature Construction.

In the previous article on armature windings it was shown that the cylindrical surface of an armature is covered with conductors parallel to the shaft, and that these conductors are so connected that when currents are sent into the armature at certain points of the commutator, currents will flow in these conductors in such a direction

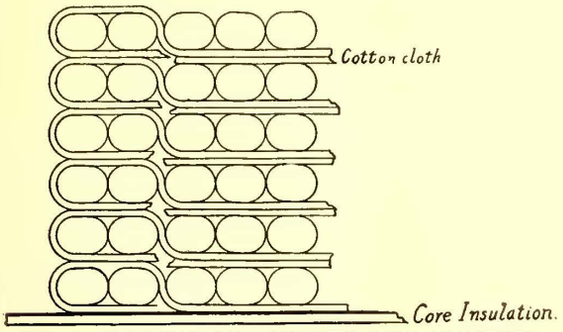


FIG. 1.—WINDING OF "SHORT" RING ARMATURE

as to produce rotation of the armature core to which they are fastened. While it is a simple matter to draw lines suitably representing the various wires, it is by no means as easy to run wires which actually convey current from one conductor to another. There are so many of these connectors that they interfere with each other, and before the systematic arrangements of the present day had been perfected, the ends of every drum armature presented a most unsightly wad of wire, which was composed of the various connectors running from section to section, heaped upon each other in great confusion.

There are two types of railway armatures—the drum and the ring. The ring armature is the simplest as regards mechanical winding, and will be first described. The one obvious way of winding a ring armature is by wrapping the wire around the torus of the ring, and if it be neatly done, a smooth, symmetrical winding will result. There are only two ring armatures which are use at present in American electric railway motor work, and they are

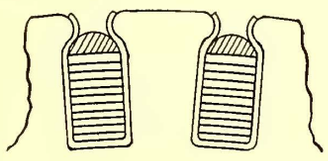


FIG. 2.—W. P. WINDING

those of the W. P. 50 and 30, of the Thomson-Houston Electric Company, and the S. R. G. Short motor, made by the Short Electric Railway Company, formerly of Cleveland, Ohio. Both of these armatures are wound with flat wire in order to build up a more solid bobbin. The Short motor was wound in bobbins of several layers —a lead being brought out from the middle of the bobbin in order to sub-divide it and diminish the number of turns per commutator bar. The wire was equivalent to a circular section of about .09 in. diameter, and a very substantial winding was formed, which was strengthened by layers of cloth, wound in as the work progressed. These prevented the outside wires from falling down as the bobbin was built. In Fig. 1 is shown the method by which this is accomplished. The bobbin is wound in a box or trough, formed of fuller board and mica insulation. The active wire of this armature is carried on its sides, and between each of the coils are small teeth; indeed, this was one of the first toothed armatures ever constructed for railway work.

Both the 15 h. p. and 20 h. p. W. P. motor windings are alike, so far as mechanical method is concerned, and the description of the W. P. 50-winding will suffice. As before stated, a flat conductor is used. It could be more appropriately termed a ribbon, for it is .34 in. broad by .04 in. thick, and insulated with cotton winding. The cylin-

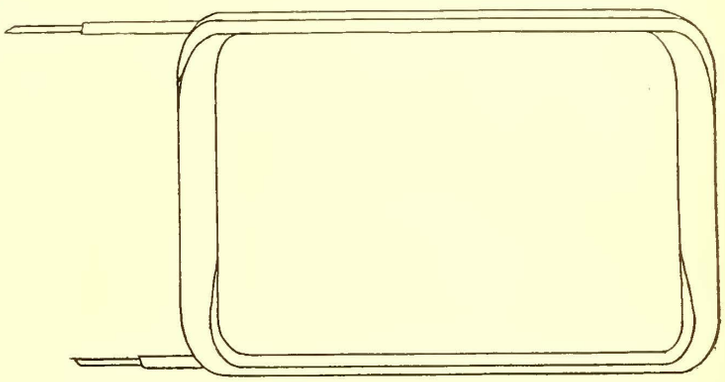


FIG. 3.—SHAPE OF THE FIRST FORMED COILS

drical surface of this armature is slotted to receive the active portion of the wire, and the latter is wound in these slots, one turn per layer, until the requisite number of turns have been filled in. It has been customary to wind these armatures in three different ways, according to the work that they have to do, with 9 turns, 12 turns or 13 turns per bobbin, those having the greatest number of turns possessing the most torque, while those of fewer turns have higher speed. Indeed, it has been quite customary to vary the character of the output on railway armatures in this way.

The slots of the W. P. armature are insulated by mica and fuller board, and the other parts of the core are also protected with an insulated covering. The wire is secured by driving in a piece of wood of semi-circular section, which is held in place by the T-shaped projection of the teeth, as shown in Fig. 2, thus avoiding the use of band wires. Band wires on a ring armature are not so necessary, for the reason that the method of winding is such that it inherently secures the wire very strongly in place.

We now pass to drum armatures, the construction of which is more complex. The first drum armatures were smooth-bodied affairs, and were divided into sections by fibre pegs driven into saw cuts in the end disks. The usual way was to secure the end of the wire, and having suitably insulated the armature core, to wind on a coil by hand, and having completed one, to start another, suitably covering with insulation the points where the coils crossed on the ends of the armature. The first one or two coils went on smoothly enough, but as the winding progressed, the path of the wire over the end of the armature became more and more uneven, till the final coils were some 10 or 15 per cent longer than the first ones. This work was covered with a canvas head to keep out the dust, but such a construction did not fail to be a fruitful source of faults which frequently resulted in burnouts. Moreover, if an accident overtook one of the coils, at least all of the coils which had been wound over it would have to be removed, even though they were in perfect condition, in order to get at the faulty ones.

Various methods of winding the coils in groups were used, so as to equalize in a measure their length and resistance, and thereby avoid the commutator troubles

to which such electric unbalancing gave rise. As such surface-wound armatures as this are now universally discarded, it is not necessary to describe their construction at length, but what has been said is of interest, because it points out how the railway armature has been improved.

The Short motor and the W. P. 50 and 30 motors of the Thomson-Houston Company pretty effectually demonstrated that a toothed armature was eminently superior for railway work. A core covered with slots was very much easier to wind than a smooth body armature, for the wire was very much less likely to become displaced. It was discovered about this time that an armature coil could be formed up separately and slipped on to the core

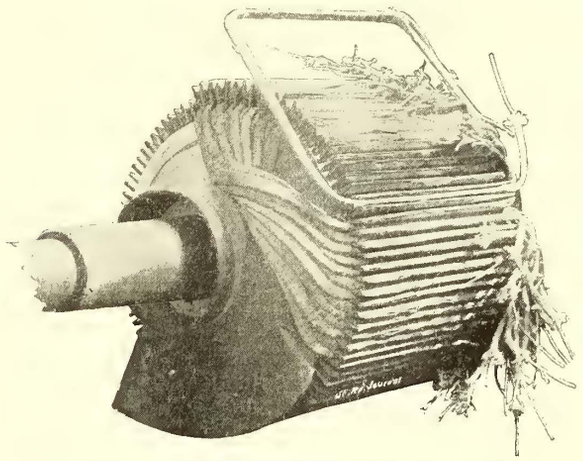


FIG. 4.—EARLY FORMED COIL WINDING

provided that a drum construction was used. Of course ring armatures inevitably demanded hand winding with a shuttle. This system of formed coils had many attractions. Cheap labor could be employed in winding them, for they were not difficult to construct and it is always easy to perfect even an uninformed laborer in the construction of a simple member, and if he has to make hundreds of these he will soon become more expert than his instructor. Besides these advantages the formed coils

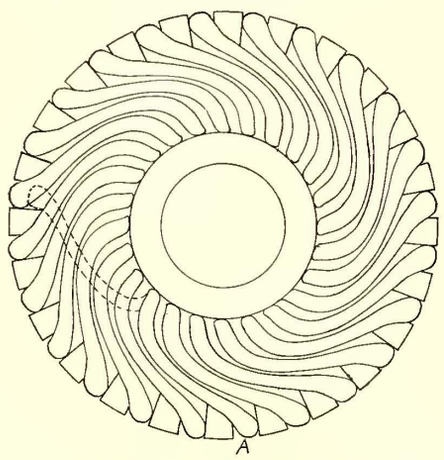


FIG. 5.—DIAGRAM OF EICKEMEYER WINDING

could be insulated separately and hence much more thoroughly. The winder could slip on the coils and shape up the heads in a fraction of the time that was necessary when the old method of winding the wire by hand was employed.

The first of these coils were, as shown in Fig. 3, a simple, rectangular affair. The back connectors are given a half turn so as to enable them to pack in place over the ends in a more substantial manner. Fig. 4, which illustrates such a winding, will show how this twist assists in the assembling of the coils. By winding the armature in groups the advantage was secured that in case of accident to any coil, all of the coils that had been subsequently put on need not necessarily be removed. In order to accommodate such a construction, the coils were often made in sets of various lengths. Those, for instance, of the Westinghouse No. 12 had twenty-three short coils and twenty-four long ones.

Even previous to the use of the formed coils already described, Rudolf Eickemeyer had invented and patented a formed coil-winding which was superior. These patents covering this winding became the property of the General Electric Company, which incorporated the principles in its well known G. E. 800 motor.

If we look at the end of a drum armature and notice the

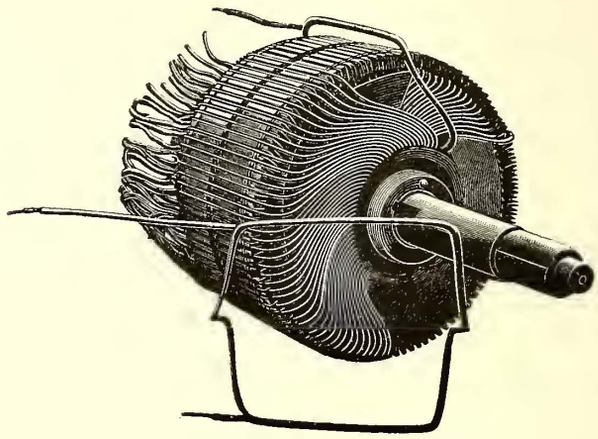


FIG. 6.—EICKEMEYER WINDING

connectors passing from slot to slot, it will be seen that they can be divided into two layers, one-half of the connector serving to form part of the lower layer next to the core, and the other half the upper layer. Diagram 5 will make this plain. The outer layer is shown in full lines and the layer next the core in dotted lines. It will at once be seen that the wires comprising a layer in such a formed head do not cross each other anywhere, and the wires of the upper layer crossing those of the lower layer can be separated therefrom by a single thin circular sheet of insulation. Moreover, such an armature head is very compact, and in a railway motor this is an enormous advantage, as the available dimensions are often limited, and a motor that is too long in the direction of the car axle may interfere seriously with the working of the brake rods or the use of an improved suspension.

That the compactness shown by the diagram is realized in practice is demonstrated by Fig. 6, which shows a G. E. 800 armature in process of winding. The inner and outer layer may be distinctly seen, and also the way in which the armature coils fit together. The principle of this winding may be made still further apparent by noting the shape of an isolated coil in which it will be seen that the wire passes outwards from the slot and down toward the axle in an evolute curve, forming a part of the outer layer, when it bends sharply inward parallel to the axle, and turning sharply again, passes upwards to its proper slot in an evolute curve, which is the inverse of the first one, thus forming part of the inner layer of end connectors.

A popular idea with these formed coil armatures is that the winding is a matter of simply slipping the coils on one after another till the armature is completely wound. This, however, is not as simple a matter as it would at first seem, and it will be best appreciated by considering the difficulty of taking apart a completed armature.

Consider diagram Fig. 5. We wish to remove one coil marked *A*. One side of it is in the upper part of a slot and can be easily lifted out, but the other part of the coil is

in the lower part of the slot, and the conductor above it must be lifted out first. Nor is this all; every other upper conductor in the span between the two slots pertaining to the same coil must be lifted to liberate the damaged coil. In a four-pole series-wound machine this means lifting one-half of all of the upper conductors in the armature. The lifting action is a progressive one, increasing in arithmetical ratio. Thus, if it is desired to lift coil No. 1, coil No. 2 must be lifted twice as much, and coil No. 3 three times as much and so on.

The result of this is to deny to the formed coil the advantage which is often claimed for it, of particularly easy repair. If an armature be run for a considerable period of time, and one of the coils fails, it is next to useless to try to replace that coil alone, for the lifting of the other coils which this operation entails is certain to crack and destroy their insulation so much that they are not fit for further service. The armature must be stripped and rewound.

American railway motors now use drum-wound armatures exclusively, and numerous methods have been tried to secure a symmetrical system of winding them. The latest development, and one which has now become universal, is the straight-out winding. This is so called for the reason that the ends of the coil project straight out from the ends of the armature in a plane parallel to the shaft, as shown in Fig. 7. This has the advantage, first, that the coils are simply polygonal figures, having no intricate curves requiring special forming devices, and, second, because the shape of the coil being practically all on one plane, is such that it is easier to remove it.

The first straight-out windings were constructed with the end of the coil protruding in a more or less unprotected manner. The coils formed a sort of cylindrical wall or ring protruding from the end of the armature, and were usually protected by tape wound on the coils individually and on the assembled ring as a whole.

Another improved method which is now being universally adopted, is to provide a metal support for this ring, which is usually a part of the end disk which holds

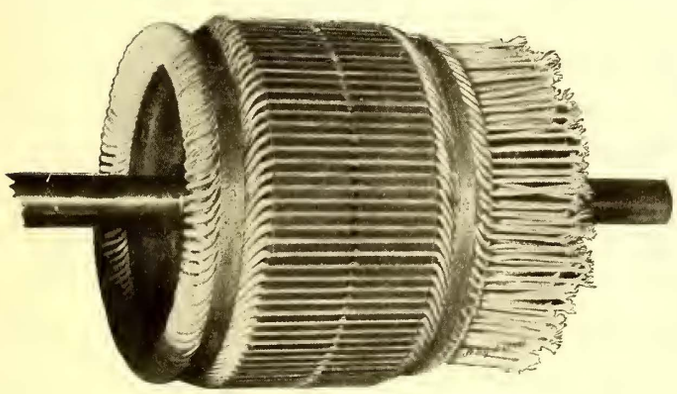


FIG. 7.—"STRAIGHT OUT" WINDING

the laminæ of the armature together. Such a construction is shown in Fig. 8. It may be mentioned that this figure illustrates a simple dynamo armature wound on this plan, but it is selected because it shows the principle of this method of winding to excellent advantage. The shape of the coil of a straight-out winding is shown in Fig. 9. If the machine be a small one, taking but little current, the coil usually has two or more turns, as shown in the upper part of the figure, while if the machine is of large capacity, a simple loop between the commutator bars constitutes a coil. These loop conductors are frequently made of flat ribbon, which is very conveniently manipulated, the only difficult part being the abrupt bend at the sharp angle of the coil. A substitute for this bend can be made, as shown in Fig. 10, which consists simply in folding the ribbon on itself. This has the disadvantage of producing two more sharp bends in the ribbon and causing a lump at this part of the armature coil, which is not quite as sightly, but for which there is always room.

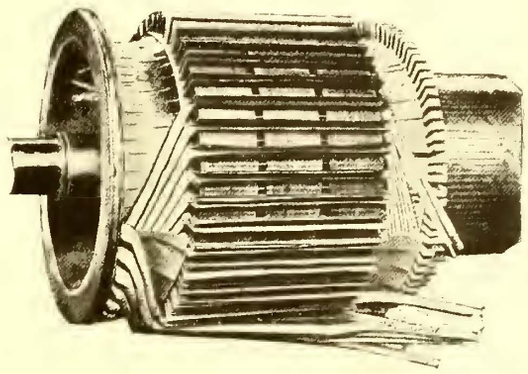


FIG 8.—PACKED "STRAIGHT OUT" WINDING

In winding drum armatures, it is usually customary to cover the core heavily with insulation and place troughs of composite insulation in the armature slots in which the conductors are laid, but with some motors, notably the

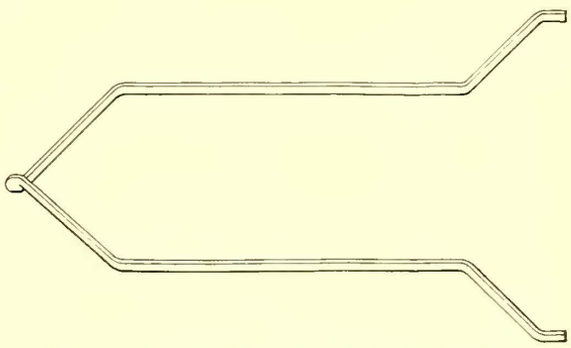


FIG. 9.—SHAPE OF "STRAIGHT OUT" COIL

G. E. 800, the core insulation is omitted, and the coils are more heavily taped. This has the advantage that it takes less time to prepare an armature core for winding, but it cannot be said to be as safe a winding as where the core and coil are separately insulated.

All drum armatures require band wires, a precaution not necessary in most ring constructions. The number and position of these bands are quite important. The fewer there are in the clearance space the better, and such bands as are required there should not be soldered more than is necessary to secure their ends, for they are revolving in a strong field, and the currents which are generated in them tend to flow at right angles to the wires of which they are constructed. If a path for these currents be provided in the shape of a soldered connection, these eddying-currents may be very large and sufficient to overheat the bands at a temperature where the solder will melt, and it should therefore be used very sparingly. In the straight-out winding, bands may be placed outside the clearance, which may be soldered together throughout their entire length, and which may be made as large as desirable. In fact, it is well in such cases to throw the work of holding in the conductors as much as possible on these outer bands, the bands within the clearance serving merely to hold in the protecting fillers in the tops of the slots.

Modern railway armatures seem to prove that the formed coil has come to stay. The comparative cheapness with which it can be produced, the ease of winding an ar-

mature so constructed and the general symmetry and durability of the result are features which no other method of

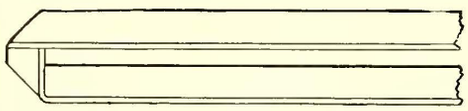


FIG. 10.—SUBSTITUTE FOR BEND IN "STRAIGHT OUT" COIL

winding has offered, and which are specially desirable in railway work.

Brooklyn's Electric Fountain

By Frederic W. Darlington.

Brooklyn's electric fountain is at the entrance to Prospect Park, called the "Plaza," which is at the junction of Flatbush and Ninth Avenues, and is Brooklyn's pride. On this Plaza is erected the massive arch which patriotism reared to the memory of departed heroes in the army and navy. Directly in front of this arch, and constructed prior to it, has stood for thirty years a cascade fountain, designed by Mr. C. C. Martin, now chief engineer and superintendent of the Brooklyn Bridge. The cascades fell over a glass dome, which was illuminated from beneath by means of gas jets.

After the arch was constructed it became necessary to remove these cascades, in order that the view of Memorial Arch should not be obstructed from the city side. Brooklyn is proud of her Plaza, and justly so, for there are but few cities possessing such a beautiful place in which to erect monuments.

After the old fountain was removed, the question as to what kind of a fountain should take its place was settled by accepting the designs prepared and submitted by the writer for an electric illuminated fountain. The conditions of the case required everything in the shape of machinery or piping to be placed beneath the surface of the water, that the view of the arch should not be obstructed by structures of any kind by day. It was therefore impossible to introduce architectural effects, leaving the fountain in the peculiar position of being designed for purely water and light effects. The novelty and success of the designs and interest excited are well attested by the widespread praise it has received at the hands of the daily papers, notably by those in New York and Brooklyn.

The fountain basin is 120 ft. in diameter, and is situated directly in front, or on the down-town side, of the Memorial Arch. Surrounding this basin and forming its outer rim is a kosmocrete curb handsomely finished with an ogee top. The floor of the basin and the walks surrounding it are of the same material, making it appear as if the basin had been cut out of solid granite. The intricate system of piping is located in this basin, but is entirely covered with water. This makes the outward appearance of the whole fountain and oval surrounding it seem very simple in construction.

Altogether there are over 2000 jets in the fountain producing the various water displays and combinations shown in the accompanying cuts: Fig. 1, "Sheaves of Wheat by Daylight;" Fig. 2, "Spray Effects by Daylight;" Fig. 3, "Geyser by Daylight;" Fig. 4, "Beehives at Night;" Fig. 5, "Sheaves of Wheat at Night;" Fig. 6, "Geyser at Night;" Fig. 7, "The Fan;" Fig. 8, "Sun Rays Effect;" Fig. 9, Ribbons of Light;" Fig. 10, "Flaming Torches."

One man operates the whole fountain, assisted only by a helper, who remains under the main basin to keep an eye on the searchlights.

Situated in the operating-room under the sidewalk and apart from the main chamber under the fountain, but connected with it by a tunnel, the operator stands looking out of his windows, just above the surface of the water in the basin, through which he can see the effects of each movement he makes of levers or colors. Immediately in front of him and in easy reach is a row of levers, each of which controls the water to one set of the fountain jets. In front of him is also a long board, on which are arranged a large number of push buttons controlling the various combinations of colors. Each individual color is controlled by a button of same color.

The fountain was erected by the city of Brooklyn, but is operated jointly by the Brooklyn Heights Railroad Company and the Nassau Railroad Company. The power is taken from the power stations of these companies, from that of one company on one night and that of the other on the next night.

As for the cost, electric fountains are like dwellings. They can be made to cost any sum. If, for instance, a railroad company has $20,000 to spend for a fountain, $5,000 of it can be spent on making the interior beautiful and the balance in producing a water display, or these proportions can be varied. The result, however, as an investment will depend upon the skill with which this proportion is determined, and it must be borne in mind that this proportion varies for every locality, and depends on the class of people to be attracted to see it.

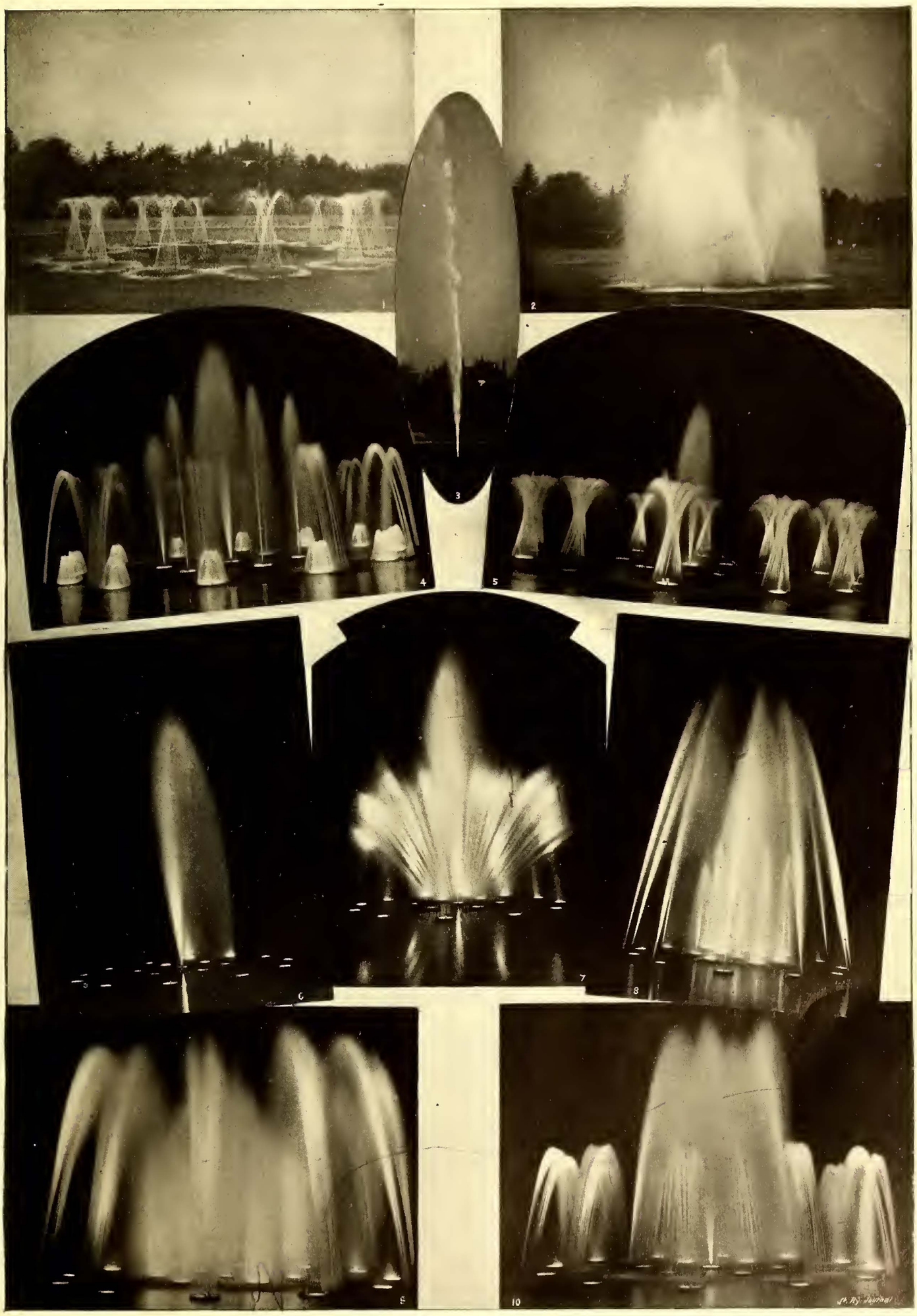
It is therefore most advisable that each fountain should be made a study in itself, and, in fact, it is only by doing this that the purchaser can be sure he is making a profitable investment. It is safe to say that every electric railroad in the country which is operating a park, or at whose terminus a park exists, can install an electric fountain and make it pay for itself in one season, if the size and style of it are wisely chosen. Fountains can be built for as small a sum as $1,000, and as large as desired.

The evidence that an electric fountain is a permanent and profitable drawing card for travel on any road is shown in the satisfaction of all roads which have installed them up to the present, and the widespread interest taken in them by those managers who are awake to the interests of their roads, and are anxious to keep novelties before the riding public. The displays of an electric fountain can be changed and varied from season to season for small cost, and by so doing produce each season a practically new fountain. But even without this it is found to be a permament attraction when the coloring and the design of the jets harmonize. It is in this very matter of jets—their design, their grouping—that the success of the fountain is determined.

When water is scarce, or a particularly high display is required, a pump can be installed to use the water over and over, and produce pressure; but usually for smaller fountains the ordinary city or town pressure is sufficient.

The Knoxville (Ky.) Street Railway Company has published a notice to the effect that on the first of January and July of each year it will present a suit of clothes to those motormen who have not cost the company more than $5 because of accidents during the preceding six months.

A bill has been introduced in the New York Legislature providing that whenever a company in any city or village of the State pays its operating expenses, maintenance, repairs, interest and fixed charges, and then earns 5 per cent on its capital stock, it shall issue a transfer ticket to all its branches for a 5-cent fare in the middle of the day, and shall sell thirty tickets for $1, good between 6 and 8 a. m. and 5 and 7 p. m.



DIFFERENT FORMS OF ELECTRIC DISPLAY—ELECTRIC FOUNTAIN IN BROOKLYN.

The Economy of the Booster

By J. Lester Woodbridge.

At a recent meeting of the Electrical Section of the Franklin Institute, following a paper which I read on the "Booster System in Railway Work," there arose some little discussion on the question of cost of operation. I had made the statement that, other conditions remaining constant, the cost of operation at the power-house would usually be about the same, whether the booster were in operation or not; in other words, that the power used by the booster unit, when in operation, would be deducted from that otherwise required for the rest of the plant, leaving the total the same. This statement, I am confident, will be found to hold good under ordinary conditions, while in cases of excessive drop on the feeders, the advantage would undoubtedly be with the booster on the score of economy. During the discussion following the paper, however, an exception was taken to this statement by one of the engineers present, who advanced the opinion that the entire power consumed by the booster unit constitutes an additional drain on the coal pile and increases by so much the cost of operation. Now, these two positions are so diametrically opposed that they would seem worthy of little further discussion. As the booster affects only that section of road which is boosted, we are narrowed right down to the question, "Does the raising of the pressure on a section of the road from an average of, say, 350 volts, fluctuating more or less violently, to an almost constant potential of, say, 550 volts, reduce the average amperes used on that section, assuming constant conditions of operation—i. e., the same cars, the same loads, the same details of schedule, speed, headway, stops, etc., in both cases?"

The question might be very simply but effectively answered by the statement that if the ampere output is the same in both cases, we could reduce the entire power-house voltage from 550 to 350 volts, and, obtaining the same practical results in the operation of the cars, save 36 per cent of the coal consumption—a manifestly ridiculous conclusion.

But the reductio ad absurdum form of argument does not appeal to every one as forcibly and conclusively as it might, and I anticipate an objection to the above reasoning, on the ground that one cannot always obtain the same operative results with 350 volts as with 550. Very true; but I am not attempting to maintain that by raising the voltage it is possible both to do more work and reduce the amperes. I merely hold that one can either do proportionately more work (make more trips or operate more cars) with the same ampere output, or, doing the same work, reduce the amperes in proportion to the increase in voltage. I had supposed this self-evident, until I found it called in question. To test this latter point, it is simply necessary to determine what can be done in operation with 350 volts, and then what can be done at 550, and ascertain whether the average current be not reduced in inverse proportion to the voltage.

A little consideration of the characteristics of the series motor will show why this must necessarily be the case. To pull a given load, a series motor requires a certain fixed current, independent of voltage or speed. The speed, on the other hand, will be practically proportioned to the voltage, so long as the load remains constant. So that while an increase of voltage on the line from 350 to 550 will not reduce the amperes used by any one car while in operation, it will increase the speed, and a car that used, say, 55 amperes for eleven minutes at the lower voltage will, while using the same current, require only seven minutes to cover the same distance at the higher voltage, and in order to maintain the same schedule as before, it will have to lie over the other four minutes and use no current. It is very evident that the average amperes will thereby be reduced from 55 to 35. This reduction would not be noticeable by a merely casual observation of an ammeter, even when a number of cars were in operation. The readings would probably appear to be the same in both cases, and it would require a series of readings taken at a definite interval of a few seconds, or a recording ammeter to show that by a reduction in the frequency and duration of the maximum loads, and a corresponding increase in that of the minima, the average current was actually reduced in proportion to the increase in voltage.

Such careful observations are rarely made under conditions which render them of any value, and it is not surprising that the erroneous opinion above referred to should frequently be advanced. Moreover, it is usually the case that instead of a reduction of current it is an increase in the power utilized that is effected by the application of the booster. Certain it is, that if the ampere output does not remain the same, the loss in transmission must be the same and we must seek the additional power used in boosting in an increase of the useful work done. In fact, it is rarely the case that the booster is resorted to, except for the purpose of operating more cars or making more trips per car than would otherwise be possible.

A simple concrete illustration will perhaps put the matter in a clearer light. Take the case of a blockade of cars at the extreme end of the line. The current required to move them simultaneously is, say, 550 amperes. Suppose the resistance of the circuit to be 1 ohm. Evidently the drop will be 550 volts, and without boosting the motors will have practically no voltage and the cars will not move, or will just crawl. Now, start the booster, add 550 volts the power-house, making it 1100 total; the cars, of course, get 550 volts, after deducting the drop, and run in at full speed, using the same total current as before—550 amperes. It is evident in this case that the power used by the booster unit while in operation is added, in toto, to that otherwise required. But it is manifestly no cause for complaint that whereas in the one case an output of 300 k. w. is practically all wasted in heating the circuit, in the other 600 k. w. is half utilized, even if this were all. But we must go further. In the first case the 300 k. w. must be developed for many hours in order to bring the cars all in at the greatly reduced speed. In the second case the output of 600 k. w. will do the work in perhaps one-tenth the time, and the total coal consumption for this particular work is reduced to one-fifth of what it would have been. This is one of the cases alluded to above, where excessive drop in the line enables the booster to show up a remarkable increase in economy.

Some increase in economy would in all cases be secured by boosting were it not for the fact that as a rule the booster unit develops electric power under an efficiency somewhat less than that of the rest of the plant, because it cannot generally be loaded so nearly up to its full capacity. This decrease in the efficiency of producing will often nearly offset the increase of efficiency of transmission at higher voltage, where the voltage is but slightly raised, so that under average conditions it is safe to say that the economy of operation will not be materially affected by the use of the booster—certainly not reduced.

In view of the above, since the total k. w. output of a station is not increased by boosting, it follows that the total cost of machinery required to handle that output will be about the same in either case, assuming a proper margin for momentary fluctuation, provided the plant is properly proportioned to the work to be done. The question of interest on first cost is thus practically eliminated. This

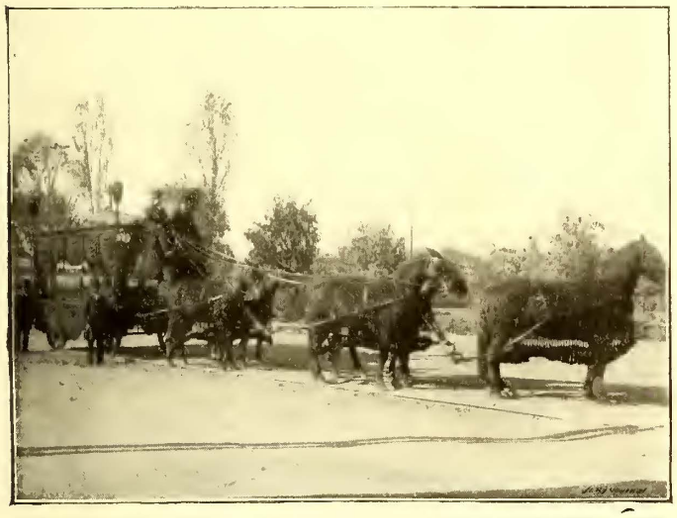
proper proportioning is greatly facilitated by the use of the convertible booster-generator, which gives great flexibility to the plant.

But the usual question asked in this connection is whether it is more economical to boost than to put up more copper. This, in fact, involves two wholly independent questions. The first, "Is it economical to boost?" I have endeavored to answer above. The second, "Is it economical to put up more copper?" is to be answered without regard to the other. The proper size of conductors is fixed by equating the cost of power lost in them to the interest on their cost. This involves the average load. Having determined this, the question of boosting is not one of economy, but of necessity. It is best to boost, if, having put up the proper economic amount of copper, it is still necessary, at times of maximum load, in order to secure the desired results in operation.

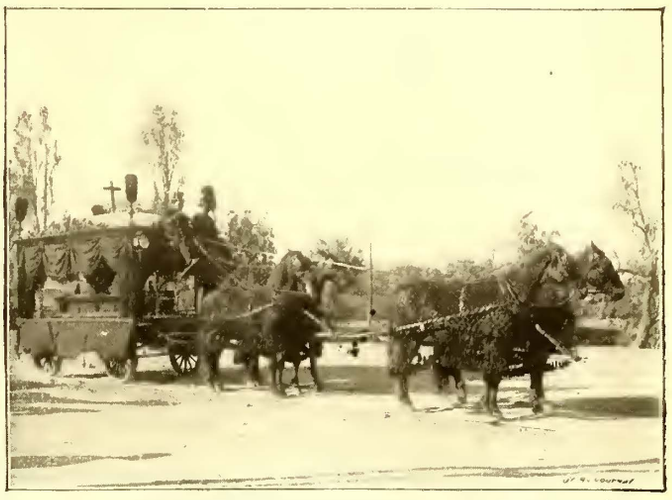
A company has recently been formed in St. Petersburg, Russia, with a capital of 4,000,000 roubles, to be known as the St. Petersburg Company for the Electrical Transmission of Power from waterfalls. It is the intention of the company to install a plant for the utilization of the Narowa, Imatra and Wuozen waterfalls in the generation of electrical energy, and to transmit and distribute the same in the St. Petersburg district for lighting and power purposes. It is thought that the company will have no difficulty in finding a market for all the power it can supply.

Funeral Cars in Mexico

The street railway company in the City of Mexico, known as The Compania de Ferrocarrilles del Distrito Federal de Mexico, derives a considerable portion of its receipts from the rent of funeral cars and hearses, and this service has become so popular that nearly all of the funerals in the vicinity of Mexico are now conducted over the lines of this company. The accompanying illustrations show the different classes of hearses which are employed. Fig. 1 shows the highest class which is used at the funerals of the very wealthiest people. This hearse is sent out with six horses, coachman and three attendants, the price charged being $140 for the service. This hearse is also sent out with but four horses, coachman and one attendant, when the charge made is $100. The charges for the other classes of hearses are as follows: for No. 2, $70; No. 3, $30; No. 4, $25; No. 5, $10; No. 6, $10; No. 7, $6, and No. 7 without draping, $3. These amounts are all in Mexican currency. These charges are made for the funeral car or hearse alone, and do not include the passenger cars required for the mourners. The prices for the latter are as follows: Large first-class car, with curtains and driver in livery, $12; medium-sized first-class car, with curtains and driver in livery, $8; large first-class car, without curtains, and without driver in livery, $10; medium-sized and small cars, without curtains and without driver in livery, $6; second-class cars, $4.

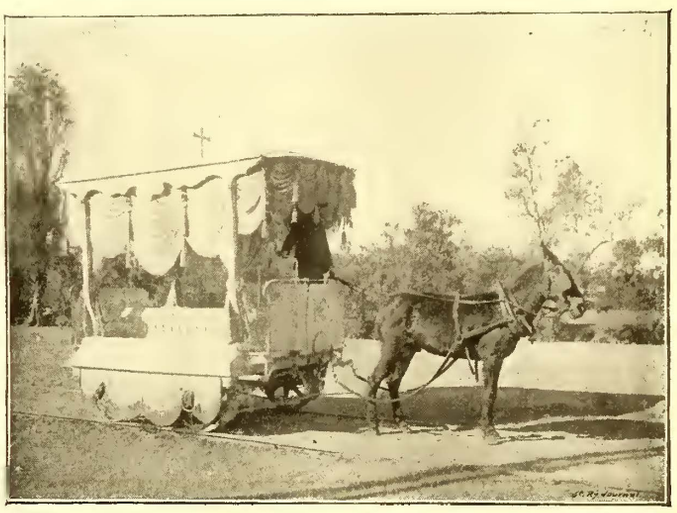


HEARSE NO. 1.—PRICE OF SERVICE $140.



HEARSE NO. 2.—PRICE OF SERVICE $70.

HEARSE NO. 3.—PRICE OF SERVICE, $30.



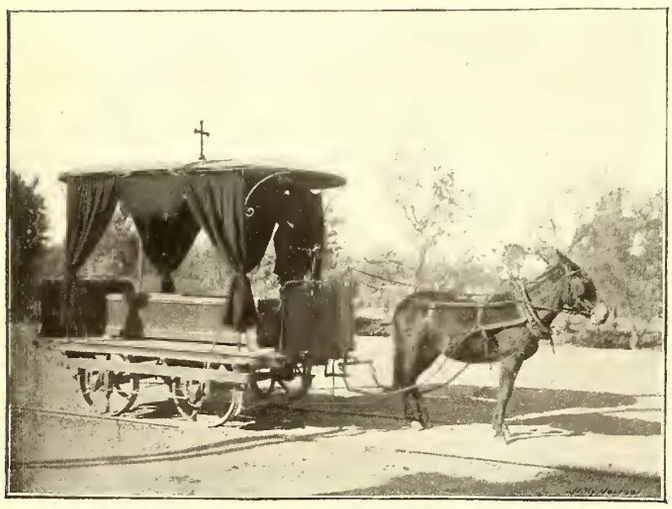
HEARSE NO. 4.—PRICE OF SERVICE $25.

To the above prices 33 per cent is added if the service is from the City of Mexico to any of the suburban towns. If the service is from a suburban town to any of the cemeteries close to the city, 50 per cent is added to the original tariff price. In the large first and second class cars twenty-eight passengers are admitted; in the medium-sized cars eighteen, and in the small ones sixteen.

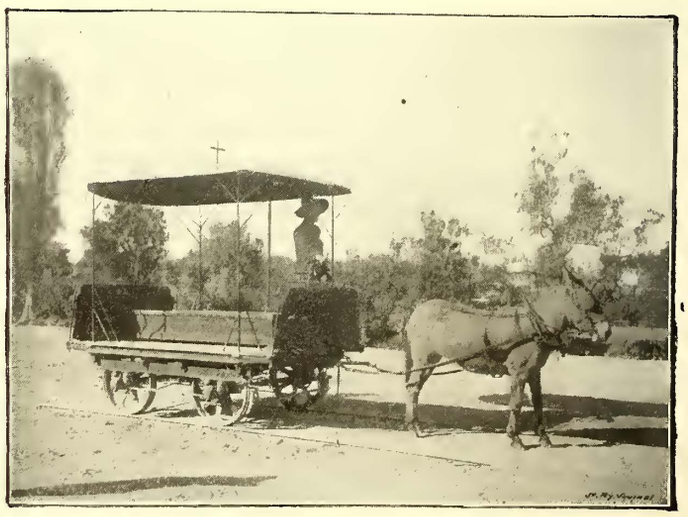
When the house in which the funeral is held is not on the line of the road, the cars are placed at the nearest curve or on a branch track, and at the return the company is only obliged to take the passengers to the public square, called "Zocalo" (Plaza de la Constitucion). One hour is allowed to the attendants to remain at the cemetery, and for every additional hour a charge of $1 extra is made for each car. A fixed hour is appointed for the body to be taken out, and no delays are allowed, so that the funeral service in no way interferes with the ordinary traffic. A total revenue of about $80,000 a year is derived by this company from the rent of hearses and funeral cars.

HEARSE NO. 5.—PRICE OF SERVICE, $10.

HEARSE NO 6.—PRICE OF SERVICE $10.



HEARSE NO. 7.—PRICE OF SERVICE [$6.



HEARSE NO. 7.—WITHOUT DRAPING. PRICE OF SERVICE $3.

The cost of one mile of double track, with paving for 18 ft. in width of right of way, based on Chicago prices, would be $25,879, but if granite had been used instead of wooden block, the cost would have been $38,587.—From report of committee, St. Louis Convention, 1896.

Testing Cement Samples

Many contractors and power-station engineers accept off-hand the statement that a certain cement "is the best," without verifying the claim. Such action, especially in case of a new or untried cement, often leads to future trouble and perhaps litigation. Let a cement machine be procured, and the contractor inform himself of the quality of the material he uses.

The briquette should be cast in a mold which leaves an enlargement at each end of the specimen, and the section to be acted upon should be exactly 1 in. square. If a little too large, the sample may be filed, but if too small it should be promptly thrown away.

In selecting a testing machine, choose one so constructed that it never puts the least jar upon the specimen while under test. This demonstrates that it does not answer to test cement by means of a bar or lever, and a scale beam, as some contractors crudely attempt to make so-called tests.

The power should be applied very gradually, at the rate of about 400 lbs. per minute, and the balance weights so arranged that they are added automatically without the least jarring or straining the test piece. In this manner an accurate test of the value of any cement may be made, which will be of value in the erection of masonry work.

LETTERS AND HINTS FROM PRACTICAL MEN

Improvements in Interurban Railroading

AKRON, O. Feb. 8, 1898.

EDITORS STREET RAILWAY JOURNAL:

The number of interurban electric railways in this country, upon which speeds of from 25 to 50 miles an hour are maintained, or exceeded, is on the increase, and demands, I think, special attention from the manufacturers of electrical apparatus and rolling stock. The conditions are so different from those of ordinary city railways that the cars fitted for the latter service are not at all suitable for the interurban lines. The practice of the steam roads is more like that of high-speed electric railways, but cannot, of course, be closely followed on account of the difference in motive power. What is true of the cars is equally true of the motors and other parts of the equipment, and I believe that with the increase in the number of high-speed railways, a type of equipment will be devised by our prominent builders of cars and motor manufacturers which will be radically different from that now in use.

A few thoughts have come to me on this subject in connection with my work on railways, and if they are of any value to interurban railway managers or engineers, I shall take pleasure in presenting them through your columns.

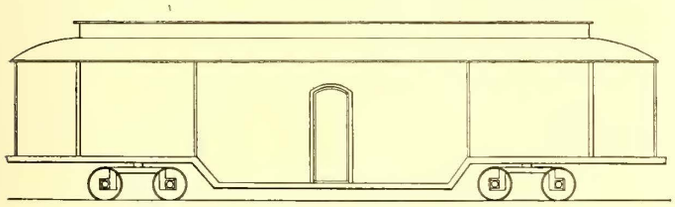


DIAGRAM OF PROPOSED INTERURBAN CAR.

The car body should be designed to be stable, have a low center of gravity, be easy of access, and give plenty of room between the ends of the sills and the track, so that wheels of 36 or 42 ins. diameter can be used. The last three requisites can only be secured by the use of bent sills as shown in the diagram. These should be preferably of iron and four in number. With this arrangement side doors can be placed in the center of the car, similar to the Kuhlman pattern, which has proved popular in Cleveland and elsewhere. I would suggest dividing the car into three compartments—a central compartment and two end compartments for smokers, as experience shows that provisions should be made for the latter contingent. The conductor's place would be on the rear platform, where he could open the central door with a lever; and, as on a road of the character under description, stops would only be made at infrequent intervals, he could leave the rear platform and go to the side door to assist the passengers in alighting from and entering the car. This construction of sills would not only accomplish the three desiderata specified, but would also have an important function in case of the breakage of a wheel or other accident. In such a case the sills would act as runners overlapping the rails on each side, and the car would slide along on the roadbed and be prevented from leaving the track.

The car bolsters I would make of iron, stamped by a die and hollow. During winter or at any other time when extra traction was required, these bolsters could be filled with lead, etc., which could at other times be removed when its weight was not needed. The motors I should make of the gearless type, with the armatures sleeved on the axle. This will avoid the great expense involved in the use of gears and pinions and a great many other parts of the motor equipment which now are a continual source of trouble in high-speed work. In addition to their wear, the gears under the best conditions undoubtedly consume 10 per cent of the power produced in the motor, and with the ability with which our modern engineers and designers of electrical apparatus have shown, I believe they can design a gearless motor which would operate within this margin, as compared with a single reduction motor. In such an equipment the motor frame would be split, so that it could be easily removed from the axle, and it is not impossible to assume that some of our motor designers can produce, if necessary, a split armature. Until this is done, however, the armatures should be built to be fireproof, by the exclusive use of mica for coil insulation, the coils being of copper bars.

The trucks for this purpose should be built with a pedestal having a side opening as shown in the drawing, so that the wheels can be slipped out of the ends of the pedestals without jacking up the car to any great extent. Rolling the wheels out would carry the motor with them, and unbolting the motor frame would leave the armature exposed to inspection.

These are simply some of the thoughts that have occurred to me, and are in rather crude form. They have not been put into practical use, and so of course might have to be considerably modified, but they may perhaps be of some value as indicating some improvements which may be introduced on high-speed lines in the future.

FRANK J. J. SLOAT.

Proper Handling of Controllers

PARIS, Jan. 25, 1898.

EDITORS STREET RAILWAY JOURNAL:

I have read with great interest the controversy which has appeared in your columns about "The Proper Handling of Controllers," and I would ask if it is not founded on a mistaken understanding between the learned engineers who have contributed to the discussion.

Certainly Mr. L. H. Parker is right when he states that as rapid an acceleration as possible is desirable when "a car or train is to run a certain distance in a certain time," if he means when the car or train is to run on acceleration only, or at least when the time spent to attain the maximum speed V is the greatest part of the whole time during which the current is applied to the motors. In that case, the greatest average speed during the time when the current is applied permits the making of the schedule with a smaller maximum speed, and so lessens the value of $\frac{1}{2}$ MV^2; moreover, if the time gained is sufficient, the car or train may be made to run on momentum for a part of the distance, as Mr. Potter explained in a very interesting contribution to the October issue of the "Journal."

But this theory is not right when the train is to run for a distance at a constant speed; the importance of the time necessary to attain it decreases with the distance traveled at that constant speed, and the possibility of the car or train running "a certain distance in a certain time" depends mainly on the value of that constant or maximum speed. This is the case encountered with the street railways, for we see from Mr. Knox's experiments that maximum speed is attained after a travel of at most 150 feet (with ten seconds handling), and a car generally runs several blocks without stopping. The maximum speed to be attained is therefore predetermined, and the only problem to be solved is to see how that maximum speed may best be attained. Mr. Parker's theory, at first expounded, I believe, by Mr. Robert Lundie, of Chicago, is only ap-

plicable to the determination of the best suitable maximum speed for a given run made only on acceleration, positive or negative (that is, acceleration or retardation).

The problem so restricted is completely answered by Mr. Knox's experiments in favor of the slow handling.

I will add that even when the greatest acceleration is desirable, one must not lose sight of the fact that acceleration is produced only by the useful tractive effort applied to the periphery of wheels, and that this effort, being generated by electric motors, the good and bad qualities of these motors have to be taken into account. If a motor is not calculated to give the proper tractive effort at a given speed, and if you try to get it by "crowding the current," you run the risk of burning out your motor and you get a very bad efficiency. In certain applications, as on elevated lines, suburban railroads, etc., where a very high commercial speed must be attained in spite of very frequent stops, it is quite right to look for a very rapid acceleration, but that result must not be acquired at the cost of a bad efficiency. The conclusion is that even for a road where quick acceleration is necessary, the rapid handling of the controller is objectionable if the motors are properly calculated for the work to be done. It is the more objectionable as the quantity of energy and the power required theoretically necessary grow greater. If the motors are not properly calculated, the quantity of energy gained by a rapid acceleration may compensate, and more, for the loss of efficiency, and that, I believe, partly accounts for Mr. Heft's results, curve A indicating that the travel was made with constant acceleration and retardation, and the motors had not been calculated to give rapid acceleration.

I understand from Mr. Potter's article, above referred to, that the General Electric Company has now constructed electric motors specially adapted for that service, and I trust that when they shall be put in service it will be found also that for rapid acceleration rapid handling is not convenient. G. Pellissier.

Electrical Features of the Tramway System of Sydney, New South Wales

New South Wales Government Railways,
Sydney, N. S. W., Jan 17, 1898.

Editors Street Railway Journal:

In the article in your last October issue on the tramway system of Sydney, N. S. W., no mention is made of the system of distribution of energy and the return between the power station and the cars, and, as this includes certain novelties, it may be interesting to your readers to give a short description of what has been done and is proposed in the immediate future.

The difficulties to be overcome in the application of electric traction to these lines were unusually great, owing not only to the natural conditions of heavy grades and very numerous curves, especially on the lines first equipped electrically, but also owing to the existing system of cars drawn by steam motors possessing an exceedingly high carrying and seating capacity. Many of the steam trams have seating accommodation for 210 passengers, and, on the main trunk line, fourteen hundred of such trams pass a given point daily. A parallel trunk line will shortly be completed, and it is then proposed to largely reduce the size of the trams, and proportionately increase the number, in order to give a more frequent service to the various suburbs, but in any case the units must remain somewhat large, and the load on many of the feeders must consequently fluctuate to an abnormal extent. Another requirement for which provision has to be made is the special traffic to the Cricket Ground, Agricultural Ground and Race Course, all of which are situated on one of the Eastern suburban lines terminating at the ocean beach. Great interest is taken in cricket, the ground being equal to any in the world, and, on occasions of matches with teams representing the best players in England, upwards of 30,000 spectators are sometimes present. At agricultural shows and race meetings the crowds are similar. As many as 20,000 people have to be conveyed from the cricket ground, which is about three miles from the power station, in about half an hour on special occasions.

As the normal traffic on this line is very light in comparison with the above, it will be seen that the system of distribution and return to meet such conditions must be very carefully laid out if the greatest economy in power and copper is to be obtained.

The Railway Commissioners of New South Wales were probably the first to introduce storge batteries as equalizers at distant points from the power station on lines where there is excessive fluctuation in the load, they having designed and constructed a suitable battery for this purpose in 1893. This battery, formed from plain lead plates by the action of the current on the Planté system, was set up complete at a cost of under £4.0.0 per electric h.p. discharge, or, in round numbers, £300.0.0 for a discharge of 100 amps. at 500 volts for short periods, and it has proved practically indestructible. The action of this battery is similar to, but infinitely better than, that of a flywheel driven by a motor acting as a generator whenever the potential falls sufficiently on that part of the line. To provide a greater storage capacity, a second battery, of the pasted plate type (E. P. S. "K.") was set up in parallel with the Planté cells a year ago. This furnishes a current of 100 amps. for two hours continuously and the action of the two batteries in parallel is very perfect, the Planté being of higher internal resistance, only taking charge when the line potential is at its highest, or when no cars happen to be taking current, while, on the other hand, it discharges during the period of heaviest loads and saves the E. P. S. battery from excessive strains.

In addition to the above, two batteries of the "chloride" type are now being installed for the same purpose on two new lines where the traffic conditions and grades are similar.

In connection with these batteries, motor-boosters for automatically raising the charge and discharge current have been installed at two of the distant battery huts. These consist simply of a shunt-wound motor directly connected to a series-wound generator, through which both charge and discharge pass alternately without any switching or change in direction of rotation. With the potential of line and battery equal, the booster runs idle, the motor only taking about 1½ amp. Now, supposing two or three cars happen to be ascending heavy grades simultaneously, the potential falls just sufficiently to cause a few amperes to pass out of the battery; this excites the booster and the discharge increases as the excitation of the booster increases, the maximum P. D. of the latter being about 50 volts. On the other hand, should no cars happen to be taking the current, or only very little, the line potential rises slightly above that of the battery, causing current to pass in the reverse direction through the booster, which again comes into service for raising the charging current —also to the maximum limit of about 50 volts. There being no current passing through the booster between reversals, these take place quite sparklessly and smoothly.

By this means much more use is made of the battery, and the line is maintained at a more even potential. As the booster works both ways, a machine of 10 h.p. is practically equal to one of 20 h.p. boosting only in one direction. The station generators are over-compounded to the extent of 5 per cent instead of the usual 10 per cent, as this conforms best with the conditions existing.

The new power station now in course of erection is fairly centrally situated, the points of heaviest traffic being within two miles radius, and, although it is intended to feed the entire system from this point eventually, and the advantages of the polyphase system for primary distribution to substations were well considered, it was decided to lay down 5000 h.p. in direct current plant to begin with, and again consider the question of three-phase transmission when additional units were laid down. The standard unit adopted is 850 k.w., and provision is made for twenty of these in the new station. The fitting of collecting rings to take three-phase currents from the direct current generators was at one time considered, but the idea was relinquished, owing principally to the very low frequency of the currents obtainable, a frequency that certainly would not be adopted as a standard when laying down three-phase generators.

Another very important feature in the local conditions, affecting especially the cost of the return conductors, and consequently the adoption of a high-tension primary distribution and substations, is the existence of sea water at or near the terminus of most of the lines. This suggested a means of obtaining a good return conductor for the current without excessive expenditure in copper, and experiments are being made with various descriptions of electrodes immersed in the sea water and provided with scrapers, or other cleaning device, to keep down the resistance which would otherwise increase rapidly with the deposition of salts on the plates at the power station. It happens conveniently that the electrode requiring periodical cleaning will be close at hand, while those which will naturally keep clean and give little or no trouble will be at the distant termini. No less than twelve of the roads terminate at or near the salt water, and it is confidently anticipated that capital to the extent of many thousands of pounds may be saved by this means.

The feeder cables are being laid underground, and a novel point in the system consists in the laying of submarine cables in the bottom of the harbor to carry the power for the north shore lines. Two of these cables, each of 500,000 c.m., rubber-covered and sheathed with brass tape, are being laid in the first instance. The harbor is 500 yards across nearest points and 70 ft. deep. A water main and a number of telegraph cables now lie on the bottom in the mud, and ships are not allowed to cast anchor in this locality.

Sydney has a very fine sewerage system, and, in order to prevent sewage falling into the waters of the harbor, pumping stations are being erected in all the bays to raise the sewage from the low levels to the necessary height for gravitation by the main tunnel to the ocean, and arrangements have been made for all these pumping stations to be operated electrically from the new power station above mentioned. Current for lighting purposes and for motive power in the railway workshops will also be supplied from this station. The Commissioners have not yet considered the question of electric traction on the suburban railways, but are watching developments in the three-phase alternating system for this purpose.

P. B. ELWELL,

Electrical Engineer for the Railway Commissioners of New South Wales.

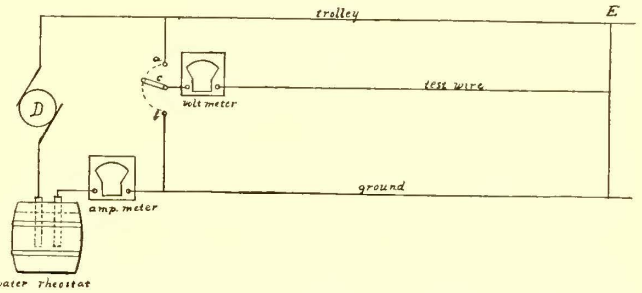
Testing the Resistance of the Railway Circuit

ATLANTA, GA., Jan. 20, 1898.

EDITORS STREET RAILWAY JOURNAL:

Having become interested in testing the resistance of the feeder and return circuits of a street railway system, it has occurred to me that a very practical rigging for making such tests, and also one that would definitely locate any trouble that might exist, would be the one outlined in the accompanying diagram. The test wire may be of iron and of any convenient size, and is strung from the station to any point at which it is desired to make tests.

The tests can only be made at night when the line is not in use. The water rheostat is adjusted so that when the line is short-circuited, a small amount of current will flow, say, from 50 to 150 amps. Any nice adjustment of the amount of current flowing may be made by changing the voltage of the generator so that the water rheostat need not be disturbed after once adjusting it. Now, if it is desired to test the resistance of the line from the station to a point E, a connection is made from the trolley



PROPOSED ARRANGEMENT OF TESTING RESISTANCE OF CIRCUIT

wire at E, directly to the ground, and E is also connected with the test wire. The operator at the station now places the double-throw switch (c) on (a) and the reading of the voltmeter gives the drop on the trolley and feeders from the station to the point E, and likewise by placing (c) on (b) obtain the drop on the return circuit.

If the resistance of the test wire is small as compared with the resistance of the voltmeter used (as would ordinarily be the case), the effect of this resistance on the readings may be neglected, but if it is desirable to have them absolutely correct, the drop on the entire circuit from (a) to (b) may be taken, and the sum of the first two readings compared with this and corrected accordingly. The test-wire may also be used for signaling to the station to notify the operator when the line is ready to be tested at the various points. I have never seen an auxiliary test-wire used in making such tests, and would like to get the opinion of some of your readers as to its practicability.

SHERWOOD F. JETER.

A Poor Piece of Engineering

EDITORS STREET RAILWAY JOURNAL:

Feb. 12, 1898.

In regard to the letter in January issue of the Street Railway Journal, I think it is no more than fair to the railway company upon whose premises the switch in question is located, to state that since my letter in your January issue was written, the switch in question has been replaced by a spring switch, which is normally closed to the shop spur. When a car is to be taken from the main track, it is necessary for some one to go to the front of the shop about 40 ft. from the switch, and there hold back a lever until the car has passed wholly on to the shop track.

This arrangement prevents one man from handling a car from main line to the shop, but it does not prevent a single hand from running a car out of the shop on to the main line, because then the switch opens upon passage of the car. This arrangement is even handier, and still as safe, as long as the spring does not break, as the arrangement illustrated in your February issue, by Mr. Alden, as there is not the trouble of drilling the car back and forth to get it on the out-bound track before it can pass to the shop track. An arrangement could be effected by the use of two spring switches whereby there need be no switching or throwing of levers in order to get a car in or out of the shop.

It would be arranged as follows: Run out of shop according to plan in February issue to the outer track over a spring switch therein, the spring switch being open to the shop track all the time, regular cars running in the usual direction merely spring the switch in passing. Another spring switch in the main track nearest shop allows cars being backed up in that track, to pass to the spur leading from the shop to the farther track. Cars then can be backed at all times, from the inner to the outer track, and backed direct from that track, or from its shop's spur, with a car on it from the inner track, directly into the shop. J. F. H.

Booster Connections

NEW YORK, Feb. 12, 1898.

EDITORS STREET RAILWAY JOURNAL:

In your February issue, under the caption "Ingenious Booster Connections," I notice a description corresponding so exactly to that of the booster installation which I introduced at the power-house of the Coney Island and Brooklyn Railroad Company, of Brooklyn, N. Y., last spring, that I judge it to be the plant referred to. I want to add to what Mr. Austin has remarked about the convenience and flexibility of this arrangement the further statement that when the load on the boosted section becomes too great for either the small outlying power-house or the booster alone, they can be operated together in multiple and the load can be properly divided between them by adjusting the voltage of both.

I have introduced this arrangement on a number of roads, and find that not the least among its advantages is the fact that it involves neither an investment for new machinery nor the disabling of any of the old for its ordinary duties when not required for boosting.

J. LESTER WOODBRIDGE.

Allowable Cylinder Compression in Engines

PORTLAND, ME., Jan. 26, 1898.

EDITORS STREET RAILWAY JOURNAL:

I have read with interest the articles of Dr. Emery on engines for railway work. The first article in particular attracted my attention, as some of the statements therein do not fully agree with the doctrines of some of our operating engineers. The Doctor says an engine cannot operate without a trifling amount of slack in its bearings. That is what my experience has been. Again, he says in another place, "to give the *necessary* cushion to bring the reciprocating parts gradually to rest at end of the stroke." For some time quite a discussion of this latter subject was carried on in "Power," under the title of "Compression," and one writer, signing himself "F. S. Johnson," makes the broad statement that excessive compression is wasteful. Later on he advanced the same ideas in "The National Engineer," and says: "I have seen a 26-in. by 48-in. simple condensing engine run without compression for over two years without keying," but does not say how far away it could be heard, what piston speed it made, the style of valve gear, or, still more, the work it was doing. Further, he says that excessive lead causes more "knocking" in engines than all other causes combined, and, continuing, remarks, "I am one of the few [and I think he might have said there are a few of us left] who believe the crankpin should stop the moving parts, and am opposed to the use of either cushion or compression. Pressure on the piston when engine is on the centre is simply a brake, and steam used to produce this pressure is not only wasted, but wastes part of the energy of steam gone before." All very good, but now comes his pet brag, slightly abbreviated, "Two engines sold for 500 h.p. develop several hours daily over 750 h.p. each. I have carefully experimented with them, and know they do the work with less steam, with little or no compression [somewhat indefinite] than with compression up to one-half or two-thirds boiler pressure. They are keyed as often as necessary—once in three or four months." He doesn't say what they are—"Corliss," slide valve, slow or high-speed, simple or compound. If the latter, he cannot avoid some compression (call it back pressure if you will) on the high-pressure piston, and if a tandem, he is safe. Now, isn't it too bad Dr. Emery didn't read Mr. Johnson's articles before setting forth his statements in October, '97, Journal?

In "Power," November, '97, appeared an article on compression signed "M. E.," which does not mean me, which treated the subject very clearly and concisely. His conclusions were that up to a certain percentage of piston travel, compression resulted in a greater efficiency. I think it was between 5 and 6 ins., but with an exhaust closure earlier or later the efficiency was less. We have still to hear from Mr. J. on this, which I trust he has duly read. Should this meet the eye of Mr. J., I shall be pleased to hear from him, and would he please let us see a facsimile of an indicator diagram from his ideal engine, for I think the profession might learn something from it, and surely he will not "hide his light under a bushel"? It has been my fortune, or misfortune, the past three years to run "Corliss" engines with widely and frequently varying loads, all being simple engines, single eccentrics, at times taking steam full stroke, again looping below atmosphere, according to diagrams taken. Now, I shall be greatly obliged if some one will kindly tell me how to adjust these engines to run quietly under all conditions with a constant initial pressure. I am at present running a double simple "Allis," 24 ins. by 42 ins., 74 revs., under conditions mentioned. With a fair load, they are not noisy, but suddenly the load goes off, then things are different, and we know there is an engine in the place.

J. M. CHENEY.

Tramway Matters in Paris

COMPAGNIE GÉNÉRALE DES OMNIBUS.

PARIS, Jan. 25, 1898.

EDITORS STREET RAILWAY JOURNAL:

Mechanical traction is developing more and more in Europe, and it will be very extensively adopted if the municipalities do not paralyze the efforts of the tramway companies by constantly increasing the burdens and restrictions under which they operate. It is astonishing to see the differences which exist in this particular between the transportation facilities on the two sides of the Atlantic

Ocean, and how in America private capital remains free, and the municipalities do not attempt to control it as in Europe. In the September issue of your paper one of the editors discusses this question of the influence of transportation systems on the development of cities. For their own sake the city authorities should not be allowed to meddle in the affairs of the tramway company. It will be impossible for them to gain the end which they seek, which is to give service to the public, for it is always for the interests of the tramway companies to provide this, and they can do it best when unhampered.

Traction by compressed air in Paris continues to give good results and, as your readers know, we have several lines, representing about 40 km., which employ this motive power. While the cost of operation is rather high, the railway company has a large power at its disposal, and it is always possible to add a number of trail cars, and thus diminish considerably the total cost of operating cars. It is also an undeniable fact that the service is an agreeable one, with neither smoke, noise nor heat, and for cities as populous as Paris, this is a great point.

As for electricity, it is well known that the trolley has been established in several French cities. In Paris, the municipal government continues to oppose its introduction, fearing for the aesthetic appearance of the streets. However, we hope it will be permitted in the outlying districts. Accumulator traction continues to make progress, and I have read in the German papers that the most serious difficulties have been overcome.

In a work which has just appeared, written by an engineer, Mr. Godfernaux, on "Mechanical Traction," the statement is made that the cost of traction by trolley is .484 fr. per car km., and that by accumulators .47 fr. I confess to you that I am very much astonished by these figures. It seems to prove, first of all, that those who are operating the different systems do not use the same bases for determining the cost of operation. This is why there is only one means of knowing the truth, and that is to employ one's self the different systems and so determine the real cost. This is what the companies ought to do, and we are going to undertake the experiment for our own satisfaction. We expect to establish electric lines operated by both accumulators and trolley, if we are permitted to do so.

We have continued our experiments with steam motors —that is, the Serpollet, the Rowan system and a new system called the Purrey, which seems to give satisfaction.

Important improvements have been made in the Serpollet system, and these machines are certainly desirable for tramway service. They are most economic from the fact that they do not require in their installation a high expenditure, and since they can operate in any direction desired without depending on a wire or a central station.

E. J. LAVALARD.

White Washing and Color Washes

BY J. F. HOBART.

Ordinary whitewash is such a commonplace article that it is apt to be despised by the station engineer and car house foreman, and not given its proper value in building operations. For the finishing of rough stone walls, and the lighting of dark passages in a car house, the wash is of great value. It can be made in such a manner that it will last for years if applied for a protecting covering in the place of paint, and deserves more than it gets

One of the best whitewashes consists of the best quality of unslaked lime (air-slaked will not do), slaked with warm water, using just enough of water, and no more, to keep the lime from burning. Do not drown it under any circumstances. After the lime is slaked, reduce to a thin wash with water, but do not have it pasty. If put on too thick, the wash will not penetrate, and after several coats have been applied will flake off.

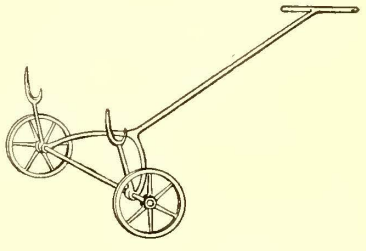
For treating a very rough wall, mix some salt and ashes with the first coat. Mix salt alone with the succeeding coats, and it will stay if put on thin. Where a pure white is required, it may be obtained by mixing a little blue with the wash. Ordinary laundry blue will answer, but any dry blue may be used by first mixing it with a few drops of water, then reducing to a thin consistency and mixing well with the wash.

Any color of wash may be obtained by mixing in the proper pigments, using the above described wash as a base. A cream color is obtained by adding yellow ochre; pearl or lead color, by the addition of lampblack. For fawn color, use raw umber, Indian red and lampblack. For stone color use only the raw umber and lampblack. A delicate peachblow is obtained by adding a little red lead, and shades are obtained by mixing the above ingredients.

Lampblack is of so greasy a nature when dry that it is hard to mix it with whitewash so that some of the black will not float on top in little lumps, which give a darker color than is desired when they are rubbed out with the brush. To prevent this, slake a little lime in just as little water as will make the lime fall into powder when slaked. Some of the lime thus prepared should be rubbed up with the lampblack while dry. The lome seems to destroy the greasy nature of the lampblack, and the mixture may then be easily worked into a paste with a knife and a little water, after which the paste thus made will readily diffuse itself through the whitewash. It should be added little by little until the desired tint is reached.

An Ingenious Form of Armature Cradle

The accompanying engraving shows a novel form of armature cradle or truck employed in the Glenwood shops of the United Traction Company, of Pittsburg. The special feature of this truck is that it is equipped with projecting forks or rests, so that it will pick up armatures when the latter are resting on the floor, saving in this way the labor of raising the armature by hand or tackle. The armature can then be drawn to any point desired in the repair shop. The truck is simple in construction, and can be made by any blacksmith. The handle is about 5 ft. in length.



ARMATURE CRADLE

The United Traction Company is also employing an efficient kind of sand-box hose hope. The usual hose, of course, is of rubber, and is satisfactory in warm weather, but in winter often becomes clogged by frozen mud. In place of rubber hose, the United Traction Company is using a tube of coiled steel wire, which, naturally, is just as flexible as rubber, and has the additional advantage that when it becomes clogged it can be stretched three or four times by the hands, which breaks up any lumps of frozen mud which it may contain. The tube is japanned to prevent rusting.

STREET RAILWAY JOURNAL

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

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

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

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

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The Secretary of the American Street Railway Association has announced that the headquarters of the Association during the Boston Convention will be at the Hotel Brunswick, and has issued a circular giving details in regard to the hotels in the city and as much of the program of the convention as has now been decided upon. The convention at Boston promises to be most successful.

The advantages of consolidation in the economy of current generation are being shown already in Philadelphia. The several stations which were built by the different companies existing before the consolidation are being tied together by feeders, and it is thought that considerable reduction in fuel consumption will be secured by this step. It is interesting to note that in the reconstruction of the power station at Thirteenth and Mount Vernon Streets, which was destroyed by fire last year, natural draft is being substituted for forced draft.

One of the most remarkable instances in the growth of industries in this or any other country is that of steel rails in America, of which product a very considerable percentage is that of rails for street railways. Recent statistics show that the output of street railway rails has increased from 7720 gross tons in 1879 to 145,210 tons in 1896. The record year was 1895, in which 163,109 tons were produced from our mills, as compared with 81,302 tons in 1891, 44,951 tons in 1888, and 17,357 tons in 1883.

A coronor in Cleveland has charged the trolley with a new evil—that of producing appendicitis. We have heard of other objections raised to it, but this is the first time that this charge has been brought against the modern electric car. It is needless to say that the leading physicians in that city and elsewhere do not attach any weight to this proposition, and all the statistics that are available show that motormen and conductors on electric cars are as free from this trouble as any other body of men.

When we consider the extent of the electric railway industry, it is hard to realize that it is only a decade old. It was just ten years ago last month that the historic electric road at Richmond, Va., was put in operation by Frank J. Sprague. Although not the first electric road to be built in this country even by Mr. Sprague, this line was the first to show that the electric system was electrically and financially practicable for a city service. Few who did not take part in the early experiments at Richmond or elsewhere can realize the many problems which had to be solved, and the little data existing upon which to base proper practice. Some mistakes were undoubtedly made, but the wonder is that they were not more numerous, and that many of the principles of electric railroading, as it is now understood, were even then given their proper value.

The important announcement was made last month that the Brooklyn Elevated Railway Company had decided on an electric railway equipment, had ordered its apparatus, and that one of its lines will be in operation electrically by June 1. Heretofore the city of Greater New York has been in the rear of Chicago and Kansas City, so far as the use of improved motive power on its elevated lines is concerned, but according to the plans outlined the equipment of the Brooklyn elevated road will be modern in every respect, and among other features will use the multiple unit system of car operation. It is hoped that the improved service given by the electrical equipment will be the means of bringing about an understanding between the Rapid Transit Commission and the officials of the Manhattan Elevated Railway of New York, by which the latter will be granted the right to construct its extensions as proposed. This, it is supposed, is the principal reason for delay in equipping the latter line with electric power.

The cars of the several Brooklyn trolley systems are now operating successfully over the Bridge to New York, and their popularity is so great that the demand has already risen for better terminal facilities. This is a good indication of the wisdom of the surface companies in Brooklyn in extending their lines across the Bridge to the New York City Hall. The financial results to the Bridge property, and

also to the railway companies, are yet to be determined, but the operation of the cars will undoubtedly add many inhabitants to Brooklyn, as the through fare from that borough to City Hall Park, New York, has been reduced 33⅓ per cent. President Rossiter estimates that the patronage of every new family that settles on the lines of his company is worth $35 a year to it, so that the added expense of carrying the passengers to and from New York will be more than made up, it is thought, by the increase in other directions. Some of this increase in population will undoubtedly come from the Borough of Manhattan, but the greater part will undoubtedly be drawn from New Jersey.

Readers of the STREET RAILWAY JOURNAL will find in this month's issue an extended account of the proposed underground railway in London. This is the most important electric railway now being constructed in Europe, and probably in the world, and through the similarity of its conditions, as mentioned elsewhere, to the proposed rapid transit railway in New York, will possess a peculiar interest to American engineers. Many novel features are involved in the construction of this line, but none will possess a greater interest to the average railway engineer in this country than the distribution system. The question of adopting the three-wire 600-volt system of distribution, or a 500-5000-volt, three-phase distribution, with rotary converters, was carefully considered, and the losses by the two methods, as calculated by the engineers, are diagrammatically represented in the article. It is interesting to note that the latter system was adopted, although the line is but 6¼ miles in length. Greater economy is secured by it, however, as in its employment the maximum drop on the service line is but 1.6 per cent, an important feature in a line of this character. It seems, probable, also, that the possibility of future extensions must have had considerable to do with the selection of the three-phase system, as its advantages naturally increase with the size of the system served. While in general the system of distribution will be similar to that adopted by the Metropolitan Street Railway Company of New York, the generating units will be much smaller—850 k.w., as compared with about 2400 k.w. in the latter city.

The most important problem in the operation of a street railway system is undoubtedly that of the relations of the management to the employees. Many different theories upon this subject prevail, and undoubtedly many methods which are applicable under one set of circumstances would be unadvisable under others, but it is undoubtedly true that the management of large bodies of men is a gift which men possess in different degrees. It is in this respect more than in any other that the electric railway industry differs from the electric lighting industry. In the latter there is no large body of employees which is brought into constant contact with the public and that industry is not therefore complicated by the problems which this condition entails. The introduction of electric power has undoubtedly brought into the railway service men of a much higher grade, intellectually, than when horses were used as a motive power, and the efforts to produce an esprit du corps among the employees of a company is growing. Thus, a number of lines, as already mentioned in the JOURNAL, have adopted with satisfactory results the military system of awarding honorary stripes for service of different lengths of time with the company, while others possess a regular civil service system of promotion and discipline. The practice of offering rewards to conductors and motormen who have shown an immunity from accidents during a certain period is also on the increase. Among those who have tried this latter course is the New London Street Railway Company, whose treasurer reports that he believes that this practice has effectually prevented accidents. The bonus paid to each conductor or motorman on that road in this way has been in the neighborhood of $15 per year.

Another excellent method of increasing the efficiency of the motormen and conductors is undoubtedly that of holding periodic examinations, asking both classes of the service to give written answers to a series of inquiries relating to their understanding of the different duties pertaining to their positions. A set of questions of this character presented to the motormen and conductors of the Union Depot line of St. Louis was published in the last issue of the STREET RAILWAY JOURNAL, and in a recent letter the General Manager of that line states that a very large percentage of the employees secured an average of over 90 per cent in their answers, and that the average of the entire force was very high. It is easy to see a number of advantages to both the railway company and the employees in examinations of this kind. It enables the latter, first, to realize just what the different rules formulated by the company mean, and, what is more important, it makes them appreciate their own possible deficiencies, because a man often does not realize that he does or does not understand any specific proposition until he attempts to define it in writing. The advantages to the managers of the railway company are equally important, and do not consist only in knowing what employees are unacquainted with the rules, but it enables them to learn the construction which is placed upon different regulations by the employees whose duty it is to carry them out, and shows them whether any rule is so worded that its meaning is so obscure as to be misunderstood by any considerable number of their conductors or motormen. The very fact also that both management and men have to rehearse on paper, at intervals, the duties of the latter teaches both whether the rules are up to date and whether all the exigencies which may arise in the service are covered in the book of instructions completely and in the best possible way.

Not quite a year has passed since a few of the most progressive and enterprising accountants connected with street railway interests met together in Cleveland and organized what is called the Street Railway Accountants' Association of America. The gathering was a pronounced success, and the enthusiasm of its members and the large amount of good work that was accomplished at the initial meeting demonstrated beyond a doubt that there was excellent reason for adding still another to the considerable number of business and technical organizations of the country. Working committees were appointed and the date of the first regular convention was fixed—to be the same as that of the American Street Railway Association, and to be held at the same place. The proceedings of the Niagara Falls convention are known to all our readers, for they were presented in careful detail upon these pages, together with special articles relating to some of the subjects discussed. Since the adjournment of the convention

the work has still further progressed. Not only have there been important accessions to the membership of the Association, but a number of representative street railways have marked a special point in the history of their progress and development by formally adopting, under date of Jan. 1, the standard system of accounts indorsed and recommended by the association. All these things are matters of history which have been duly recorded in our columns as they have occurred. We refer to them only for the purpose of furnishing the reader a comprehensive view of the situation as it is at present and as an appropriate introduction to the pertinent suggestions which follow.

There is no improvement so likely to secure additional economies in the conduct of a street railway enterprise as the introduction of an efficient, up-to-date system of accounts. By this we do not mean that all street railways are deficient in this regard, for we know that many of the companies have excellently manned and very thoroughly administered accounting and auditing departments. But however efficient the systems in use by these companies may be, it is still possible to improve them. There is no more likely road to ultimate perfection than a comparison of notes by those who are actively responsible for the accounting work. However, it is not the righteous but sinners who are called to repentance and to the bringing forth of good works. Therefore we address our remarks particularly to those who have not got in use at present the "best" system. There are numerous companies throughout this broad land whose accountants are doing the very best they can, who are working up to the limit of their experience, but who fall short of being in the front rank in their records and statistics simply from lack of knowledge. All such companies will profit by the work of the Accountants' Association, if they will put themselves in position to reap its benefits. Their accountants would do better if they had broader experience, and they would also improve if they were permitted to come in contact with those who have experience and are willing to contribute of it for the benefit of their fellows. Broadly, we contend that both classes, first the companies with efficient systems, and second the companies with poor and insufficient systems, will profit by co-operation with and membership in the Accountants' Association. The expense is not large, and the reflex influence upon the accountant or auditor of the company, from merely attending the annual gatherings, thereby obtaining a perspective view of his own office, would in itself amply justify the outlay. The benefits, however, are sure to be of a more positive character. They include everything that usually attends associated effort. It is scarcely necessary, we think, to argue the value of association, nor yet the advantages of interchange of thought; and it is safe to assume that the same kind of benefits will follow from the accountants getting together as attends the corresponding efforts of engineers, of electricians or of railway managers.

How to Make Small Street Railways Profitable

The problem of wringing an adequate profit out of small street railroading in the United States is a difficult one, as many companies, formed with high hopes, in the first flush of the electric railroad era, have found to their sorrow. In small cities and towns, particularly where there are no extensions to neighboring population centres, the struggle has been in many cases an almost hopeless one from the beginning, and there is no possibility of success for not a few companies so situated. Nevertheless, there are others which, with skillful management, might be made profitable.

The first and greatest difficulty is that of securing traffic. "Small cities" are usually small not only in population, but in area, and consist of business centres surrounded by residence districts. Their street railway systems generally consist of a number of short lines radiating from the business district—lines so short that people do not really need to ride in ordinary weather, and particularly if the time intervals between cars is long.

For small locals systems of this kind, we believe that the cars should be run at high speed, and very frequently, at least during the busy hours of the day. Conductors should be dispensed with, and some form of fare box adopted, but one or more thoroughly trusted men should be employed whose business it should be to ride constantly on the cars throughout the day, checking up passengers and fares. Special inducements for riding at other than the busy hours of the day should be offered whenever possible, and for this purpose some form of amusement resort would probably be profitable in many cases. Every effort should be made to serve the public to its own complete satisfaction, to keep the cars clean and bright, to uniform employees and to give an appearance of "smartness" which will attract travel. At the same time the equipment must be used to the greatest possible extent. In most cases 200 miles per day per car would not be an excessive service, and schedule speeds of 10 to 12 miles per hour are necessary if time is really to be saved to the company's patrons. This will, of course, cut down the operating expenses to a very low figure per car mile and thus the earnings per car mile need not be large, while traffic would be much more likely to follow this quick and frequent service than if more shortsighted economies in other directions were adopted.

In a great many places the salvation of the enterprise depends upon a real or virtual consolidation with the street railway system proper of every other enterprise in the least degree kindred to it, such as, for example, the furnishing of electric light and power throughout the city, of steam for heating purposes in the business district, and the performance of every service required in the town which would tend to give full employment to station labor.

Above all, the "railroad" idea should be subordinated to the "business" one, and no attempt should be made to perfect an elaborate organization involving the payment of unnecessary salaries and wages. The owner or owners of the railroad should handle the business as they would handle a store, making themselves popular by giving the best possible service in the most economical way, and at the lowest possible price. The conductors, motormen and other employees should be made to take an active interest in the company's prosperity—perhaps by some method of profit sharing—and we are by no means sure that, in these smaller places, where "everyone knows everyone else," it would not be possible to get the "gilded youth" of the town practically interested as apprentices in electric railroading, all to the end of making riding fashionable and bringing about a friendly intimacy between the public and the company.

Central London Underground Railway

Perhaps the most important electric railway now in actual course of construction on either side of the Atlantic, and one of the most interesting from an engineering standpoint, is the deep tunnel underground road of the Central London Railway Company. This will serve a district in London in general characteristics curiously like that served by the Broadway and Columbus Avenue lines in New York City. At one end is the great financial section of London—Lombard Street and the Bank of England, corresponding to the Wall Street section of New York. Passing thence westward the line serves Cheapside and the General Post Office, a partly wholesale, partly retail district; Holborn Viaduct and High Holborn, the latter the seat of the great bicycle and typewriter houses and others similar to what are found in the district on Broadway in New York, immediately above the post office; the great shopping and theater neighborhood of Oxford Street, Regent Street and others corresponding to the district between Fourteenth and Forty-second Streets in New York; Hyde Park, the "Central Park" of London; Queen's Road, Notting Hill Gate and Holland Park, residential sections which are much the same in character as the upper west side in New York; and Shepherd's Bush, which is comparable to the Harlem District.

It is certain, therefore, that this new underground road of London will be watched with peculiar interest by Americans, and particularly by New Yorkers, on account of the bearing which its success or failure, from a financial and engineering standpoint may have upon the long talked-of underground rapid transit line in New York. The possibility of drawing interesting comparisons between these two roads in the two cities may be still better understood, when it is said that the Central London line bisects the area now served by the Metropolitan (underground) District Railway, which runs along the "inner circle" of London on routes similar in some respects to those taken by the Manhattan Elevated Railway lines; while on the surface of the street immediately above this new line is a frequent and reasonably rapid omnibus service, far less important, of course, as a competitor, than are the Broadway cable lines, but still popular and with low fares.

A contract for the construction and equipment of the Central London Railway has been placed with the Electric Traction Company, Ltd., a company organized especially for carrying out this work, for a sum slightly less than £3,250,000, this to cover construction of the main station tunnels and subways, track, rolling stock, power stations, distributing circuits, elevator plants and all other equipment features. The entire road is to be 6¼ miles in length.

A preliminary description of the Central London Railway has already appeared in the STREET RAILWAY JOUR-

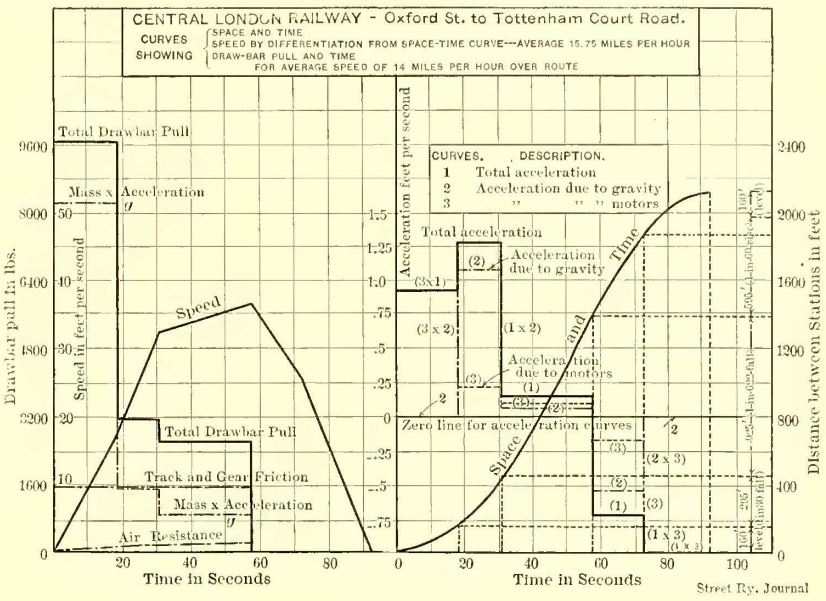


FIG. 2

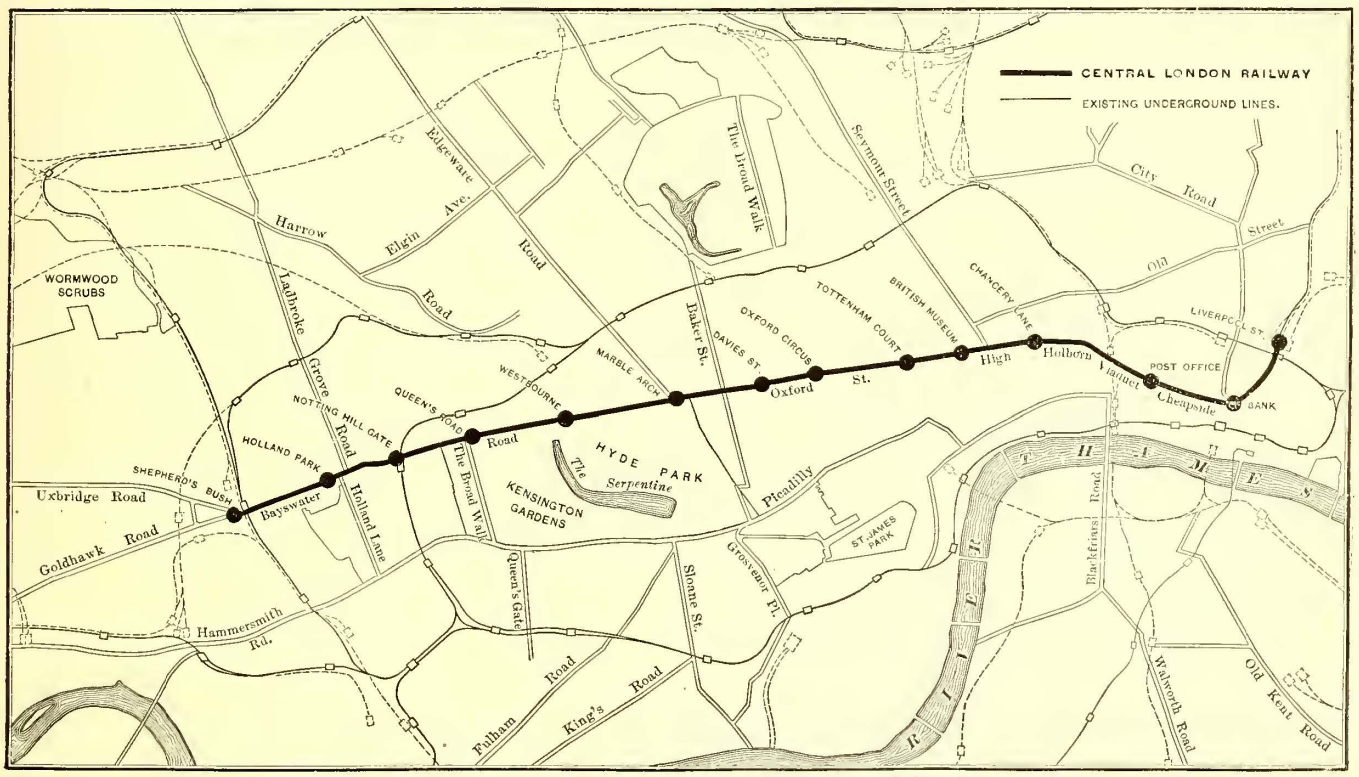


FIG. 1—MAP SHOWING ROUTE OF CENTRAL UNDERGROUND LONDON RAILWAY

NAL (July, 1897, page 423), and from this a general idea of the tunnel construction, the subways and the stations may be obtained. The map of the road there given is reproduced here for the convenience of reference.

The subcontract for the complete electrical equipment of the road was awarded in August, 1897, by the Electric Traction Company, Ltd., to the British Thomson-Houston Company, as a result of the submission of most careful and elaborate plans for equipment by this and other of the principal electric manufacturing concerns of the world. H. F. Parshall, consulting engineer of the British Thomson-Houston Company, designed the main and detail features of the electrical equipment, and his plans were approved substantially in their entirety by the engineers of the Central London and Electric Traction Company, Ltd. Readers of the STREET RAILWAY JOURNAL may now obtain for the first time a thorough understanding of the most important mechanical, electrical and engineering problems met with in laying out the generating, transmission and motor conversion systems—problems which have been attacked along bold, novel and yet highly conservative lines, and in a manner worthy of the able engineering talent employed.

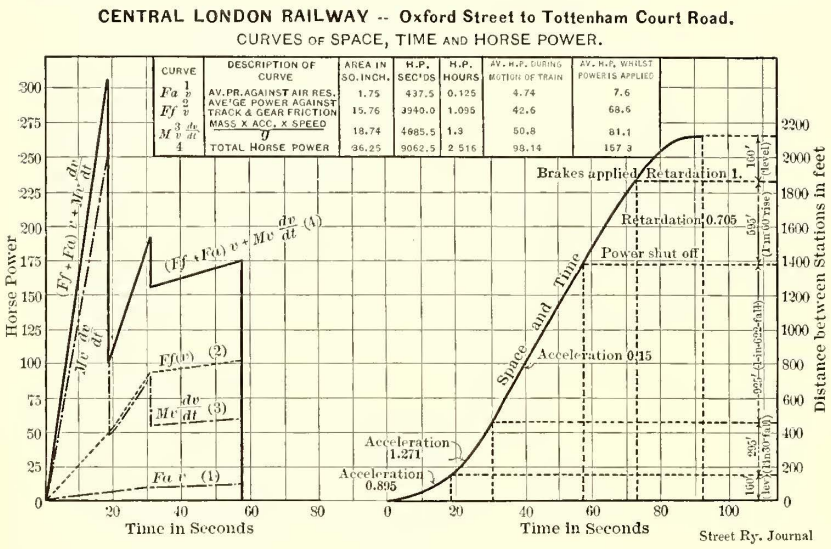


FIG. 3

CONDITIONS OF TRAFFIC AND LOAD.

It is intended to employ thirty-two locomotives in regular service, each drawing a train of seven carriages, a total seating capacity per train of 336 passengers, and weighing 105 (long) tons loaded, exclusive of the locomotive. The average speed of the trains is specified at 14 miles per hour, including twenty-second stoppages at each station, and this necessitates a maximum speed of 30 miles per hour. A $2\frac{1}{2}$-minute service is to be given at first, and if the traffic requires it a 2-minute service later on, and it was required of the engineers that they should provide for the more frequent service in laying out the plans.

In order to minimize the power requirements, the novel and ingenious expedient was devised by Sir Benjamin Baker, consulting engineer of the Electric Traction Company, Ltd., of running the tunnel, not on a dead level, as usual, but with a series of down and up grades between the stations, in such a way as to allow gravity to materially increase the train acceleration on leaving a station, and to increase the braking effort on arrival at the next. By this plan the power called for is estimated to be about 33 per cent less than the requirements with a level road.

The position of the stations and their distances apart, measured from center to center of the platforms, are approximately as follows:

Shepherd's Bush to Holland Park....	1,012 yards
Holland Park to Notting Hill Gate....	683 yards
Notting Hill Gate to Queen's Road....	768 yards
Queen's Road to Westbourne Park....	986 yards
Westbourne Park to Marble Arch.....	1,288 yards
Marble Arch to Davies Street.....	642 yards
Davies Street to Oxford Circus.....	499 yards
Oxford Circus to Tottenham Ct. Road	666 yards
Tottenham Ct. Road to British Museum	682 yards
British Museum to Chancery Lane...	746 yards
Chancery Lane to Post Office.....	1,163 yards
Post Office to Bank.....	828 yards
Total	10,163 yards

ESTIMATED POWER CONSUMPTION.

The first step in the engineering calculations was the determination a priori for the average power per train required for this service. A series of curves similar to those shown in Figs. 2 and 3 was plotted for the runs between each pair of stations on both up and down lines. These curves take into account all conditions necessary for the fulfilment of the required schedule time, and from the entire series of such curves an accurate estimate of the average power per trip can be obtained. Between the Oxford

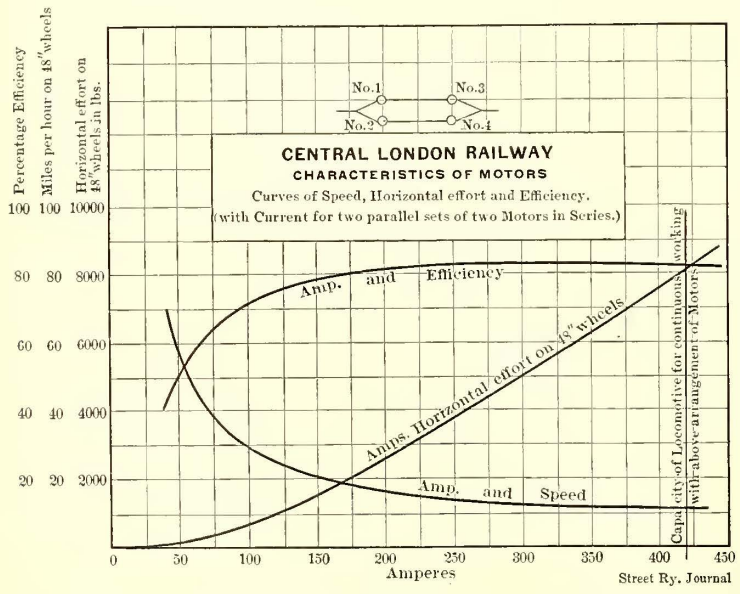


FIG. 4

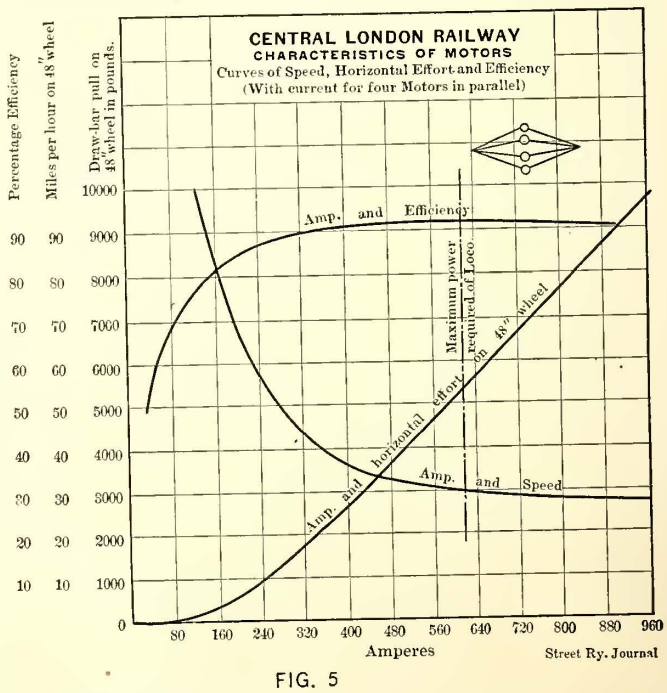


FIG. 5

Street and the Tottenham Court Road Stations, for example, it will be seen from Fig. 3 that the power required to overcome the air resistance—a considerable factor in tunnel work—amounts to .125 h. p. hour; the traction requirements are 1.045 h. p. hours, and the requirements for acceleration are 1.3 h. p. hours, making a total of 2.516 h. p. hours. This is the equivalent to an average of 98.14 h. p. during the time when the train is in motion, or of 157.3 h. p. during the time that power is actually taken from the station. The proportions of the accelerating and retarding forces, due to gravity and to the motors, are also shown by the curves in Fig. 2.

REQUIRED CHARACTERISTICS OF MOTORS.

The next step was to determine the general nature of the characteristic curves of the motors to be employed on the locomotive, in order that proper specifications might be issued to the manufacturers. These curves are shown in Figs. 4 and 5, Fig. 4 showing the curves of speed, of horizontal effort, of efficiency and of current for two parallel sets of motors each with two in series; and Fig. 5 showing the characteristic curves when all four motors are in parallel and the locomotive is exerting its maximum power.

THE LOCOMOTIVE.

The type of locomotive now building in the shops of the General Electric Company, at Schenectady, on the lines indicated by these curves, and in accordance with the specifications of the British Thomson-Houston Company, is shown in plan and elevation in Fig. 6. It was originally intended that the locomotive itself, exclusive of the electrical equipment, should be built in England, but the English manufacturers, with the great engineering strike on their hands, were too busy to carry through the necessary special work in time for the requirements of the road, and the contract for the thirty-two locomotives complete was placed with the General Electric Company. The main characteristics of these locomotives are as follows:

Distance between wheel centres of each truck, 5 ft. 8 ins., and 6 ft.

Distance between the two truck centres, 14 ft. 8 ins., and 14 feet.

Number of wheels (all driving), eight.

Diameter of wheels, 42 ins.

Total wheel base, 20 ft. 4 ins., and 20 ft.

Total length of locomotive, 29 ft. 8 ins., and 28 ft.

Total height of locomotive, 9 ft. 4½ ins., and 9 ft. 8½ ins.

Weight of each wheel, about 5 tons.

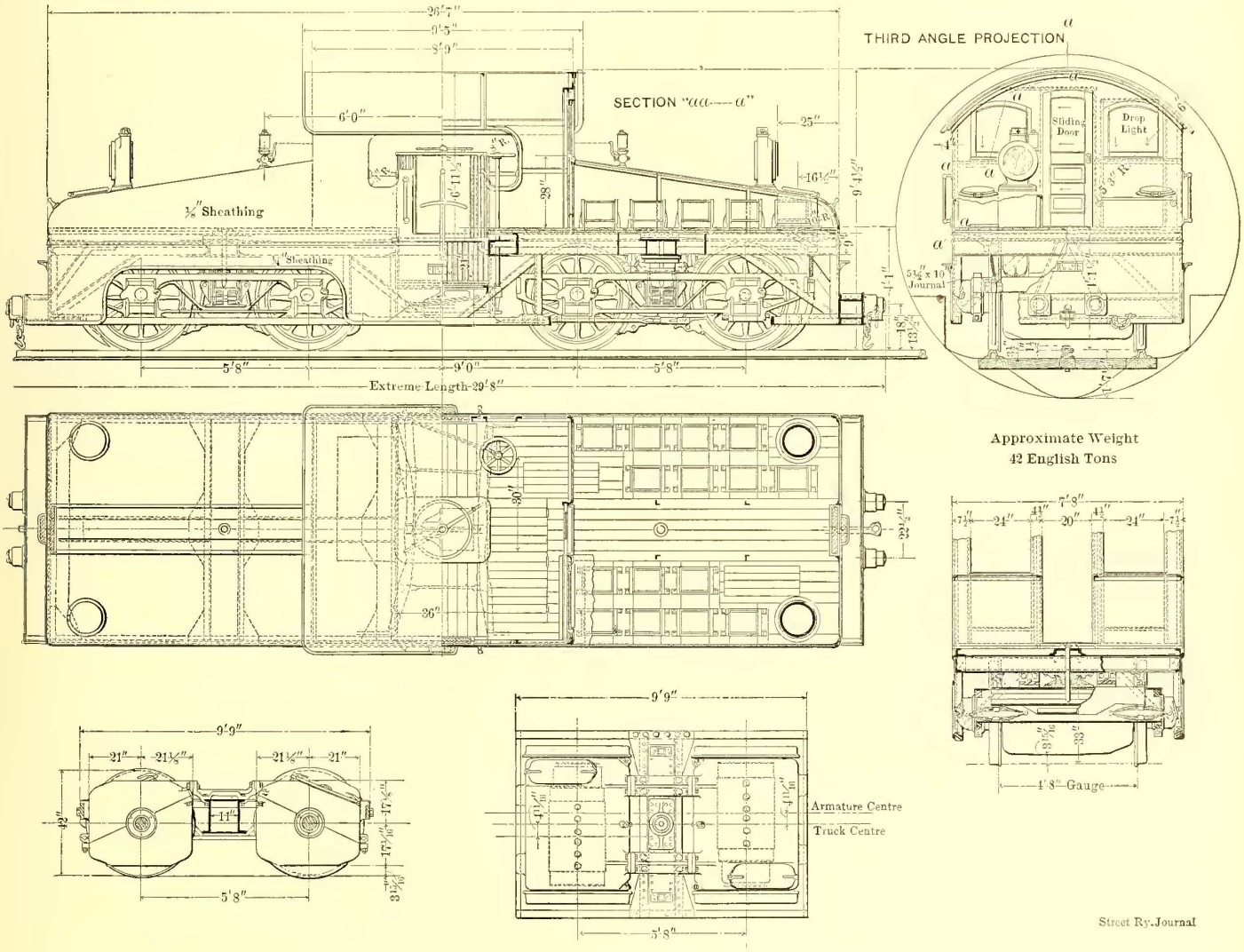


FIG. 6.—ELECTRIC LOCOMOTIVE—CENTRAL LONDON UNDERGROUND RAILWAY

Total weight of locomotive, about 42 tons.

Maximum draw-bar pull required at starting, 14,000 lbs.

Draw-bar pull running at 22 miles per hour, 8,000 lbs.

Weight of each motor frame complete, with field coils in place, 6,500 lbs.

Weight of the armature complete with sleeve and conductor, 2,500 lbs.

Total weight of motor, 12,000 lbs.

Inspection of the locomotive drawings will show how ingeniously the various mechanical difficulties have been overcome. To design a locomotive of so large a power within the space limits of an 11-ft. 6-in. tunnel is no light task, and the final plan adopted is the result of the com-

bined experience and designing ability of H. F. Parshall, of the British Thomson-Houston Company, the engineers of the Electric Traction Company, Ltd., and the engineering staff of the General Electric Company.

The truck wheels are spanned by cradles of mild steel,

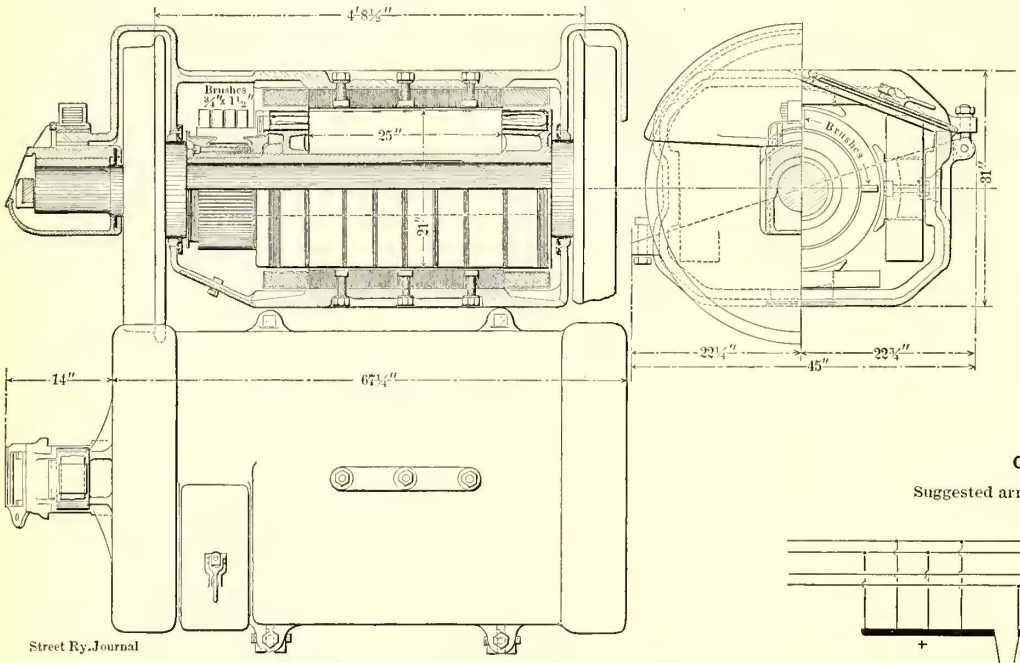


FIG. 7.—THE MOTOR—CENTRAL LONDON RAILWAY

which rest on the axle-boxes and carry the bearing springs on each side of the truck, the truck frame itself resting on the spring. The axle-boxes are of bronze and work in cast steel guides attached to the truck frame. The latter is of mild steel, the side frames and cross members firmly riveted together. The main locomotive frame is constructed of mild steel beams, with longitudinal cross-beams and bolsters firmly riveted together. The latter rest upon and are connected with the trucks below by centrepins and plates. Besides the supports at the centres of the trucks, the main frame is further sustained by side bearings over the springs.

The cab is built upon the main frame and consists of a frame-work of angle-iron plated up with 8-in. wrought iron plates. The cab structure slopes off at each end downwards to the buffer beams, to allow of an extended range of view for the driver from the cab proper in the middle. Trap doors are provided in the flooring of the cab over the motor. The wheel centers are made of wrought-iron and consists of hubs, spokes and rims, all carefully forged and with joints thoroughly welded together; the wheel rims have steel tires shrunk on at a low heat, and further held in place by fastening rings. The axles are of mild forged steel, 6 ins. in diameter in the middle and 4½ ins. diameter at the journals. The axles are pressed into the wheel seats, with a (hydraulic) pressure of 50 tons.

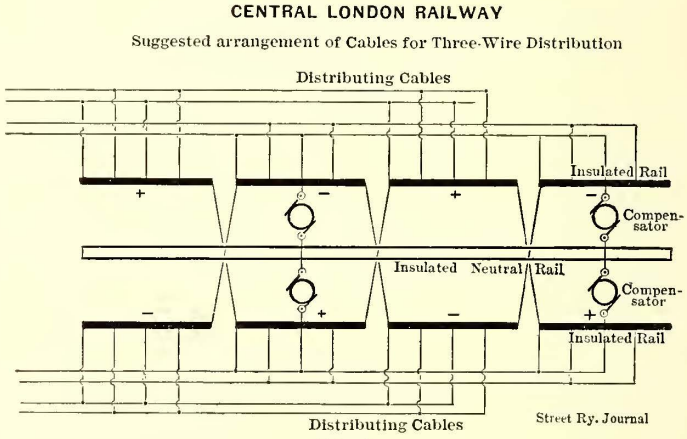


FIG. 8

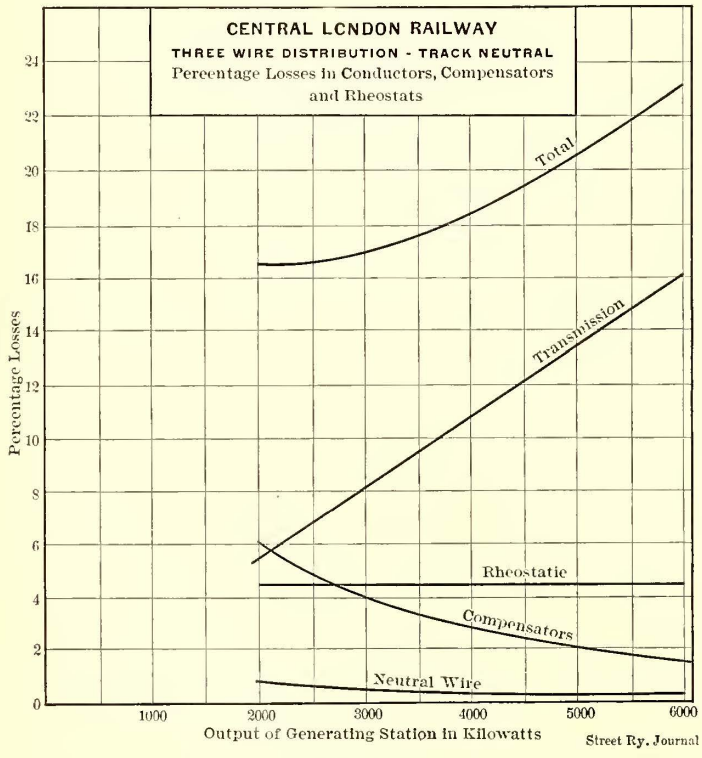


FIG. 9

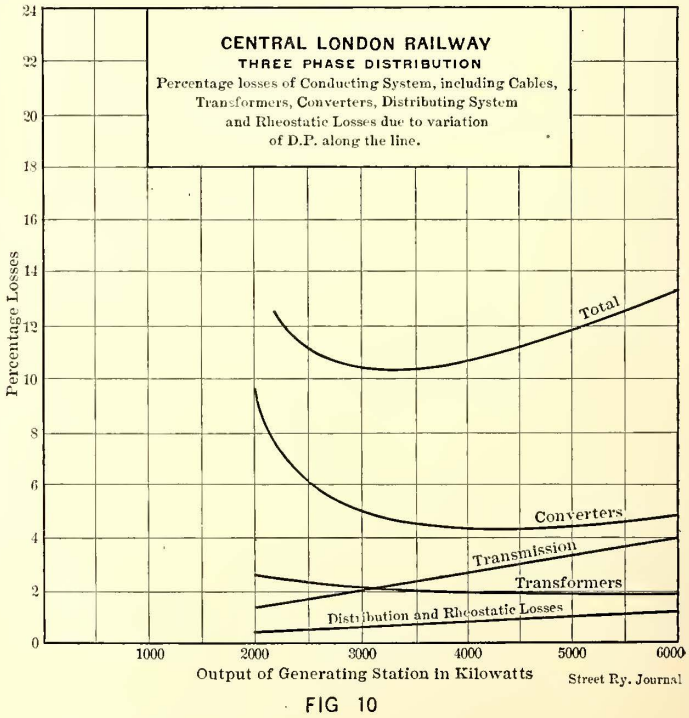


FIG 10

Current is taken from the third rail by means of two contact shoes placed one at each end of the main frame, by means of which the circuit will not be broken at points and crossings. A voltmeter and ammeter are placed in each cab. The circuit is closed through a combined switch and circuit breaker. The locomotives are furnished with sand-

boxes and the necessary hand gear for operating them. A whistle is provided for signaling, and is operated by compressed air taken from the brake reservoir.

The motors are each required to furnish a draw-bar pull of 2,000 lbs., with 40 in. wheels at 22 miles per hour, when 500 volts are at the terminals, and they must give out not less than 65 tractive h.p. at the rim of the wheel at a speed of 27 miles per hour, with a power expenditure of not more than 123 amps. at 500 volts. The maximum current density in the motor is not to exceed 1500 amps. per sq. in. at any speed above 15 miles per hour. All insulation is required to stand a test of 5,000 volts alternating current. The motors are of the G. E. 56 type, recently designed for this class of service by the General Electric Company, and are shown in Fig. 7.

It is expected that the efficiency of the locomotives will rise to a maximum of between 92 per cent and 93 per cent and that the temperature of the circuits will not rise more than 90 degrees F. on a two hours' run with full load. The performance of the motors, with the 48-in. wheels originally proposed, is specified to be equal to that shown in Figs. 4 and 5.

For the control of the locomotive a series parallel controller of a new type, and provided with a magnetic blow-out, will be used. This will place the four motors (a) in series, (b) two in series and two in parallel, or (c) all four in parallel, as desired.

The trains will be fitted throughout with the Westinghouse air-brake.

DISTRIBUTION CIRCUITS.

Given the profile of the road, the desired frequency of service and the average power requirements per train, the next problem to be solved is evidently the design of the distribution circuit. Here there was a decided difference of opinion among the engineers called in to deal with this problem, several advocating a 3-wire 600-1,200 volt direct current system, while the engineers of the British Thomson-Houston Company advocated a 3-phase 500-5,000 volt transformer system. In order to finally determine the relative economy of the two systems for a given expenditure of money, Mr. Parshall prepared a series of curves based upon experience with both systems and with the machines it would be necessary to employ in each. These curves are shown herewith. Fig. 8 is a proposed diagram of connections for a three-wire system with insulated neutral rail. This system, as planned, has a certain advantage over the transformer system, in that with

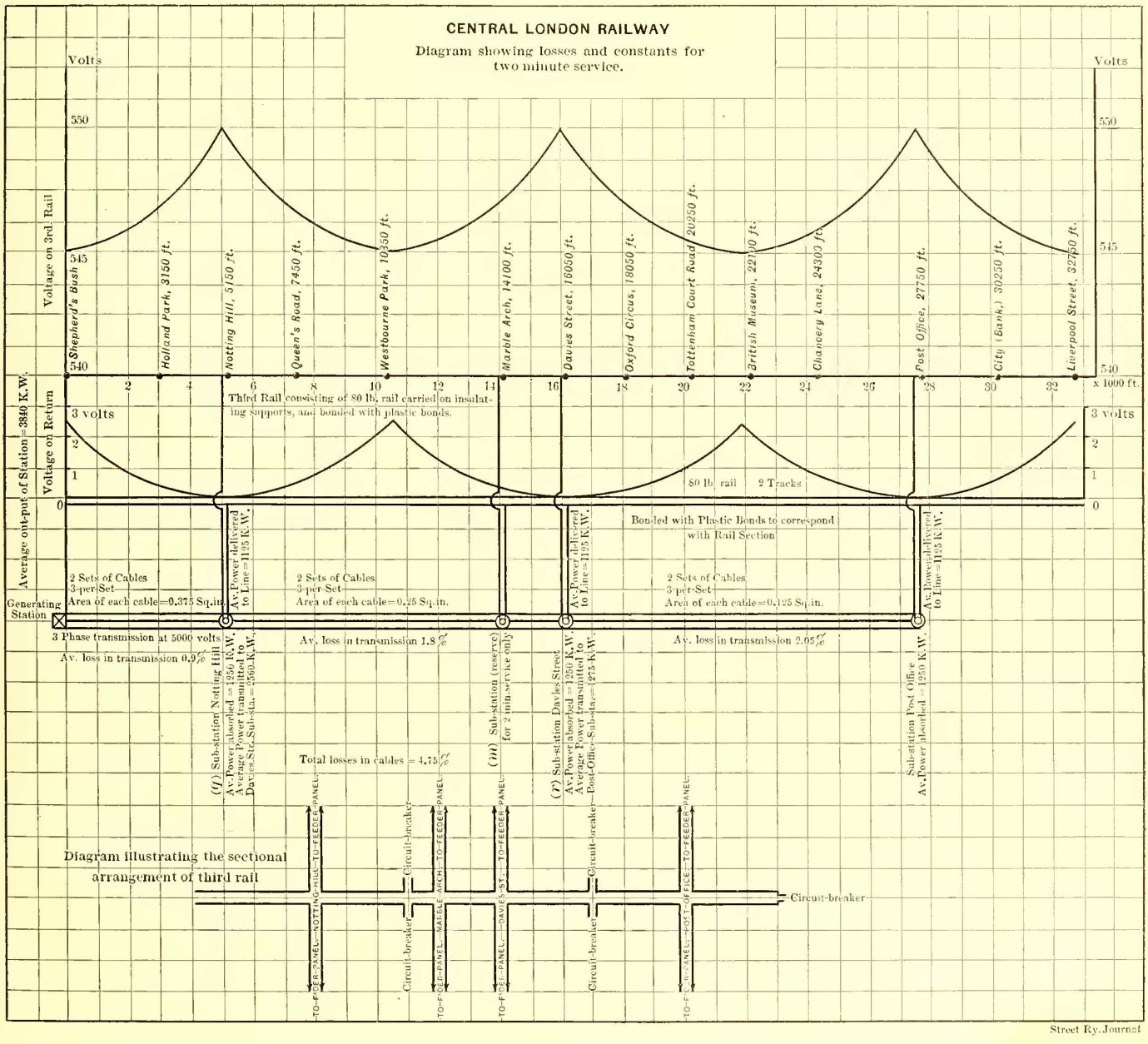


FIG. 12

the former it was proposed to feed the line at 600 volts, and in the latter at 500.

Figs. 9 and 10 show the curves of the calculated losses in detail in each of the two systems, and in Fig. 11 the total losses are shown in direct comparison. The much greater drop on the line necessary with 3-wire distribution entails large losses in the controller rheostats as well,

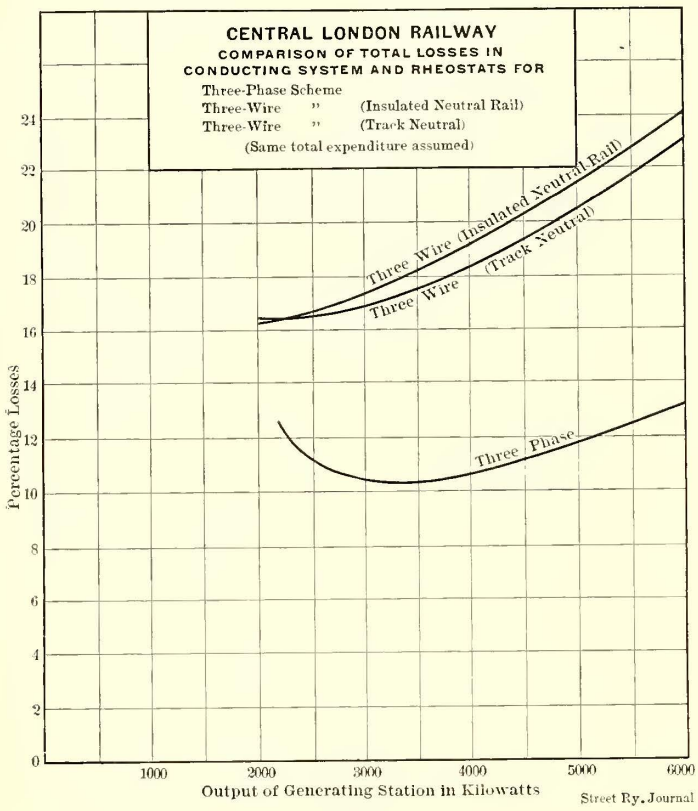


FIG. 11

since the motors must be capable of fulfilling the schedule time with the minimum voltage available, and must, therefore, in practice, waste in the rheostats anything above this. The transmission loss is, of course, much greater with the 3-wire system than with the transformer system; but, on the other hand, the combined losses in the converters and the transformers is greater than the combined losses of the compensators and the neutral wire of the 3-wire system. The relative economies of the two systems are as a whole (Fig. 11) largely in favor of the transformer system, and Mr. Parshall's plans were finally approved by the engineers of the Central London and Electric Traction companies.

In the practical working out of these plans, the circuits are designed as shown in Fig. 12. The generating power station is at Shepherd's Bush, the extreme western end of the line, and at Nottingham Hill, Davies Street and the Post Office are three transformer sub-stations, which receive current from the feeders at 5000 volts and deliver it through the transformers and rotary converters to the third and track rails at 500 volts. A fourth sub-station, at Marble Arch, is provided for in case a two-minute service becomes necessary, as is expected. The total cost of feeder copper in the high tension circuit is but $60,000, and in the low tension circuits, consisting of the third and track rails only, the cost of bonding and of third rail construction was $75,000.

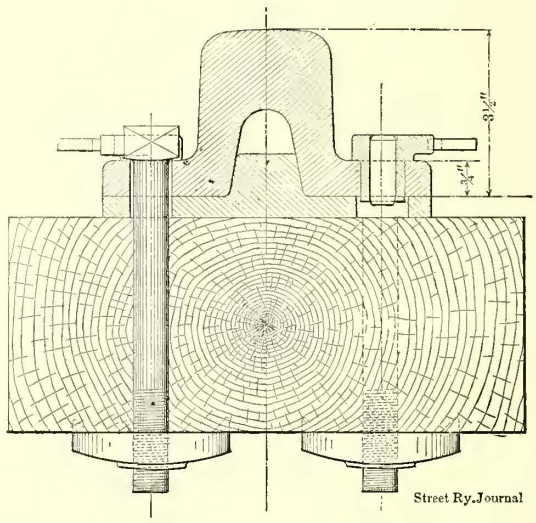


FIG. 14.—SECTION OF TRACK RAIL

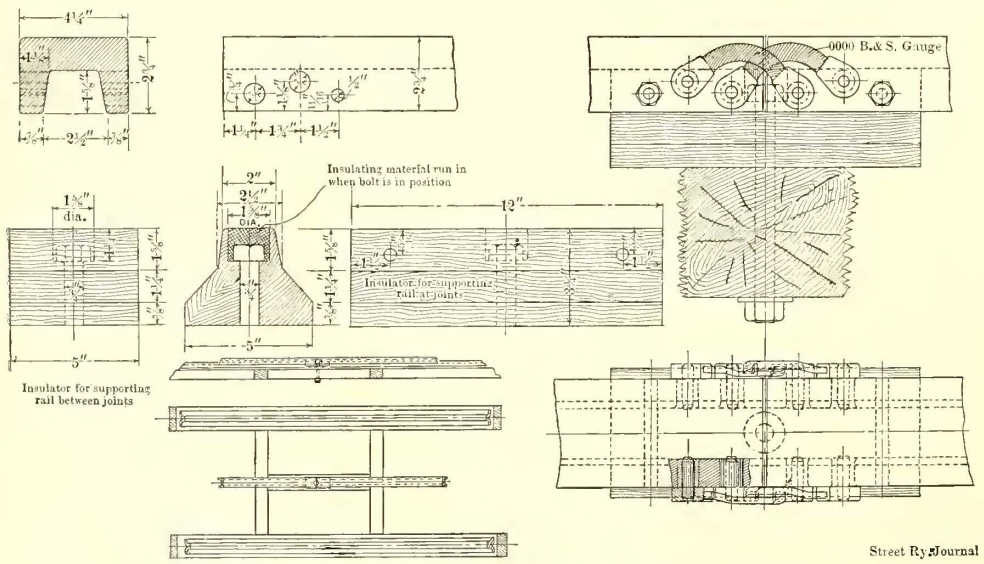


FIG. 13.—THIRD RAIL, INSULATOR AND METHOD OF BONDING

Starting from the generating station, the average transmission loss in the first section will be put 0.9 per cent, in the second section 1.8 per cent, and in the third section 2.05 per cent. The total losses of all kinds in the cables will amount to but 4.75 per cent.

From an inspection of the voltage curves on the third and track rails, shown in Fig. 12, it will be seen how small a drop is intended, and how well the transformer system lends itself to the equalization of pressure over an extended line. The maximum drop in the third rail will be less than 3 volts, and in the track return but 5 volts. Rheostatic losses will thus be minimized, and satisfactory lighting of trains will be secured, the latter a very material improvement over any three-wire system of distribution possible to design at equal capital expenditure.

The transformer sub-stations are to be connected with the generating stations by cables laid on brackets in the tunnel; these cables will be paper insulated and lead encased, and will be furnished by the British Insulated Wire Company.

THIRD AND TRACK RAIL CONSTRUCTION.

In Fig. 14 are shown the details of the third rail construction and bonding. The third rail is of steel, weigh-

ing 80 lbs. to the yard, is rolled to a channel section, and is supported on the creosoted wood insulators shown. No fish-plates will be employed at the joints, and each joint will be bonded with two 0000 B. & S. short flexible crown bonds "Chicago" pattern. The third rail will be 1½ ins. higher than the track rail to avoid trouble at crossings.

The track rails are of bridge section, shown in Fig. 14, weighing 100 lbs. to the yard, and are laid on longitudinal sleepers. The joints will be bonded by two 0000 crown bonds similar to those employed on the third rail, and by the Brown plastic plug bond inserted under the fish-plates. The track rails will be cross-bonded every 248 ft., and the two tracks will be bonded wherever convenient. Test wires will be provided so as to make possible a continuous record of the potential on the lines.

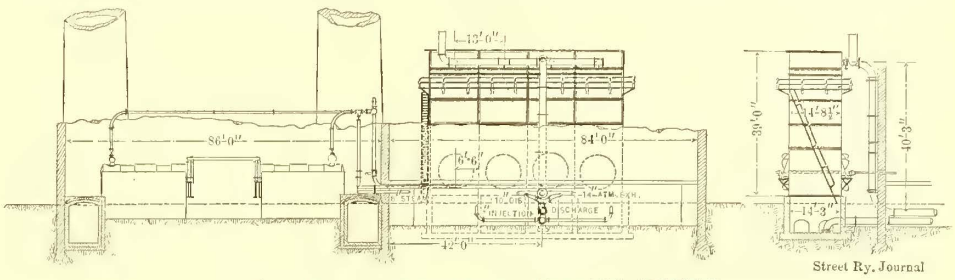


FIG. 16.—SECTION OF GENERATING STATION

GENERATING STATION

The general design of the main generating station at Shepherd's Bush is shown in Fig. 15 (the switchboards are placed in a gallery, not shown, at the right-hand end of the station).

The boiler house will contain sixteen Babcock & Wilcox boilers grouped in eight batteries. The evaporative power of each boiler is 12,000 lbs. per hour, the heating surface 3,580 sq. ft. and the pressure 150 lbs. per sq. in. The steam and water drums are 42 ins. diameter and 23 ft. 7 ins. long, and have a cross drum 24 ins. diameter and 90 ins. long, to which will be attached an 8-in. stop valve.

The boilers are to be fitted with Vicar's mechanical stokers, which are supplied by a cold storage tank at the top of the boiler house, having a capacity of 1,500 tons, fed by a coal conveyor furnished by the C. W. Hunt Company, of New York. This conveyor also serves for the removal of ashes, and will be driven electrically.

The steam and atmospheric exhaust piping is shown in Fig. 15, and is quite novel in arrangement. Each engine is served directly by a pair of boilers through an 8-in. steam pipe. This direct service pipe is also connected, however, through globe valves to a main header, so that the latter may be used whenever desired in the usual way or in conveying steam from any pair of boilers to any engine. It is claimed for this system of piping that its flexibility is complete and its prime cost for pipe, and particularly for valves and fittings, is much lower than with the usual duplicate system, on account of the smaller valves and pipe sections required. All the steam pipe bends and valves were made by the Crane Company, of Chicago.

An independent combined jet condenser and air-pump located in the basement, is supplied to each engine and is of sufficient capacity to take the maximum quantity of steam from it. The steam cylinder of this pump is 14 ins. diam. by 24 ins. stroke; the air-pump is double-acting, with a cylinder 28 ins. in diameter by 24 ins. stroke, and

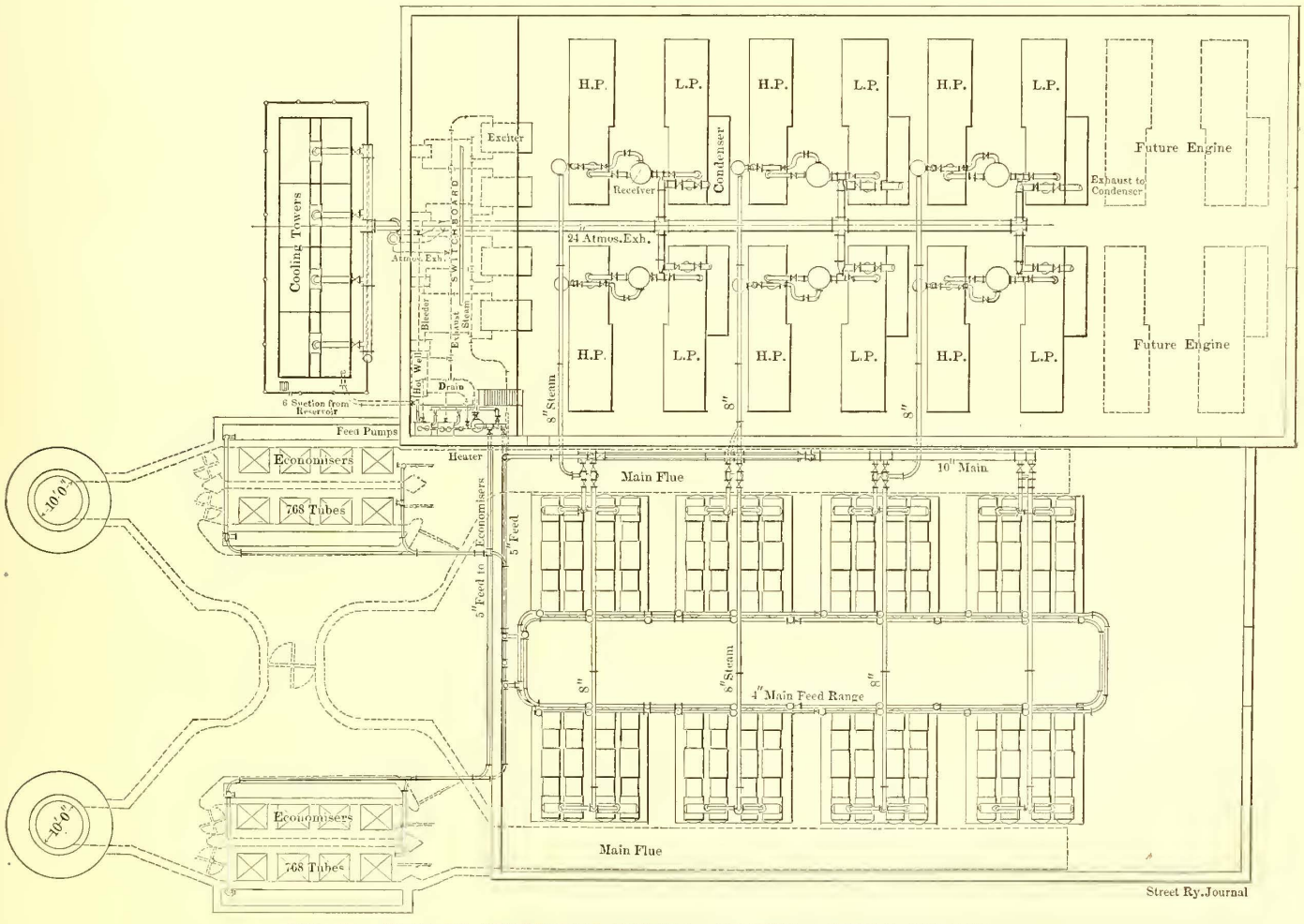


FIG. 15.—PLAN OF GENERATING STATION—CENTRAL LONDON RAILWAY

is capable for forcing the condensed and injection water to the top of the four Barnard cooling towers at the end of the station. Each cooling tower will be furnished with two fans, direct driven electrically by motors located inside the power house at one end. Green economizers will be used, arranged in the usual manner, so as to make it possible to use either both or none, as desired. Blake & Knowles' pumps will be employed.

The engine plant will consist of six Reynolds Corliss cross-compound condensing engines, 24 ins. and 46 ins. by 48 ins., each coupled direct to one 850-k. w. three-phase generator. These units run at 94 revs. per minute, and will generate in regular service 1,300 i. h. p. each, and in emergencies 1,950 h. p. The engines can be run non-condensing, and either high or low pressure side can be run independently. The speed variation is guaranteed not to exceed $1\frac{3}{4}$ per cent between minimum and maximum load. The main journals are 20 ins. diameter and 36 ins. long, and the flywheel weighs 100,000 lbs., and is made in eight segments, held together by wrought iron arrowheads. The engines are guaranteed for a consumption of

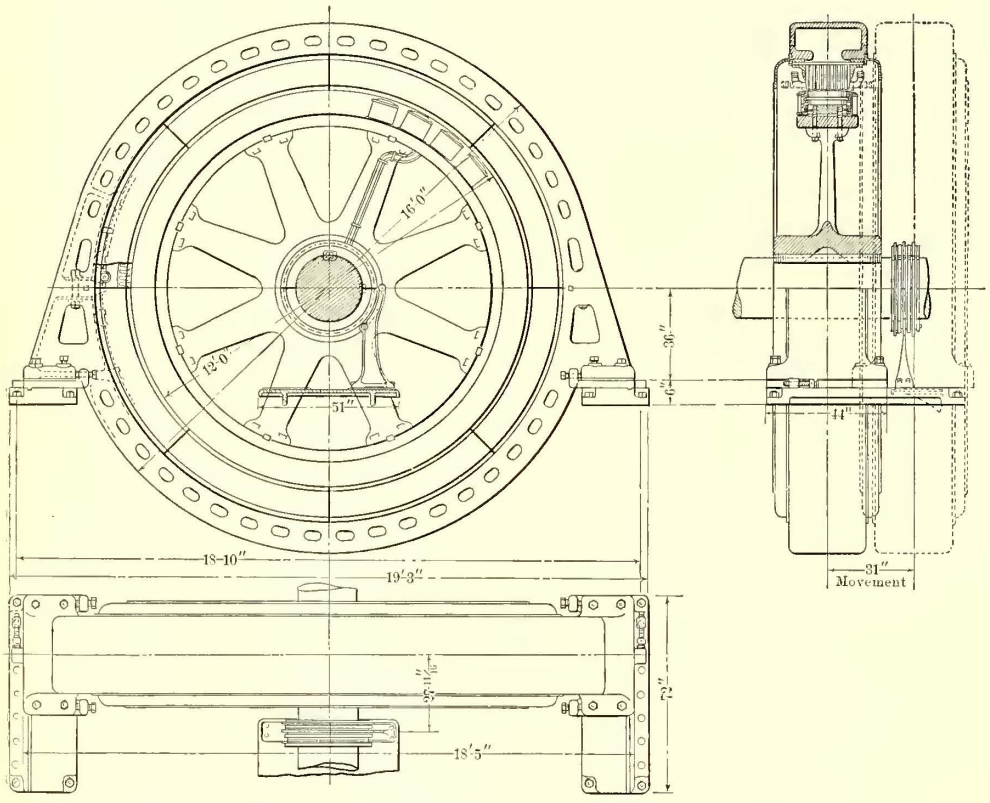


FIG. 17—GENERATOR

14.5 lbs. of steam at 1,000 i. h. p. when run condensing with 26.5 ins. vacuum.

The three-phase generators have thirty-two poles, and will deliver ampères at 5,000 volts, and 25 cycles per second. They are of the revolving magnet type, the coils being held in slots in the outer stationary ring. The efficiency is guaranteed to be 95 per cent at full load and 91 per cent at half load, and the power used in excitation to be less than 16 k. w. The total weight of each generator is from 75,000 to 80,000 lbs. The generator is shown in Fig. 17, and its efficiency curve in Fig. 18.

The exciters for these machines will be placed under the switchboard gallery at the end of the station. It will be noticed that there will then be room in the station for two extra combination units, in case of further extensions along the line. It is expected that four of the six units will be sufficient to take care of the average load, so that with the six units ample spare power will be provided for present requirements.

The switchboard will consist of six generators and two feeder panels, each made of marble, and the apparatus will be mounted on ebonite. Each generator panel will carry one triple-pole, single-throw, quick-break switch, three ammeters, one in each of the three-wire circuits, and one 5,000 100-volt station transformer for voltmeter and synchronizing purposes. Behind each panel will be a fireproof rheostat, and the sub-base will carry the closing switch for the generator circuit, a wheel for regulating the generator field, and an ammeter for the exciting circuit. The feeder panels will each contain a triple-pole switch, three ammeters and other necessary recording and indicating apparatus. One of the feeder panels carries at its base a wheel connected with a rheostat by means of which all the generator fields can be si-

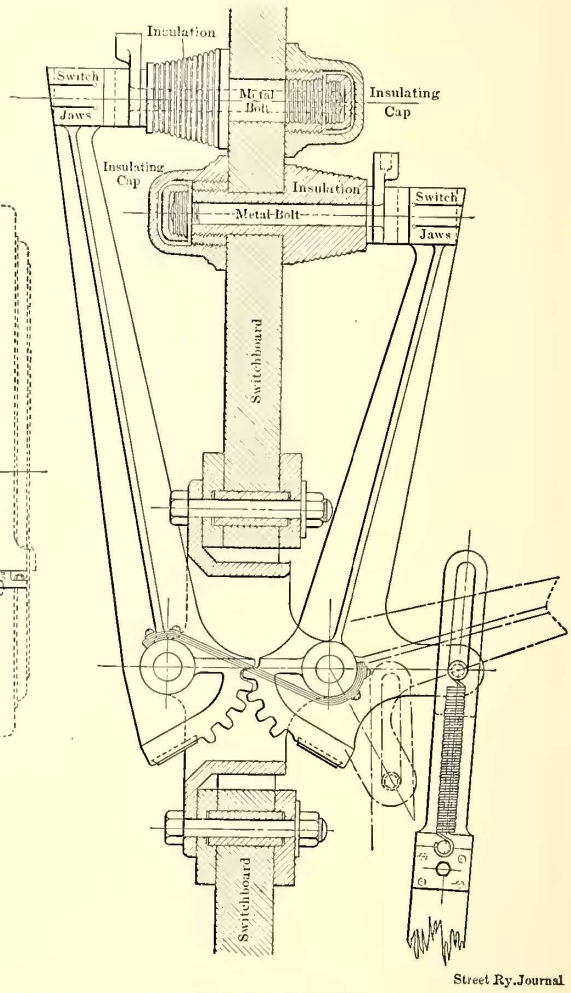


FIG. 19.—HIGH TENSION SWITCH

multaneously reduced and cut out of service in case of emergency.

Alongside the generator panel will be a synchronizing panel, containing a voltmeter for indicating the difference of potential on the bus bars; two voltmeters for indicating the voltage on the generators; two eight-way, single pole switches for connecting voltmeter to generator terminals and for synchronizing purposes, and one three-way, single pole voltmeter switch.

The exciter switch-board will consist of one voltmeter and four generator panels.

In the switch boards at the generator and sub-stations the chief feature of novelty will be a high-tension switch, shown in Fig. 19, which has been designed by Mr. Parshall to meet English requirements. These switches are so mounted on the switch board as to cause the double break to take place on opposite sides of the board, and as the three phases are in series the effect of this switch is to interpose instantaneously an air-gap of 9 ft. in toto. or

3 ft. in each phase. The method of accomplishing this result is highly novel and ingenious.

TRANSFORMER SUB-STATIONS AND EQUIPMENT.

The four transformer sub-stations will consist of pro-

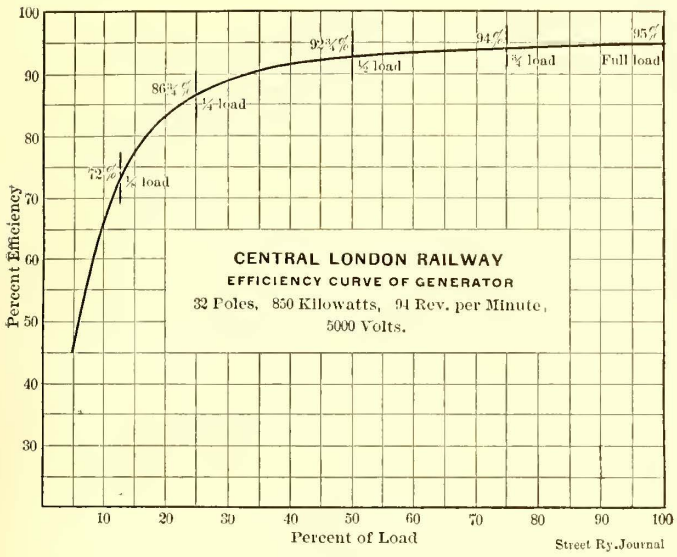


FIG. 18

longations of the elevator shafts, and the general arrangement of each is as indicated in Fig. 20. The static transformers with fan and ventilating apparatus and the high-tension switch arrangements will be contained in one shaft, while the converter switchboard, the rotary converters and the generator and feeder panels will be located in the other shaft. The other two sets of high-tension mains will be led into the switchboard and connected through triple-pole, quick-break Parshall switches to a common set of bus bars. Two switches of the same type will be provided for connecting the two groups of three transformers each to the same set of bus bars.

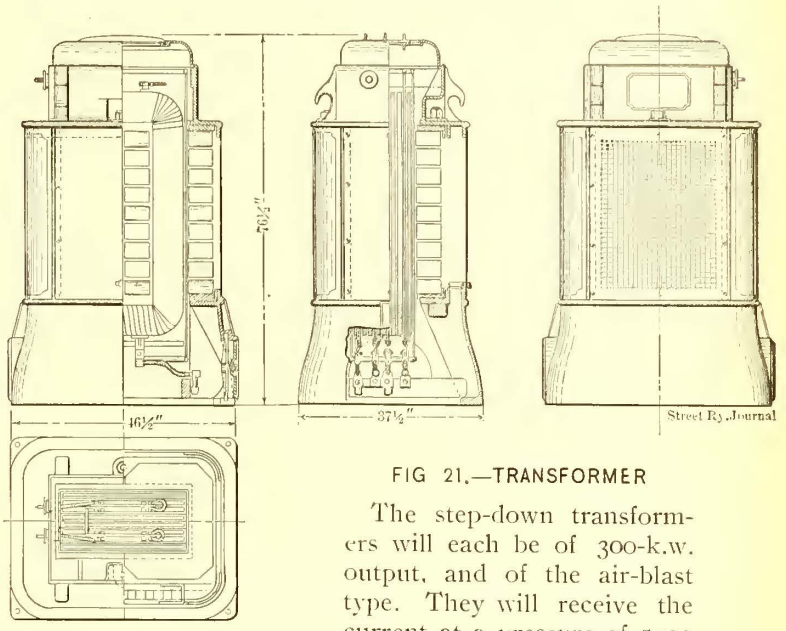


FIG 21.—TRANSFORMER

The step-down transformers will each be of 300-k.w. output, and of the air-blast type. They will receive the current at a pressure of 5000 volts, and will deliver to the rotary converters at 316 volts. Two sets of cables will be laid across the tunnels to the secondary switchboard in the second shaft; the cables will be connected to two triple-pole Parshall switches, and through them current will pass to the 900-k.w. rotary converters, the connection being such that either converter can be switched on to either set of cables. At the Marble Arch and Post Office stations two rotaries are to be employed, and at Notting Hill and Davies Street but one.

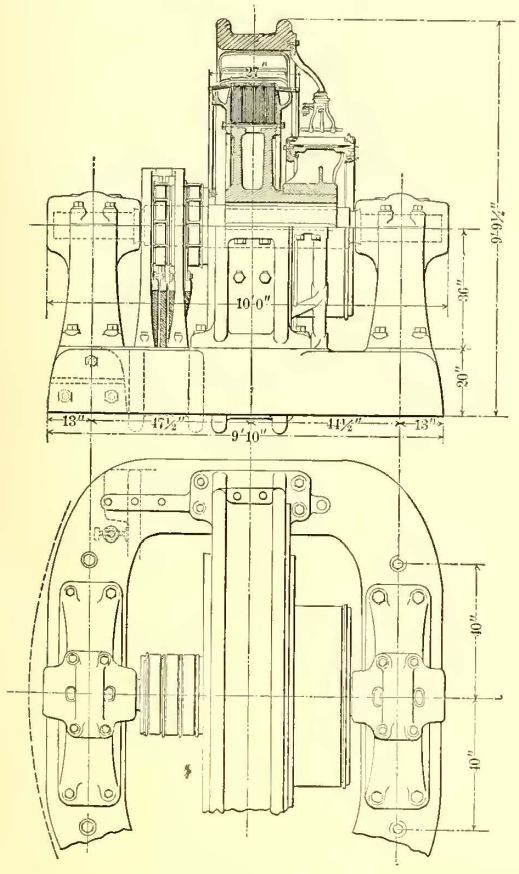
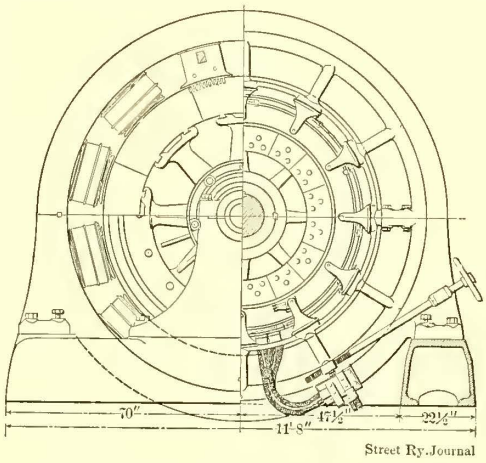


FIG. 22.—CONVERTOR



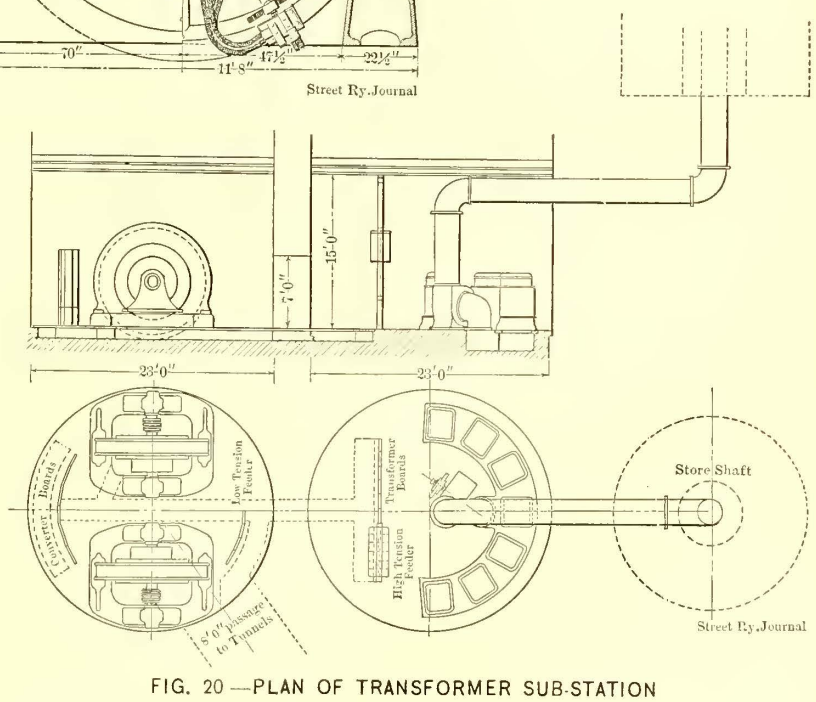


FIG. 20.—PLAN OF TRANSFORMER SUB-STATION

The switchboard panel carrying the quick-break switches will also have mounted upon it ammeters for the

transformer and converter circuits, a voltmeter connected across the converter bus bar, and a voltmeter for indicating the D. P. on the three-phase cables at the sub-station. There will also be synchronizing apparatus.

On the continuous current side of the converter there will be standard railway generator panels, through which the converter will be connected to the bus bars supplying the line; the bus bars will be connected through four switches to four separate sections of the line, and two starting rheostats will be provided, by means of which either rotary converter can be started from the continuous current side and brought to synchronous speed. This arrangement of starting from the continuous current side has been provided for, because at heavy loads there is an objection to starting the rotary converters from the three-phase side on account of the fact that the magnetizing currents tend to lower the voltage in the system generally and to lessen the maximum output of the plant.

The rotary converters will have twelve poles, will run at 250 revolutions and will be capable of being run up, either from the three-phase or direct current sides, although, as before stated, the latter will be usually employed. These transformers (Fig. 21) are now being made by the Union Elektricitäts Gesellschaft from drawings furnished by the General Electric Company, and the rotary converters (Fig. 22) are being made by the General Electric Company, at Schenectady.

With enclosed substations, such as are here employed, it is necessary to make arrangements for getting rid of the hot air from the transformers. It is therefore proposed to reverse the usual arrangement and to suck air instead of forcing it through, and this hot air will be expelled through sheet pipes running up the center of the spiral staircase. This arrangement is shown in Fig. 20.

The following guarantees have been given:

Efficiency of steam engine, full load, condensing, 92 per cent.

Efficiency of three-phase generators at full load (neglecting excitation), 95 per cent.

Average efficiency of transmission, including loss in sub-stations at full load, 90 per cent.

Efficiency of locomotive at full load, 90 per cent.

Elevators will, of course, be provided at each station, and it is proposed that these should be operated electrically, with current taken from the third rail. The Sprague Electric Company, of New York, has the elevator contract.

The present condition of the Central London Railway installation is as follows: Three-fourths of the main line tunnel and one-half of the station tunnel has been done, and nearly all the elevator and staircase shafts have been constructed. The very difficult work of diverting the sewer gas, water and other pipes underneath the pavement at the Bank station, in order to provide for the subways at that important point, is well advanced, and the work of connecting the Waterloo and City Railway, and the City and South London Railway with these subways at the Bank is also making satisfactory progress. Contracts for all the electrical apparatus have been placed. The building of the locomotives is under way, and these will be tested by Mr. Parshall in June. Work has commenced on the construction of the generating station, and it is expected that this will be completed by September, 1898, and the generators and transformers will be delivered by Aug. 1. The locomotives will be delivered by the General Electric Company, as required by the engineers of the Electric Traction Company, Ltd. Owing to a rule of the Board of Trade that important installations of this character shall be tested most carefully and thoroughly, and that but half the intended equipment shall be put in service at the beginning, it is not expected that the road will be in full operation until Jan. 1, 1899.

Among the prominent British capitalists interested in this important railway project may be mentioned Sir Richard Farrant, Chairman of the Electric Traction Company, Ltd., who is perhaps better known to the general public in connection with his philanthropic work of housing the poor of London by means of the well-known "industrial buildings," H. Tennant, Chairman of the Central London Railway Company; the Rt. Hon. Lord Colville, of Culross, K. T.; Sir Francis Knollys, K. C. M. G., C. B.; the Hon. A. H. Mills; the Rt. Hon. Lord Rathmore; T. Davidson, F. E. Warburg and H. Smith, directors of the two companies. Sir John Fowler, K. C. M. G. (Engineer of the Forth Bridge); Basil Mott and F. Hudleston (Engineer of the Liverpool Overhead Railway), are the engineers, while, as before stated, H. F. Parshall has been prominently identified with the design and the carrying out of the electrical equipment.

Handling Asphalt

By a Practical Engineer.

The street railway manager is nowadays required to use asphalt to such an extent in street paving and repairing that a considerable plant is necessary for melting, mixing and handling this substance. Apparatus for "asphalt boiling," as the operation is termed, has been greatly improved of late. Formerly it was common practice to throw a dozen barrels of asphalt into a big tank kettle; then, when melted, to add the other ingredients necessary for the product.

Some of the ingredients may be very volatile and inflammable, so much so that fire and explosion are the rule, and occur quite regularly. The reason for this is found in the fact that asphalt is quite a poor conductor of heat, and in melting a large quantity the outer part of the mass becomes over-heated before the interior has been melted. Again, asphalt requires a long time to cool after it once gets hot, and after the temperature has equalized itself, the workmen are unable to wait long enough for the mass to cool sufficiently to get below the danger point.

Trouble may be prevented in asphalt working by dividing the mass. This is best done by abandoning the great tank kettle and substituting a number of smaller cauldrons, known to the trade as "farmer's kettles." These may be had, ranging from 8 to 120 gals. About 60 gals. is the best size for asphalt use.

An I beam should be rigged above the line of kettles, six of which make a handy number, and a trolley attached to the I beam, and fitted with some kind of hoisting apparatus, preferably a chain tackle of 1,000 lbs. capacity. At a distance of about 30 ft. from the fires, a couple of mixing tanks may be placed in separate compartments, the whole plant being covered with an iron building, the iron frame covered in turn with corrugated iron. Probably a building 90 ft. long by 10 ft. wide and high, is the best for the purpose.

A system of power agitators and pumps may be arranged if desired, for the purpose of handling the hot asphalt, or for handling it cold, after the asphalt has been made into a paint or coating, by mixture with "Biolite" and kerosene oil. If pumps are used, they should be of the rotary variety, and the piping all arranged that it may be taken down easily for the purpose of cleaning, for the pipes, though large—2 in. in diameter—often become stopped up.

A Recent New England Railway

The prediction made eight or ten years ago of the large number of electric railways which would be built in the thickly settled portions of the country are being realized, but the development has been in somewhat different directions from that prophesied by some a decade ago. As yet, as readers of the "Street Railway Journal" know, but little application has been made of electric power to existing steam lines, and long interurban lines and light freight electric lines have not been built as yet to any great extent in New England. Electricity has, however, furnished an excellent motive power for short country lines, which could not have been built to use any other power, and among this class, construction is increasing in that section of the country.

Among the most recent and best equipped lines in New England is that connecting Torrington and Winsted, Conn., a single line, 13½ miles in length, including the sidings, tracks in car-houses, etc. The conditions of a line of this character differ so greatly from that of large city systems, that they are worthy of special study. As the traffic is limited, especial attention has to be given to the item of first cost, which must be kept low in order to show a fair return on the investment. As profits are usually in the future, and depend on the development of traffic, liberal and extensive franchises are essential to financial success.

The population of Torrington is about 10,000, and that of Winsted and West Winsted about 7000 or 8000. The fare between the two cities for the entire ride of thirteen miles is 15 cents. For nine miles of this distance the company operates over its own right of way.

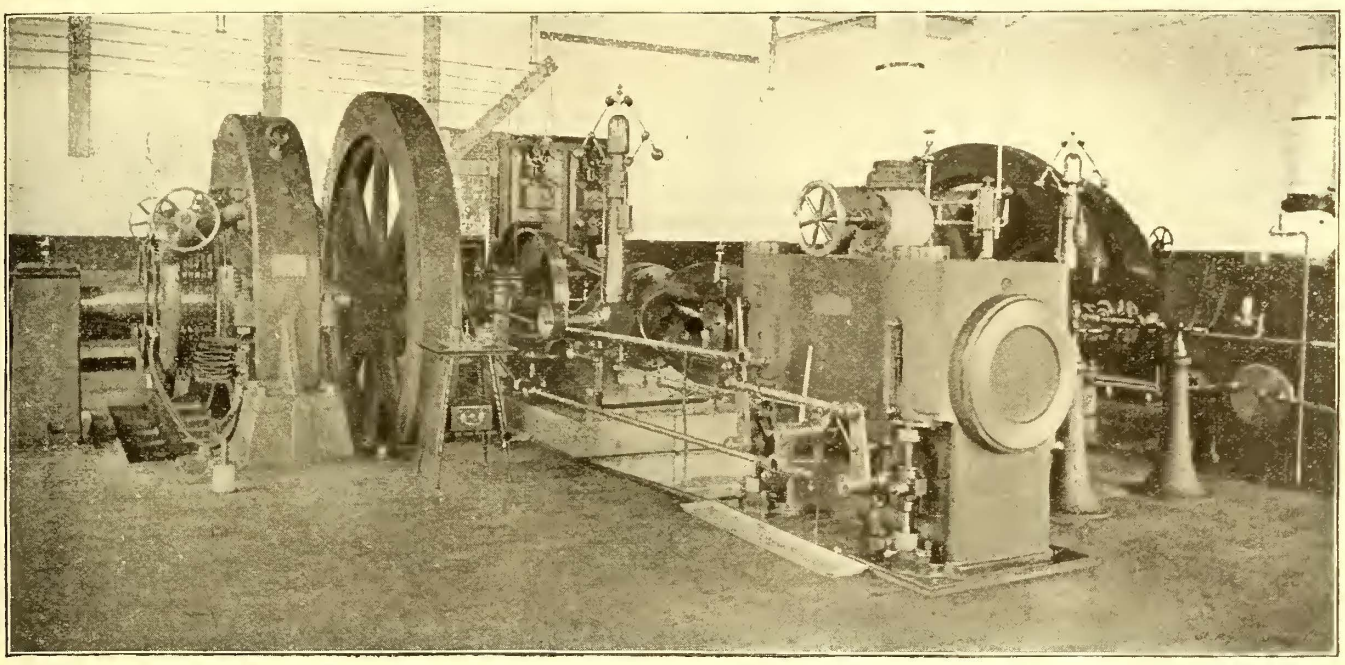
The Torrington & Winchester Street Railway was put in operation July 1, 1897. The track is laid with 60-ft. 56-lb. T-rails on 5-in. by 5-in. by 6½-ft. chestnut ties, spaced 2 ft. 6 ins. centre to centre. The line crosses three bridges: one an open truss, 72 ft. long, over the Philadelphia & Reading and New England railroads, at East Winsted; one a 35-ft. girder at Roberts Brook, on the Lake Line, and a 230-ft. bridge over Still River, a public highway and the New York, New Haven & Hartford Railroad. The latter bridge consists of a 124-ft. span and four girder spans, two of 26 ft. in length, one of 26 ft. 6 ins. and one of 28 ft. The power station is at Burrville, about the middle of the line, and is located on the Still River. The company has five closed cars and eight open cars.

For the six months ending Jan. 1, 1898, the company earned about $25,000.

The total cost of construction up to date has been as follows:

Roadbed and overhead line construction	$250,000
Rolling stock and equipment	30,000
Power station building	10,000
Power station equipment	45,000
Car house	10,000
Office and other buildings	5,000
Park and buildings	13,000
Total	$363,000

The park referred to is that at Highland Lake and very attractive, but being constructed late last season the company derived but little or no benefit from it last year. The capital stock of the company is $200,000, and the bonded indebtedness $153,000.



INTERIOR OF POWER STATION—TORRINGTON & WINCHESTER STREET RAILWAY

The following were the contractors for the apparatus used:

Power Station.—Engines, Slater Engine Company; pumps, Deane Steam Pump Company, of Holyoke, Mass.; injectors, Hancock Inspirator Company; feed-water heater, National Pipe Bending Company; generators, General Electric Company; boilers, Stewart Boiler Company; piping, M. J. Daly; station roof, Berlin Iron Bridge Company.

Track and Overhead Construction.—Rails, Pennsylvania Steel Works; special work, Barbour, Stockwell Company; wooden poles, Thos. F. Carey; bridges, Berlin Iron Bridge Company.

Rolling Stock.—Cars, Ferguson & Richardson; trucks, Peckham Truck Company; snow ploughs, Smith & Wallace; motors, General Electric Company; registers, New Haven Car Register Company.

The general contractors were the Worcester Construction Company, the designing engineer was E. H. Kitfield, and the constructing engineer and architect M. M. Wheeler.

Following are given abstracts of the specifications used in the construction of the line:

TRACK AND OVERHEAD CONSTRUCTION.

The gage of the road will be 4 ft. 8½ in. The ties are to be of chestnut or hackmatack, at least 6½ ft. long and at least 5 in. thick, and 5 in. face on both sides of the small end, and are to be placed 2 ft. 6 in. apart from centres, thoroughly tamped with gravel. All ties are to be thoroughly inspected. Four hole angle bars, with not less than 1¼ in. bolts, are to be used.

The track is to be constructed of "T" rail, weighing 56 lbs. per yard. All rails are to be fastened at all joints with four hole angle plates and bolts, and spiked to each and every tie, with four railway spikes, 4½ ins. by 9-16 ins. Provide special work, if called for, for connecting the tracks with the car house, and rails for tracks in the car house and all necessary labor. Furnish necessary gravel, take up and re-set cross-walks, and do all the labor for the entire distance, according to the requirements of the locations granted by the town and borough authorities.

There are to be three turnouts, split or sidings, as the Executive Committee may desire, to be constructed at such points as said Executive Committee may direct. The rails, switches, frogs and the track construction are to be of the same kind as are to be used in the construction of the track with which the sidings connect.

The sidings are to be at least 100 ft. in the clear.

The contractor will furnish its own engineer.

The track is to be laid to the lines stipulated by the authorities of the boroughs and towns. All earth removed by the contractor in streets and highways shall be replaced in as good condition as it was before the work was begun. Where the soil is not suitable for a good roadbed, the same is to be removed and gravel substituted in its place.

soldered and strongly attached to supports and effectively insulated.

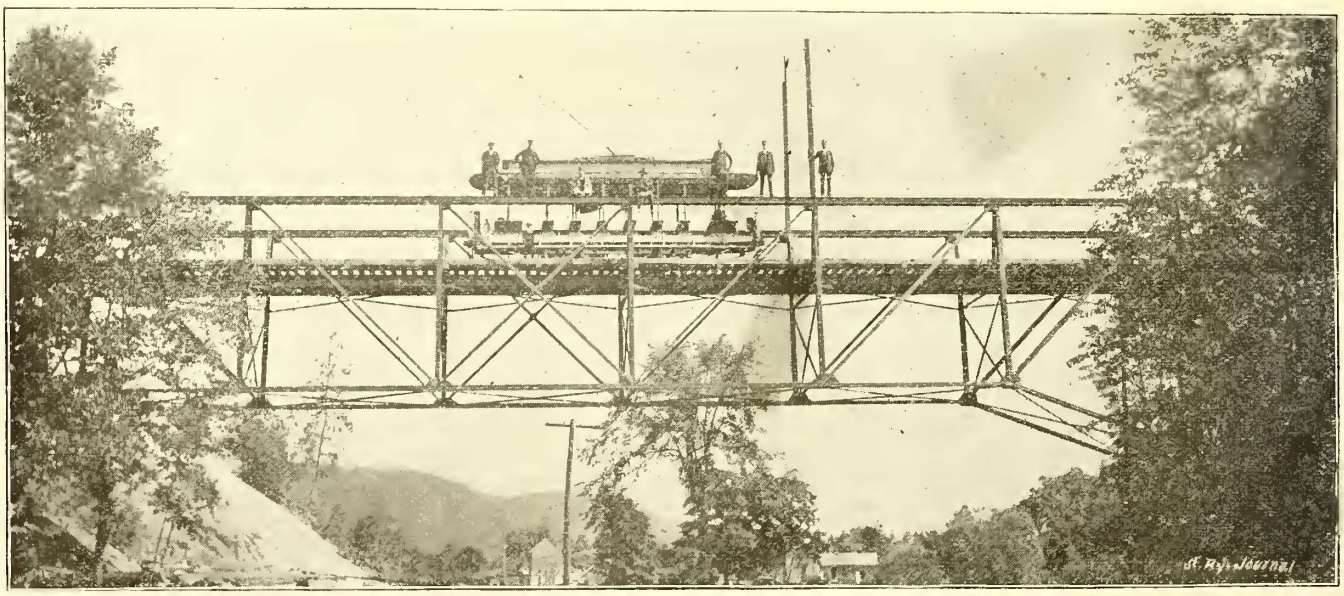
No. 0000 triple braid wire of heaviest and best quality is to be used for feed wire for 8 miles, and for 10 miles if necessary. It is to be presumed that all wire is to be suspended on brackets, but a comparatively small portion may be by cross-suspension. All brackets are to be of wrought iron, at least 7 ft. 6 ins. long, and 1½ in. pipe, such as are made by the Walworth Company, the Durgin Company, or others equally as good, as the said Executive Committee may determine. All ears, switches and pull-offs, etc., are to be such as are made either by the General Electric Company, the Johns Company, or others equally as good, and are to be placed so as to effectively prevent the trolleys from jumping the overhead line.

The rails are to be bonded and connected by not less than first-class No. 0000 copper steel wire, to make a first-class electrical connection at each joint in the rails, and a cross-bond is to be made every 500 ft. Ground connections are to be made, and as often as every 1000 ft., either by iron rods driven into the ground deep enough to reach sufficient moisture, or by copper plate connections. (Ground plates of 12 in. x 12 in. x 8 in. copper were used.)

Macadam is to be used wherever it is now used in the streets and highways on which the track is to be located and constructed.

The contractor is to do all necessary lighting of the material, excavations, etc., at night.

All the work required to be done under these specifications is to be done to the satisfaction of the authorities of the various towns and boroughs, in accordance with the locations granted, so far as they may apply, and to the satisfaction of said Executive Committee. If the length of line is longer or shorter than at present



GIRDER BRIDGE AND OPEN CAR—TORRINGTON & WINCHESTER STREET RAILWAY

Overhead construction is to be for the single trolley system. Such poles are to be erected as are required by the orders of locating granted by the authorities of the boroughs and towns, and the same are to be placed not more than 125 ft. apart. The hard pine poles are to be not less than 30 ft. long, 7 ins. square at the top, and 9 ins. square at the bottom, and squared throughout their length. The chestnut poles are to be 28 ft. in length, and at least 6½ ins. at the top. All poles are to be reasonably straight and neatly trimmed and shaved and set firmly in the earth to a depth of at least 6 ft. Whenever the character of the ground makes it necessary, longer poles are to be used than those above described. Wherever necessary, poles are to be boxed or braced, and butts set in concrete. Brace irons, cross arms, or insulators are to be affixed to poles for carrying feed wires, wherever necessary.

Two-pin cross-arms are to be used. All poles to which span wires are to be attached are to be fitted with extension screws, or ratchets, to keep the wires taut. All poles and cross-arms are to be painted two coats of such color and quality as may be determined by the said Executive Committee.

The span wire is to be of galvanized, double-twisted steel cable, sufficiently strong to easily support all weights that may be placed upon it while in use, and is to be drawn as tightly as possible. The overhead construction is to be frequently anchored to insure rigidity and stability. The trolley wire is to be of No. 00 hard-drawn copper wire, not less than mile lengths. All joints are to be made with end at splicing ears, and the wire is to be effectively

estimated by the engineer, the contractor shall be paid a proportionate sum, or shall make a proportionate deduction in the contract price, as the case may be, the sum in either case to be determined by the engineer of the company. All work and material is to be satisfactory to said committee, but no paving is to be included in these specifications.

The contractor shall at all times hold the railway company and the several towns and boroughs harmless from all suits for damage arising from injury to persons and property on account of the carelessness of any person employed in the construction, equipment or installation of any part of the work covered by the foregoing contract or specifications.

POWER STATION.

The contractor is to be furnished all land, rights of way and immunity from all legal difficulties in relation thereto by the railway company. A set of drawings will be furnished, showing principal dimensions of the work to be done, and detail drawings will be made as the work progresses, or as required.

The contractor is to furnish all transportation, labor, materials, apparatus, scaffolding and utensils needful for performing the work in the best and most workmanlike manner, according to the drawings and specifications. All material to be of good quality. Should the contractor introduce any materials different from the sort and quality herein described, or meant to be implied, it shall at any time during the progress of the work be removed at the

contractor's expense immediately upon notification of the Executive Committee. The work to be executed in the best and most workmanlike manner, according to the true intent and meaning of the specifications and plans referred to, and which are intended to include everything necessary for the proper and entire finishing of the building, notwithstanding every item involved in the work is not particularly mentioned. The work when finished to be delivered in a perfect and undamaged state without exception. The contractor is to be responsible for all violation of the law caused by his obstructing the streets, sidewalks, etc., with his materials, making good any damage caused to any adjoining premises arising from the carrying out of all work mentioned in these specifications. The contractor shall hold the company harmless from all damage or expense arising therefrom, and shall clear the building and sweep it out at completion; he shall remove all rubbish or other materials from off the premises, and leave everything in a finished state and ready for occupancy. The contractor is to furnish suitable protection to all openings, if such be needed, to keep out cold or rain.

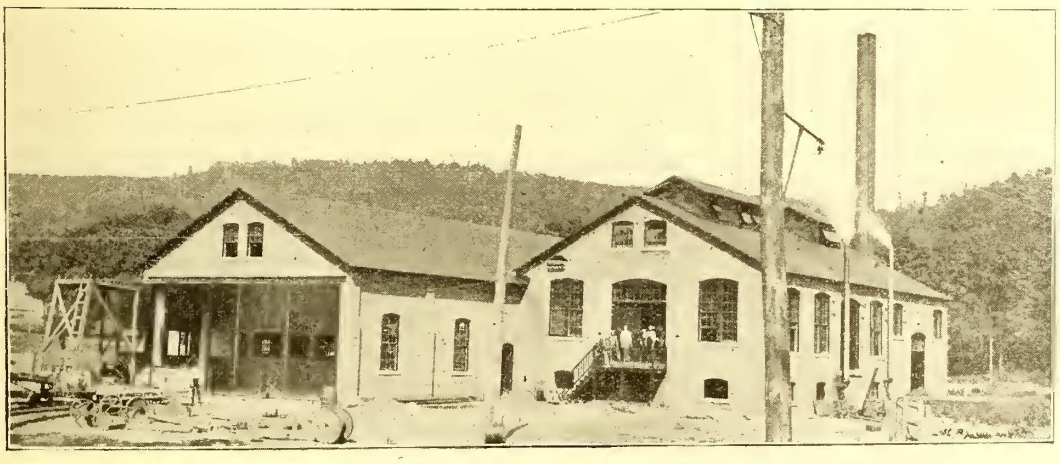
The building is to be of brick, divided internally into a four-track car house, 131 ft. 4 ins. long by 44 ft. wide, and engine dynamo and boiler room 65 ft. by 46 ft., the latter to be divided internally as the Executive Committee may determine. There is to be an iron stack of proper height and size, the dimensions and locations to be determined by the engineer.

The whole building above mentioned is to be covered by a corrugated iron roof, supported by steel trusses. Said roof is to have ventilating windows over the engine room and louvre windows over the boiler room, and that part of the roof over the engine room is to be lined with an anti-condensation lining.

The entire roof will be built by the Berlin Iron Bridge Company, and will be erected in place by them. The above is to conform essentially with the detail plans of the same. After the machinery is set in place, the engine room is to be provided with a floor consisting of 2 in. spruce plank, covered with a ⅞ in. maple finished flooring in narrow strips, tongued and grooved and planed smooth after being laid, and finished with two coats of oil.

The car house is to have space for four tracks. The front of the house to be planked over with 2 in. rough spruce for its entire width, and the remainder of the car house, excepting that part used as a pit track, to be brought to an even grade of the underpinning of the building with gravel. Track No. 2 is the pit track, and the pit is to extend, as shown in the plans, 4 ft. 6 ins. from the top of the rail in the car house, to its bottom, and said track is to consist of 8x12in. hard pine track sticks, resting upon 12x12 in. brick piers; the side walls are to consist of 1½ in. rough spruce

After the boilers are set the remaining space in the boiler room floor is to be covered with 2 ins. cement concrete or paving, as



POWER STATION AND CAR HOUSE

the owner may select. The cellar bottom under the engine room is to be covered with 2 ins. of cement concrete. The materials above mentioned are to be of the best of their several kinds, and all work is to be done in a workmanlike manner by skilled mechanics, and when completed to be satisfactory to the Executive Committee.

The contractor is to furnish a roof of corrugated iron, manufactured by the Berlin Iron Bridge Company for the power station and car house, the same to be painted one coat of mineral paint, except the galvanized corrugated iron erected in place above the brick sidewalks, the same to be erected practically in accordance with the Berlin Iron Bridge Company's blue print No. 4,002, of April 6, 1896. The roof covering to consist of No. 22 corrugated iron, black painted, and the engine room roof to be lined with Berlin anti-condensation fire-proof lining. The monitor over the engine room is to have a glazed swing sash, and the monitor in the boiler room is to have fixed louvres in sides. All surfaces inaccessible after assembling, must be well painted before the parts are assembled. All necessary mason work shall be done, all anchors set and stone bolt holes drilled by the contractor. The work shall be machine riveted as much as possible, and all field connections shall be securely bolted. The 2½ in. corrugated iron covering shall be painted one coat of mineral paint on both sides,

35 FT. GIRDER BRIDGE OVER ROBERTS CREEK

and shall weigh per square, approximately, as follows: No. 24, 111 lbs.; No. 22, 138 lbs. All rods with forged ends used for tension members shall be of wrought iron. All the wrought steel or iron materials shall fulfill the requirements of the Manufacturers' Standard Specifications, and all workmanship shall be first class.

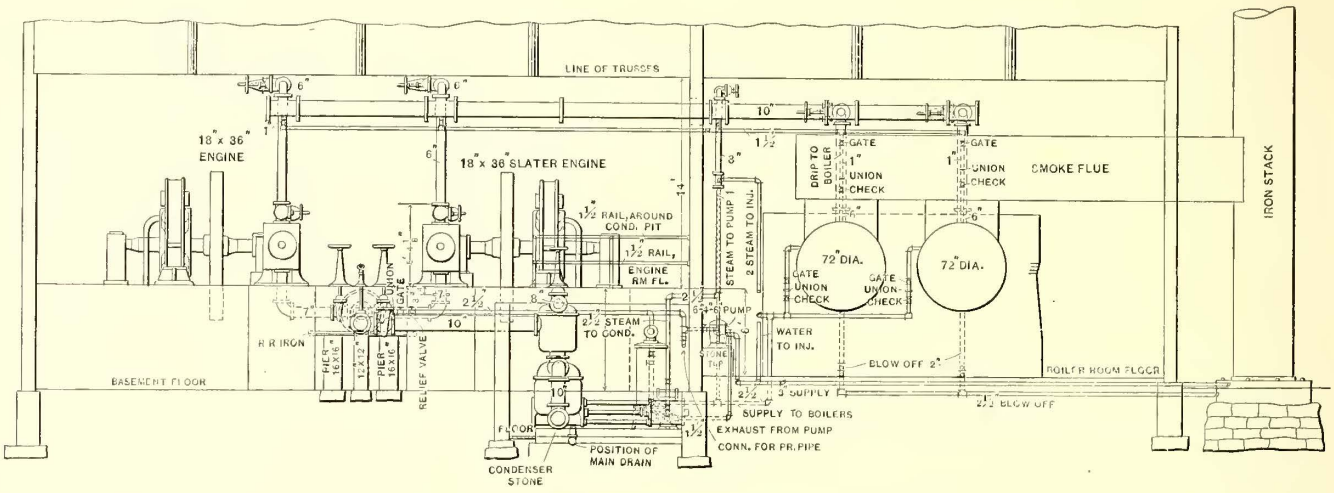
Two automatic cut-off engines, to be constructed by Slater Manufacturing Company, of Warren, Mass., each capable of running safely up to 300 h.p., and steam pressure from 80 to 150 lbs.; speed of engines to be 100 to 150 revolutions; cylinders to be 18 ins in diameter x 36 ins. stroke. The cylinder is to be cast in loam of extra strong, close-grained iron. The casting to be sound and perfect in every respect, the exhaust chambers in the cylinder to be separated from the trunk of cylinder and insulated, and to be neatly lagged with sheet steel. All joints are to be fitted to sustain a working pressure of 150 lbs. per sq. in.

The valve gear and governor are to be of the releasing type; the point of cut-off in cylinder regulated by governor; the bell crank for opening the release steam valve to be faced with hardened steel. The form of steel plate to allow four wearing surfaces to be used in each one before it is necessary to replace them with new ones. The valve connection heads are to be made of broze metal, the latter provided with screw adjustment for taking up wear. The dash pots for closing the valves are to be of neat design and finished. The pot is to be bolted to cylinder feet. The governor is to have a stop motion that is automatic in itself, so that it will not be necessary to depend on the engineer to throw out a safety catch. The steam and exhaust cylinder is to be operated by independent eccentrics and wrist plates.

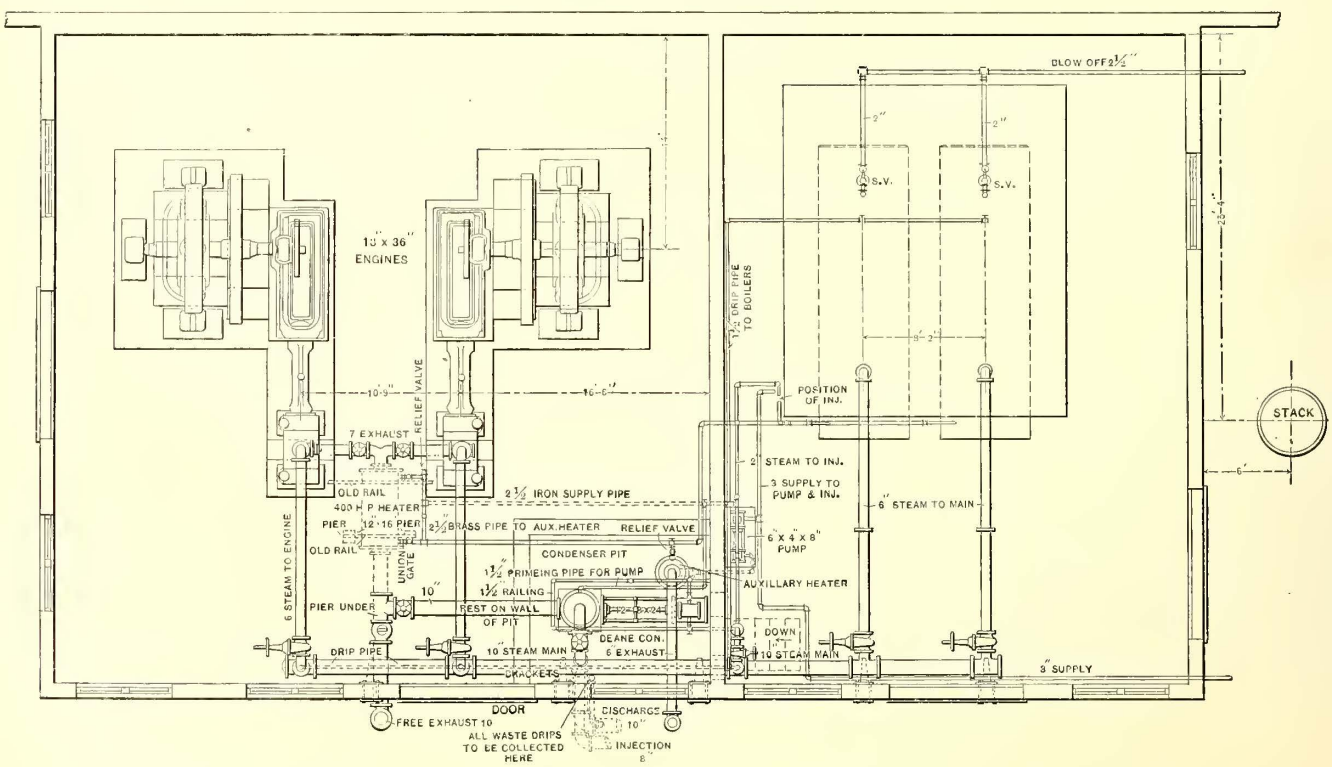
The frame and guide is to be of Tangye style, extra heavy guide bored. The main pillow block to the guide is to be cast in one piece, with extra large bearing surface on foundation, to support the weight of the wheel, and firmly bolted to guide and cylinder; the ends of the guide and pillow block are to have provision made

for catching the drip. The main pillow block boxes are to be made in four pieces, and lined with the best babbitt metal peined in and bored, and fitted to shaft and check boxes, to be adjustable, with wedge adjustment.

The crank is to be of charcoal iron of the disc type, and keyed on shaft; crank pins to be made of the best forged crucible steel, crank shaft to be of the best hammered iron. The cross head is to be made of cast iron with babbitt; shoes to have exceptionally large wearing surfaces and to be adjustable by means of wedge blocks and screws; pin to be made of forged crucible steel. The cross head is to be fitted with taper and keyed to piston rod. The piston in cylinder is to be fitted with bull rings, having large wearing surfaces, and to be centred in cylinder with steel set



CAR BARN



PLAN AND LONGITUDINAL SECTION OF STATION

screws and bronze metal jam nuts, and packed with self-adjusting rings. All joints are to be scraped and fitted steam-tight. The connecting rod to be made of the best hammered wrought iron, ends to have wedge adjustments, to be fitted with bronze metal bases; lined with genuine babbitt metal. The fly-wheel is to be 10 ft. in diameter, and made in two sections; bolted together and keyed; weight to be 14,000 lbs. The oiling device is to be glass, self-acting oil cups of the Nathan make, with sight feed. The crank is to have a centrifugal oiler, and the cylinder provided with sight feed lubricator. These engines are to be direct connected to generators with balance pulleys. A full set of wrenches for all nuts liable for adjustment, also eye bolts to be furnished. All parts of engine not finished are to have coat of filler and priming coat of paint before leaving the shop. The workmanship and materials are to be of the best quality adapted for purpose intended, and guaranteed one year, provided no disarrangement is caused by carelessness or want of attention of person in charge.

The engine running from 100 to 150 revolutions per minute, non-condensing, must develop 1 h.p. with 24 lbs. of water when running 200 h.p.

The following are general dimensions:

Diameter of cylinder	18 in.
Length of stroke	36 ins.
Number of revolutions per minute	100 to 150
Diameter of fly-wheel	10 ft.
Weight of fly-wheel	14,000 lbs.
Diameter of main shaft in bearings	10 ins.
Length of main shaft in bearings	16 ins.
Diameter of main shaft in wheel fit	11½ ins.
Diameter of crank pin	4½ ins.
Length of crank pin	5¼ ins.
Diameter of cross head pin	4¼ ins.
Length of cross head pin	4½ ins.
Diameter of piston rod	3 ins.
Size of steam pipe	6 ins.
Size of exhaust	7 ins.
The weight of engine with wheel is about	40,000 lbs.

BOILERS.

Two boilers of the horizontal tubular pattern, 160 h.p., 18 ft. tube, are to be supplied. Each boiler to be built to stand 160 lbs. working pressure, shell to be 7-16 in. fire-box steel, heads to be 9-16 in. flanged fire-box steel. The boilers are to be triple riveted, butted and strapped, to conform to the requirements of the Hartford Insurance Company for the above pressure. There is to be also a flue of sufficient diameter for the two boilers specified, with necessary up-takes to connect boilers with flue, and to be designated to receive the third boiler and to enter the stack on a line with the top of the boilers. The foundations for the same are to be of sufficient depth, and walls to be 26 ins. wide and lined with the best No. 1 fire brick, contractor to furnish all sub-foundations that may be required. The contractor is also to furnish one pump of the Knowles, Deane, Snow or Valley make, size No. 5. One Hancock injector of sufficient size, one National feed water heater, size No. 30; one Spencer damper regulator, size No. 4; all to be piped and ready for operation, including all the piping from the engines, and from engines to exhaust, and the same to be covered. He is also to furnish all necessary foundations and sub-foundations for the engines and boilers.

POWER STATION APPARATUS

The contractor is to furnish two direct-connected generators, General Electric pattern, also one generator panel of suitable capacity for each of the above machine, consisting of a polished slate slab, with the following instruments mounted thereon, namely: One circuit breaker, one ammeter, two single pole main switches, field rheostat and lamps, field switch, lightning arrester, and lightning switch, together with sub-base supporting single irons and tie rods, and all necessary electrical connections between the instruments of each panel and between panels; also one equalizing switch, with stand to be erected next to the generator. He is also to furnish all necessary cable of standard insulation and capacity for above machine; also all necessary No. 10 wire for field circuits from generator panels to generator, and all necessary insulator cleats, tape and solder for above wiring. Each generator is to be furnished with rails, ratchets and levers (by which machine can be slid to adjust tension of belt) and company's standard pulley; but without foundation bolts.

CAR EQUIPMENT.

The contractor is to furnish twelve double motor car equipments with k-2 controllers. Twenty motors are to be of the G. E. 800 type, having a horizontal effort of 800 lbs., when mounted on wheels 33 ins. in diameter, according to standard rating, and four of G. E. 1,000 type, each motor to be furnished with iron gear, gear case, axle collar, steel taper bore pinion and drum armature of 4 turns per segment, and prepared for 3¾ in. axle.

The balance of each equipment is to consist of the following articles:

1 trolley pole, form "C."
1 trolley base, form "D 2."
2 motor circuit switches.
1 main cut-out.
1 type M form "C" lightning arrester.
1 core for kicking coil.
1 form "K" resistance box.
2 form "K" controllers.
1 form "K" resistance box (including field shunt).
1 controller handle.
1 reversing handle.
1 set made-up cables.
75 ft. No. 6 cable for roof wiring.
10 No. 6 two connectors.
25 wood cleats (⅜ in. slot).
30 brass corner cleats.
25 brass flat cleats.
1 pound solder.
1 pound ¾ in. okonite tape.
1 pound 1 in. adhesive tape.
100 1¾ in. No. 8 R. H. blued wood screws.
110 ½ in. No. 4, R. H. brass screws.
20 100-amp. fuses.

and the following for lighting car:

1 combination switch and cut-off.
1 three-light cluster.
3 keyless sockets.
5 anchored filament lamps.
2 ft. 2-amp. fuse wire.
3 ft. No. 16 wire, G. E. fixture.
50 ft. No. 16 wire (U. S.)
50 brass cleats for No. 16 wire.
100 ½ in. No. 4 R. H. brass wood screws.
4 ⅞ in. No. 8 R. H. brass wood screws.
6 1¼ in. No. 6 R. H. brass wood screws.
11 ½ in. No. 6 R. H. brass wood screws.

CLOSED ELECTRIC MOTOR CARS.

The contractor is to furnish five closed cars, vestibule ends.

Length of body in frame ..... 20 ft.
Length of body over platforms ..... 26 ft.
Length of platforms ..... 4 ft.
Width of car at sill ..... 6 ft. 2 in.
Width of car at belt rail ..... 7 ft. 6 in.
Height inside at centre ..... 8 ft.
Height of sill to under plate ..... 5 ft. 8½ in.
Height under sill to top of trolley board ..... 8 ft. 11 in.
Height top of track to top of trolley board ..... 11 ft. 4½ in.
Height with 33 in. wheels and AX trucks, Peckham.
Height of draw bar from top of rail to centre ..... 16½ ft.
Wheel base, 6 ft. 6 in.; gage, 4 ft. 8½ in.

The length of platforms to be 4 ft., having dashers high, made with openings at side of platform, openings being fitted with folding doors. The sills and other framing in bottom framing are to be made thoroughly seasoned, best quality dry white oak, side sills 3¼ in. x 6 in. All cross timbers are to be white oak, framing to be done in the most thorough manner, and all mortises and tenons to be thoroughly white leaded, and driven together and to be secured with necessary tie rods of best quality refined iron. The floor boards are to be of ⅞ in. yellow pine, well dressed, and secured with wire nails. The framing of the trap doors is to be arranged to suit the motors to be used, each door to have two strong hinges and one flush chest lift, securely bolted. The longitudinal edges of the trap-doors are to be fitted with canvas strips to protect motor from moisture.

All body framing is to be of straight grain ash, free from all imperfections, and thoroughly dry. All joints are to be thoroughly dry, white leaded, and all tenons pinned. The posts are to be mortised into sills. The belt rail is to be grooved in to receive panel and dovetailed into posts. The roof is to be of steam car pattern, the whole length of car, with iron car-lines concealed in the frame to strengthen the roof. The roof covered with No. 6 cotton duck, properly coated with white lead and painted. The ceiling to be three-ply veneer of any wood, neatly decorated. The back is to be well painted, also the under side of the roof, before the ceiling is placed in position. All ceiling panels and mouldings are to be put up with screws, so as to be easily removed. There are to be bevel edged mirrors in each end of car, in neat frames. The deck sash is to be pivoted in centre and glazed with Muranese or flash finished glass. There is to be one lamp in each end and a triple lamp, oil and electric, in the centre. The inside trimmings are to be of bronze, of the newest pattern, selected to suit purchaser. The hand rails are to be of cherry, mounted on bronze brackets and supplied with the necessary number of hand straps. All sash is to be glazed with best quality double thick French glass, and imbedded in rubber on all edges. 2½ in. at bottom. Curtains are to be fitted to windows. The inside finish of cars is to be of mahogany throughout, including doors and ends, and all side trimmings, and removable window casings. The seats and backs must extend the whole length of car body, with cushions covered with West End Standard Moquette carpet. Space to be provided under the seats, and enclosed with panel work, with door at each end. The platforms at each end of cars are to be built with four heavy oak supports. The platform timbers are to be properly placed and strengthened with rods and other iron work to suit the framing; length, 4 ft.; width, 5 ft. 10 in. There are to be four steps, 12 in. deep and 36 in. long, Stanwood Manufacturing Company type. Each car to be provided with iron bumpers of suitable design. Each car to be provided with one large double-jaw radiating draw bar, with necessary slides and attachments on each end of car. Each car to be supplied with one alarm gong on each end, and to have two conductor's signal bells, with the necessary cord and fixtures. The bell cord is to be 5-16 in. raw hide.

The body of the car is to be painted under the most improved method and formula, with proper priming in lead coats, rough stuff, rubbed down to a smooth surface. There are to be three coats of color, ornamented, lettered, striped and finished with three coats of best varnish. All paint is to be of best quality lead and oil, and varnish to be of highest grade of preferred make. The material and workmanship entering into the construction of these cars is to be performed in a thoroughly first class and workmanlike manner. The cars are to be subject at all times during construction to inspection by the railroad company's engineer or representative. The painting is to be as follows: central panel light maroon, lower panel cream maroon.

The lettering to be "The Torrington and Winchester Street Railway Company."

Accounts of Materials in Store—I.

By A. O. Kittredge, F. I. A.

In every manufacturing and transportation enterprise wherein materials more or less in quantity are consumed, there is ever present the question of the management of the accounts of the stores. In manufacturing enterprises systems of cost amounts and other modern methods have very generally determined the course to be pursued. In street railway operations, which from one point of view are only a kind of manufacturing, less attention has been given to the management of the accounts of stores than to other divisions of the necessary records. In thus placing side by side street railways and factories, I do so solely for the purpose of more clearly indicating the unity of principle and method underlying the requirements in the two cases.

Street railway companies must have supplies. They consume more or less of a considerable list of materials. Various parts of their equipment are continually wearing out or becoming broken and must be replaced. Repairs and renewals are recognized as an important division of the expenses of operation. How are the records to be managed? The costs of repairs and renewals consist of two items—labor and material. In making up the final accounts of any division of work in this respect, it is necessary to show that the expenditure was such and such an amount for labor, and so much for materials.

In the matter of labor the case is simple, for it is consumed as it is paid for, or perhaps the proposition would be more clearly stated if the terms were placed in the reverse order: it is paid for only as it is consumed. With materials more complications arise. In many cases the stock must be bought a considerable time in advance of the actual need. This is necessary in some instances, because the material has to be transported a long distance, and must be carried in store because it cannot be obtained on short notice. In other cases, it is necessary because only by buying in considerable quantities can the lowest prices be obtained. Two questions then arise: How shall the accounts be kept with materials in store so that as the materials are used a correct charge shall be made to the proper expense account, and so that the balance in the account shall always represent the cost value of materials on hand?

So far the suggestion relates only to those materials which are consumed in repairs and renewals, but the same general principle applies to such materials as are consumed in daily operation, as, for example, coal burned under the boilers. If a street railway finds it expedient to store a hundred tons or a thousand tons of coal, purchasing it in advance of consumption, by way of providing a supply to carry it over the inclement season, when shipments are not easily and regularly made, or in the case of a river town, to take advantage of the shipping stage of water and consequent low freights, how shall the account be kept so that cost of power shall be charged with the fuel as consumed, leaving a balance in the coal account at all times, representing the cost value of the stock on hand?

This subject was briefly touched upon by two or three of the speakers at the convention of street railway accounts, at Niagara, in October last. W. G. Ross, of Montreal, in answer to a question, stated that he maintained regular accounts with stores, debiting them with materials received and crediting them with materials put out. Several other members intimated by their remarks that they did not keep such accounts at present, but were studying the question, and therefore desired such information as would enable them to manage intelligently in this regard whenever the time for inaugurating the system should arrive. The subject, therefore, may be supposed to have more than passing interest for all who are concerned with the operating accounts of street railway companies.

In the discussion above referred to, there were suggestions of three possible methods to be pursued in street railway operations with respect to stores and supplies. One is to ignore the fact that an unconsumed balance of materials may be on hand. By this plan, as supplies are bought they are charged directly to the accounts representing the operations in which they are to be used. If, for example, coal is bought, it is charged to fuel account or to whatever subdivision may be appropriate among the accounts representing the cost of power. If materials to be used in repairs and renewals are purchased, they are at once charged to the expense accounts to which they fall by classification. If, then, any considerable amount of coal or other material were to be bought in advance of actual need, it would have the effect of swelling the expenses of the month in which the purchase was made or the bills charged up somewhat beyond the actual cost of operations for that month.

It is sometimes argued with reference to this plan that by judicious purchasing and careful distribution of deliveries, even though a small amount is carried on hand from time to time, the months in the long run will even themselves so that the net results will be about the same. This, perhaps, is true, but nevertheless the plan is not a safe one to depend upon, and it is not good accounting. A mere makeshift with respect to managing upon this plan is to allow the company's purchasing agent to buy just as to him seems best, but to hold the bills back in the office, charging them up only at about the rate that corresponds to the consumption. This also is something else than good accounting.

A second plan, and one that is in successful operation with several companies that are very favorably situated, is to make the supply men carry the stock—to arrange with those from whom supplies are bought to keep on hand always a certain stock, from which instant deliveries can be made. Among those who referred to this method at the accountants' convention was C. N. Duffy, of St. Louis. Enjoying a market as large and diversified as that presented by the supply dealers of that city, Mr. Duffy explained that it was possible to place orders for all the materials that his company requires, from coal down to the smallest article of repairs, so as to have the supply come forward at a rate closely corresponding to the rate of consumption. The dealers' bills properly O. K.'d become the vouchers of materials consumed. By this plan he avoided all accounts with stores, all makeshifts, like manipulating bills in the office, and all danger of having one month charged with a larger share of expenditures than was fair comparing it with other months.

The third plan is that of having an account or set of accounts with materials in store, and as already mentioned was that in part explained by Mr. Ross, of Montreal. By this plan materials as bought are charged to stores, and from stores they are given out as required for consumption and charged to the proper expense accounts. If the accounts representing stores, therefore, are debited with the materials going in and are credited with the materials withdrawn, then the balance in these accounts must show the cost value of the several amounts of materials remaining on hand. Stores on hand accordingly would appear among the current assets of the company in its regular balance sheet statement.

So much for a bird's eye view of the plans most commonly employed and from which a choice is to be made by

the accumulant. At another time we will inquire into the methods to be employed with a store's system undertaken where store keepers or warehouse men cannot be afforded on account of the smallness of the operation and the consequent large percentage of expense.

Special Accounting Forms

The standard accounting system adopted by the Street Railway Accountants' Association is essentially nothing more than a classification of the accounts of operating expenses. The broad principles upon which the general accounting of a street railway is to be conducted are not in the least altered by the adoption of that classification, but various benefits flow from employing it. Among its advantages are the uniformity with which records are kept in different organizations, and the facility with which comparisons can be made from time to time. Not only are advantages discovered in the matter of comparisons between the statements of different roads and companies, but more particularly are they in evidence in making comparisons year by year and month by month within the office of a company that has adopted the system.

Every enterprise may be supposed to have its own proper system of accounts, irrespective of the work done by any association. Each street railway company ought to have its accounts thoroughly systematized and well kept, and as a fact many companies stand very high in this regard, but in the best regulated organizations, with occasional changes of officers and employees, there is the constant danger of changes in detail, notwithstanding the accounts in general features may remain the same. Such changes greatly interfere with those statistical comparisons which are the very life of economical management. Hence the desirability of a permanent scheme or plan. One great advantage following upon the adoption of the classification devised and sanctioned by the Street Railway Accountants' Association is permanently establishing within a company that classification of operating expenses which, irrespective of the changes in officers and clerks, shall be systematically maintained. It alone will promote comparisons between the results of one period with those of another.

After the classification has been adopted, and after the general books have been arranged upon the plan recommended by the committee and practically indorsed by the convention, there still remains the need of summaries and recapitulations, so arranged as to be convenient for examination by the general officers, when figures are new, and also for comparison, one with another, after an interval of time has passed. Accordingly, those accountants who have been foremost in adopting the system recommended by the association are now giving more or less attention to still further steps in utilizing the plan of classification in the records of the roads in their charge. Forms of abstracts, summaries, recapitulations and comparisons, either in book or in sheet form, are the pregnant subjects of thought at the present time in various directions.

Among the matters of this kind which have recently been perfected, and which deserve more than passing attention in this connection are the new blanks prepared by J. F. Calderwood, auditor of the Twin City Rapid Transit Company, Minneapolis. These have been especially prepared as necessary supplements to the new system, which, as announced in our last issue, this company has already introduced. The blanks are of a character that scarcely permit of reproduction upon these pages, and therefore we are obliged to content ourselves with a mere verbal description.

The blanks before us are four in number, and all are aranged to fold in general document style for filing away. Each has printed on its back the general title by which it is known. One of them is called a "Comparative Statement of Payrolls;" a second is a "Comparative Statement of Earnings and Operating Expenses." Both of these are planned for half months, and both are arranged in a form to compare the current half month with some previous half month. A third is a "Comparative Statement of Earnings and Expenses" for a complete month, while the fourth is the "General Balance Sheet and Comparative Monthly Statement" of the entire operations of the company.

"The Comparative Statement of Pay Rolls" for the half month is printed on a sheet of paper some 22 ins. wide by 18 ins. deep. Across the top the form is divided into three principal spaces representing the different divisions of the company's operations. One of these is entitled "Minneapolis," another "St. Paul," the third "Twin City Rapid Transit Company. Each of these in turn is divided into four amount columns. One of the amount columns recounts the number of men employed and the amount paid for the current period; the second the same items for the period with which comparisons are being made; while the remaining two columns are entitled respectively "Increase" and "Decrease." Still a fourth grand division represented by the vertical columns on the sheet is a general summary of expenses, being the amounts paid to date, wherein the items relating to Minneapolis, St. Paul and Twin City Rapid Transit Company are spread, each under the three heads, Amount, Increase and Decrease, respectively.

Down the left-hand side of the form are first the general classes of labor corresponding to the grand divisions in the classification scheme adopted by the association. There is first "Maintenance of Way and Structure," subdivided into track and roadway, electric, conduit and buildings. Under each of these is an indication of the class of labor employed. For example, under Track and Roadway appears, road masters, curve men and cleaners, laborers on track and repairs, and laborers on snow and ice.

The next division is "Maintenance of Equipment," under which the subheads are repairs and renewals of power plant, machinists and laborers' steam plant and machinists and laborers' Falls plant. Following this is "Repairs and Renewals of Car and Car Equipment." Under this title are recounted the various shops maintained by the company—for example, carpenter shop, paint shop, blacksmith shop, machine shop, brass foundry, etc. In addition to the general shops there follows an enumeration of the car station shops.

The next division is "Conducting Transportation." The items under this head are divided into two classes, power plants and car service. Under each of these are enumerated the different classes of laborers employed. Following this comes the grand division of "General Expenses," wherein are enumerated salaries of general officers, salaries of clerks in general manager's office, salaries of clerks in auditor's office, storekeeper and purchasing agent and his help, claim agents and their help, legal department, stable expenses, parks and park properties, janitors and contingent. Finally there is shown the total of operation pay rolls and with it items belonging to construction.

The second blank, entitled "Comparative Statement of Earnings and Operating Expenses," for a complete month, and arranged for comparing with some other com-

plete month, takes totals instead of the analysis under the several divisions of the company's operations, as shown in the previous blank. The vertical divisions on this sheet are first current month, under which are noted the comparative expenditures in gross and per mile with the corresponding month of a previous year in the same items. Following this are two columns, in one to note the increase and in the other to note the decrease. The next division vertically makes similar comparisons of items from January 1 to date with the corresponding period of the previous year. These columns occupy about half of the sheet. The remaining portion is devoted to divisions for the current month, in which are nine amount columns.

The items down the left-hand side of this blank are in the first division as follows: passenger earnings, chartered cars, freight, mail and express, producing a total of earnings, which is extended across the entire set of columns. Next is the statement of expenses under the heads of the established classification. Under maintenance of way and structure are presented repairs and renewals of track and roadway, the same of conduits, electrical, the same of overhead equipment and the same of buildings and improvements. Next maintenance of equipment is similarly analyzed, including such heads as repairs and renewals of steam plant, of water plant, of electric steam plant, of electric water plant, of cars, of car equipment, of miscellaneous equipment, of shops, etc. Then follows a similar presentation under the head of conducting transportation, subdivided into two classes, operation of power plant and car service. Following this is general expenses, summarized in the same manner.

It is interesting to note that in the preparation of this blank in particular Mr. Calderwood has held strictly to the form laid down in the classification recommended by the association. The lines are numbered 1 to 38, corresponding to the items put down in the classification reported by the committee under heads A, B, C and D.

The total of expenses is thrown across the width of the sheet, and is then subtracted from the corresponding total of earnings. The result is net earnings from operations. Added to this are income from advertising and from other sources, resulting in a footing extending clear across the sheet, entitled gross income from all sources. Next comes deductions from income. The deductions enumerated are regular taxes apportioned, special taxes apportioned, interest on founded debt apportioned and interest on floating debt apportioned. Total fixed charges, being deducted from incomes from all sources, leaves net income from all sources, from which in turn are made the following deductions: dividends on preferred stock, dividends on common stock and betterments and additions. These deductions from total income having been subtracted, leaves the company's net surplus. Then follows certain statistical deductions, as follows: Total mileage motor, total mileage trailer, total mileage motor and trailer, total passengers revenue, total passengers free, total passengers revenue and free, transfers redeemed, per cent of operating expenses to earnings, average earnings and operating expenses per day.

The third blank, entitled "Statement of Earnings and Expenses" for the month, is much smaller than those which have preceded. It is 8½ ins. deep by 10½ ins. wide. There are two stated forms presented upon it. First there is an itemized statement of earnings and expenses, as follows: total passenger earnings, and total miscellaneous earnings. Then there are operating expenses under the heads of maintenance of way and structure, maintenance of equipment, operation of power plants, car service, general expenses, legal expenses, injuries and damages, insurance and with the final result of surplus earnings. This form is arranged ledger fashion, with two amount columns, headed by Dr. and Cr., respectively. Below this is the comparative statement arranged under heads, each one having a line across the form as follows: total gross earnings, total operating expenses, total surplus earnings, total car mileage, gross earnings per car mile, gross expense per car mile, surplus earnings per car mile, comparison of operating expenses to gross earnings and comparison of operating expenses to total earnings. The vertical columns in this statement are arranged first for the record of the current month, next for the record of the preceding month with which comparison should be made, and then two columns for increase and decrease, explained by per cent. This is repeated in a second set of columns to the right, allowing a column first for the total for the year to date, and then a total for the preceding year to corresponding date, with the resultant increase and decrease expressed by way of percentage.

The "General Balance Sheet" of the company is arranged upon the progressive plan, with auxiliary columns for noting increase or decrease. Its items are presented in what may be called ledger fashion. Dividing the sheet vertically into two parts the assets are on the left-hand side and the liabilities on the right-hand side. Four amount columns are provided for each. There is first the condition of the company at the close of the previous year (December 31), and next are the amounts of the accounts at the date of the balance sheet. The other two remaining columns on each side are devoted respectively to a record of increase and decrease.

The company's assets are arranged under the following heads: roadway and equipment at cost and securities in treasury at value. Under the head of current assets are the following: notes and accounts receivable, cash in bank, insurance paid in advance, car license paid in advance, interest paid in advance, storehouse material and supplies.

The company's general liabilities are presented as follows: capital stock common and capital stock preferred. Then under the head of current liabilities are the following: unpaid vouchers and accounts, pay rolls accrued and not due, bills payable, trainmen's deposits, taxes accrued and not due, interest on funded debt accrued and not due, interest on floating debt accrued and not due, dividends on preferred stock. Below this is a recapitulation of the items of the funded debt, and, finally, at the bottom, is the surplus as it was January 1 of the current year, compared with the surplus at the date of the balance sheet.

On the back of one-half of this sheet is a "Comparative Statement of Earnings and Expenses, Both Fixed and Operating," for the current month. The amount columns here are arranged to two sets, one for the current month and the other for January 1 to date. Under each are two amount columns and also a percentage column divided into two parts, one for increase and the other for decrease. The items down to the left-hand column are as follows: passenger earnings and then miscellaneous earnings, producing a total earning, which is extended across the entire width of the form. Under operation are maintenance of way and structure, maintenance of equipment, operation of power plants, car service, general expenses, legal expenses, injuries and damages. Total operating expenses are then deducted from total earnings producing net earnings from operation. Then follow deductions from income as follows: regular taxes apportioned, special taxes apportioned, interest on funded debt apportioned, interest on floating debt apportioned and dividend on preferred stock. Deducting total fixed charges, from net earnings for operations, gives surplus.

LEGAL NOTES AND COMMENTS*

Edited by J. Aspinwall Hodge, Jr., and George L. Shearer, of the New York Bar

A Decision in Electric Heater Patents

An important decision in regard to the ownership of electric heating devices was given February 18, in the United States Circuit Court of Appeals for the First Circuit, in the case of the Consolidated Car Heating Company, of Albany, vs. The West End Street Railway Company, of Boston. The former claimed that the heaters used by the latter, and made by the American Electric Heating Corporation, were infringements of its patent No. 500,288, granted to J. F. McElroy, June 27, 1893. The decision was rendered by Judge Aldrich and was entirely in favor of the Consolidated Car Heating Company. An abstract is given below:

The patent in controversy relates to mechanism and a device for converting the energy of an electric current into heat energy for the purpose of heating street cars, railway trains and houses, by electricity. There are two claims in the patent and, in the Circuit Court, the second claim was held to involve patentable invention and the defendant appealed, while the first claim was held invalid upon the ground that all of its substantial features were covered by the second claim and the complainant appealed. We are, however, not only not satisfied that the court went too far in sustaining the patent, but are satisfied that it stopped short of giving the patent the scope to which it is fairly entitled through what is expressed by the inventor in his first claim. We will consider first the general question of invention.

While the heater in question is described generally as for the purpose of warming an apartment, it is obvious from reading the whole specification, that the real problem which the inventor intended to solve was how to heat street cars. As is well understood, when electrical power was applied to street railways and the lines increased so as to involve long runs and include places at a considerable distance, the question how to suitably heat the cars at once become an important one. It is not necessary that we should reiterate a description of the inventive device and the mechanism which connected the described structure with the electric current. The ingenious means by which this result was accomplished are sufficiently set out in the opinion of the Circuit Court. In practical use the heating coils are placed under the car seats in different parts of the car, arranged with a radiating surface capable of heating the car in extreme cold weather, and with practical stops or cut-offs for reducing the radiating surface and thus properly adjusting the heat to milder degrees of cold. The spiral coils are safely insulated, electrical contact avoided, and the current safely conducted through means of a mechanism so adjusting the parts as to make the whole self-protecting against the jar and vibration resulting from rapidly moving cars. Looking at the general use, and the substantial results accomplished though the mechanical arrangement and the device described, with the practical view of giving the inventor, it is difficult to see how the patentability of the device in suit can be seriously challenged.

Great stress is laid upon the English patent to Rose as embodying anticipatory features; but the Rose device did not do the thing that this device does. It did not undertake to do it, and, so far as appears, no one ever thought of its being applied to such a situation and doing the work in the manner in which the device in question does it. Quite likely the Rose patent had some of the ideas involved in the patent in question, as for instance, the idea of radiating heat by means of coils of wire, but it did not describe or even suggest the distribution of heat, either in detail or in substance, in the manner and by the means employed in the complainant's device. As was said by the Circuit Court, under the rules applying to foreign patents, it cannot be viewed as anticipating the McElroy invention.

Now as to the claims: In practice the coils of wire are wound or laid around an insulating substance, usually porcelain, in paths or grooves which form a ridge of non-conducting material serving to keep the coils apart and thus prevent short-circuiting.

While the first claim expresses the idea that the layers of spirals shall be separated from each other, it does not describe the mechanical detail for accomplishing such result. The second claim is more explicit in respect to this feature or detail of the contemplated structure, and describes the separating or insulating substance as a non-conducting material placed between the adjacent layers. It is reasonable to conclude, we think, from the inventor's statements in his claims that he had thought out the situation and contemplated that other means than the non-conducting material between the layers of spiral coils, might be employed by the skilled mechanic, and that he would therefore make his first claim broader than the limit which he puts upon his second claim by expressly describing a non-conducting material, as the means of performing the function of keeping the coils separated. He quite likely anticipated that, if he expressly limited himself to non-conducting material, as a means for keeping the wires separated, the value of his patent might, at least, be threatened by the construction and use of heaters made in accordance with his scheme, except in respect to the means employed to prevent short circuits. In other words, some one might construct a heater like his, except the coils might be kept separate in other ways than expressly described by him in his second claim.

What the inventor intended to cover by his second claim, and what he might rightfully cover, was a heater constructed upon the general principles and with the general features of his device, with the coils of wire separated by non-conducting material, such as a porcelain ridge between the coils, formed by the grooves into which the coils were laid as they were wound about an insulating substance; while by his first claim he intended to cover a structure with the same general features, with such other means separating the coils as might occur to the ordinary skilled mechanic as a useful means for performing the particular function of keeping the wires separate. In other words, by the second claim he describes non-conducting material as his means for separating the coils and preventing contact; while by the first plan he describes the layer of spirals as something to be separated, without specifically setting out the means of separation.

Holding these views, both claims are sustained as valid, and with such results we are not called upon to consider the question raised by the sixth assignment of error.

The remaining question is that of infringement, and as to this, we agree with the conclusion of the Circuit Court. The decree of the Circuit Court will be modified so as to stand in favor of the complainant on the first claim of the patent in suit as well as on the second claim, and the case is remanded to that court for further proceedings accordingly. Costs in this court are decreed in favor of the Consolidated Car Heating Company.

The American Heating Corporation states that its present heaters, as well as those manufactured by it during the last three years, differ from those declared to be infringements in the above decision by avoiding the use of the patented features described.

CHARTERS, ORDINANCES, POWERS, ETC.

U. S. COURT.—An injunction restraining the enforcement of a statute reducing the rates of fare chargeable by plaintiff, a street railroad company, was sustained by the Circuit Court on the ground that such statute was in violation of the State constitution, which provided that corporations should be created only by general law, while the statute in question was an amendment of the general law under which plaintiff was incorporated, but applied to no other corporation of the State. Held, that the Circuit Court of Appeals was not without jurisdiction of an appeal from the order on the ground that the contract clause of the Federal Constitution was involved, which fact gave exclusive appellate jurisdiction to the Supreme Court, since such claim could only arise in case the statute in question was passed in violation of the provision of the State constitution, in which case it was invalid, without reference to the question of impairment of contract.

Same—Impairment of Contract Rights—State Statute.

But the further contention in support of said injunction, that, if valid, the statute was an impairment of a vested contract right to charge a higher rate of fare, given plaintiff by the city ordinance under which it constructed its road, involves the application of the contract clause of the Federal Constitution, and fixes exclusive jurisdiction of an appeal in the Supreme Court.—(City of Indianapolis v. Cent. Trust Co., 83 Fed. Rep., 529.)

NEW YORK.—Where a street railway has not obtained the consent of the local authorities having control of the highway and the property owners abutting thereon to the building of a street railroad thereon, as provided by Railroad Laws, § 91, it cannot maintain an action to determine the manner and the compensation for crossing another railroad, under Laws 1890, c. 565, § 12.

The commissioners of highways of a village, by an instrument in writing signed and acknowledged by them and duly filed in the County Clerk's office, consented to the construction of a street

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railway in the highway to connect the village with another town. The instrument recited that, before acting on the application, public notice was given thereof, fixing the time and place of considering it, by a notice published according to law, for at least fourteen days, in a newspaper published in the village. Held, that the instrument complies with the provisions of § 19 of the Railroad Act.

It will be presumed that the notice was properly published, in the absence of proof to the contrary.

Where a railway is to be built from within one village to within another, consent to build in the streets by the local authorities of one village is sufficient for the construction of the road in their village, without proof of the consent of the local authorities of the other.

Consent of the requisite number of abutting property owners to the construction of a railway on a highway, given to certain individuals, and by them assigned to a corporation, is not a valid consent to a building of a track by such corporation, within the railways laws.—(Geneva & W. Ry. Co. v. New York C. & H. R. R. Co., 48 N. Y. Supp., 842.)

NEW YORK.—The property of a given rule or regulation of a street railway company is a question of law for the court.

A rule of a street railway company forbidding passengers from standing on the rear platform is reasonable and proper.

A street railway company has the right to enforce a rule prohibiting passengers from standing on the rear platform by expelling from the car one who refuses to comply therewith.

A conductor is justified in enforcing the rule of a railway company prohibiting passengers from standing on the platform against a passenger who stated that he was suffering from nausea, and might have to relieve himself by vomiting; and it is error to leave the question to the jury. Green and Ward, JJ., dissenting.—(Montgomery v. Buffalo Ry. Co., 48 N. Y. Supp., 849.)

PENNSYLVANIA.—Street railways may diverge from the street for a short distance to avoid grade crossings.

A steam railroad company stood by while the tracks of a street railroad company were laid on an avenue nearly parallel to the former's road, and on a street which crossed said road at right angles. Without objecting to a grade crossing, it negotiated with the street railroad company as to the manner in which it should be made. When its demands were acceded to, it objected to a grade crossing. After its suggestions as to an overhead crossing were accepted and acted on by the street railroad company, and the latter had purchased a right of way, and was proceeding with a construction which would not interfere with the operation of the steam road, it, for the first time, objected that its property rights were encroached upon. The injury to its property was infinitesimal. Held, that it was not entitled to an injunction to prevent the construction of the overhead crossing.—(P. R. Co. v. Glenwood & D. El. St. Ry., 39 At. Rep., 80.)

NEW YORK.—The provision of § 73 of Laws of 1897, c. 278 (Greater New York Charter), that, "after the approval of this act, no franchise or right to use the streets, avenues, parkways, or highways of the city shall be granted by the municipal assembly to any person or corporation for a longer period than twenty-five years," etc., became operative on May 4, 1897, and applied to the Board of Aldermen, then in office, notwithstanding its reference to a Municipal Assembly which was not to come into existence until January 1, 1898.—(Gusthal v. Board of Aldermen of City of N. Y. Supp., 652; see, also, Norris v. Wurster, *Id.*, 656.)

LOUISIANA.—The obligation assumed by a railroad company in a contract between itself and the City of New Orleans (through which contract it acquired the right of occupying with its tracks certain streets in the city), that it would pave a certain portion of one of those streets, can be changed by consent of the contracting parties so as to substitute a different portion of the street for that originally designated, without legal cause of complaint on the part of the owners of property abutting on the portion originally selected for paving. The city, both in making the original contract and in modifying it, was acting in the exercise of its general administrative powers, and not in any wise on behalf of any special class of citizens or property owners.—(Schmitt v. City of New Orleans, 21 South., 24, 48 La. Ann., 1440; State v. City of New Orleans, 19 South., 690, 48 La. Ann., 649; Barber Asphalt Paving Co. v. N. O. & C. R. Co., 22 S. Rep., 955.)

U. S. COURT.—The mere granting of consent by the local authorities to the building and operation of a street railroad does not constitute irreparable injury to abutting property, so as to entitle an owner to maintain a suit to enjoin such action.

Under the New York statutes authorizing suits by taxpayers (Laws 1881, c. 531; Laws 1887, c. 673; Laws 1892, c. 301), although the entire body of taxpayers in a city, the city itself, and the general public may be interested in the result, a complainant cannot be compelled to admit others as co-complainants; and a Federal court has jurisdiction of such a suit where the requisite diversity of citizenship exists between the parties to the record.

That section 74 of the Greater New York Charter (Laws 1897, c. 378), which prescribes the procedure in granting franchises in the streets of the city, took effect upon its passage, instead of coming into force with a majority of the charter provisions, on January 1, 1898, is not so clear as to warrant a Federal court, in the absence of a construction by the State courts, in restraining by a preliminary injunction the action of the municipal authorities in granting a franchise to a street railroad in accordance with the provisions of previously existing statutes, where such injunction would have the effect to prevent any action by such authorities during the remainder of their official existence.—(Seccomb v. Wurster, 83 Fed. Rep., 856.)

U. S. COURT.—A cable sold to a cable railway necessary to keep the road a going concern, the claim for its price is entitled, on the solvency of the company and the appointment of a receiver, to priority over the mortgage bonds, without showing any diversion of income. And such priority may be allowed though more than two years elapsed between the time the cable was furnished and the appointment of the receiver.—(N. Y. Guaranty & Indem. Co. v. Tacoma Ry. & M. Co., 83 Fed. Rep., 365.)

CANADA.—The plaintiff was ejected from a street car of the defendants in which he was a passenger, and brought an action to recover damages for his ejection.

The conductor who ejected the plaintiff did so because he refused to take his feet off the seat when requested to do so, and because he used bad language.

Held, that the conductor had, upon the undisputed facts, a right to eject the plaintiff for the misconduct stated, and that the action should be dismissed.—(Davis v. Ottawa Electric R. W. Co., Canadian Laws Times, April, 1897.)

DELAWARE.—Where the charter of a street railway company provides that it may cross any track of any railroad, provided that it conform to the grade of the track to be crossed, injunction will not lie at the instance of a steam railway company to prevent said street railway company, operating by electricity under the trolley system, from stretching or extending its trolley wires over, or from operating its line of street railway at grade across the tracks of the steam railway company at a street crossing in a city.

Except under special statutes, the crossing by a street railway, at grade, of a railroad's right of way across an existing highway, will not be enjoined on the ground that the great volume of the railroad company's traffic and the number of its trains at such crossing rendered the crossing dangerous.

An electric street railway, as operated by the trolley system, is not an additional burden upon the soil in the common highway.

Where the act of an electric street railway in crossing complainant railroad company's tracks on a public highway does not take property of the complainant, and does not work some damage to it, differing in kind from the damage which the complainant would suffer in common with the rest of the community, it has no standing to ask an injunction merely because the respondent proceeds *ultra vires*, or usurps a franchise.—(P. W. & B. R. Cor. v. Wilmington City Ry. Co., 38 At. Rep., 1067.)

LIABILITY FOR NEGLIGENCE.

NEW YORK.—In an action against a street railroad company for the death of a five year old boy, there was evidence that the boy and others were playing in the street, and passing back and forth across the tracks; that the motorman had seen them do this three or four times; that the car approached at a speed faster than cars usually run; that, when the car was 29 feet from the boy, he crossed the track in front of it, and stopped 4 to 6 feet from the track, and then turned to run back across the track, from 5 to 7 feet in front of the car; that he was struck by the lifeguard, fell upon it, was carried along some distance, and was finally jolted off, and the front wheels of the car ran over him; and that the car ran over 60 feet after he was struck before it was stopped. The motorman testified that he saw the children when 200 feet away; that he could stop the car in 30 feet; that when the boy first crossed he turned off the power and applied the brake, and brought the car under control; and that, after the boy crossed over, he immediately applied the power and released the brake. Held, that the question of defendant's negligence was for the jury.

It also appears that when the boy was 3 or 4 feet in advance of the lifeguard, and the car was under control, and practically stopped, the power was applied, and that the boy then passed over a distance of 4 feet while the car was passing over the same distance. Held, that the evidence did not justify a charge that

the jury could not predicate a finding of negligence on the facts that the car, after leaving a certain avenue, over 400 feet from the place of the accident, went on south with the power on and the brake loose; that motorman saw said boy and the other children playing at the side of the street; that said boy had run across the track; that the motorman then put on the brake and threw off the power and slowed up the car; that the boy got safely across the track, and continued running after he got east of the rail; and that then the motorman threw off his brake and put on the power.—(Howell v. Rochester Ry. Co., 49 N. Y. Supp., 17.)

PENNSYLVANIA.—Portions of a charge complained of must be considered in connection with the other parts thereof.

Where a child suddenly and unexpectedly appears near a street car track some distance from a crossing, under such circumstances that the driver of a car cannot discover its presence in time to avert the accident, the company is not liable for its injury.—(Kierzenkowski v. Phil. Tr. Co., 39 At Rep. 220.)

Legal Publications*

The usefulness of a work which is a compilation of the essential features of statutory law regulating corporations, not only in the various States, but in the various countries of the world, can scarcely be called in question. Such a work to the investor in American securities, to the business man who deals with corporations in different States, as every business man does, to the directors and managers of corporations, whose business extends beyond the limits of a single State, as well as to the lawyer, is almost an essential book. The very fact that space compels the editor to condense and epitomize, while it renders the work less accurate and reliable, has its advantages precisely as the digest has its uses quite apart and distinct from the uses of a full set of legal reports.

One cause of constant misunderstanding, both in the courts and out of the courts, is the effect of a decision in one State under one set of statutes as authority in another State where the statutes are quite different; and, on the other hand, oftentimes those in the management of corporations and even lawyers fail to take any interest in or to notice a decision in one State, assuming that its statutes are different from the State of their domicile; whereas a single glance at such a work as we are now considering may show that the laws were identical or so similar as to make the case one of controlling interest.

Further, like the digest, the work ever extends to the reader the opportunity of quickly finding the full text of the statute he desires to examine, or the decision which is referred to in the notes, for the work is extensively annotated.

So, too, with regard to the drafting of new statutes (a work which is unfortunately far more prolific than it should be), the book is a quick and ready guide to precedents to the street railway men, for there are 150 pages devoted to a synopsis of the laws governing street railway corporations in each of the States and Territories of the United States. These pages contain annotations which purport to contain all the important decisions of the courts relating to the matters treated of in the statutes. They are satisfactory, so far as they go, but they fall short in fullness of detail the compilation of the general corporation law which precedes it.

In a work of its title it would seem to us that a greater amount of space should be given to street railway corporation law, and chapters should be added epitomizing the statutory law of railroad corporations in general as well as upon the law of banking and insurance corporation law, e. g., the practice of the United States Patent Office and the patent, trademark and copyright laws of the world. An examination of the street railway law reveals the fact that in two States, Delaware and Rhode Island, street railway companies are organized by special legislation, while in three, Georgia, Louisiana and Nebraska, they are organized under the general railroad act, and in thirteen, by special acts, to wit, Alabama, Arkansas, California, Connecticut, Indiana, Maine, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio and Pennsylvania.

In all the other States the street railroad companies are organized under the general business corporation act; although, of course, in some of these States there are special provisions relating only to street railway companies. From the above, the general tendency of legislation, in the larger and more popular States, would seem to be the enactment of statutes making the street railway corporation *sui generis*.

* **The American Corporation Legal Manual for 1898, Volume 6, edited by Charles L. Borgmeyer. The Corporation Legal Manual Company, Plainfield, N. J.**

Program of the Boston Convention

The secretary of the American Street Railway Association has issued during the past month official notification of the plans for the Boston Convention. From it the following is taken:

The seventeenth annual meeting of this association will be held at the Massachusetts Charitable Mechanics' Association Hall, Boston, Mass., Sept. 6, 7, 8, 9, 1898. This early date was chosen by the executive committee, as it was the only week until late in December that the hall could be obtained. This will be a special meeting, but will take the place of the regular one. It is expected to have a very large, if not the largest, exhibit of railway appliances ever shown to this association. The headquarters of the association will be at the Hotel Brunswick. Hotel Vendome is managed by the same parties, and will be used in connection with the Brunswick.

HOTELS AND RATES.

Brunswick,	American plan	.....	$4.00 per day	and up
Vendome,	"	.....	4.00 "	"
Copley Square,	European	.....	2.00 "	"
Nottingham,	"	.....	2.00 "	"
Victoria,	"	.....	2.00 "	"
Touraine,	"	.....	2.00 "	"
Parker,	"	.....	2.00 "	"
Young's,	"	.....	2.00 "	"
Thorndyke,	"	.....	2.00 "	"

The five mentioned are within five (5) minutes' walk of the hall; the others are down town, with street cars to the door of the hall. The executive committee advises all who desire rooms to apply at once, as the rooms at the Brunswick and Vendome are limited, but no rooms will be assigned until March 15, and will be assigned in the order in which applications are received. Railroad rates will, in all probability, be as before—one and one-third fare for the round trip, due notice of which will be mailed in time.

Papers will be read on the following subjects: "Maintenance and Equipment of Electric Cars for Street Railways;" "To What Extent Should Street Railway Companies Engage in the Amusement Business;" "Underground Electric Roads—Construction and Management;" "Carrying of U. S. Mail on Street Railways;" "Comparative Earnings and Economy of Operation Between Single and Double Track Cars for City Use;" "How to Care for Return Current;" "Inspection and Testing of Motors and Car Equipment by Street Railway Companies."

The annual dinner will be held at the Hotel Brunswick, Thursday evening, Sept. 8.

NEWS OF THE MONTH

The Market Street Railway Company is equipping its cars with fenders.

The Flatbush and Nostrand Athletic Club, composed of employees of the Flatbush division of the Brooklyn Heights Railroad Company, held its second entertainment at the club house at Flatbush and Vernon Avenues on Feb. 10. The entertainment was furnished mainly by members of the club, and was highly satisfactory to those who witnessed it.

The employees of the Mahoning Valley Railway, of Youngstown, O., gave an entertainment under the auspices of the employees' room committee, in the rooms at the power station on the 23d of February.

The Cleveland (O.) Street Railway Employees' Beneficial Association held its eleventh annual prize masquerade ball at Red Cross rink on the evening of Washington's Birthday, Feb. 22. A very pleasant time was enjoyed by all present.

The conductors of the Lynn & Boston Railroad of Boston, Mass., will hereafter be required to secure themselves to the company by obtaining two bondsmen, each bond amounting to $150, making $300. No bondsman will be accepted by the company who has not at least $1000 worth of real estate. Previously the conductors have deposited $50 with the company as a guarantee of good faith.

The Hartford (Conn.) Street Railway Company is now building a new car house, which will probably be the largest street railway car house in New England. The building will be 300 ft. x 198 ft., and fourteen tracks will be laid the entire length of the floor, furnishing storage room for about 100 cars.

As announced in the last issue of the Street Railway Journal, the electric cars of the Brooklyn street railway systems are making regular trips across the Brooklyn Bridge. Under the terms of the contract with the Bridge Trustees, the street railway companies were to pay five cents toll for each car crossing the bridge. Up to the present time the conductors of each car have paid this toll, but a rather novel mechanical device will soon be installed for automatically counting the number of cars that pass each day. This will be accomplished by insulating a section about 60 ft. long of the main trolley wire. This insulated section will be fed direct from a feeder, and the circuit in passing from the feeder to the insulated section will actuate an electro-magnet, which in turn will actuate a recording mechanism. Of course the magnet will only be actuated when a car comes into the insulated section, and in this way a correct count of the total number of cars passing will be obtained.

The Nassau Electric Railroad, of Brooklyn, N. Y., has been making a number of interesting experiments in order to determine the average distance in which an electric car equipped with ordinary hand brakes can be stopped at different speeds. It was found that a well-trained motorman under usual conditions should be able to stop a car running ten miles an hour within fifteen feet if necessary.

The street railway employees of Detroit have held a number of meetings to protest against the introduction of a United States mail system on the street railways lines of that city. The protest is founded on the fact that if the mails are carried by the street cars it will give the companies a great advantage in case of a strike as United States troops can be called in to keep the cars running.

The Boston Elevated Railway Company has an unusually complete method of examining all men that are employed as conductors or motormen on its lines. This includes examination as to mental, moral and physical qualities, and all applicants must pass a high average in all these requirements. In addition to this, the company pays a high rate of wages and the hours of work are short. In this way the company has at all times an intelligent, competent and satisfied force of employees.

A contemporary prints the following letter, which, it is stated, was received by a Chicago concern. The letter speaks for itself: "Dear Sir—I wrote you for circulars of canned Electricity in an order invoiced No. 49531, and You wanted more of the Particulars of what I wanted it for. I have read of electricity that is sold every morning in cities (the same as milk, gasoline, ice, etc.) in cans, to run sewing machines, churns, & small house hold articles, and there is bicicles run with electricity of cans of some kind. The reason I wrote you was I thought there was electricity generated from dynamo motors and put up & sold in cans, & it would be light. I expect to want something that will develop about 2 horse power & be as light as possible to experiment in aerial navigation."

A Canadian paper prints the following: "There are 569 miles of electric railway in Canada, exclusive of those in British Columbia. The train mileage run in 1896 was 21,917,151, and the number of passengers carried was 73,496,069. The total capital and bonded debt was £4,600,000."

The Montreal Street Railway Company is circulating the following notice: "Sealed tenders, marked 'Tender for Advertising Privilege,' addressed to the Montreal Street Railway Company, Montreal, Can., will be received up to the first of April next for the privilege of advertising in the company's cars. The conditions under which the said privilege would be granted may be had upon application to Martin H. Watts, secretary, at the office of the company, in Montreal. The company does not bind itself to accept the highest or any tender."

The special committee appointed by Gov. Wolcott of Massachusetts to investigate the relations between cities and towns and street railway companies has presented its report to the Legislature. A radical change in the method of taxing street railway corporations is proposed, and while municipal ownership of tracks is favored, private ownership of equipment and cars is held to be preferable to municipal management of the entire street railway business.

The St. Lawrence Power Company, of Massena, N. Y., has certified to the Secretary of State that the whole amount of its capital stock of $6,000,000 has been paid in. The certificate is signed for the company by William C. Bane, president, S. M. Gardner Stewart and C. H. Reese.

A number of bills affecting street railways have been introduced recently in the New York Legislature. Among these may be mention a bill to compel street railway companies in cities of the second class to give passengers who are compelled to stand while a car goes five or more blocks tickets entitling them to another ride. One to compel all railroad companies in the Borough of Manhattan, operating by cable or electricity, to have two conductors on every car between the hours of 6 A. M. and 9 A. M., 12 noon and 2 P. M., and 4 P. M. and 8 P. M. One of the conductors to be qualified to act as motorman. A penalty of $25 per car is provided for any violation of the law. Another provides that all cars on a line of railroad in New York City running less than the entire length of the road are to have a sign on them showing their final destination, and in case there is no such sign to run to the end of the line. A penalty of $100 is provided for any violation of this act.

Foreign Notes

The town council of Llandudno, Wales, has under consideration the granting of rights of way to the Great Orme Electric Tramway. E. W. Johnson represents the promoters of this road.

An electric railway, to run from Flamborough to Budlington, England, is under consideration, and the prospects are that a franchise will be granted.

Lightning, of London, prints the following: "The Corporation of Hull, England, is taking up the tramway question in earnest. Powers to borrow £270,000 on tramways account are to be sought, and a tender has been conditionally placed with Siemens Bros. & Co., at £42,228, for the equipment of an electric line. This is no doubt the beginning of a big municipal system of electric traction."

The Town Council of Beaumaris, Wales, recently took up the subject of the proposed electric tramway from Beaumaris to Llanfair. Local option seems to be in favor of the project, but further discussion was postponed until April. Theophilus Rowlands, of Anglesea, Wales, is the chief mover in the new scheme.

At a recent conference between the Tramways and the Lighting Committees, held to consider the proposals of A. B. Holmes, the city electrical engineer, for erecting a new power house so as to deal with the coming demands for electric traction, street lighting and machine driving, the plans were referred to Dr. Hopkinson for report.

The joint report of Mr. Blackman and of gas engineer on extending the electric supply to the west end of Aberdeen has been submitted to Prof. Kennedy for his opinion. To deal with this distant part of the city it will be necessary either to build a generating station on the spot or to install a high-tension plant at the existing works, and in view of the probable introduction before long of electric traction, Mr. Blackburn thinks that a high-tension continuous-current system would be most suitable.

The Municipal Council of Grenoble, France, has had under consideration for some time the question of awarding franchises for electric railways presented by the Grenoble Electric Tramway Company. A decision has just been announced in favor of granting franchises, which include four city lines and two suburban lines.

The tramway mileage in Hamburgh is now 188 km., all of which was installed by the Union Elektricitats Gesellschaft.

The "Elektrotechnische Zeitschrift," of Berlin, for Jan. 6, prints some very interesting statistics concerning the street railways of Germany. The paper gives the following table, showing the growth in the number of towns in that country in which electric tramways have been built.

Number of towns in which tramways were in operation:

Year.	
1891	3
1892	5
1893	11
1894	20
1895	32
1896	44
1897 (September)	56

In addition to the fifty-six towns given for September of last year, there were thirty-four other towns at the beginning of that month where electric tramways were either in progress or finally decided upon, while in thirty other towns extensions of existing lines were either being carried out or were projected. At the close of 1897 eight of the lines promoted in the thirty-four towns in question had been completed, so that on Jan. 1, 1898, no less than sixty-four towns were in possession of electric tramways. On Sept. 1, 1897, there were in operation 840 miles of tramways, 2,255 motor cars and 1,601 trail cars. The total capacity of all the power stations require to operate this mileage is about 24,920 k.w.

A standard gage electric railway has been built from the town of Trossingen in Germany to the railway station bearing that name, a distance of 2.8 miles, with no gradient exceeding 3 per cent. According to the "Elektrotechnische Zeitschrift" the power house will contain two Körting gas engines, each of 100 h.p., two 75 h.p. dynamos, and a battery of 300 cells, for the railway service, and two more dynamos and a battery of 124 cells, for the supply of light and power in the Trossingen district. There will be two motor cars, each equipped with two 40 h.p. motors. It is expected that the railway will be opened in September.

The "Electric Engineer," of London, prints the following: The Wann See Railway, for which there was lately issued a prize competition for proposals to enable the increased traffic to be coped with, is to be worked by electricity if the trials now to be made are successful. The line, which is about 7½ miles long, is between Berlin and Zehlendorf. The trial train is expected to make fifteen double journeys per day with a load of 210 tons. The current is to be conducted to the train by a special conductor rail 1 ft. above the edge of the running rails. The conductor rails will be carried upon insulators placed four or five yards apart. The latter will be fixed upon wooden saddles, which will be firmly attached to the ends of the sleepers. The return current will pass through the running rails. The compressed-air brake now in use is to be retained; the air will be pumped by electromotors, but trials will also be made with an electrical brake. The line current will be used to light the carriages. Accumulators on the cars will be employed to prevent extreme fluctuations in the light.

The following extract from the presidential address of John S. Raworth, president of the Northern Society of Electrical Engineers of England, will be of interest: "The total mileage of electrically-worked tramways in Great Britain is now 93. The projected lines, however, amount to no less than 340 miles in length, and the capital required for their equipment will certainly not be less than £3,000,000. But even this large amount of prospective business represents only the beginning of the demand. Very soon horse traction will be superseded by electricity on the whole 1000 miles of tramway now existing; and in addition to this, London will be honeycombed with subterranean electric railways, and provincial towns will adopt systems of surface tramways far more elaborate and extensive than those which now exist, even if they have to widen their streets to accommodate them. There is already sufficient indication of what is coming in the attitude of Manchester, Leeds, Sheffield and Glasgow. The fact is, that electric trams pay both the owner and the user; wherever they run no one can afford to walk, except for exercise, for the saving of time is enormous. Even in England, where the eight-mile-an-hour rule is in force, there does not appear to be any difficulty in getting over the ground."

New Equipments for New York

During the last month the Metropolitan Street Railway Company, of New York awarded a number of important contracts for rolling stock for its new conduit line, rapidly approaching completion. It is understood that the order for cars was given to the John Stephenson Company and the J. G. Brill Company, that the truck order was awarded the Peckham Truck Company and the J. G. Brill Company, and that for the motors was given the General Electric Company. The E. P. Allis Company was also awarded an order for six 4000 h.p. engines.

Electrical Exhibition in New York

The Electrical Exhibition Company, which is conducting the electrical and kindred industries exhibition to be held at Madison Square Garden, New York, in May, 1898, reports that over 100 companies throughout the country have signified their intention to make exhibits at the next show. This number is more than five times as great as the number that had been secured at a corresponding period before the last show.

Some very interesting exhibits in electric railway work will be made at Madison Square Garden, including several ingenious methods of perfecting the conduit electric and third-rail systems. Among these will be an operative exhibition consisting of a section of conduit electric road, with yokes, tracks, etc., blocked up above the floor of the exhibition hall, showing the method of picking up the current, etc. This will be a complete reproduction of a section of the system as in use on Madison Avenue, New York, with one of the new cars in actual operation. This exhibition will be made, in addition to their displays, by the John Stephenson Company, Ltd., Peckham Motor Truck and Wheel Company, Walker Company, Gold Car Heating Company and other companies who furnish supplies and material in connection with this class of work.

The Manufacture of Air Brakes

That the popularity of air brakes in steam railroad service promises to be repeated in the electric railway field seems to be indicated by the comparatively large number of brake equipments which the factories devoted to their construction are putting on the market. The application of these brakes has naturally been made first to heavy interurban and elevated railroad cars, where the inefficiency of the ordinary hand brake is most clearly apparent, but other companies are investigating the subject, and a considerable number of them have already declared themselves in favor of a power brake.

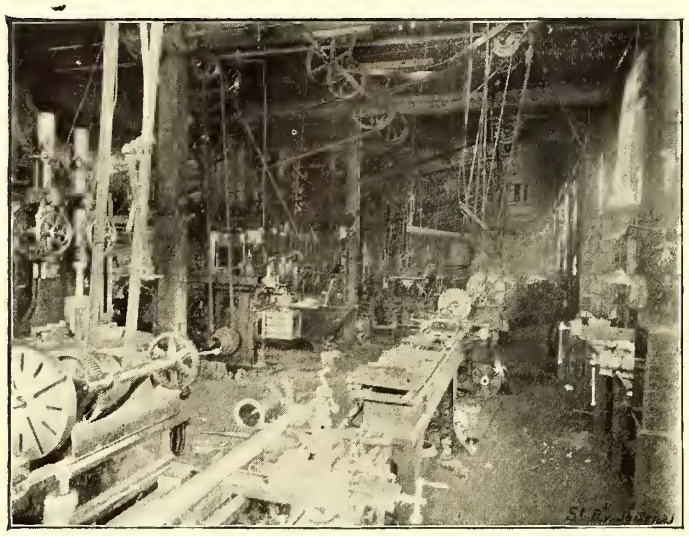


FIG. 1.—MACHINE SHOP

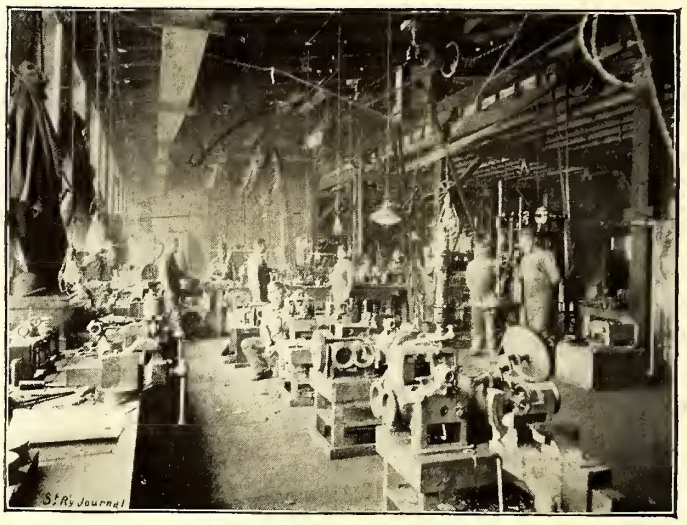


FIG. 2.—ASSEMBLING DEPARTMENT

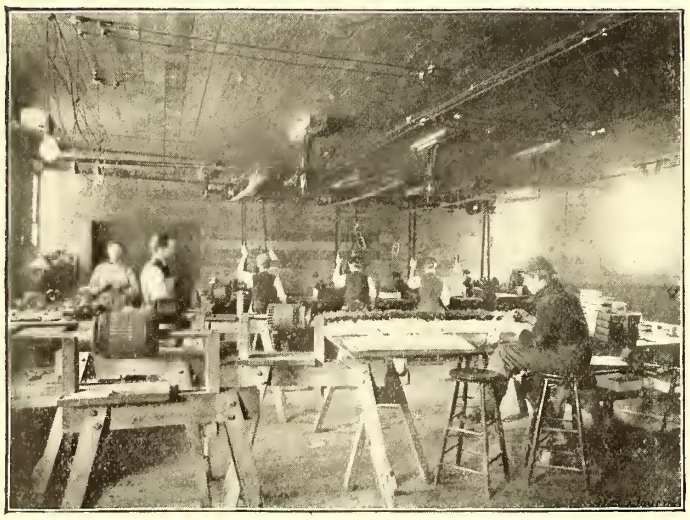


FIG. 3.—ARMATURE ROOM

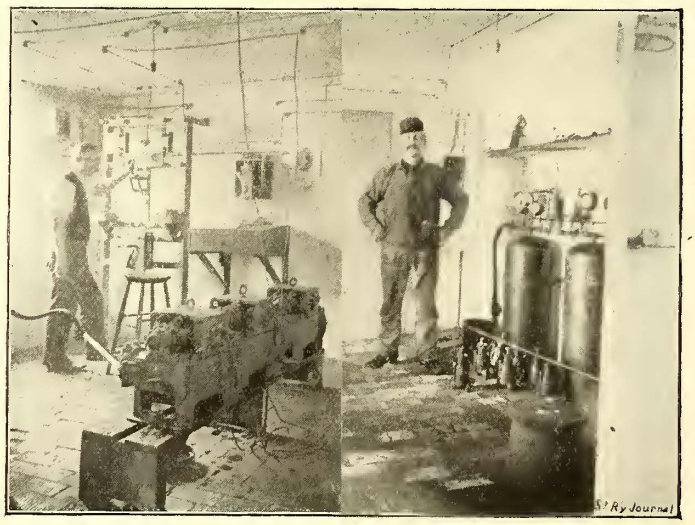


FIG. 4.—TESTING ROOM

The accompanying engravings were taken in the shops and of the apparatus of the Christensen Engineering Company, and give a good idea of the facilities possessed by this company for manufacturing, and of its latest type of independent motor-driven compressor brake system. The output of the company's shops, which are in Milwaukee, is three independent motor equipments and 7 axle-driven equipments a day. The company manufactures in its own shops all its apparatus, including the electric motors for driving the compressors in the independent system. These motors vary in capacity from 2 h.p. to 10 h.p., according to the size of the compressors. The details of the manufacture are under the direct supervision of N. A. Christensen, M. E., the inventor of the brake, who is an authority on all matters connected with this branch of electric railway service. Mr. Christensen has had a long experience in electric railway air brakes, having been engaged in their manufacture since 1892, and much of the success of the brakes which bear this name is due to his energy and mechanical skill.

Fig. 1 shows a view of the machine shop, where only a few of the machines of the entire plant are shown. This machine shop occupies a space of about 120 ft. x 60 ft. Fig 2 shows the assembling department, with a capacity of assembling eighteen sets of apparatus at a time. This room measures 100 ft. x 40 ft., and the machines shown in the engraving are some intended for use on the Alley Elevated Electric Line of Chicago.

Fig. 3 gives a view of the armature department, and Fig. 4 the testing room. These two departments, with the pattern shop and offices of the company, are on the second floor of the building. The testing room is fitted for thoroughly testing all the compressors, engineers' valves and other parts of the apparatus.

A thorough test is made of each individual motor compressor, both for capacity in free air per minute, for current consumed and for temperature of both armature and fields, as well as for speed. Each compressor has its own number, and a corresponding test sheet is filled out showing all the particulars of the test. These test sheets are kept on file and give a complete record of the machines from which they are taken. All of the motors are tested with current of 550 volts, and all of the cylinders, pipes, valves, etc., with an air pressure of 90 lbs. per sq. in. This 90 lbs. pressure is that generally used in the main reservoir of the automatic air brake system, but for the straight air system the pressure usually employed is 70 lbs. per sq. in. In this room the automatic controllers are also tested and set. The company's controller is brought down to the simplest possible construction and has been found to be reliable under all circumstances of duty regardless of temperature or other exterior causes. It is so arranged that when the maximum pressure is reached the motor is stopped, and when the minimum pressure is reached the motor is started. The action of the controller is without resistance, and the arc caused by the breaking of the circuit is extinguished by an air blast which is directed against the arc at the right moment with the full force of the pressure in the main reservoir. The variation between the

maximum and minimum pressure is from 8 to 10 lbs. The solution of the problem for making a successful automatic controller to work under these conditions has been one of the hardest encountered in working out this whole apparatus.

Fig. 5 shows the independent motor compressor, type No. 1, boxed in, and with forgings all in place, ready to bolt to the lower part of the car body. This box is about 21 ins. cube, and with motor compressor and forging complete, weighs in the neighborhood of 400 lbs. Fig. 6 shows the box of the motor compressor partly opened, when access is readily had to the air valves as well as to the commutator and brushes, simply by doors which are easily opened at any time without taking the car over a pit. The attachment is sometimes made to the floor of the car and sometimes the motor compressor is placed on the platform. The former

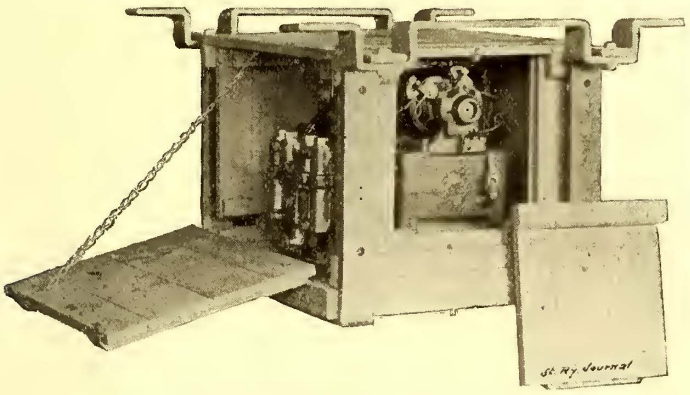


FIG 6.—MOTOR COMPRESSOR WITH CASE OPEN

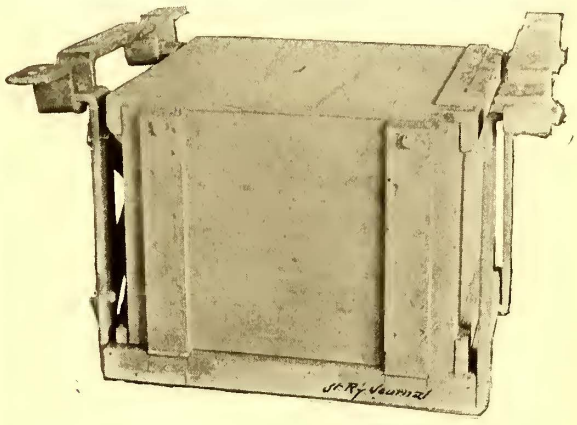


FIG 5.—COMPRESSOR BOXED

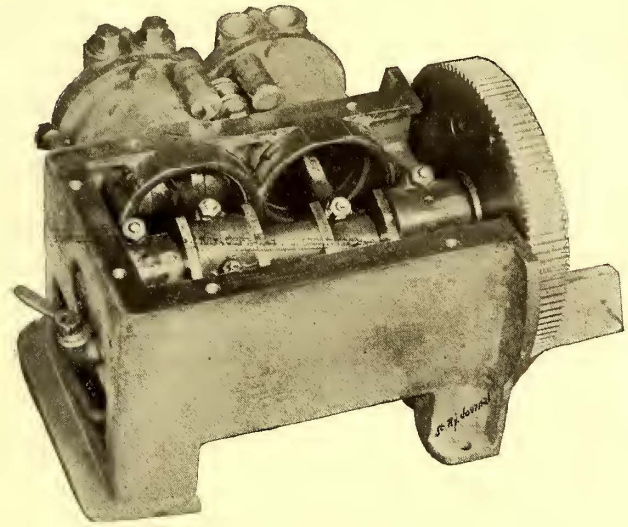


FIG. 7.—COMPRESSOR WITH MOTOR REMOVED

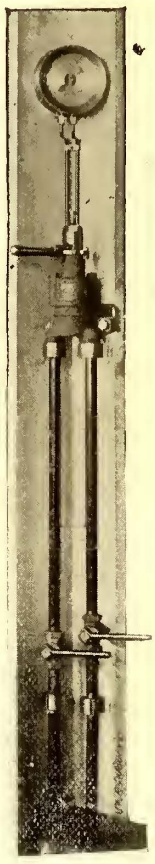
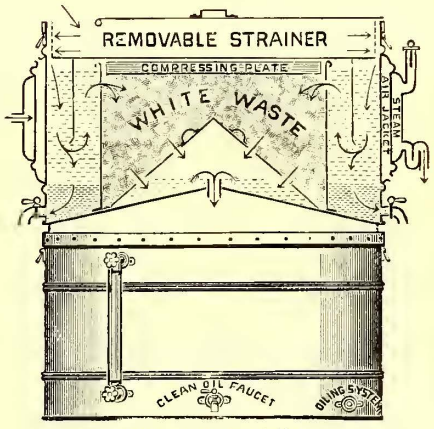


FIG. 8.—VALVE AND PIPING



NEW OIL FILTER

plan is used on the Alley L road of Chicago, the latter on the Metropolitan L and Lake Street L roads of Chicago, and, as a general rule, on interurban electric cars.

Fig. 7 shows the motor compressor with the motor removed and the two single acting plungers, and the manner in which they are operated from the crank shaft by connecting rods is clearly illustrated. The interior part of this compressor case is partly filled with oil, by which all the moving parts of the compressor are constantly lubricated. The motor base, together with the gear case, forms a complete enclosure for this, and thus not only secures perfect lubrication at all times, but does away with the necessity of constant attention. As the oil in this case needs replenishment or renewal only at long intervals, it is introduced into the compressor through a fitting shown on the left hand side of this engraving. The aperture in this fitting is closed up by a screw plug.

Fig. 8 shows the engineer's valve, piping and air gage, as arranged in the vestibule of a car. In this instance the apparatus shown is that used on the South Side Alley L in Chicago, for which this company is at present filling an order for 120 complete air brake equipments, arranged and adapted for the Sprague multiple unit system.

Electric Headlights for Street Cars

An electric headlight for street cars, embracing several points of merit and some very distinctive features, is known as the "Syracuse changeable electric headlight." It can be changed from one end of the car to the other without the slightest trouble, so that but one headlight is required for each car. The set of headlights used on the winter cars can be changed to the summer cars as easily as can the controller handles. Inexpensive electrically connected sockets are fastened to the dashboards without cutting, and by simply inserting the contact stem of the headlight into either socket the lamp lights. The manufacturers, Crouse-Hinds Electric Company, claim that an open and closed car can be equipped at less cost with these headlights than either car could be with fixed lights, particularly if the cars run either end front and require a light on either dash. In this case, the summer car and the winter car would, with fixed lights, require two each, or four headlights in all, while with the Syracuse changeable headlight, one headlight and four inexpensive sockets would meet the same requirements. This company's goods are well spoken of, and the company reports that it is crowded with orders.

A New Principle in Oil Filters

The accompanying illustration shows an oil filter, which embodies a number of entirely new features, and which, it is claimed, will effect a very large saving, both in waste oil and in the friction of engine bearings due to the use of gritty oil. The main purifying medium employed in this filter is a low initial heat by exhaust or live steam, which is admitted into the steam jacket at the left hand side, as will be seen from the cut.

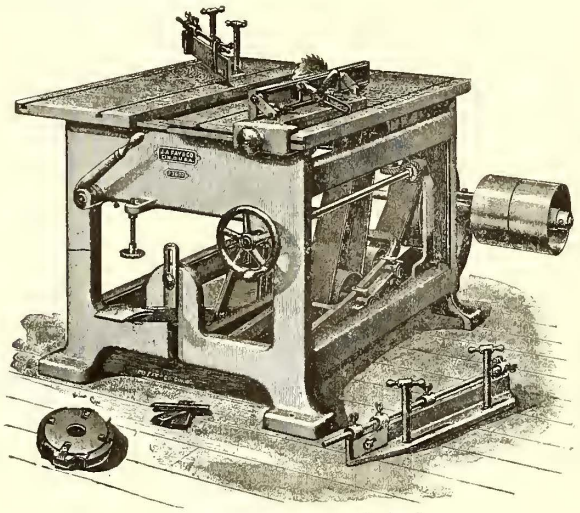
This filter is so arranged that it first thoroughly strains the dirty oil and then allows it to settle. This settled oil is heated to 150 degs., or over, with a low initial heat of less than 200 degs., and is then passed, while still hot, through a suitable filtering medium. This purified oil is then run into a chamber to allow it to cool before using. The heat as applied to the oil after it has passed through the first straining material, thins it and makes it bright and clear, causing all water and heavier impurities to become separated and precipitated on the bottom of the refining chamber, whence they are readily withdrawn through dirt faucets provided for that purpose. This makes the apparatus practically self-cleaning.

After leaving the heating chamber and passing through the sec-

ond filtering material, the oil comes from the apparatus in as near its original refined condition as is possible to make it. This filter is known as the "Famous," and is manufactured by the Famous Filter Company.

New Combination Saw and Dado Machine

In the accompanying illustration is shown a new combination saw and dado machine, which has been placed on the market by J. A. Fay & Company. This machine is designed for use in shops where light ripping, cutting off, mitering, grooving and dadoing is done, and the manufacturers think its construction, simplicity and the variety of work it will perform will commend it to every practical machine operator.



SAW AND DADO MACHINE

The frame is of iron, with complete sides and ends accurately planed at the joints and securely bolted together. The table is of iron planed perfectly true, and is 48 ins. x 36 ins. It is made in two sections, being divided at the saw line. The section at the left hand is gibbed to the frame and slides to and from the saw, being operated by the lever at the operator's hand. This permits the use of heads of special saws for cutting grains or grooves of various widths. A hand wheel and screw below this lever serve as a stop for always bringing the table to a determinate point.

Extensive Mountain Electric Road in Switzerland

An important mountain railway, to be equipped with electric power is now being built by Brown, Boveri & Company, at Zermatt, to afford access to the Gornergrat. The track was nearly completed last fall, when the winter put a stop to further construction, but it is thought cars will be in operation by July 1, 1898. The fact that the three-phase system is to be used adds to the interest of the installation. The line will have a total length of 9.2 k.m., in which space it will rise 1,600 m., and its cost will be about 3,500,000 fr. On account of the grades the Abt rack system will be employed.

Water power will be used to generate the current, and will be furnished by two 250 h.p. turbines, which will operate under a head of about 100 m. The generators, which will be built by Brown, Boveri & Company, will have twelve poles, and will supply a 5,400 volt current, with forty cycles per second. This voltage will be reduced to about 540 volts on the trolley wire.

The two trolley wires will be eight m.m. in diameter, and placed forty c.m. apart. Each of the electric locomotives, of which there will be two, will weigh about 10.5 tonnes, and each will be equipped with two 3-phase motors. The motors will be geared down to the rack in the ratio of 12 to 1, and the locomotive will have a speed of seven k.m. per hour. Each train will consist of one locomotive, one closed car and one open car, the former holding sixty and the latter fifty persons. Both cars and locomotives are well equipped with brakes and safety devices.

Novel Truck at Atlanta

The accompanying engravings show a car and truck recently built at the shops of the Atlanta Railway Company. As will be seen, the truck is constructed upon original plans. The principal features of it are its simplicity and low cost of construction. As will be seen, two motors are used. The wheels being close together, the truck can turn between the sills of the car, thereby bringing the body within one step of the ground. The motor frame is used for supporting the car body, doing away with the necessity of an outside truck frame. The equipment has been in service for about five months, and has given the best of satisfaction.

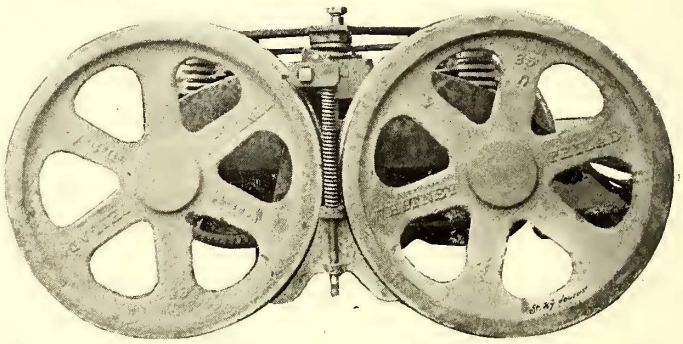
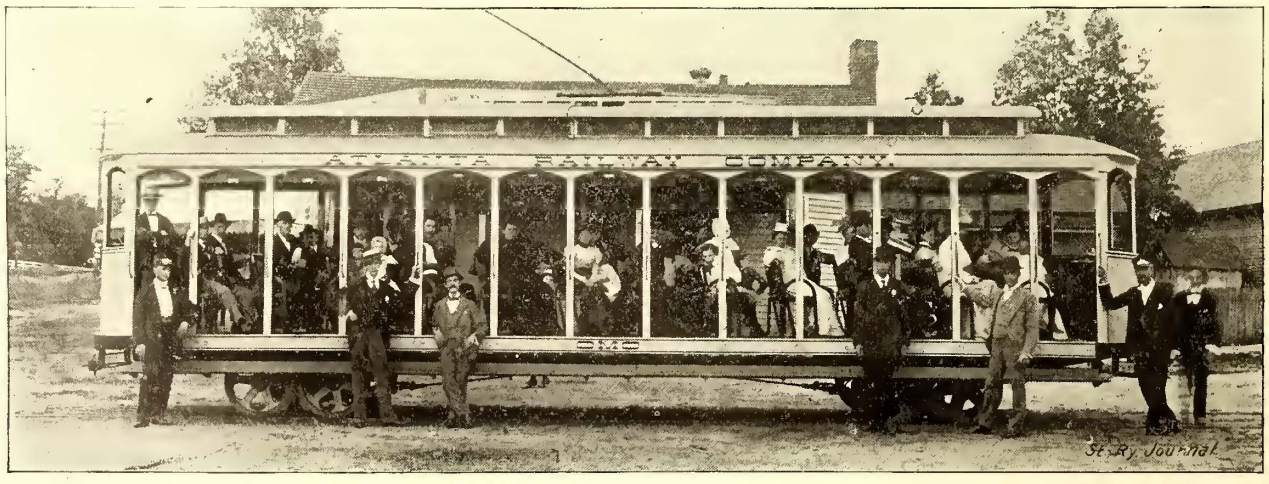


FIG. 1.—NOVEL TRUCK—ATLANTA

The truck was designed by Frank Zimmerman, superintendent of the Atlanta Railway Company. Mr. Zimmerman has had a long electrical experience. He was connected at one time with the Sprague Electric & Motor Company. He was afterwards with the Westinghouse Electric & Manufacturing Company and with the Detroit Electrical Works, with which company he remained until August, 1895, when he accepted the position with the Atlanta Railway Company, which he now holds.



CAR AND TRUCK—ATLANTA

"Metropolitan Special" High Speed Electric Truck

The demand in New York for a very substantial truck for extra long high-speed cars induced the Peckham Truck Company to build the special truck shown in Fig. 1. The truck has proved so successful as to warrant the belief that it will be equally desirable where similar conditions of weight of car body and speed are encountered. The design differs in a number of points from the other models of Mr. Peckham, as will be seen by a study of the accompanying engravings.

The side frames are the same cantilever truss construction as is used in all Peckham cantilever trucks, but they are made of extra strong construction; the pedestals and side bars also are heavier, and additional upright posts are used to tie the upper and lower members of the side frames together.

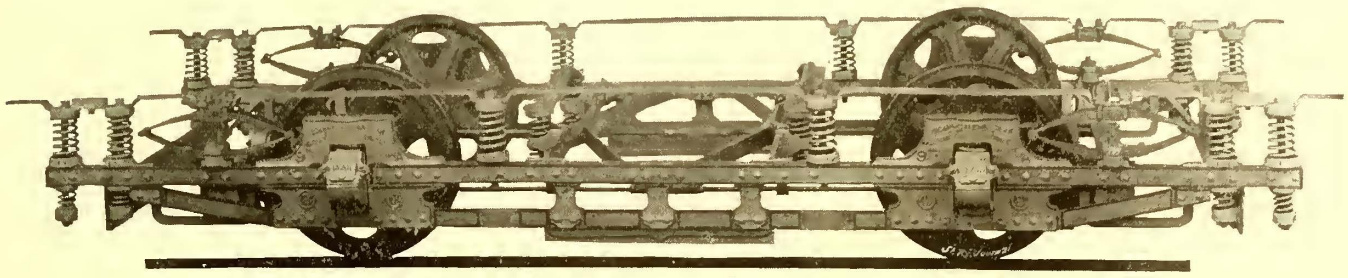


FIG. 1.—"METROPOLITAN SPECIAL" TRUCK FOR CONDUIT ROADS

To prevent oscillation at high speed the end extensions of the truck are fitted with two under tension springs, with double check nuts, which can be so adjusted as to take up the lost motion of the spiral springs, both upper and lower, and hold the truck and car body attached thereto steady, and prevent their teetering. By securing the car body firmly and flexibly to the truck by this arrangement of the springs any tendency to oscillate is counterbalanced by the weight of the motors, wheels and axles, as either end of the car body can rise or fall only about the nearer car axle as a fulcrum.

To strengthen the truck frames and keep them in alignment the center of the truck is provided with a cross brace, having a center member and two side braces so attached to each other and to the side frames of the truck that it relieves the truck frame from the lateral strain and keeps it strictly in line with the car body and the track. The construction of this center brace is varied to suit the different conditions of electric service. For overhead trolley cars the brace is made as shown in Fig. 2, with a center cross-bar, and for electric conduit system the brace is made as shown in Fig. 1, so as to leave an open space in the center for the removal of the electric plow. The strength of the brace is practically the same in both constructions, however. Where the electric conduit system is used the lower members of the side frame are provided with a support for the electric plow, consisting of angle bars riveted firmly to the inside of the lower members of the side frame.

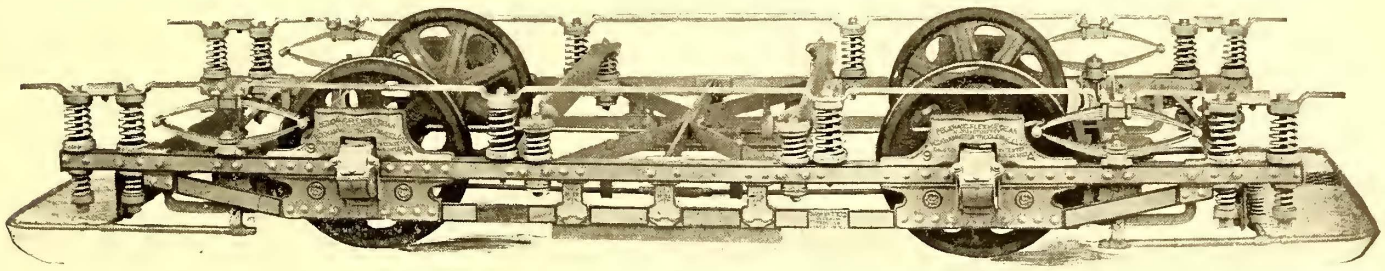


FIG 2.—"METROPOLITAN SPECIAL" TRUCK FOR TROLLEY ROADS

One hundred and fifty of these trucks are running on the Madison Avenue line of the Metropolitan Street Railway Company, of New York, under box cars 22 ft. long in body and 31 ft. long over platforms. These cars ride easily without any perceptible oscillation, although the speed at which the cars run through the tunnel is often as high as 20 miles an hour.

The Peckham Truck Company guarantees these trucks to handle 20 ft. and 22 ft. closed cars and 30 ft. and 32 ft. open cars on good track at a speed of 25 miles an hour without oscillation.

New Lighting Plant in Boston

The Boston Electric Light Company has concluded a contract with the General Electric Company for the equipment of its large generating station now in course of erection. Up to the present time the Boston Electric Light Company has operated a number of stations throughout Boston. Two of these, however, have recently been abandoned to make way for the new railroad stations now being built and the company has, therefore, decided to consolidate all the small stations into one mammoth generating plant to be erected in South Boston.

The system will involve the use of the three-phase alternating current, selected on account of its greater flexibility, and the fact that by its use the value of the present distributing system will not be diminished. The dynamos will be four in number, each of 1,500 k.w., with a reserve capacity of 50 per cent, giving a total output of 12,000 h.p. They will be of revolving field type, a type adopted to permit a high voltage to be taken directly from the dynamos to the wires without the use of transformers to increase the pressure. The revolving field on each dynamo will be mounted on the shaft of an engine, and the voltage of the generated current will be 2200 volts. To excite these dynamos, two smaller ones, each of 100 h.p., will each be driven by a synchronous motor. In addition eighteen large synchronous motors, each of 200 h.p., will drive thirty-six arc lighting machines. Each motor will be set between two Brush 125 light arc dynamos, the shaft of the motor armature being extended to become the shaft of the armature of the arc dynamos. The power transmission for this arc lighting plant, therefore, will be confined to the width of the dynamo room. If this system were not employed small engines would have to be used, whereas, by the method selected, only the large main engines will be employed.

For the power circuits, that is, for the stationary motors, two rotary converters, each of 500 k.w., or 650 h.p., are included in the contract. These will take the three-phase alternating current and convert it into direct current at about 550 volts. For the incandescent lighting system, the three-phase current wires will simply be connected to the existing network, using the transformers now in use.

Important Decision Affecting Steam Users in the United States

The Circuit Court of the United States for the Northern District of New York made a decree on February 8, injoining the Sherwood Manufacturing Company from infringing on the patents of the Union Boiler Tube Cleaner Company.

Equipment of the Brooklyn Elevated Railway, Brooklyn

The Brooklyn Elevated Railroad Company, whose line is now being operated by steam dummies, awarded a number of important contracts on Feb. 23 for the equipment of its lines by electric power. The president of the company also stated that the structure of the company would be immediately extended to the Brooklyn terminal of the New York and Brooklyn Bridge, and connections would be made by which the cars would run across the bridge, as agreed with the bridge trustees.

The Fifth Avenue line is the first which will be equipped. The first order calls for twelve motor cars, each to be equipped with four Walker 80 h.p. motors; later other cars will be ordered until the road is entirely equipped. The Sprague Multipolar Unit system will be used, and the third rail method of taking current, as in use on the Chicago roads, will be employed.

The new cars will be built by the Pullman Car Company, and will be equipped with Christensen air brakes. It is stated that power will be taken at first from the stations of the Brooklyn Heights Railroad Company until the company's plans for its own power station has been settled upon.

The motors were designed by S. H. Short, of the Walker Company, especially for elevated railway service, and will be built upon the lines of generators. The frame is cast entirely from the best quality of soft steel, the magnetic ring being circular in form and containing four laminated field magnets with pole shoes. Each one of the magnets is wound with bar copper, insulated with asbestos, forming a perfect fire-proof coil. The motor frame is divided on a horizontal plane, with the axle bearings and armature bearings carrying the lower half, so that the lower half is supported by the axle and the truck bolster, leaving the upper half of the magnetic frame free to be removed from above, exposing the armature and the whole interior of the motor. The armature bearings are held in pockets cast in the lower frame of the machine, and can be lifted out with the armature from above by means of an overhead crane. The axle is arranged to pass through a tubular cavity cast in the motor frame so that any oil which may ooze from the axle bearings will run into this cavity and back into the oil wells, with no possibility of leaking into the interior of the motor. The armature bearings are also arranged in solid cast iron boxes containing brasses, and arranged so that the oil which lubricates them returns immediately to the oil wells and does not creep out along the shaft and onto the motor shell. The armature is hollow and provided with air ducts running radially through the laminations to insure perfect ventilation. The winding is made from bar copper, with only one turn for each commutator bar. The modern practice of very few slots is used in the armature, with four inductors in each slot, the insulation being entirely of mica, rendering it also fire proof.

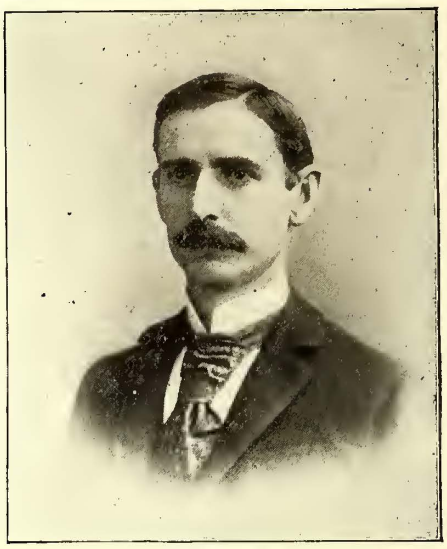
The frame of the motor is left practically open for complete ventilation, so that the heated air on the interior of the motor can escape freely, thereby increasing the capacity of the motor for sudden and heavy overloads. The motor is so designed that it will not spark under any conditions of load, and can take currents two or three times the normal current of the motor without damage to any part of the machine.

The brush holders are provided with four brushes each, held firmly in movable brass and bronze boxes, each box being connected directly with the terminals of the brush holders by means of flexible cables, so that the current is not permitted to pass through any moving joints, which would cause heating. The commutator bars are insulated from the shell by means of continuous molded insulation made from pure mica. The commutator bars are made from drop forged copper of the purest quality. The current density in the brushes is about 35 amps. per sq. in., or about the same as is used on the latest types of generators. These machines are so designed that they will run in practice as cool as ordinary generators in the station. The carrying capacity of the copper used in the machine is very great, the resistance being reduced to a minimum, so that they are very efficient for very heavy overloads—a necessary requirement for motors which have to start heavy trains at short intervals of time.

The motors are also provided with armature covers, which can be used to close the motors up tightly during the winter weather, when they will be required to run through snow.

These machines are built especially for elevated railway work, although they can be applied to heavy surface railways, such as branch lines of steam railways, many of which are now experimenting in this line. A large number of these motors have also been ordered by the Metropolitan and West Side elevated railways in Chicago, where they are to be used in operating four-car trains. The Brooklyn motors are, however, of 80 h.p. each, while the Metropolitan motors are of 150 h.p. each. The wheels used are 33 ins. in diameter, with steel tires.

These motors will be known as the "Short" elevated railway motors, from their designer, Sidney H. Short. Mr. Short, as our readers know, has given a great deal of attention and thought to the problems involved in the equipment and operation of elevated railways by electric power, and is regarded as an authority on this subject. It is interesting to note that Mr. Short's early figures and proposals for elevated railway equipment are almost identically those which modern practice has shown to be the most desirable. As far back as June, 1892, Mr. Short, at the request of the Manhattan Elevated Railway Company, submitted to Col. F. K. Hain, then vice-president and general manager of that system, specifications and figures for the equipment of that line by electric power. Basing his estimate upon the operation of a five-car train, Mr. Short stated that an electric locomotive which would be required to operate the train on Third Avenue, from the Battery to 129th Street, in forty-three minutes, should be capable of working up to 400 h.p., and that the average of efficiency of conversion from the engine in the power house to the locomotive wheels would be about 41 per cent. He recommended the use of a third rail, of steel, and of the ordinary T form, carrying about 6 ins. above the ties, and protected on either side by timbers; and for braking proposed an automatic electric motor compressor, similar to that used on the present systems.



S. H. SHORT

Mr. Short has been thoroughly identified with the development of electric railways since its infancy. He was born in Columbus, O., in 1857, and was graduated from the Ohio State University in 1880. While in college he invented and patented a long-distance telephone transmitter, and an improved arc lamp. After graduation he was appointed professor of physics and chemistry in Denver University, and while in that city built, in 1885, his first electric railway, which was a conduit line. In 1887 he returned to Columbus and built a 2½-mile line in that city. He built another line in St. Louis in 1888, and in 1889 moved to Cleveland, where he organized the Short Electric Railway Company. After the practical absorption of this company by the General Electric Company, he became associated with the Walker Manufacturing Company, now the Walker Company, as its vice-president and electrical engineer, and his work is now well known in Europe as well as America.

A Complimentary Dinner

F. S. Pearson, formerly chief engineer of the Metropolitan Street Railway Company, of New York, has recently resigned his position for the purpose of taking a much-needed rest, and in order to show the esteem in which they held him, the employees of Mr. Pearson's department on Feb. 1 tendered a complimentary dinner to him at Delmonico's, at which nearly two hundred guests were present. Mr. Pearson was presented with a loving-cup, a gold watch and chain and a diamond watch charm. Among the guests present were William C. Whitney, H. H. Vreeland, president of the company; H. S. Beattie, treasurer of the company; D. B. Hasbrouck, the vice-president; H. A. Robinson, the company's counsel; M. G. Starrett, the assistant chief engineer, and a number of other officials. There were also guests from Philadelphia, Boston, Steelton, Pa.; Syracuse, Montreal and Halifax, including W. L. Elkins, Jr., of Philadelphia, and a delegation of Mr. Pearson's old associates in the West End Street Railroad Company, of Boston.

Mr. Pearson is well known not only in this country, but in foreign countries as well, as an eminently successful and able engineer, and he holds the position of consulting engineer for about twenty companies at home and abroad. Mr. Pearson expects to make an extended trip through Europe, and will probably remain in the south of France for some time.

Personals

MR. S. F. GIVEN has assumed the management of the lines of the Pennsylvania Traction Company, of Lancaster, Pa.

MR. ALFRED WALLACE has resigned his position as superintendent of the Columbia Electric Street Railway, Light & Power Company, of Columbia, S. C.

MR. J. H. WILSON, president and general manager of the Mobile Light & Railroad Company, of Mobile, Ala., spent a few days in New York during February.

MR. G. W. KNOX has been appointed to the position of electrical engineer and engineer of construction of the Chicago City Railroad Company.

MR. C. J. REILLY now holds the position of superintendent of motive power in charge of both the cable and electric power stations of the Chicago City Railroad Company.

MR. F. J. J. SLOAT, superintendent of the Akron, Bedford & Cleveland Railroad Company, visited New York last month. He stated that his company had recently installed some electric brakes.

MR. W. M. HABLISTON has resigned his position as general manager of the Richmond Traction Company, of Richmond, Va. Mr. Habliston will, however, retain his position as vice-president of the company.

MR. A. E. WORSWICK, who has had charge of the electric equipment of the Cape Town, South Africa, tramways, has left that place to supervise the electric equipment of the tramways in the City of Mexico.

MR. F. H. FOWLER, of Springfield, Mass., has accepted the position of superintendent of the Washington & Great Falls Electric Railway Company, of Washington, D. C. Mr. Fowler was formerly connected with the Bemis Car Box Company.

MR. HENRY HOLGATE, until recently general manager of the Montreal, Park & Island Railway, has resigned that position and will go to Kingston, Jamaica, to take charge of the construction of the West India Electric Railway Company.

MR. JOHN HOWARD YARDLEY has resigned from the Philadelphia Car Wheel Company, and has associated himself with the Pennsylvania Car Wheel Company, of Pittsburg, which he will represent in Philadelphia. Mr. Yardley is well acquainted with the street railway trade, in which he is popular.

MR. AUGUST C. HEIDELBERG has been appointed assistant superintendent of the Chicago City Railroad Company. Mr. Heidelberg has been connected with this road for three years as trackmaster, and will now have charge of all track and line departments, with supervision of barn foremen, inspectors, etc.

MR. F. A. SCHEFFLER, who recently represented the Sterling Company in New York, is now general factory manager of the Sprague Electric Company. His headquarters are at the factory of the company at Watessing, near Bloomfield, N. J. Mr. Scheffler is well equipped in both mechanical and electrical knowledge for his present position from his long experience in the manufacture of electrical apparatus with the Short Electric Railway Company, the Brush Electric Company and other companies.

MR. GEORGE O. NAGLE was recently promoted to the position of superintendent of the Chicago City Railroad Company. Mr. Nagle was born in Milton, Pa., Dec. 31, 1868. He received his early education in Lima, O., moving to Chicago in 1886. Shortly after this he entered the employ of the Chicago, Burlington & Quincy Railroad, first in the ticket auditor's office and later in the general auditor's office. In February, 1891, he entered the employ of the Chicago City Railroad Company as junior in the claim department. Six months later he was promoted to the position of private secretary to the superintendent, which he held until appointed superintendent, on Jan. 18, 1898.

MR. A. H. HAYWARD, who was recently general manager of the Houston Electric Street Railway Company, of Houston, Tex., has accepted the position of engineer in charge of electrical construction in Buenos Ayres, Argentine Republic, for the system of railroads controlled in the city by Mr. Carlos Bright. Mr. Hayward has a high reputation as an electric railway manager in this country, and has been general manager of the Allentown & Lehigh Valley Traction Company, Allentown, Pa.; the New Jersey Electric Railway, of Rutherford, N. J., and recently of the Houston Electric Street Railway. He sailed for Buenos Ayres, via the Etruria, on Feb. 19, and was married the same day. Mr. Hayward takes his bride with him to Buenos Ayres.

MR. THOMAS H. McLEAN has accepted the position of general manager of the Toledo Traction Company, of Toledo, Ohio. Mr. McLean has been president and general manager of the street railway lines in the city of Mexico for the past two years, and has made an enviable record while holding this position. He has introduced a number of new features upon the system, and has succeeded in greatly reducing the operating expenses as well as increasing the gross receipts. Mr. McLean is very well known throughout the United States as an unusually successful general manager, and his many friends will learn with pleasure that he will again take up his duties in the United States. Mr. McLean will enter into his new position about April 1.

MR ERNEST WOODRUFF, formerly vice-president and general manager of the Consolidated Street Railway Company of Atlanta, Ga., has recently been elected president of that company, to fill the vacancy caused by the resignation of Mr. Joel Hurt. Mr. Woodruff has been connected with the Consolidated Street Railway Company since 1893, and has served in the capacity of vice-president and general manager since that time. Though still a young man, Mr. Woodruff has had a long business experience. After graduating from the schools of Columbus, Ga., his native place, he went into business with his father, and was for years actively connected with the management of the Empire Flouring Mills of that city. Mr. Woodruff, in his present position, is the highest executive officer of the seventy miles of the Consolidated Street Railway system, which is one of the finest street railway properties in the South.

W. A. GASTON

E WOODRUFF

MR. HOWARD I. BETTIS, auditor of disbursements of the Southern Railway, has resigned to take effect March 1, and will probably re-enter the street railway business. Mr. Bettis has been in the roadway, engineering, stores and auditing departments of large Eastern and Southern steam roads for some years, and has had about seven years' experience in street railroad work. He was with the Thomson-Houston Electric Company in 1888 in charge of their West End Street Railway accounts, and while there prepared a pamphlet on "Classification of Expenses for Electric Railways," which had a large circulation and was adopted by several roads. This "classification," slightly modified, was afterwards adopted as standard by the American Street Railway Association at the Atlanta Convention, and later was the basis of such changes as were made by the New York State Board of Railroad Commissioners in preparing the new form of reports to be made by the street railroads in the State. Mr. Bettis was general manager, assistant secretary and treasurer of the Atlanta Consolidated Street Railroad, and auditor of the Paterson, Passaic & Rutherford and the New Jersey Electric Railroads, besides opening the books, formulating the system of accounts and auditing the accounts of several other roads.

MR. WILLIAM ALEXANDER GASTON, who has just been elected president of Boston Elevated Railroad Company, was born in Roxbury, May 1, 1859. His early education was obtained in private schools and in the Roxbury Latin School. He was graduated from Harvard in the class of 1880, and subsequently from the Harvard Law School. After admittance to the bar he began practice with his father and Charles L. B. Whitney, entering into partnership with them Oct. 1, 1883. His present partner is Frederick E. Snow, under the firm name of Gaston & Snow, who have a very large practice. He is regarded as one of the ablest members of the Suffolk bar, and has given much attention to corporation law. Mr. Gaston is a director of the Manufacturers' National Bank and a trustee of the proprietors of the Forest Hills Cemetery; he is a member of a number of clubs—the Somerset, the Puritan and the Athletic Club of Boston, the Country Club of Brookline, the Commodore Club of Maine and other associations. He was a member

of the staff of Governor William E. Russell. When the Boston Elevated Railway was organized he was elected its president, which position he now holds, and the successful organization of this company is conceded to be due to him more than any other man.

Obituary

HENRY W. JOHNS died at his home at Park Hill, Yonkers, February 15, after an illness of several months. Mr. Johns was best known through his connection with the asbestos industry, of which he was a pioneer in this country. He was born in West Stockbridge, Mass., in 1857, and at an early age came to New York, engaging for a short time in various lines of business before determining upon that which was to be his life work. In 1858, while experimenting with a view to perfecting a fire-proofing compound, he became aware of the existence of asbestos, the indestructible, fibrous mineral, at the time but little known outside of laboratories and mineralogical collections. From this time until his death he worked continuously at the development of its commercial uses, and built up a business of great magnitude based upon his numerous inventions.

A man of great business sagacity and ability, of large information and pronounced views on public and commercial topics, he nevertheless avoided public life, preferring to devote himself exclusively to his chosen field of accomplishment. Mr. Johns was president of the company bearing his name and of the Johns-Pratt Company of Hartford, and was at one time a director in the Western National Bank of New York.

AMONG THE MANUFACTURERS

W. H. HOOPER has been appointed general agent in Chicago for the Safety Car Heating and Lighting Company, of New York City. Mr. Hooper takes the place of George N. Terry, resigned.

THE EDISON DECORATIVE & MINIATURE LAMP DEPARTMENT, of Harrison, N. J., has issued a new catalogue of the candelabra special series and battery lamps which it carries in stock.

THE WESTERN ELECTRIC COMPANY, of Chicago, manufactures a very superior disc Le Clanche porous cup cell, especially adapted for bell and annunciator work. The company makes the batteries complete or furnishes the porous cup without zinc or glass jar.

THE BROWNELL CAR COMPANY, of St. Louis, it is understood, has resumed operations, and will again do a general car building business. It is also understood that Mr. Brownell has recently received a contract for six cars from the Baltimore Consolidated Railroad Company.

W. P. SEGUINE, formerly with Joel H. Woodman, has recently left this firm, and is now connected with the Frost's Veneer Seating Company, Ltd., of New York and Chicago. Mr. Seguine has a large business acquaintance, and his many friends will wish him success in his new position.

THE LOMBARD WATER WHEEL GOVERNOR COMPANY, of Boston, Mass., who supplied the governors for the wheels of the Butte, Mont., Power Company, whose plant near Butte was described in our last issue, call our attention to the fact that the type of governors used are the "Standard," not the "Stoddard."

THE CAMBRIA IRON COMPANY, of Philadelphia, Pa., has recently issued its new catalogue of girder rails for street railway use. The catalogue is very tasteful and neat in appearance, and is devoted almost exclusively to fine full page diagrams of rail sections. This book will be found of great value to everybody interested in the purchase of steel rails.

C. K. KING, secretary of the Ohio Brass Company of Mansfield, O., who was in New York for a few days recently, reports that thus far the year has brought his company more orders and inquiries than was even anticipated in the general revival of business. Its factory was running full and the officers and salesmen are unsually busy for this time of year.

WILSON, THOMSON & COMPANY, of Brooklyn, have recently equipped the cars of the Norwalk Street Railway Company, of Norwalk, Conn., with the Wilson patented trolley pole catcher. The Norwalk Street Railway Company has been testing this catcher for some time, and the decision to equip their cars with it speaks well for the satisfaction it is giving.

WENDELL, FAY & COMPANY, of New York, selling agents for the Middlesex Company, of Lowell, Mass., report that they are doing a good business with street railway companies. This company makes a specialty of furnishing a high-grade cloth of extra strength and fabric, expressly for making uniforms for police, fire and street railway employees.

EUGENE MUNSELL & COMPANY, of New York and Chicago, importers and dealers in amber "mica," report a very gratifying demand for all their insulating specialties. The India "mica" is being used very largely by electrical manufacturers and street railway companies, both in this country and in Europe, on account of its being free from iron as well as its high insulating qualities.

THE NATIONAL ELASTIC NUT COMPANY, of Milwaukee, held its annual meeting on Jan. 27, and the following gentlemen were elected directors for the ensuing year, viz.: C. F. Ilsley, E. M. Spalding, Joshua Stark, T. L. Paine, John Campbell. The Board of Directors elected officers as follows: C. F. Ilsley, president; T. L. Paine, vice-president and general manager; John Campbell, secretary and treasurer.

THE EDWARD P. ALLIS COMPANY, of Milwaukee, recently secured an order for six 4000 h.p. engines for the Metropolitan Street Railway of New York. Some idea of the size of this contract can be obtained from the fact that it will require 120 cars of 50,000 lbs. capacity each to carry these engines to New York. The Edward P. Allis Company also recently secured a contract for one 1,000 h.p. engine to go to Berlin.

THE JACKSON & SHARP COMPANY, of Wilmington, Del., has recently made the following shipments: One six-bench open car, to the Umtali Tramways, Limited, South Africa; thirty 30-ft. open motor car bodies, to Tramvias Electricas de Buenos Aires; five 18-ft. 6 ins. cross seat closed cars to the Syracuse & Suburban Railroad; also, two long double truck cars, 26 ft. 6 in. in body, to this same road.

THE SARGENT COMPANY, of Chicago, has secured the order for furnishing the steel castings and gears for the machinery of the Snow and Ice Transportation Company, which intends to build a railway over the snow and ice field to the Klondyke. This order was secured by the Sargent Company on account of its ability to make prompt delivery, the time being a week less than that of any of their competitors.

THE SWARTS METAL REFINING COMPANY, of Chicago, wishes to announce to the trade that it is not in any way connected with the Swarts Iron & Metal Company, which recently sold out its business. The Swarts Metal Refining Company takes pleasure in announcing that it is still doing business at its old stand, and is ready to fill any orders that may be entrusted to its care.

THE PARTRIDGE CARBON COMPANY, of Sandusky, O., reports that its factory is exceedingly busy. The company has recently shipped an order of 19,000 street railway brushes to Antwerp, and it has on its books a large number of excellent orders from street railway companies at home and abroad. The Partridge Carbon Company aims to produce only first-class goods at fair prices, and strives to give entire satisfaction to every customer.

S. C. STROCK, Bowling Green Building, New York City, is doing a particularly gratifying business, considering the season of the year, in manufacturing square and octagonal yellow pine poles. He makes a specialty of poles, from 25 ft. to 65 ft., and over. Poles of this size are difficult to purchase, and street railway companies desiring them will no doubt be glad to learn of a reliable firm that makes a specialty of this class of poles. Mr. Strock also reports a good trade in railroad ties, round poles, etc.

THE PAWTUCKET BRASS FOUNDRY, of Pawtucket, R. I., has issued an exceptionally artistic and valuable catalogue of the electric railway supplies which it carries in stock. This company makes a specialty of all necessary overhead appliances and insulators, railway motor bearings, axle bearings, etc., and in addition solicits orders for castings, under 1,000 lbs. in weight, in bronze, copper and brass. The company also casts in aluminum, tin, zinc and lead.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, has issued its catalogue for 1898, showing different types of electrical instruments which this firm manufactures. These include switchboard and portable voltmeters, ammeters, wattmeters, ground detectors and other measuring instruments. The Keystone instruments have a world-wide reputation for accuracy, constancy and durability, and are now in use in many of the leading power stations of the United States.

THE NEW YORK SWITCH & CROSSING COMPANY of Hoboken, N. J., has recently published a very tasteful cata-

logue, illustrative of the various types of rails and special work which it manufactures. Among the former are shown all the standard sections in common use, and among the latter the latest type of hardened centre work, as well as bolted-up frogs, rail benders and other track tools. Particulars are also given of the electric automatic switch manufactured by the company.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, reports that it is receiving a large number of orders daily for its emergency trolley wire splicer. This splicer has now been in use for some time and has successfully stood a number of very severe tests. The Ohio Brass Company has received such a large number of favorable reports from this splicer that it now feels justified in heartily recommending it to all street railway companies, and feels confident that it will give entire satisfaction wherever it is used.

WENDELL & MAC DUFFIE, of New York City, have recently issued an unusually complete catalogue of the machinery and supplies which they manufacture. The catalogue contains complete illustrations of all the different lines of goods which this company carries in stock, together with prices and description. The catalogue is bound up with alternate blank pages for notes, this being a unique and valuable feature. This company reports an excellent business and thinks that the prospects for the coming season are unusually bright.

THE JOHNSON COMPANY, of Lorain, O., announces that after three years' experimenting it has overcome the difficulties that were developed in electric welding, and that it is now prepared to resume operations in that field with the guarantee of the results. The company offers, first—a stronger joint with one that must be forever permanent; second, absolute conductivity and cure of electrolysis; and, third, the cheapest continuous joint in the market. H. F. A. Kleinschmidt has been placed in charge of the department that will give its attention to this class of work.

WARREN WEBSTER & COMPANY, of Camden, N. J., have recently issued a neat pamphlet describing the "Webster System" of low pressure steam heating. The operation of this system of heating is based on the principle of the flow of steam and condensation from a pressure slightly above into a pressure slightly below that of the atmosphere, or into a partial vacuum, which has been effected throughout the supply pipes, radiating surface and return pipes in advance of turning on the steam—which, when turned on, flows rapidly into the lower pressure.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., reports a very much increased demand for its various street railway products. This company carries a complete line of insullac and armalac for the insulation of generators and motors for all kinds of high potential work. These two compounds are rapidly establishing a reputation for permanency and absolute reliability. The Central Electric Company anticipates a very large business during the coming season. The Central Electric Company is also prepared to furnish from stock India or amber mica, cut or uncut, in rings, washers, or any other standard form, a specialty being made of standard shapes for commutators.

D. W. RICHARDSON, of Standish, Mich., writes that he has on hand a large amount of hemlock and tamarack cross ties of excellent quality, as well as a good supply of cedar fence posts. Owing to the unfavorable winter in many sections, it is believed that there will be a great shortage in the stock of cross ties, and it is the general opinion that most anything with "two faces on," as the lumber men express it, will pass along before June, judging by what passes inspection at the present time. Mr. Richardson's location in the heart of the lumber district gives asurance that his stock is of first quality.

THE WARD LEONARD ELECTRIC COMPANY, of Bronxville, N. Y., has issued its catalogue for 1898 of the cast iron outlet boxes which it manufactures. This company manufactures these outlet boxes in every desirable size and shape, and is prepared to turn out large orders at short notice. The Ward Leonard Electric Company has installed in New York City alone, during 1897, 81,000 of its boxes. Among the buildings in which these boxes are used may be mentioned the New York Life and Metropolitan Life Insurance Companies, the Manhattan Hotel, Columbia College buildings, the Waldorf-Astoria Hotel, American Tract Society Building, Delmonico's and many others.

PIERCE & MILLER ENGINEERING COMPANY, of New York, reports it is experiencing a very prosperous and rapidly increasing business, which is an indication of the general and permanent improvement of the conditions of business throughout the country. This company is now executing orders for engines, boilers and complete plants for use throughout the United States, for the United States Government and other customers, as well as for Japan, Mexico, Central and South America. Its high reputation as contracting engineers, gained by past experience, gives its estimates more than favorable consideration on the numerous large and important plants, orders for which are now pending.

THE B. F. STURTEVANT COMPANY, of Boston, Mass., has received a number of letters testifying to the satisfaction which its mechanical draft system is giving. Among the letters received is one from the Holyoke Street Railway Company, of Holyoke, Mass., dated Jan. 7, 1898, and reading as follows: "Speaking from our experience with mechanical draft, it is time for a grand change all around, from costly great chimneys to what we find to be a more economical and better way, that of the fan process of furnishing precisely the amount of draft required at all times and during all kinds of weather. The theory of mechanical draft is correct, and what is better, the practical use of it is correct and saving in expense."

THE HUNT AIR BRAKE COMPANY, of New Kensington, Pa., having received numerous calls for a portable air compressor suitable for use in cleaning generators, motors, etc., has placed upon the market an air compressor for this purpose, which, it is believed, will entirely meet all requirements. The apparatus is capable of discharging a steady and powerful jet or stream of air, at the same time maintaining a constant air pressure of 30 lbs. in reservoir when using a 250-volt current. With a higher voltage a higher pressure can be maintained in the reservoir, with the outlet valve wide open. The company is also pushing its combined motor compressor for heavy double truck electric cars, and its automatic axle compressor expressly designed for use in braking trail cars.

THE FALK MANUFACTURING COMPANY, of Milwaukee, Wis., reports that from present indications and orders to date it expects to do more business this season in track welding than it did during the four preceding seasons. The company now has orders from cities all over the United States. About four years ago the Falk Manufacturing Company cast welded a portion of the tracks of the National Railway Company's lines in St. Louis. These joints have been in constant service since that time and the officers of the National Railway Company state that the welded joints are giving entire satisfaction, and it is probable that this system of casting joints will be generally extended over the lines of the company. This speaks well for the successful operation of the Falk joint.

THE Q. & C. COMPANY, of Chicago, Ill., manufacturers of railway specialties, portable rail saws, track jacks, rail drills, for both street and steam railways, have purchased the entire stock of the Stanwood Manufacturing Company, and will continue the manufacture of the popular steel car step, which is now in use on about 200 street railways, as well as on government vessels, etc. All inquiries or orders for these goods should be addressed to this company. These goods will hereafter be known as the Q. & C.-Stanwood car step, and they will be made at the large and commodious factory of the Q. & C. Company, located 27 miles from Chicago, on the C. & E. I. Railway, at Chicago Heights, Ill., the general offices of this company being at 700-709 Western Union Building, Chicago.

THE DORNER TRUCK AND MFG. COMPANY is the name of a new company which has recently been formed in Cleveland, Ohio, for the purpose of manufacturing railway trucks exclusively. The president of the company is Henry A. Dorner, who is well known throughout the street railway field in connection with the Dorner & Dutton Company. The new company's factory is located at the corner of Mason and Belden Streets, in the old works of the Brush Electric Company. This factory is well adapted to the building of motor trucks, having a fine machine, blacksmith and setting-up shop. It is also equipped with traveling cranes, and electricity is used for driving the different machines. Railroad tracks in the yard and a large boom crane give unusual facilities for loading and shipping trucks.

THE MICA INSULATOR COMPANY, of 218 Water Street, New York, and 117-119 Lake Street, Chicago, and 12 Camomile Street, London, reports a heavy increase in its volume of business. Many of the large manufacturers are using its "Micanite" segments in the construction of their generators and motors exclusively. The company has made many valuable improvements in its well-known insulation, "Micanite," and is turning out a very fine commutator segment. It would be pleased to send a set of segments for any of the smaller machines, as samples, to electrical manufacturers or repair concerns, who may make application. This company's M-I-C friction tape and "Empire" cloth are meeting with a large sale. It is using it in the winding of fields and armature coils, and render the highest possible grade of insulation.

THE INTERNATIONAL REGISTER COMPANY, of Chicago, has lately doubled the capacity of its factory, and although working its full force overtime, reports that it is impossible to keep up with the orders for its double register. This would seem to indicate that this register is proving fully as popular with street railway managers as have the portable and single type of registers manufactured by this company. With the new double register the cash fares and the transfers are registered on separate totalizers, the figures of which are large enough to be seen from any point in the car, and it is claimed that it is absolutely impossible to "beat" these totalizers. The present officers of the company are: A. H. Woodward, president; A. H. Englund, vice-president; W. H. Brown, secretary and treasurer; Charles E. Pratt, Superintendent.

THE FISCHER POWER & MACHINE COMPANY, of Pittsburgh, Pa., reports recent sales of its four-valve crank automatic engine, as follows: Newtown Electric Light & Power Company, Newtown, Pa., one 150 h.p.; The Reid & Barry Company, Passaic, N. J., one 125 h.p.; The Union Traction Company, Philadelphia, Pa., one 400 h.p.; Standard Electric Light, Heat & Power Company, Avoca, Pa., one 150 h.p.; Jersey Shore Electric Company, Jersey Shore, Pa., one 125 h.p.; I. C. Cochran, for the Holland & Lake Michigan Street Railway Company, Chester, Pa., one 300 h.p.; A. Groetzinger & Son, Pittsburgh, Pa., one 125 h.p.; William H. Keech & Co., Pittsburgh, Pa., one 75 h.p.; Rochester Tumbler Company, Rochester, Pa., one 150 h.p.; John T. Parker, Needham, Mass., one 100 h.p.; Waterloo & Cedar Falls Rapid Transit Company, Waterloo, Ia., one 350 h.p.; I. Jackson & Bros., Pittsburgh, Pa., two 125 h.p.

W. R. GARTON, of Chicago, is the name of a new firm, with headquarters in the Ashland Block. Mr. Garton has had a long experience in the electric railway field, and is well known throughout the country. He was, until recently, manager of the railway department of the Central Electric Company, of Chicago. Mr. Garton will represent the Garton-Daniels Electric Company, the Pittsburgh Steeel Hollow Wire Company, the Massachusetts Chemical Company, the Rastor Carbon Rheostat Company and a number of other Eastern firms. Mr. Garton is a large stockholder in a number of these companies. He will also handle the B. & S. drop forge commutator bars, and electrical railway supplies in general, but will not give any attention to minor supplies or repair parts. Mr. Garton will have the best wishes of his large circle of friends, and any orders intrusted to his care will undoubtedly have excellent attention.

J. A. FAY AND EGAN COMPANY, of Cincinnati, has its Chicago branch in one of the finest stores on South Canal Street, Chicago. The tracks of the P. C. C. & St. L. R. R. run directly in the rear of these buildings, and make them a particularly favorable location for shipping and receiving goods. The company's stores occupy Nos. 22, 24 and 26, and are maintained for the convenience of customers in Northern Illinois, Wisconsin, Minnesota, Colorado, Iowa and Nevada. A full line of both J. A. Fay & Company and Egan Company machinery is carried at these stores, so that parties residing in this territory should write direct to Chicago to save time. J. A. Fay & Company have recently issued a large poster, giving in convenient form for ready reference all of the principal types of wood working machinery which the company manufactures. These include machines for planing mills, sash, door and blind, furniture, chair, buggy, carriage, wagon, spoke and wheel factories, pattern makers, car shafts, etc.

THE J. G. BRILL COMPANY, of Philadelphia, has issued a very neat circular giving full description and several illustrations of the Brill Perfect Truck No. 27. This truck is designed expressly for high speed, city, suburban and interurban service, and the manufacturers claim that in its construction many of the difficult problems of motor car building have been solved. In building this truck the manufacturers have introduced the following important features: The side thrust is absorbed by a greater width of spring base than usual. This greatly steadies the car when rounding curves, because it reduces the rolling on the springs, which is apt to happen when the elliptics are close to each other. The swing links, with their springs, are outside the wheels, and cushion all side motion. Nearly all the weight is spring carried, and no uncushioned load comes on the journal boxes. The load is perfectly equalized among the wheels, and is carried at the centre of the equalizer without the introduction of leverage against springs. The catalogue contains a number of very valuable letters from several street railway managers regarding the durability and easy riding qualities of the Brill Perfect Truck.

THE CHRISTENSEN ENGINEERING COMPANY, of Milwaukee, Wis., is doing an excellent business in the manufacture and sale of its air brakes for electric cars. The fine exhibit made by this company at Nigara Falls attracted widespread attention, and the company is now receiving orders from a number of managers, who gave the system careful consideration at that time. The works at Milwaukee are crowded with orders, and are working full time. The results secured on the South Side elevated cars in Chicago have been most satisfactory, and the company has now equippped between fifty and sixty of these cars. Among other roads whose cars the company has equipped are the St. Louis, Belleville & Suburban Railway Company of St. Louis, Mo.; the Union Traction Company, of Anderson, Ind.; the New Paltz & Walkill Valley Railroad Company, New Paltz, N. Y., and the Cripple District Railroad Company of Cripple Creek, Col. That the brake meets the commendation of steam railroad managers as well as street railroads, is shown by the fact that the company has also equipped with its axle-driven brake the composite car of C. Peter Clark, Jr., of the New England Railroad, described in a recent issue of the Street Railway Journal.

THE WALKER COMPANY, of Cleveland, O., has secured an order from the Standard Light & Power Company, of Dallas, Texas, for two alternators, one of 225 and the other of 325 k.w. capacity. They are to be direct connected to Erie engines, and are designed to run at 125 revolutions per minute. The current will be two phase and 60 cycles. In addition to these the Walker Company will furnish this company with two direct connected railway generators, of 225 and 235 k.w. capacity, respectively. The Walker Company is also building two alternating generators of 250 k.w. capacity for the North River Electric Light Power Company of New York City. They are to be of the belted type. Townsend, Reed & Company, of St. Louis, have purchased for the St. Louis, Belleville & Suburban Electric Railway two 200 k.w. direct connected Walker railway generators, besides eight double 10-S railway equipments, with "S" controllers." On the other side of the Atlantic the Glasgow Municipal Tramway will place a number of Walker motors on its cars at an early date, while the electric railway of Alexandria, Egypt, will increase its present Walker plant by the addition of one 150 k.w. belted generator with switchboard, and four double 3-N equipments.

WARREN WEBSTER & COMPANY report the following contracts since December, 1897, taken by various steam heating contractors: Gulf, Colorado & Santa Fe Railway Company, depot, Temple Station, Tex.; M. Gould's Son's factory, Newark, N. J.; Horne Building, Pittsburgh, Pa.; Allen County Court House, Fort Wayne, Ind.; Lane shoe factory, Brooklyn, N. Y.; Aroostook Mills, Gardiner, Me.; Singer Manufacturing Company, new foundry, South Bend, Ind.; United States Appraisers' warehouse, New York City; Norton Emery Wheel Company, Worcester, Mass.; Rambo & Reger, Norristown, Pa.; P. R. R. Company, machine shops, Columbus, O.; Mystic Velvet Mills, Mystic, Conn.; New England Knitting Company, Winsted, Conn.; Converse Building, Boston, Mass.; Steiner & Sons, Bradley Beach, N. J.; Stohn & Son, Jersey City, N. J.; annex to Hospital of North Texas Insane Asylum, Terrell, Tex.; Rothschild Building, 205-207 Monroe Street, Chicago, Ill.; J. G. Brill Company, Sixty-second Street and Woodland Avenue, Philadelphia, Pa.; Universal Loom Company, Reidville, Mass.; Diamond Portland Cement Company, Middle Branch, O.; Indiana State Reformatory, Jeffersonville, Ind.; Charles Wolf & Company, Allentown, Pa.

THE DORNER & DUTTON COMPANY, of Cleveland, O., has recently changed its name to The Van Dorn & Dutton Company. This company manufactures a well-known line of trucks, gears, track cleaners, etc., and under its new name will endeavor to merit the continued patronage of the street railway companies of the country. The officers of this company are now as follows: President, J. H. Van Dorn, who is also president of the Van Dorn Iron Works Company; vice-president, E. I. Leighton, president and general manager of the Cleveland Punch & Shear Works; secretary and treasurer, W. A. Dutton, who is well known as the general sales agent of the original Dorner & Dutton Manufacturing Company, and the Dorner & Dutton Company, and will have full charge of the sales department of the new company; directors, H. H. Hodell, proprietor of the Cleveland Galvanizing Works, and director of the Lake Shore Banking & Savings Company, and Thomas Burton Van Dorn, engineer of the Van Dorn Iron Works Company. The Van Dorn & Dutton Company has secured the services of Frank Schneider, formerly with the Brush Electric Company and recently superintendent of the Sperry Engineering Company, who is well known as a thorough mechanic and designer, with a large experience in street railway work. Mr. Schneider will be superintendent of the truck and gear department of the new company.

THE SARGENT COMPANY, of Chicago, reports a very large business in railway supplies during the past few weeks, and states that orders for the new Diamond "S" shoe are coming in

rapidly. The shoe is manufactured of cast iron, with an insert of expanded steel, giving great friction and long life to the shoe, without injury to the tire. These shoes have been tested on a large number of railroads with uniform satisfaction, the results of which are shown by the large number of orders on the company's books. W. D. Sargent, the vice-president and general manager of the Sargent Company, has just returned from England and the Continent, where he has been engaged in introducing the Diamond "S" brake shoe. Notwithstanding the proverbial conservatism of foreign railway managers for American inventions, the merits of the shoe are so clear that several of the railroads in England are already using them, and the prospects for a large extension of this business are most flattering. The Sargent Company has recently published the second volume in its series on the Diamond "S" brake shoe, giving the results of the remarkable tests of the shoe, which were conducted on the brake shoe testing machine at the shops of the Westinghouse Air Brake Company at Wilmerding, Pa. The company will be pleased to furnish copies of these pamphlets, together with results of service tests, to all railroad men upon request.

HENRY W. BULKLEY, engineer, of New York City, reports a number of recent orders for the "Bulkley" condensers, among them being one from the United Verde Copper Company, of Jerome, Ariz., for three condensers aggregating 1800 h.p. Mr. Bulkley is receiving a number of very fine testimonials regarding the satisfactory working of his condenser, one of them from the Washburn & Moen Manufacturing Company, reading as follows: "Referring to your letter of Feb. 12, in relation to Bulkley condensers. When installing our plant here we put in six Bulkley condensers, all of which are connected with Porter-Allen engines. No. 1 engine, 3,000 h.p., cylinders, 40 ins. and 60 ins. × 66 ins.; No. 2 engine, 2,000 h.p., cylinders, 40 ins. and 60 ins. × 48 ins.; No. 3 engine, 1,500 h.p., cylinders, 30 ins. and 52 ins. × 48 ins.; No. 4 engine, 1,500 h.p., cylinders, 30 ins. and 52 ins. × 48 ins.; No. 5 engine, 1,500 h.p., cylinders, 30 ins. and 52 ins. × 48 ins.; No. 6 engine, 100 h.p., cylinders, 11½ ins. dia., 20 ins. stroke. We have been running all of the above engines for over six years and the Bulkley condensers have given us no trouble whatever; in fact, we have not laid out one cent for repairs. We get a vacuum of from 26 ins. to 28 ins. We cannot speak too highly of the Bulkley condensers and we not only have them in use here at Waukegan, but have several at our Worcester works and all along the line they give perfect satisfaction, and we recommend them to all parties who want to run their engines economically."

THE BERLIN IRON BRIDGE COMPANY, of East Berlin, Conn., reports the following new construction in which its material will be used: The Boston Gas Light Company is erecting a new gas plant at Commercial Point, in the vicinity of Boston. This new plant consists of a building about 52 ft. wide and 185 ft. long, having brick side walls and brick partition walls, dividing the building into three distinct parts, made up of a generator house, blower room and condenser room. No wood is used in the construction of the building, and it is absolutely fire proof. The floors are of steel throughout. The roof is covered with slate, supported on steel roof trusses and framing. The contract for furnishing and erecting the steel roof work complete was let to the Berlin Iron Bridge Company. The American Coffee Company, of Brooklyn, N. Y., is erecting a new power house in connection with its plant, which is about 70 ft. wide and 120 ft. long. The power house and boiler house have brick side wall construction and steel supports and roofing. Adjoining the boiler house is a coal bunker, about 20 ft. wide, which carries the supply of coal in a steel bin about 30 ft. above the ground. The whole plant has been designed with convenience and economy in view, and when constructed will be a complete plant, which can be economically operated. The contract for furnishing and erecting the steel framework of this building was also let to the Berlin Iron Bridge Company. M. C. Henry & Company, of New York City, are enlarging their plant and making some extensive improvements. Their new steel stone shed, which is about 50 ft. wide, is to be extended about 70 ft. in length. The metal work, which consists of the steel framework of the building, the covering upon the roof and sides, and the metal runway for traveling crane, is being furnished and erected by the Berlin Iron Bridge Company.

THE GENERAL ELECTRIC COMPANY, of Schenectady, N. Y., is now building at its shops what is claimed to be the largest generator for electric traction work ever constructed. When finished it will be installed at the Logan Street Station of the Louisville Railway Company, Louisville, Ky. On account of its large diameter the armature of this generator cannot be transported over the railroads in its complete state, either erect or on its side. The generator will, therefore, be assembled in Louisville. The completed machine will have 22 poles, an output of 2,400 k.w., or 3,000 h.p., and will be driven at a speed of 75 r.p.m. by a 4,000 h.p. engine, to be furnished by the Allis Company. The generator will be constructed to stand an overload of about one-third, so that the capacity in case of emergencies may equal 3,200 k.w., or about 4,000 h.p. The principal dimensions of the machine will be as follows: Diameter of field frame, 19 ft.; width of field frame, 4 ft. 1 in.; diameter of armature, 12 ft. 9 ins.; diameter of commutator, 9 ft. 8 ins.; diameter of shaft, 2 ft. 3 ins.; total weight of armature and commutator, 83,000 lbs.; width of armature, 5 ft.; width of commutator, 21 ins.; total width of generator, 77 ins.; total weight of generator complete, 174,000 lbs. Previous to the manufacture of this machine the largest generators constructed for electric railway work were those of 1,600 k.w., or about 2,500 h.p., the first of which were used in the Intramural power house at the World's Fair. Dynamos of the same enormous output have since been installed in Philadelphia, Boston and Chicago. Four are also operating in the Kent Avenue station in Brooklyn. At present this power house contains the largest single exhibit of moving machinery in Greater New York. In no other city of the State, with the exception of Niagara Fall, can 10,000 h.p. engines and dynamos be seen in almost constant daily operation.

New Publications

REFERENCE CATALOGUE TO THE SCIENTIFIC AMERICAN SUPPLEMENT. Published by Munn & Co., New York. 48 pages.

This is an index to all the articles and subjects treated in the "Scientific American Supplement" for the past year and will be found of value to anyone desiring to investigate a subject that has been discussed in this supplement.

ALGEBRA MADE EASY. By Edwin J. Houston and A. E. Kennelly. Published by American Technical Book Company. 97 pages.

This volume is prepared for the purpose of elucidating the mathematical formulæ appearing in the pages of "Dynamo-Electric Machinery" and "Polyphase Electric Currents," by Silvanus P. Thompson.

POCKET ELECTRICAL DICTIONARY. By Edwin J. Houston. Published by American Technical Book Company, of New York. 945 pages. Price, leather binding, $3; cloth binding, $2.50.

This is the fourth edition of this extensive, popular and standard dictionary and contains over 11,000 words and about 15,000 definitions, including 6,000 new electrical words, terms and phrases that have come into use since 1894. This book is probably the most up-to-date, complete and reliable electrical dictionary ever published.

THE AMERICAN ACCOUNTANT'S MANUAL, VOLUME I. Published by Broaker & Chapman of New York City. 210 pages. Price, $3.

This book is compiled by Frank Broaker, State Examiner of Public Accountants of New York and president of the American Association of Public Accountants, and contains a large number of the examination questions prepared by the State Board of Examiners and expert public accountants appointed by the Board of Regents of the University of New York State. It also contains answers in concise form to these questions, further elucidated by the author's commentaries upon the technique and expression of modern accountancy.

MUNICIPAL OWNERSHIP VS. PRIVATE CORPORATIONS. By M. J. Francisco. Published by M. J. Francisco & Son, Rutland, Vt. 160 pages.

In this work the author presents a number of able arguments against the municipal ownership of lighting and street railway plants. Mr. Francisco, as president of the National Electric Light Association, was in a position to secure very valuable information along these lines from several official sources. He has also personally examined nearly all the municipal plants in the United States and Europe and so is well qualified to speak on the financial results of their operation. The book contains legal and editorial opinions, table and cost of lights as furnished by private companies and municipal plants and also a list of municipal plants that have been sold or abandoned.

Trade Catalogues

MACHINERY AND SUPPLIES. Published by Wendell & MacDuffie, of New York. Illustrated.

CAMBRIA STREET RAILS. Published by the Cambria Iron Company of Philadelphia, Pa. Illustrated.

PERFECT TRUCK NO. 27. Published by the J. G. Brill Company, Philadelphia, Pa, Nineteen pages. Illustrated.

OUTLET BOXES. Published by Ward Leonard Electric Company of Bronxville, N. Y. Twenty-seven pages. Illustrated.

Catalogue of Electric Railway Supplies. Published by Pawtucket Brass Foundry, Pawtucket, R. I. Thirty-three pages. Illustrated.

Keystone Instruments. Published by the Keystone Electrical Instrument Company, of Philadelphia. Twenty-six pages. Illustrated.

The Webster System of Low Pressure Steam Heating. Published by Warren Webster & Company, Camden, N. J. Fifteen pages. Illustrated.

Catalogue of Railway Appliances. Published by the New York Switch & Crossing Company, of Hoboken, N. J. Thirty-seven pages. Illustrated.

Candelabra Special Series and Battery Lamps. Published by Edison Decorative and Miniature Lamp Department, Harrison, N. J. Forty-four pages. Illustrated.

List of Street Railway Patents Issued

U. S. Patents issued Jan. 18, 1898, to Feb. 15, 1898, Inclusive.

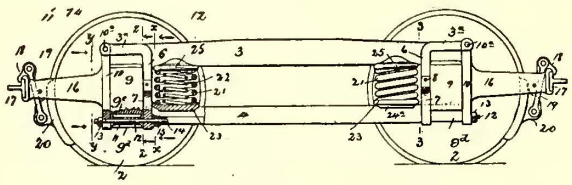
Jan. 18.

Portable Railroad Switch.—Wm. Barton, Mathiston, Miss. No. 597,380.

Electric Car Brake.—Constant F. de Redou, New York, N. Y. No. 597,432.

In a railway brake, the magnet carried by the car and at each side of the latter, combined with a pivoted brake-arm carried from the end of each magnet and turning inward in line with the length of the magnet, and a brake-shoe for contact with the rail carried by each of said brake-arms.

Electric Car Brake.—Constant F. de Redou, New York, N. Y. No. 597,433.



PAT. NO. 598,074

Trolley Car.—Jeremiah D. Hull, New York, N. Y. No. 597,467.

Electromechanical Switch Operating Mechanism.—Charles W. Squires, Springfield, Mass. No. 597,472.

Car Signal and Indicator.—Alfred Travaglini and Ettore Teti, Philadelphia, Pa. No. 597,490.

Conduit for Electric Railways.—Cyrus V. Osborn, Dayton, O. No. 597,508.

Electric Trolley Device. Custaf Valley, Johnstown, Pa. No. 597,516.

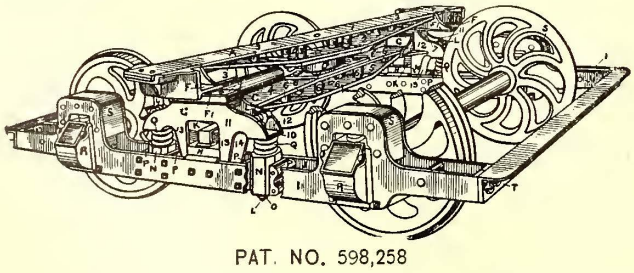
Trolley Wheel.—Harry B. Sawyer, Chicago, Ill. No. 597,693.

Jan. 25.

Rail Joint.—Charles R. Smith, Barnett, Ga. No. 597,789.

Electric Railway.—Eben C. Crocker, Bridgeport, Conn. No. 597,799.

Emergency Brake for Cars.—Philip Casey, Jr., Paterson, N. J. No. 597,813.



PAT. NO. 598,258

Trolley.—George A. Hall, Portland, Me. No. 597,848.

Car Fender.—Henry C. Spangler, Harrisburg, Pa. No. 597,864.

Fender for Street Cars.—John F. Baker, Vincennes, Ind. No. 597,936.

Safety Fender for Street Cars.—Wm. B. Heywood, Gualala, Cal. No. 598,067.

Automatic Car Fender.—Wm. B Heywood and Wm. H. Heywood, Gualala, Cal. No. 598,068.

Feb. 1.

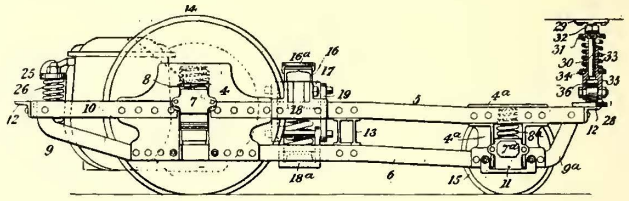
Car Truck.—John A. Brill, Philadelphia, Pa. No. 598,074.

A car truck having axle-box yokes, one arm of the yokes being movable, means for firmly holding the movable arm of the yoke, each of said arms having an extension and a cross-bar uniting the extensions, whereby the movable arm of the yoke and cross-bar connected therewith may be moved out of the horizontal plane of the wheels.

Conductor for Electric Railways.—George Ritter, Stuttgart, Germany. No. 598,184.

Rotary Motion Transmitter from Car Axles.—John H. Whiting, Belvidere, Ill. No. 568,169.

Mechanism for Starting, Stopping and Controlling Speed of Motors of Electric Cars.—Frank H. Foster, Brooklyn, N. Y. No. 598,199.



PAT. NO. 598,403

Car Truck.—Henry Tesseyman, Dayton, O. (assignor to the Barney & Smith Car Company.) No. 598,258.

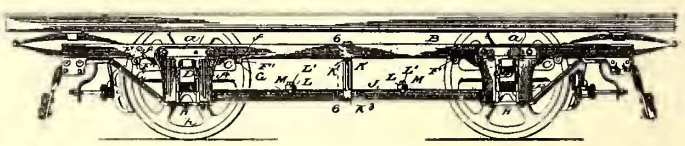
In a car truck, a truck transom, a movable pedestal attached to each end thereof and having extensions which form bearings for the upper ends of helical springs carried in pockets movable between the side bars of the truck frame, a body bolster pivotally connected to said truck transom at the centre thereof and having a centre bearing thereon, side bearings at the end of said body bolster and bearing plates below the same, said centre and said side bearings being in constant contact with their respective bearing plates.

Maximum Traction Truck.—Charles F. Ueberlacker, Kingston, N. Y. (assignor to the Peckham Motor Truck and Wheel Company.) No. 598,403.

In a car truck the combination of front and rear wheels, pedestals, side beams connecting the pedestals on each side of the truck, duplex end beams secured to opposite faces of the pedestals and projecting therefrom separated by approximately the thickness of the pedestal, said end beams being connected across the truck by a duplex crossbeam the members of which are integral with said end beams and are in contract with each other across the truck.

Railway Car Truck.—John Taylor, Troy, N. Y. No. 598,449.

The combination of the side bars of a truck frame and the hanger casting attached thereto and thereunder at opposite sides of the pedestal, having pairs of ears; and the links hinged to said castings by a bolt transfixing said ears; with the spring having eyes on its ends hinged to the upper ends of said links.



PAT. NO. 598,449

Feb. 8.

Fender or Guard for Frameway Cars.—John R. Seaton, Cohoes, N. Y. No. 598,538.

Car Fender.—Anton Mazzanovitch, New York, N. Y. No. 598,637.

Switching Apparatus for Street Cars.—John G. Groshein and George L. Seaman, Cincinnati, O. No. 508,705.

Vehicle Fender.—William Clayton, St. Louis, Mo. No. 598,769.

Steel Railway Car.—Richard T. Barton, New Haven, Conn. No. 598,842.

Feb. 15.

Trolley.—Chas. H. Johnson, Elmhurst, Cal. No. 598,937.

Combined Track and Wheel Brake.—William Timmis, Pittsburgh, Pa. No. 598,966.

Trolley-Pole for Overhead Electric Railways.—Joseph L. Walker, Louisville, Ky. No. 599,274.

Fender for Street Cars.—Henry W. Bodeman, San Francisco, Cal. No. 599,281.