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During 1907 the Street Railway Journal printed and circulated 427,250 copies, an average of 8216 copies per week. Of this issue 8250 copies are printed.

The Twelve Hundred Volt Road in Indiana

There has been so much discussion on the relative advantages of single-phase and 1200-volt direct current for interurban railway operation that a great deal of interest attaches to the description of the Indianapolis & Louisville 1200-volt line published in this issue. This system has been made possible only by the introduction of the commutating pole motor, which has now become common on a number of 600-volt lines where the conditions under which the motors operate are so arduous that a more highly developed machine than those formerly used is required. The Indianapolis & Louisville Railway, however, constitutes the first application of the motor in this country to double the usual railway voltage. Whether this line is to be the precursor of a considerable development of 1200-volt railways remains to be seen, but it is at least to be followed by an immediate and larger installation by the Southern Pacific Railway on its Oakland lines, as has already been chronicled in our news columns.

An examination of the details of the equipment of the Indianapolis & Louisville Railway shows that while the line potential in the interurban sections of the system is 1200 volts, all parts of the equipment have been designed to operate, so far as possible, on 600 volts. Thus the generators are of this voltage, but are mounted in pairs on the engine shaft and are connected in series so as to supply both potentials. The motors on the higher tension portions of the line also operate in series and the auxiliary car circuits are supplied with 600 volts by a dynamotor or motor-generator with 600 volts on each of its two commutators. Of course provision has to be made in the motors for momentary increases in voltage, owing to the slipping of wheels and other possible causes, so that they, and other parts of the equipment which are also subject to this temporary increase in pressure, have to be insulated for this contingency. On the other hand, the diagram of feeder distribution indicates the practical results secured by the system through the absence of sub-stations on a 30-mile line and the small amount of overhead copper required.

Although it involves the use of a slightly more complicated car equipment than that usually employed on interurban railways, we do not see why the system should not prove entirely practicable, and it certainly affords economies of moment. Whether the gain by doubling the voltage is sufficiently high to make the 1200-volt system a serious competitor to the single-phase equipment in a large proportion of the roads which are awaiting construction remains to be seen. Nevertheless, there must be many cases of interurban lines of about this length, where the ability to operate without sub-stations would prove very convenient, especially as the equipment can readily be employed on 600-volt sections in cities without the necessity of carrying much additional apparatus.

Looking Forward to Trouble That May Occur

When a car shop once gets behind in its work, the tendency is toward further delay and congestion unless some special effort is made to catch up. The reason is evident when the procedure in some shops overcrowded with work is watched closely for a few hours. Two men may be changing armatures under a small car, a job which should require perhaps three-quarters of an hour, but if they are delayed in their work because other departments in the shop are behind time, they may take twice as long as they should. Perhaps there are no bearings of the proper size, and the lathes may be in use on some undertaking which

cannot be stopped, so that the men engaged on the armature are compelled to scrape out bearings for themselves. Again, the brush holders may be found in need of repairs, and as none in good order can be found the work is delayed until those taken out of the motor can be put in order. There may be a dozen other causes for longer or shorter delays. If many of the details of the repair work take twice as much time as necessary, there is evident reason for the shop getting farther and farther behind with the repairs.

Much inconvenience and delay, and maintenance charges as well, will be reduced considerably if during dull periods every man will do some planning for the future. This is primarily, of course, the duty of the foreman, but with proper training the men may be taught to help. There is hardly a shop in which dull periods do not come when the foreman is at a loss to know some work at which to put his men. Occasionally he may even tell them there is nothing to do. A few weeks later the same foreman may be "up in the air" because he has no stock of repair parts ready. There may be plenty of worn bearings, shorted controller blow-out coils, burned-out canopy switches or circuit-breakers, brush holders with weak springs, and other defective electrical parts, but none can be found ready for immediate use.

The foreman who does look forward to the "rainy day," or more specifically, probably, to the lightning storm, will find that he can take care of cripples about as fast as they come in. Instead of holding a car two hours or more until a controller blow-out coil or a canopy switch can be repaired, he detains it probably fifteen minutes, or just long enough to change coils or switches. And in a hundred other ways time is saved just when time is valuable. Time in this case also means money and a saving also of nervous energy until a time when it can be used to better advantage.

Operative Aspects of Electric Railroading

We abstracted last week a paper on steam railroad electrification by W. N. Smith, which is rather out of the ordinary in that it lays especial stress on operating conditions. There is little doubt that most discussions of the electrification question have been too much from the single standpoint of cost of motive power, or from that of increased capacity due to increased acceleration. In some special cases these considerations are entirely pertinent, but when the matter of general railway operation is taken up the situation is altered. If one examines the detail of general railway operation it is at once apparent that motive power and increased capacity due to acceleration are not the determining factors in earning capacity. Mr. Smith lays especial stress on the effect of block signals and precautions generally on track capacity and his suggestions are of rather serious import. He intimates that the increased capacity for train movement found on some interurban lines is secured by a far looser system of train dispatching than is considered safe on steam railroads and goes so far as to say pretty plainly that since with single cars the probability of an accident on a large scale is diminished there is a corresponding tendency to take long chances.

We have more than once remarked that interurban roads might well profit by the dearly bought experience of steam railways in train dispatching, but that interurban managers consciously take undue risks in order to keep up capacity we very much doubt. If such a thing is true it is the rare exception. The fact is that electric railroading has grown up from street railways proper in which each car takes care of itself by observation. The growth of telephonic dispatching from this is an obvious one and before the management is aware of the fact it sometimes happens that the safe limitations of telephonic dispatching have been already past. The ease with which electric operation can be adopted to an absolute block system is well understood, yet the hesitancy of steam roads in going into automatic block signalling puts them in a bad position to criticize their neighbors. Hardly more than 3 per cent of the railway trackage of the United States is controlled by automatic blocks and only about 17½ per cent is actually controlled by any kind of block system. The full absolute block system is not a favorite with railway men since it is likely sometimes to tie up traffic which a permissive block system would in nineteen cases out of twenty let through in entire safety. Railway men do not like to remember what occurs in the twentieth case. Yet the permissive block system as carried out on many railways implies, in Mr. Smith's judgment, a considerably higher degree of caution than is usual on interurban electric roads. And Mr. Smith also points out that a block system carried out in the usual manner actually saves time over a mere telegraphic dispatching system owing to prompter notice to the train hands.

The main point of Mr. Smith's contention seems to be that in the comparisons between electric and steam motive power there has been a large unconsidered factor due to the necessities of practical train dispatching which must be fully taken into account before one can properly calculate the costs of handling traffic after electrification. The precedents of interurban roads are unsafe to follow. Practically all roads yet operated by electricity deal with a fairly uniform kind of traffic handled at fairly uniform speed. The average steam road on the contrary finds some of its chief traffic difficulties in the necessity of handling everything, from fast through expresses to local freight, on a single track, at least in one direction. One cannot therefore readily generalize on the effect of electrification regarding traffic upon a single track, or for that matter upon a double track road. Each separate case must be considered upon its merits. It may easily happen, for instance, that the limit of practicable train weight and speed in freight haulage may depend upon the necessary schedule for maintaining connections with a few fast passenger trains. The single car scheme for passenger traffic so attractive in electric railroading may become absolutely disastrous on a line already overloaded with freight, which from motives of economy must be hauled in long trains. Mr. Smith naturally favors electric traction, yet feels as do many practical electrical engineers that there are very many operative features which have been given scant consideration by those in charge of installations, who have attempted, without experience in the details of railway operation, to treat of the general case. It has in fact been far too usual to dismiss such matters with the intimation that they will take care of themselves after electric motive

power is adopted. Without doubt electrification will produce marked changes in operation, yet the great uncertainty on this point is a serious obstacle to such improvement.

Aspects of the Pay-as-You-Enter Car Problem

If the operation of the pay-as-you-enter cars now on trial in some of the larger cities of this country is sufficiently studied by executive officers, there is little doubt that some most valuable conclusions will be turned to account in the general improvement of rolling stock design with regard to traffic conditions. The problem of car selection in different climates and cities is one of such breadth that each new type of car placed in service can be made to contribute something to the general solution for a given locality or division or system. For many years the set arrangement of the interior arrangement of cars, except, so far as length is concerned, seemed as immutable as the laws of the Medes and Persians, or as the existing steam railroad coach. The Brownell "accelerator" type was perhaps the first departure which received any considerable acceptance. It is becoming more and more apparent now, however, that the details of car design are of immense importance in the successful handling of traffic, which means the minimum expense for accident claims no less than the economical movement of rolling stock in sufficient volume to meet the business offered.

The advantages of the pay-as-you-enter car have been so often discussed that they need not be repeated at this time, but it is worth while to touch upon some of the incidental features of the car selection problem with respect to the pay-as-you-enter car in particular, the introduction of new types of rolling stock upon lines where the public is familiar with long established car designs, and the securing of greater freedom from accidents under existing conditions. In some cities a change in car type is liable to arouse considerable hostile criticism from the public unless the company's patrons have the matter presented to them clearly and tactfully before the cars are placed in service and during the early days of the new operation. Following out this idea in one city where pay-as-you-enter cars were placed in commission on certain lines for trial purposes, the company distributed to its patrons a short time before the change was made small cards showing the new cars in plan, the seating and aisle arrangements, the position of the conductor on the rear vestibule and the normal path of the passenger through the car from the time of boarding to the time of departure. These cards, with the simple, straightforward directions painted on the bodies and also given by the conductor to uncertain passengers as they entered the rear vestibule proved to be a great help in reducing confusion and in preparing the public mind for the change, which was, of course, revolutionary in comparison with the former practice of requiring the conductor to collect fares inside the car and watch the steps. There is certainly a field in the local newspaper press for the clear explanation of new car types prior to their use on the tracks of a busy division.

If the full benefits of a pay-as-you-enter type of car are to be enjoyed it is important to consider the detailed features with great care beforehand. Some recent improvements suggest what can be done in this direction. The separation of entering from exit traffic is essential to short stops, measured by the average number of passengers taken on or discharged in a given time. To this end the small side door at the conductor's left in the rear vestibule should normally be closed. In times of congestion when passengers cannot well work their way out through the car aisle to the front vestibule it may be used as an exit, but care must be taken to keep passengers from entering at this point. Another point of value in a recent pay-as-you-enter car consists in placing the grab handles inside the vestibules to prevent boarding the car while it is in motion, and particularly when the doors are closed. Finally, the arrangement of a locking lever operated by the motorman in connection with the front vestibule door seems to prevent accidents at the forward end of the car. These features are not all conditioned by the type of car being of the pay-as-you-enter variety, but are applicable to the semi-convertible easy-access car as well. They may also be perfectly satisfactory in one city and not suited to the conditions of another. The point is that an inch or two of difference in the location of minor fittings may make a vast difference in the operating success of a given car type. In some cars the different operating handles are inconveniently located in the vestibules, and the lack of easy control of special features may contribute to an accident in time of emergency. Closer study on the part of car builders of the actual operation of some of these features in service is certain to result in progress.

Reducing Congestion on Terminal Platforms

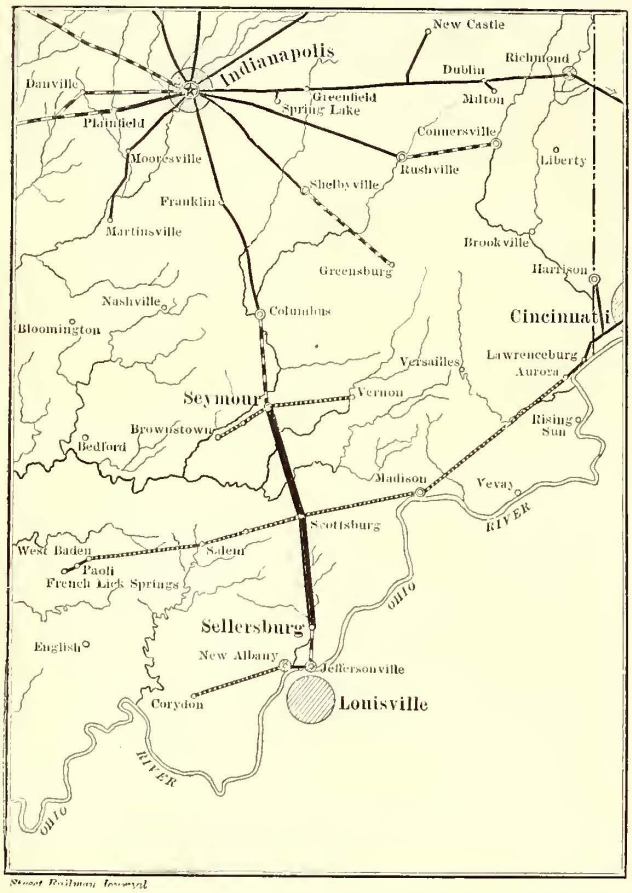
As traffic increases at electric railway terminals it becomes more and more essential to reduce the congestion of platforms caused by the short train units handled in limited trackage spaces. An example of such a terminal is the Sullivan Square station of the Boston Elevated Railway Company. This is a double level station for combined surface and elevated service, and on the elevated train level free bodily transfer is given between the trains and the surface cars which have been berthed on stub tracks after ascending an incline from the street. On the street floor there are only surface cars running through the station on loop tracks. The growth of traffic at this station has been very considerable within the last two or three years and the running of foreign cars into the station at the elevated level has added to the burdens of the terminal, largely on account of their relative infrequency.

The longer headway of these large through cars has resulted in increasing the congestion at the platforms immediately served by them through the accumulation of waiting passengers who desire to take the through rather than the local lines. Both local and through cars are operated on the same stubs, and the accumulation of through passengers was found to interfere so much with the movement of local patrons that the company has recently transferred all the through cars to the lower level, leaving the upper level free for elevated and local service in larger volume. Short stairway connections afford easy access to both classes of service. Re-distribution of this kind are well worth considering in all cases where there are several classes of interfering service.

THE INDIANAPOLIS & LOUISVILLE 1200 VOLT DIRECT CURRENT LINE

BY JOHN R. HEWETT

The lines of the Indianapolis & Louisville Traction Company extend from Seymour in the north to Sellersburg in the south, which is a distance of a little over forty-one



MAP SHOWING ROUTE OF THE INDIANAPOLIS & LOUISVILLE LINE AND CONNECTIONS

miles, and, as the name implies, the company will operate through cars from Louisville, Ky., to Indianapolis, Ind., making a run of 110 miles. The line is of special interest from many standpoints. It is the first interurban road to give connection through this section of the country with the capital of Indiana, which city holds such a prominent position in the field of electric traction, and it is one of the best constructed electric roads in the country; but the most interesting feature will be found in the fact that it is the first railway in this country to be operated on the high-tension, direct-current system. The electrical features will be dealt with later in the present article.

The connections between Indianapolis and Louisville are made as follows: The lines of the Indianapolis, Columbus & Southern Traction Company extend from Indianapolis to Seymour and are operated at 600 volts direct current. The Indianapolis and Louisville lines connect Seymour with Sellersburg and operate at 1200 volts direct current, while the Louisville & Northern Railway & Lighting Company and the Louisville & Southern Indiana Traction Companies, respectively, connect Sellersburg with Jeffersonville and Jeffersonville with Louisville, both roads being operated at 600 volts direct current, the latter penetrating into the heart of Louisville, Ky.

The accompanying map emphasizes the importance of this new road, showing the connections now made possible between Louisville and places of importance in Indiana. The Indianapolis & Louisville line parallels the tracks of the Pennsylvania Railroad for a considerable part of the way, and, owing to the fact that the steam trains run at very frequent headways, it is anticipated that a very large portion of the local traffic will be secured by the new road. The prospects for building up a large express and light freight business are very encouraging. The prices charged for transportation will be below those of the competing steam railroad, and as the 2-cent fare law is in force throughout Indiana, the facilities for cheap transportation will be increased. Excellent terminal facilities have been secured in both Indianapolis and Louisville to enable the company to carry its passengers to the center of both cities.

GENERAL SCHEME OF ELECTRIFICATION

The general scheme of electrification is of a most simple nature. The 1200-volt direct current is generated in the power house by two standard 600-volt railway generators connected in series, and is fed direct to the trolley and feeders. There are no sub-stations.

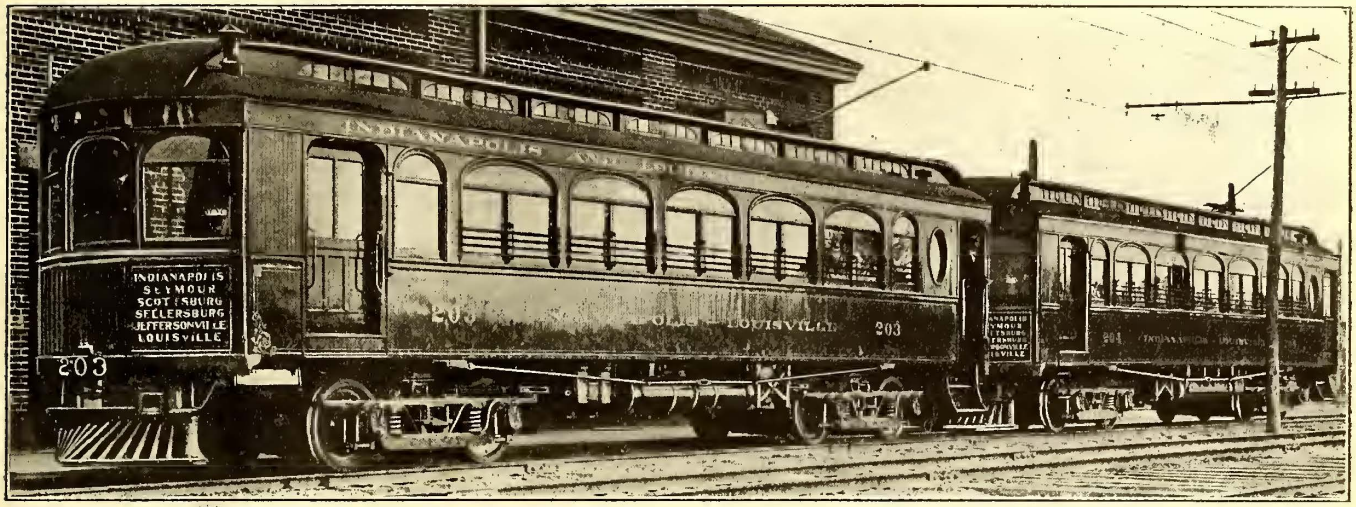
POWER HOUSE

The power house is at Scottsburg, Ind., about midway between Seymour and Sellersburg. It is a substantial red brick and steel building with a dividing wall separating the engine room from the boiler compartment. Its over-all length measures 108 ft. 6 ins. and its extreme breadth is

POWER HOUSE, CAR BARN AND ARTIFICIAL LAKE, INDIANAPOLIS & LOUISVILLE LINE

111 ft. 3 ins. The present mechanical equipment consists of two Allis-Chalmers single-cylinder Corliss engines, each rated at 750 hp, and four Babcock & Wilcox water-tube boilers, each rated at 300 hp, and designed for a steam pressure of 160 lbs. per square inch. Additional space is

provided in the power house for another engine and for two water-tube boilers of the same rating as the above. At present the engines are working non-condensing, as in the first place some uncertainty was felt as to whether an ample supply of water would be available. Now, however, an excellent water supply has been obtained by the construction of an artificial lake, and it is probable that a condenser plant will be installed.



TWO-CAR TRAIN ON INDIANAPOLIS & LOUISVILLE LINE

The chief items in the electrical equipment are four General Electric M. P. 8-300-120-600-volts, compound wound generators. Two of these units are mounted on the extended shaft of each engine and have their armatures in series to give 1200 volts. The fields are also connected in series on the grounded side.

The switchboard consists of six panels, all of which, together with the instruments, were supplied by the General Electric Company. They are as follows: Two generator panels, two feeder panels and two exciter panels. The switches are all of the knife pattern.

The provisions made for handling the coal are of a very simple nature. A pit has been constructed immediately outside of the boiler house which runs for the entire length of the building. Arched openings connect this pit to the boiler room. In this manner the coal is taken direct from the pit to the boilers. The pit is filled with coal from above, rails being laid along its length and supported by cross I-beams only, so that the hopper-car can discharge direct to the pit.

The plan of the power house gives a good conception of the general layout, while the accompanying half-tones show, respectively, the general exterior appearance of the building and the interior of the boiler room. The power house has two steel stacks, each 125 ft. high. A third will be added when the additional equipment is installed.

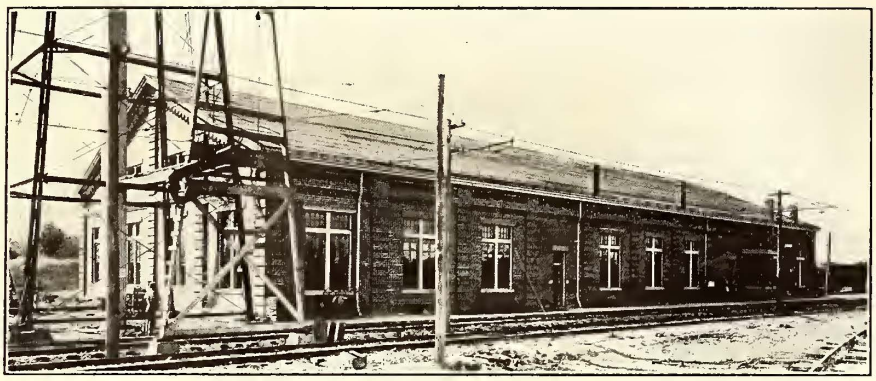
CAR HOUSE

The car house is also at Scottsburg. It is a red brick building and has more than sufficient capacity to hold the present equipment, which consists of eight 50-ft. passenger cars and two express cars. The length of the building is 173 ft. 4 ins. and the width 69 ft. 10 ins. The four tracks, which extend the entire length of the structure, each have a 55-ft. wheel pit.

One corner of the car house has been equipped as a

525-FT. BRIDGE ON INDIANAPOLIS & LOUISVILLE LINE, CROSSING MUSCATATUCK RIVER

workshop and drill presses, lathes and forges have been installed. The facilities in this direction provide for the inital equipment of the cars, as well as for the subsequent repairs. The storeroom, motormen's and conductors' room, together with the offices of the train dispatcher and general superintendent of the line, are all under the same roof as the car house. The water tower, partly seen to the right in the exterior view of the building, has been erected to reduce the fire risk. It has a capacity of 30,000 gallons.



EXTERIOR OF INDIANAPOLIS & LOUISVILLE COMPANY'S CAR BARN

One of the accompanying cuts present a general view of the company's property at Scottsburg, showing the power station, car house and the artificial lake. This lake has an estimated capacity of 15,000,000 gallons and was made by the building of the bank seen in the picture. The bank is armoured with concrete and serves as the embankment for the main track. The power house, car barn and lake occupy approximately 32.5 acres.

TRACK

The line of the Indianapolis & Louisville Traction Company consists of a single track throughout with turnouts about every three miles. The gage is standard, and the rails, which are of the Carnegie Section B, weigh 75 lbs. per yard. The rail bonds are brazed on to the outer side of the rails and cross bonds are installed about every 1000 ft. The ties are of white and black oak spaced 2-ft. centers. The track is rock ballasted for its entire length.

Illustrations are presented of the two most important bridges on the road. One, showing the bridge spanning the Muscatatuck River, is 525 ft. long with a central truss span of 135 ft. and smaller spans of 24½ ft. each; the other shows the bridge across the Vernon Fork of the same river, 480 ft. long, with a central truss span of 150 ft. and five 66-ft. spans.

BRIDGE CROSSING THE VERNON FORK OF THE MUSCATATUCK RIVER

The right of way in both country and towns is 60 ft. wide with certain stretches of 100 ft. in width. The franchises have been granted to the company for fifty years. Depots and freight warehouses are being built at all the towns along the line.

OVERHEAD CONSTRUCTION

The line throughout is of a single-pole bracket construction on tangents and of the span type at curves. The insulator used in both span and bracket construction is shown in one of the illustrations. The brackets are known as "Richmond B." and consist of an iron tube 1½ ins. in diameter and 9 ft. long. The insulators were supplied by the Ohio Brass Company and provide double the insulation which is customary for 600-volt constructions.

The poles are placed 90 ft. apart on tangents and 60 ft. spacings are allowed on curves. Native chestnut poles are used throughout. These measure 8 ins. at the top and 14 ins. at the bottom. They are all set in the ground for a depth of 6 ft. in cuts, and an additional depth of 2 ft. is allowed on fills.

A single No. 0000 trolley wire of grooved section is employed. It is held in alignment by 8 four-screw clamps reinforced with soldered strain guys every half mile. Lightning arresters are installed every 1000 ft. and are tapped alternately to the trolley and feeder. Telephones have been installed throughout the system, and jack boxes are attached to the poles at all sidings and at half-mile intervals.

FEEDERS

The feeders are supported on the telephone crossarms and the feeder distribution is shown on the diagram on page 8. The power house occupies an approximately central position, and as the arrangement of feeders is symmetrical in each direction, it is only necessary to consider one-half: For the first five miles from the power house the feeder has a capacity of 500,000 circ. mils, and for the next ten miles 300,000 circ. mils, when the capacity is reduced to 211,000 circ. mils for two miles. The feeders and trolley are tied together every 1000 ft. This is an exceedingly simple arrangement and it will be noted that there are no substations for the forty-one miles of road.

THE ELECTRICAL EQUIPMENT OF THE CARS

The entire electrical equipment of the cars was furnished by the General Electric Company of Schenectady, N. Y., and consists of ten motor equipments, eight of these being for passenger cars and the remaining two for express service.

The motors are of the G. E. 205 type, which are commutating pole units rated at 75 hp each when wound for 600 volts and insulated for 1200 volts. In general, the mechanical features of the G. E. commutating pole motor are similar to those constructed for standard 600-volt service, except that they are provided with four smaller or commutating poles between the main poles. The principal

points of difference between this and the standard type were described in the STREET RAILWAY JOURNAL for June 22, page 1112, and for June 29, page 1142.

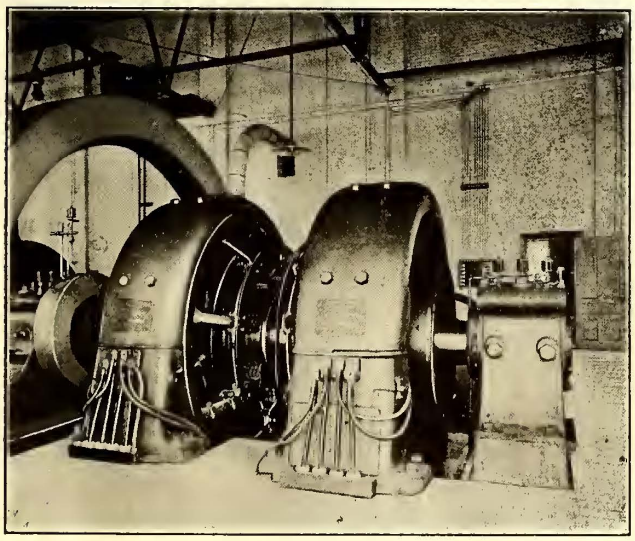
The commutating poles are permanently connected in series with the armature, which arrangement insures a variation of excitation and commutating field strength in sympathy with the load of the motor. The exciting fields are connected and handled in an exactly similar manner to those on a standard 600-volt equipment. When operating on a 600-volt trolley the motors are grouped in the standard series parallel relationship, and when operating on 1200-volt trolley they are divided into two groups, each of two motors in series. These groups are in series and parallel for accelerating and free running, respectively. The change from the 600-volt connections to the 1200-volt conections is made through the commutating switch described later.

The control is of the Sprague-General Electric multiple unit type, the most essential features of which are the master controller, situated in the cab, and contactors and reverser, etc., located under the car floor. The following paragraphs will give the principal details, which are of interest:

The master controller is of Form C-35 A, and is a standard Type M controller, exactly like those used on 600-volt equipments. It has a single cylinder with a direct connected handle and is automatic in action, cutting off the power should the motorman release his grip of the handle. and also applying the brake at the same time through a pilot valve.

The function of the commutating switch is to change the motor connections and the motor rheostat connections when the car passes from a 600-volt to a 1200-volt trolley and vice versa. The switch used on these equipments is known as Type 42A, and is placed in the car alongside the controller for operating convenience.

All chances of the commutating switch being thrown

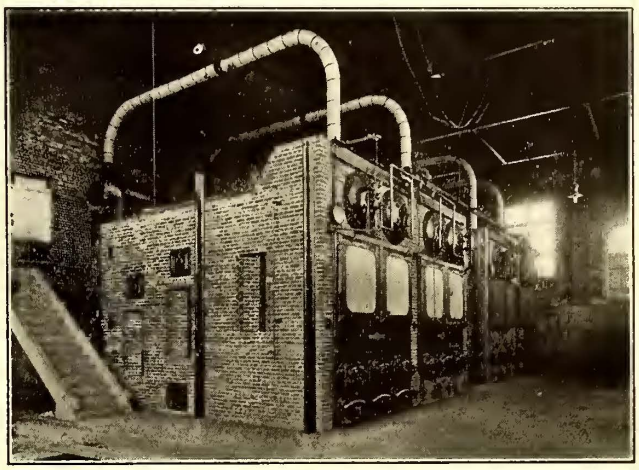


INTERIOR OF POWER STATION AT SCOTTSBURG, SHOWING GENERATORS CONNECTED IN SERIES

while the controller is in an operating position are eliminated by the fact that it is so designed as to require two hands to throw it. The controller, being automatic, returns to the off position immediately when the motorman releases his hand from the handle.

The direction of rotation of the armatures is reversed by a D.B.-22-A reverser. In this instance, the change is effected by reversing the direction of the current flow in the fields, as the motor connections are so arranged that when the car is operated on the 1200-volt trolley the motors are connected in two series, and also owing to the fact that the auxiliary control circuits are never subjected to the higher potential, the reverser is of the standard pattern used on 600-volt equipments.

A type 41-A motor cut-out switch is installed on each car and is arranged to cut out a pair of motors when operating on either 600 or 1200 volts. This switch, as regards its general appearance and operation, does not differ from those employed on standard 600-volt equipments.



INTERIOR OF THE BOILER HOUSE AT THE PLANT AT SCOTTSBURG

Contacts are provided which prevent the operation of the control system beyond the series position in the event of a pair of motors being cut out when operating on a 1200-volt section of the line.

The operating mechanism of the contactors is similar to those used on standard 600-volt equipments, the only point of difference being that additional insulation is used to meet the requirements of the higher voltage. The bell crank for operating the interlocks is insulated and the contactor boxes are insulated from the car.

The protective devices are similar to those of a standard 600-volt equipment, with the exception that an additional blow-out is provided in the main fuse-box, which makes it more effective.

To avoid changes in the connections of the controlling, lighting and heating circuits when changing from 600 volts to 1200 volts a motor generator, or more properly a dynamotor, is carried on the car. This machine can be described as a motor-generator with two sets of windings wound on the same core, and in the same slots. It is provided with a commutator at each end. The 600 volts for operating the control circuit when the car is running on 1200 volts is obtained as follows: The trolley is connected to one set of brushes on the first commutator, the other set of brushes on commutator No. 1 being connected to a set of brushes on commutator No. 2, while the remaining set of brushes on commutator No. 2 is grounded. As one set of windings is always generating while the other set is motoring, it is obvious that the potential across the brushes of commutator No. 2 will be half of the applied voltage, namely, 600 volts. The dynamotor has a rated capacity of 12 kw.

CAR PANELS

The car panel is in the baggage compartment to the right of the motorman's seat, and is, therefore, easily accessible. The principal items of its equipments are as follows: Light-

ing switch and fuse, pump switch and fuse, headlight and fuses, control cutout switch and fuses, and current limit relay.

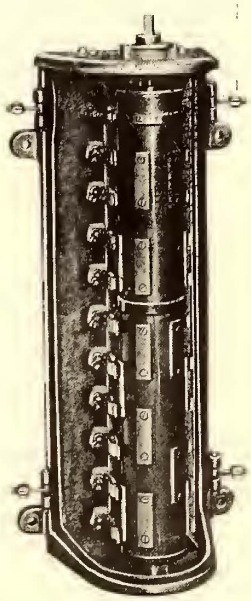
CHANGING FROM 600 TO 1200 VOLTS

The A. M. S. 22-A switch, shown on the opposite page, is employed to make the necessary changes in the control circuits when the car passes from a 600 to 1200 volt trolley, or vice versa. The normal position of this switch is for 1200 volts, which prohibits the possibility of the higher voltage ever being impressed on any of the auxiliary circuits under any circumstances. When the car is on a 1200-volt section the switch is at its normal position and all the auxiliary circuits are connected to the 600-volt terminals of the dynamotor. When the car passes to the 600-volt section the switch is thrown and held thrown by a retaining coil. In this position the auxiliary circuits are connected direct to the 600-volt trolley. It should be noted that the energizing coils of the contactors and reverser are never subjected to a higher potential than 600 volts.

All the cables are run in loricated conduits insulated from the contactor boxes by fiber couplings.

METHOD OF CONTROL

Having given the details of the more important pieces of apparatus which go to make up the electrical equipment, it is a simple matter to describe the control system.



COMMUTATING SWITCH

When operating on 600 volts the control is exactly similar to a standard 600-volt, multiple-unit, type-M automatic control. When operating on 1200 volts the motors are grouped as already described, and the control is accomplished by supplying (through the medium of the dynamotor) a 600-volt current for operating all the auxiliary circuits.

From the above it is obvious that the only difference in the controller circuits during 600 and 1200 volts operation is that in the former case the auxiliaries are connected direct to the trolley as a source of power, while in the latter case the dynamotor reduces the higher pressure to 600 volts before it is fed to the auxiliary circuits. So, in both instances, the control is a 600-volt control.

INSTALLATION OF APPARATUS

A point of special interest in these equipments will be found in the fact that the method of attaching the electrical apparatus to the under side of the car is novel and possesses some indisputable advantages. All the apparatus is hung from specially constructed wrought-iron frameworks, which, in their turn, are bolted to and insulated from the under side of the car; for example, the large contactor box, circuit breaker, reverser, control rheostat for the dynamotor, and the small contactor box for the dynamotor, together with the G.G. rheostats, are all hung from one metal framework, while the dynamotor is supported from another and the compressor outfit from a third.

These metal frameworks are built up and drilled to template and the apparatus is also drilled to template. The principal advantages secured by the adoption of this method of installing the apparatus under the car are the following:

The number of holes drilled on the under framework of the car is very materially reduced, and, therefore, the car structure is not weakened in any way; the apparatus is interchangeable from one equipment to another, everything

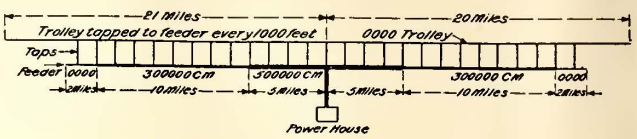
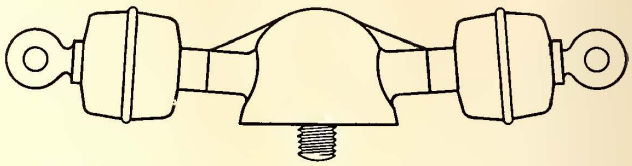


DIAGRAM OF FEEDER LAY-OUT



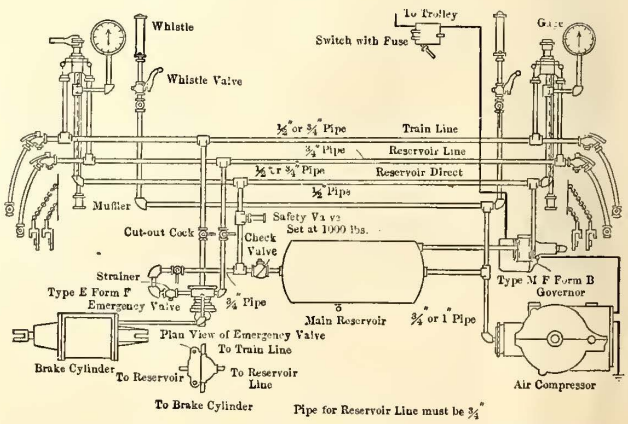
INSULATOR FOR SPAN AND BRACKET CONSTRUCTION

being drilled to template; greater clearance is left above the apparatus for the installation of the cable conduits and the brake rigging; the apparatus can be installed in a much more compact manner, and thus more available room is left on the under side of the car.

BRAKES

The brake equipments consist of standard G. E. emergency, straight-air brakes provided with differential governors. The compressors are of type C. P.-22. The function of these differential governors is to equalize the work on all the pumps on a train of cars when operating in multiple unit connection. This is accomplished by the provision of two diaphragms of an unequal area. The larger diaphragm is connected directly to the main reservoir and the smaller connected to a pipe which is in connection (when the emergency valve is in its normal position) with the reservoir line running through the train. A check valve is located in the pipe leading from the main reservoir line to prevent the passage of air from the latter to the former.

If the governor on any car starts the compressor, the pressure in the main reservoir of that car and also the pressure in the reservoir line running through the train is increased, but the pressure is not raised in the main reser-



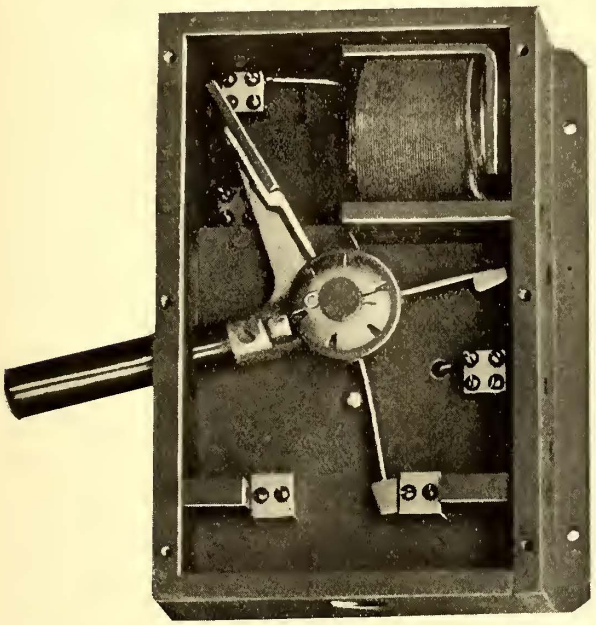
CONNECTIONS OF EMERGENCY STRAIGHT AIR BRAKE SYSTEM FOR MULTIPLE UNIT OPERATION

voirs on the remaining cars. This results in the governors on the remaining cars being set in operation and insures all the compressors doing an equal amount of work.

The connections of the emergency straight air-brake system for multiple unit operation are shown in an accompanying diagram.

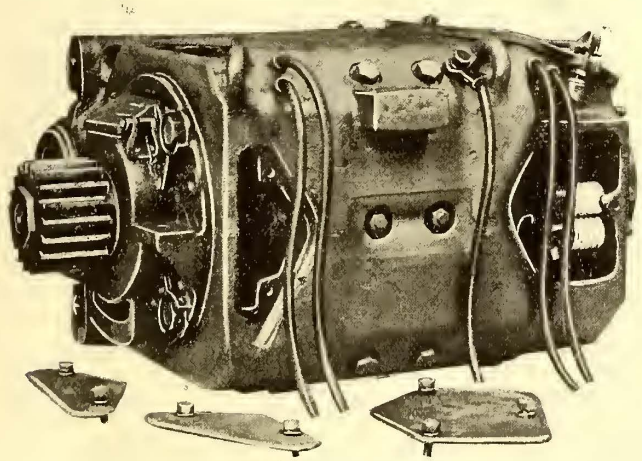
CAR BODIES

The eight cars, which were constructed by the Niles Car & Manufacturing Company, are of the combination type, each containing a passenger compartment, a smoker and baggage compartment and a toilet. They are all single-ended cars and the control apparatus is situated in a railed-off portion of the baggage compartment. The principal



INTERIOR OF SWITCH FOR CHANGING CONTROL CIRCUITS WHEN CAR PASSES FROM 600 TO 1200 VOLTS

dimensions are as follows: Length of the bumpers, 50 ft.; baggage compartment, 8 ft. 11 ins.; smoker compartment, 10 ft. 9 ins.; main passenger compartment, 23 ft. 9 ins., and rear vestibule, 4 ft. The extreme width is 8 ft. 10 ins.; height from track rails to under side of sills, 3 ft. 5 ins.;



COMMUTATING POLE RAILWAY MOTOR WOUND FOR 600 VOLTS AND INSULATED FOR 1200 VOLTS

height from under side of sill to top of trolley base, 9 ft. 6 ins., and extreme height from top of rail to top of trolley base, 13 ft. 2 ins. The seating capacity is fifty-three, allowing thirty in the passenger compartment, sixteen in the smoker and seven in the baggage compartment.

The interior of the cars is finished throughout in mahogany; the ceiling is in the semi-empire style, painted and decorated in green and gold. The floors are covered with inlaid Greenwich linoleum. The seats in the main passenger compartment are upholstered in plush, and those in the smoker are upholstered in leather. Each car is heated by a Peter Smith No. 2 hot water heater.

The trucks, which are of the Baldwin type, class No. 78-25, were designed for a centerplate load of 25,000 lbs. each and have a wheel base of 6 ft. 6 ins. The wheels are of hard, forged, rolled steel, 34 ins. in diameter, and with rims 2½ ins. thick. The treads are 3 ins. and the flange ⅞ in. deep. The axles are all forged steel 5½ ins. in diameter at the motor bearing and 6½ ins. at the gear seats; the journals, which are of the M. C. B. type, are 4½ ins x 8 ins.

The two freight and baggage cars are 50 ft. in length over buffers with an extreme width of 8 ft. 10 ins. These cars are made to resemble the passenger cars as much as possible and are painted and lettered in the same style.

WATCHING NEW YORK CENTRAL SHOES

It is the standard practice in the New York electric zone of the New York Central & Hudson River Railroad, to keep the height of the third-rail shoes within ⅛ in. of the standard. To discover shoes not complying with this requirement, a spring telltale has been installed at 110th Street. At this point the shoe passes through an open wood section containing a spring which operates a gong whenever the shoe is more than ⅛ in. high or low. A boy on the lookout at this point notes the number of the car or locomotive operating the telltale and sends in a report to the inspection department. Upon receipt of the report at the inspection shed, the men adjust the shoes and also determine whether the allowable variation of ½ in. in side play is exceeded.

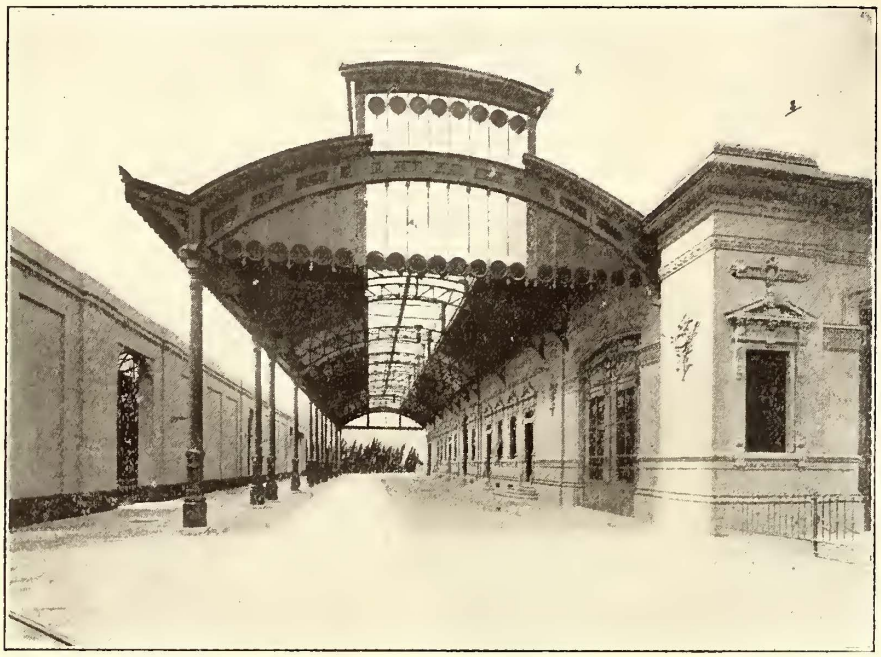
THE CONNECTING LINKS BETWEEN YOUNGSTOWN, O., AND JACKSON, MICH., 441 MILES DISTANT

With the Youngstown & Southern Railway in operation between Youngstown and Salem, a through route will be established to Jackson, Mich., a distance of 441 miles, and the running time will be eighteen hours and fifty-five minutes. In fact, the entire route would be from New Castle and other points in eastern Pennsylvania to Jackson, which lengthens it to a great extent. The Youngstown & Southern operates between Youngstown and Leetonia, while the Youngstown & Ohio River road connects with the Stark Electric at Salem. The western terminus of this line is at Canton, where it connects with the Northern Ohio Traction & Light system, with Cleveland as a northern terminus. Between that city and Toledo the Lake Shore Electric operates cars on a fast schedule and between Toledo and the Detroit & Jackson other Everett-Moore roads are in operation. On the eastern end the Mahoning & Shenango Valley Railway & Light Company operates a system of lines which reach a number of Ohio and western Pennsylvania points. While the route lies over a number of different lines, the system of selling through tickets in operation in Ohio will enable the companies to handle passenger business in a very satisfactory manner.

Through the generosity of E. J. Moore, a prominent Philadelphian, who was formerly a director of the Interstate Railways Company, the conductors and motormen of the Wilmington City Railway Company had a very merry Christmas. A fine turkey dinner had been spread for them at the company's offices and it was served to the men from 10 o'clock in the morning until 2 in the afternoon. More than 130 of the men enjoyed the dinner. The details were all arranged by General Manager S. S. Hoff, who was at the office throughout the day to greet the men.

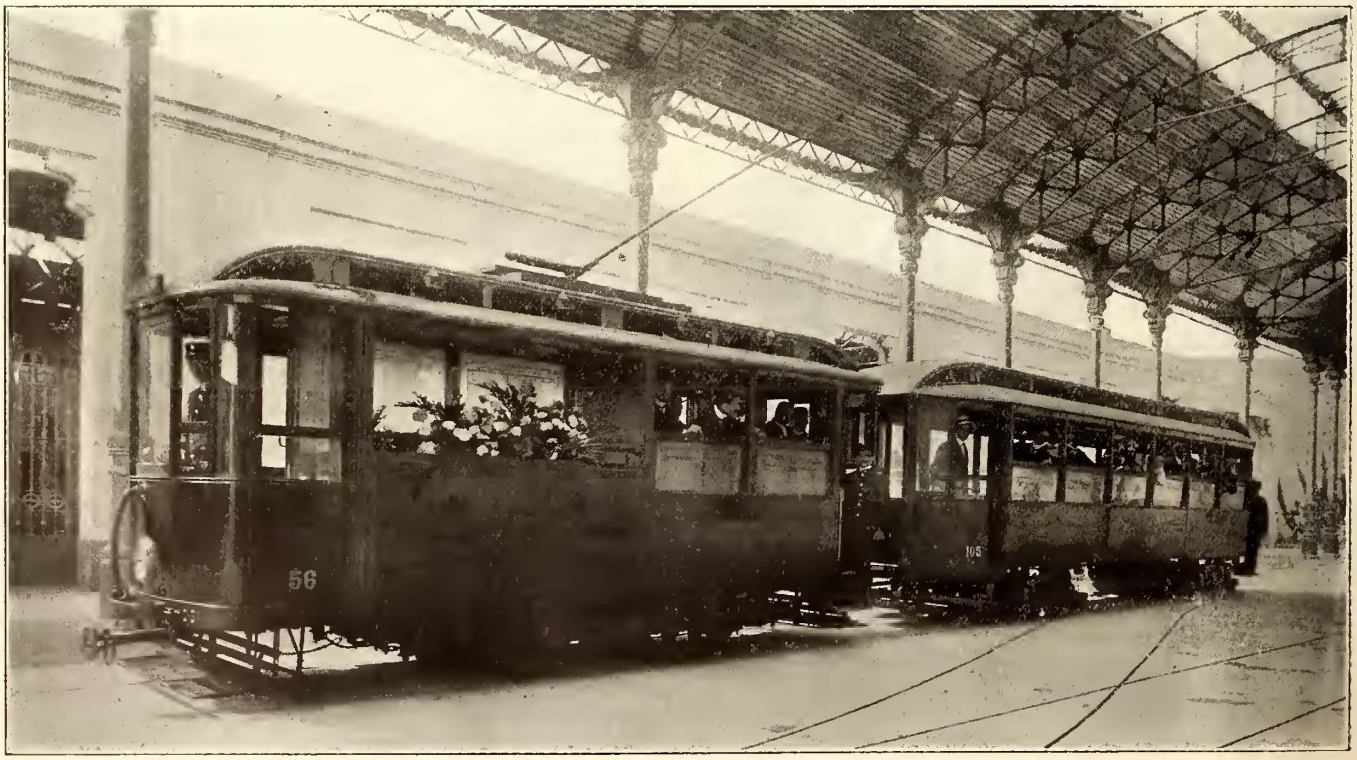
ELECTRIC FUNERAL TRAINS IN MILAN

In every great city the disposal of the dead is a perplexing problem and one which as yet has not been very satisfactorily solved. Italy, where cremation has long been extensively practiced, has perhaps led all other countries in the scientific conduct of mortuary matters. The principal cemetery at each of the larger cities in the Italian peninsular, but particularly in the Northern half, is a place well worthy of a visit from the tourist, on account of the taste displayed in laying out the grounds and the art shown in the memorials erected to the deceased. The principal cemetery at Milan is owned by the municipality and is one of the most extensive and artistic in the world. With the recent improvements which are described in this article, it forms part of what is probably one of the best organized systems of burial in existence.



TERMINAL STATION AT PORTO ROMANO, THE STARTING POINT OF THE FUNERAL TRAINS—THE STORAGE CAR HOUSES ARE AT THE LEFT

Years ago the Milan Government recognized the impracticability of having a large cemetery located within or near the city limits. The value of land, the necessity of providing for expansion, the dictates of hygiene, etc., all led the Government to adopt a policy which will ultimately close the numerous cemeteries within the city and practically all in the suburbs, with the exception of Cimitero Monumentale, which is the one with which this article deals. This new cemetery is located several miles beyond the city limits and is of sufficient area to accommodate the requirements of Milan for many years. Being at such a distance from the city, the Government decided not to make the mourners depend upon carriages, but to construct an electric railway especially for carrying the corpses and the attendants between the city and the cemetery. The cemetery was opened for burial purposes in 1895. At first the railway was single track through-



FUNERAL TRAIN WITH MOTOR CAR CARRYING THE CASKET

out, but within a year it was changed to double track, so as to avoid all delays and confusion, which tend to annoy those traveling in the funeral cortège.

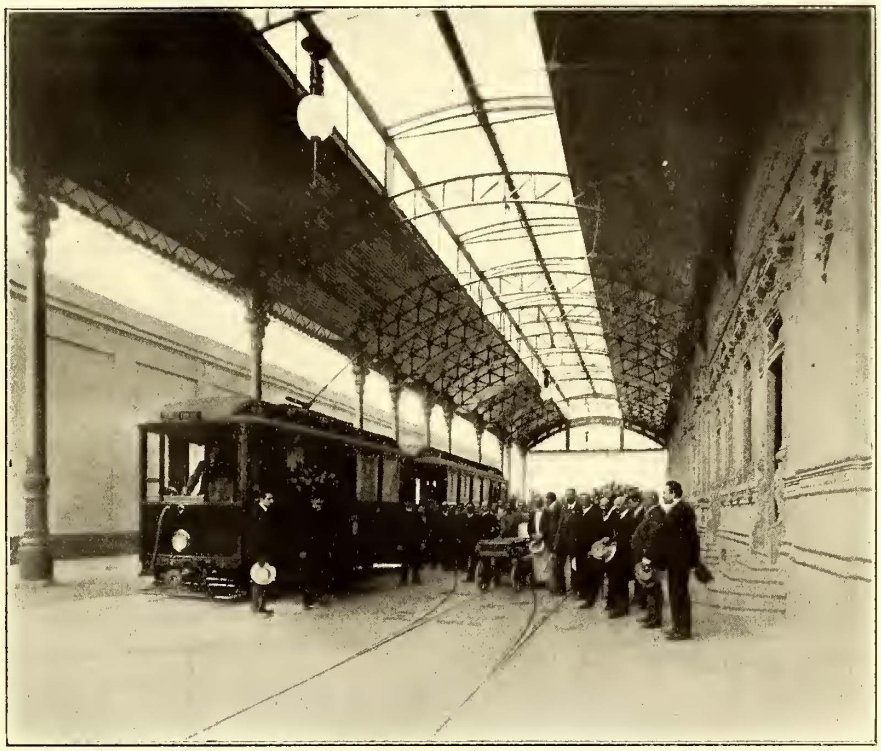
The original city terminus of this line was in Via Bramante, close to the city limits and alongside one of the

older cemeteries still in existence. At this station the body is transferred from the hearse to the electric car. Current for the operation of the cars is purchased from the Edison Illuminating Company, of Milan, which operates both the lighting and street railway systems of the city. The feeder system is so arranged that on Sundays, fête days or at other times of peak load extra feeders can be switched in to reinforce those ordinarily in use.

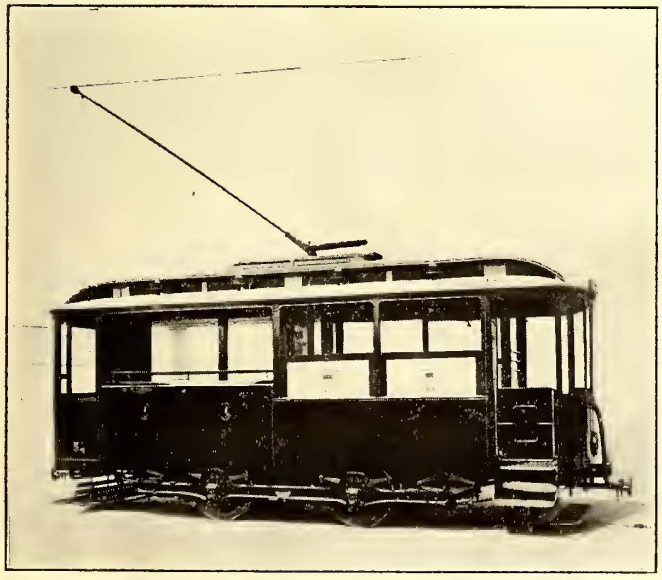
A large portion of the track of this Stygian railway occupies what is practically a private right of way, as there is little vehicular traffic at those places. As the cars run at slow speed, it has been considered necessary to use only a 36-lb. T-rail. This rail is carried on oak ties 6 ins. x 8 ins. x 8 ft. and spaced 32 ins. apart, except at the joints, where the spacing is reduced to 16 ins. In paved streets an 84-in. girder rail on steel ties is used and standard gage is employed throughout. There is nothing of special interest in connection with the construction of the line, as the ordinary bracket type of trolley construction is used.

The rolling stock was especially designed for the service. The service first inaugurated between the Via Bramante station and the cemetery consisted of hourly funeral trains and ordinary passenger trains running at 20-minute intervals. The funeral train is made up of a motor car and a trailer. The motor car carries the nearest relatives, eight of whom are furnished with free transportation to and from the cemetery. The trail car shown herewith has two compartments for caskets, with a space above them for floral or other tributes. The compartment at the rear end of the car is for the clergymen who accompany the bodies. Each funeral train is immediately followed by one or more passenger cars for the mourners, the number of cars depending upon the size of the funeral.

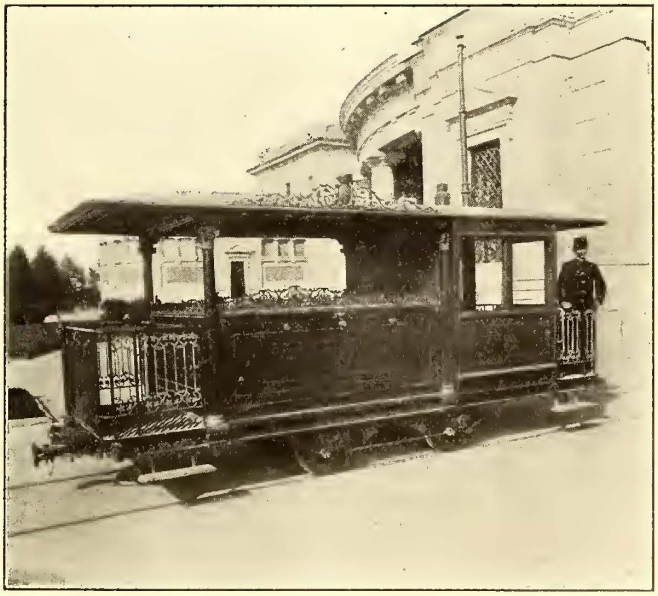
In addition to the funeral trains there is a regular passenger service for those desiring to visit the cemetery and those who live along the line. The cars used in this service and for following the train carrying the casket are similar in every way to those used on the regular city lines. The motor cars are of the single-truck type and can carry 40 persons, 20 seated and 20 on the platforms. The trail cars carry 44 people, 20 seated and 12 on each platform.



A FUNERAL TRAIN STARTING FROM THE PORTO ROMANO FUNERAL STATION



SINGLE TRUCK MOTOR CAR FOR MOURNERS

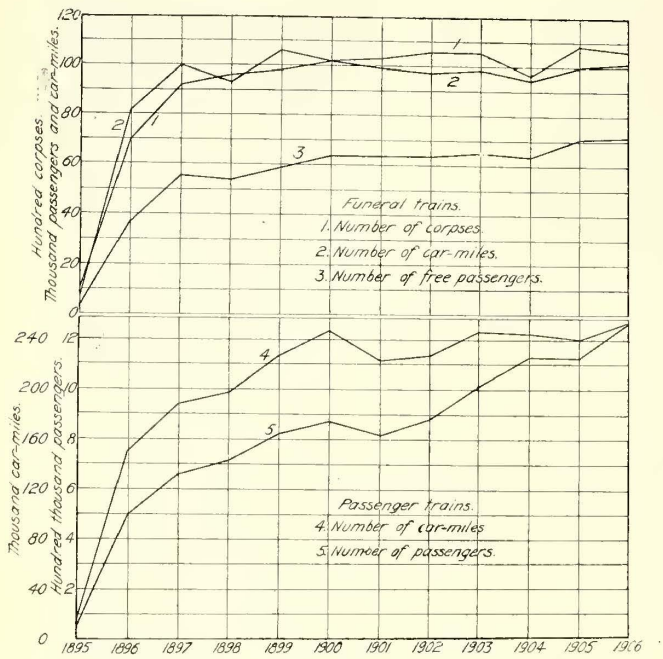


SINGLE TRUCK TRAIL CAR FOR CARRYING THE CASKET

The fare was originally 15 centimes, or 3 cents, each way, but in September, 1902, it was reduced to 10 centimes, or 2 cents. On page 12 are plotted several curves, which will give some idea of the growth of the business done by this railway line up to 1906.

The success of this first station was so marked that the Government decided to continue and improve the system.

As stated in the early part of this article, the Via Bramante station, from which the funeral trains started, is at a considerable distance from the center of the town, hence people living on the opposite side of Milan have necessarily had to travel a long distance by carriage before reaching the point of departure. After considerable trouble, the Government succeeded in purchasing a tract of 5680 square meters, or about two acres, near the Porta Romana, which is on the diametrically opposite side of the city from the Via



STATISTICS OF ELECTRIC FUNERAL SERVICE IN MILAN

Bramante station. On this tract an elaborate terminal station and mortuary chapel have been built. The building is arranged to receive funeral parties and to provide suitable rooms in which the funeral services can be carried on. Two parties can be taken care of simultaneously, each entering from opposite ends of the building. Rooms are also provided for parties who are waiting their turn. Opposite this building is a car house in which the rolling stock is stored and made up, thus avoiding all switching and confusion on the station platform.

The cars purchased for service in the new station differ considerably from those used in connection with the Via Bramante station. The motor cars are constructed to carry only one casket at a time. They are of the single-truck type, and measure over platforms 6.9 meters, or about 22½ ft. The car body is divided into three compartments—one for the casket, which takes up about a quarter of the space; another quarter is reserved for the clergymen, and the remainder of the car body, which is separated by a partition from the other compartments, is reserved for the eight mourners, who are given free transportation to the cemetery. The platforms are closed on the right and are fitted with vestibules. The inside finish of the car is in black walnut and teak. The windows are of ground glass, but can be lowered. Each window is provided with a shade of dark, lead-colored material decorated in Oriental style.

The compartment reserved for the coffin is closed on the outside by means of a hinged door, which opens from the top toward the bottom, and is balanced and fastened by two vertical chains. On the inside there is a false sliding floor, which, by means of iron rollers and a T-iron track, can be slid out upon the open door to facilitate the loading and unloading of the corpse.

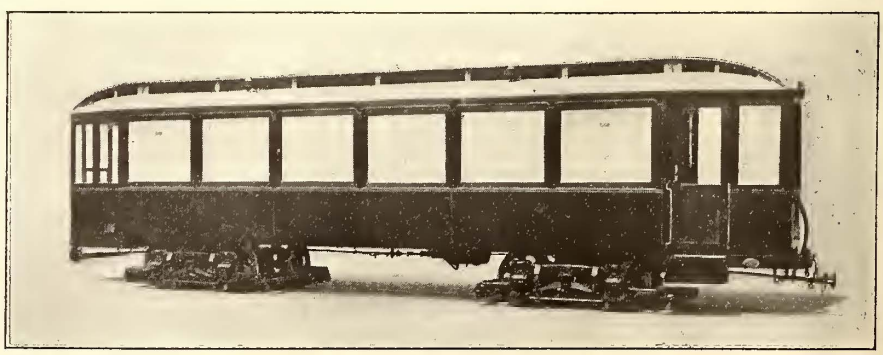
Double-truck trail cars are used by those mourners who do not travel with the body. At present there are in service eight motor cars and five trail cars. The price of tickets to those belonging to the funeral party is 30 centimes 6 cents), and passengers with these tickets are allowed to remain one hour in the cemetery.

This service was begun Oct. 3 of this year, and, for a time, only the dead from the districts immediately adjoining the terminal station will be taken care of. Later other districts will be added to the list.

With the opening of this new station it is expected that, as soon as possible, the old station at Via Bramante will be improved, and, as the system develops, two other stations will be built, one in the eastern side of the city and one in the west. This paper is indebted to Francesco Minorini, chief engineer of the Department of Public Works of Milan, for the information and illustrations contained in this article.

THE BOSTON & NORTHERN TO HAVE ANOTHER HEARING

The case of the Boston & Eastern Electric Railroad, one of the interurban projects considered in a general order by the Massachusetts Railroad Commission several months ago and held in abeyance by the commission at that time, is about to be reopened. The company has asked the commission to give a hearing with reference to approval of its general scheme as modified since the first presentation. At that time the company, having planned a new quick service line from Beverley and Danvers, through Salem and Lynn, to Boston, propose to connect it with the Boston Elevated system at the already overcrowded terminal in Sullivan Square. The commission negatived such a roundabout method without dismissing the scheme in its entirety. Now the company proposes to reach the heart of the city directly by means of a tunnel under the harbor from East Boston and a subway from the water front to Postoffice Square in the middle of the financial district. Meanwhile it has amended and readvertised its articles of incorporation, leaving out mention of Everett, a city traversed by the original line, but not included in the revised survey. The commission will shortly set a date for rehearing the matter.

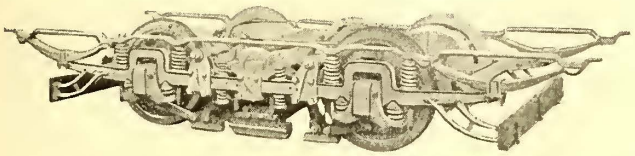


DOUBLE TRUCK TRAIL CAR FOR MOURNERS

The directors of the Manila Electric Railway & Light Company have declared a dividend of 1 per cent.

BRAKING TESTS IN LEEDS, ENGLAND

On Nov. 25, 1907, J. B. Hamilton, general manager of the Leeds (England) City Tramways, gave a public test with two cars, one No. 87, fitted with the latest type of Westinghouse magnetic brake, and the other, No. 270, with a new electro-mechanical track brake designed by the



LEEDS TRUCK WITH TRACK BRAKE

tramways' own engineer. In view of the careful manner in which the trials were carried out the following detailed report should prove of interest. All the tests were made on Whitecote Hill, the profile and grades of which are given in one of the accompanying cuts. The accompanying information is from a report by Mr. Hamilton on the subject.

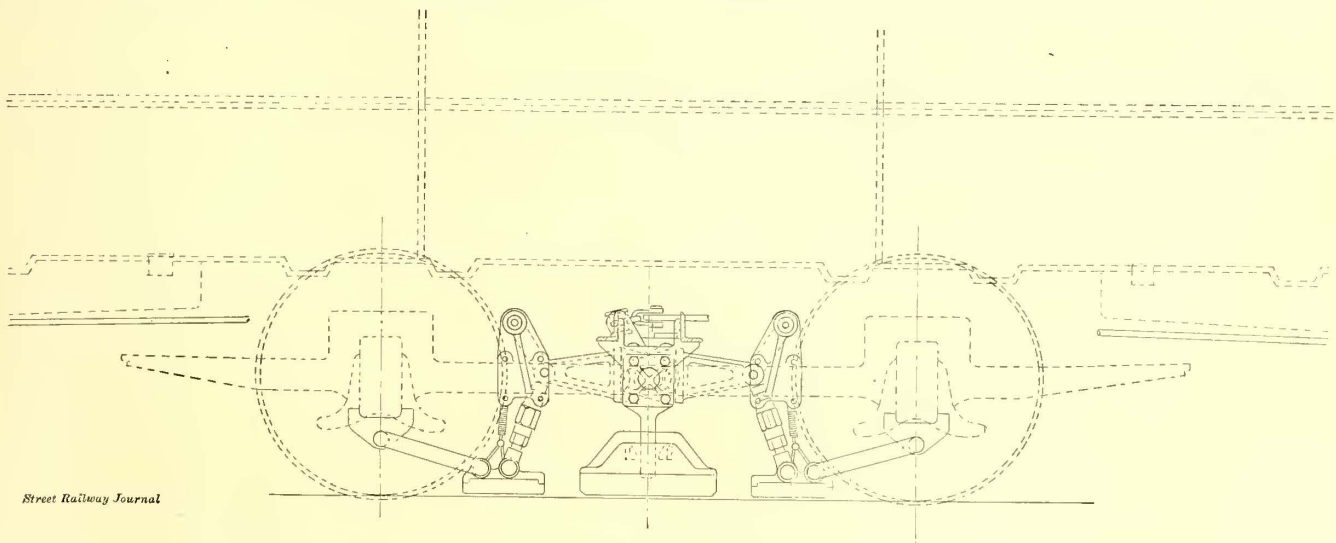
Both cars were of exactly the same weight and carried the same equipment except the brakes as noted. They had Dick-Kerr 35-A motors, and British Thomson-Houston B-13 controllers. Both cars had top deck cover, were mounted on Brill 6-ft. wheel base trucks, and weighed, unloaded, 23,600 lbs. each. The Leeds electro-mechanical track brake, used on car No. 270, had auxiliary track blocks of cast iron.

The action of the new mechanism, which is shown in an accompanying half-tone and drawing, is as follows: The main track block travels along the rail backward relatively to the car when pressure is applied either by exciting the magnet or mechanically. This action takes with it the vertical lever, which is in cam form. The cams force the triangular-shaped thrust pieces outwards and these thrust pieces tend to force the connecting links, between the bracket on the car frame and the auxiliary blocks, into a straight line, thus applying pressure to the auxiliary blocks. The drag or pull of the auxiliary blocks is taken by the separate links secured to car frame below the axle boxes.

The magnets on both cars were of the Westinghouse type with poles longitudinally along the rail and giving a vertical pull of about 4,000 lbs. on 100-lb. standard rail when the magnets are saturated. The retardation of these magnets when so energized is from 1600 to 1800 lbs. for the two on a clean rail at a speed of three to four miles per hour. This has been found by separately exciting the magnets and towing the car by another car. The brakes were also arranged so as to be applied manually and thus be independent of electric operation.

The brake was found to be practically non-skidding, and any momentary stoppage of the wheels, equivalent to perhaps one revolution of the same, could be caused only by moving the controller right around, instead of passing from notch to notch. Further, the skidding in no way affected the stop, as residual magnetism was sufficient to keep the brake in operation for the fraction of time before the car stopped. In attempting to make the wheels skid when going at high speed on a heavy grade they could not be made to do more than stop momentarily before commencing to roll again, and this, as previously stated, did not affect the retardation of the brake.

The possession of a manually operated track brake having the characteristics outlined points to the fact that the wheel brakes may be dispensed with, as their use in case of emergency is more likely to cause trouble than not, or in case of runaways (as experiments have shown) on steep grades, it is scarcely possible to stop at all with this brake. Again, in runaway conditions a motorman should never have at his hand a means of rendering more powerful brakes inoperative, which may easily be done in the excitement of the moment by the application of the wheel brake in addition to the electro-magnetic brake. It follows that by the removal of brakes acting on the periphery of the wheels the remaining methods of braking are easily arranged so that they cannot neutralize each other if all are operated simultaneously. On the other hand, they help each other up to the limit of the full braking force possible. Regarding the most difficult fault in electro-magnetic braking, namely, the failure to build up, the use of the electro-magnetic brake for service work would insure the contacts being always clean and therefore the risk of failure practically negligible, but to overcome this possibility of failure a switch is provided on the canopy which on being closed connects the trolley line to the magnets. In the event of failure of line current or trolley coming off, recourse must be had then to the manual operation of the track brake. The Leeds experiments have shown that at high speeds



ELEVATION OF LEEDS TRUCK

(on many occasions 28 to 30 miles per hour) the trolley has never once left the wire, and it is reasonable to say that the manual application would be fully applied either by the motorman, or motorman and conductor, long before 30 m. p. h. were reached.

The brake automatically limits the current in the motors in the following way: The weight on the auxiliary track blocks is taken off the wheels. The greatest amount of weight which can be so taken is the weight of the car above the axle boxes; that is, the weight of the motors, wheels, etc. (about 4½ tons), is always left on the wheels, but this is insufficient to drive the wheels to generate the high currents obtained on other forms of magnetic brakes. The answer to the argument which may be advanced that this tends to derailment is, that the same principle is common to all track brakes, but with this brake, speed sufficient to derail a car by centrifugal force in rounding a curve could never obtain, as any one of the three systems of operating would check the car before such a speed was reached.

The behavior of the new brake is not greatly affected by a greasy rail. The action of the leading block appears to scrape the rail clean for the magnet and the rear block. The large wearing surface of the brake shoes, over 3 ft. per side of car, reduces the heating of the blocks and of course the frequency of adjustment and renewal owing to wear. A feature common to all magnetic brakes, about which it may be useful to remark, is their action when on the short pieces of manganese met with at switches and crossings. When on manganese the magnets are inoperative, but the braking effort is transferred to the motors, which now act as a common rheostatic brake, as they would do if the car was off the track.

The life of the track is generally limited by the life of the rail joints, which is as a rule much less than that of the rail between the joints, therefore it seems sensible to brake on the rail (apart from the other advantages obtained therefrom) and obtain useful work from the whole of the track instead of, as at present, grinding wheels away and having to relay rails not worn out. The report also points out that use of track brakes would also tend to reduce corrugation. The results of the tests at Leeds follow:

RESULTS OF BRAKE TRIALS MADE NOV. 25, 1907, ON WHITECOTE HILL, RODLEY, LEEDS, ENGLAND

Car No. 87.—Fitted with Westinghouse latest form of magnets, but without wheel attachment to same.

Car No. 282.—Fitted with electro-mechanical track brake with auxiliary track blocks. The magnets on this car are identical with those on Car No. 87.

All tests made on grade 1 in 8.4 1 in 9.6, unless otherwise specified. No sand used on any of the stops. Rail coated with black deposit.

TEST NO. 1.

Car No. 87 with wheel gear disconnected and magnets separately excited to demonstrate the amount of braking due to the magnets.

RESULT.

With magnets excited with 42.5 amps. each, car accelerated. Initial speed before application of magnets, 5 to 6 miles per hour. Car was stopped by wheel brake in addition to magnets on lesser grade immediately above Leeds and Bradford.

TEST NO. 2.

Car No. 87.—Magnets operated in conjunction with motors.

RESULT.

Coasting the above grade at 3 to 4 miles per hour the current generated per motor was 28 amps. at 166 volts.

TEST NO. 3.

Car No. 87.—Coasting with motors only. (Known as rheostatic brake.)

RESULT.

Speed, 3 to 4 miles per hour. Amps. per motor, 40. E.m.f. per motor, 204. Car No. 87 was here sent to depot to have wheel brake attachment refitted.

TEST NO. 4.

Car No. 270.—Manual operation of track brake.

RESULT.

Coasted down at speed up to 10.3 m.p.h. and stopped when desired.

TEST NO. 5.

Brake energized from trolley by special switch on canopy. This affords an accurate idea of the work done on the brake as distinct from the motors.

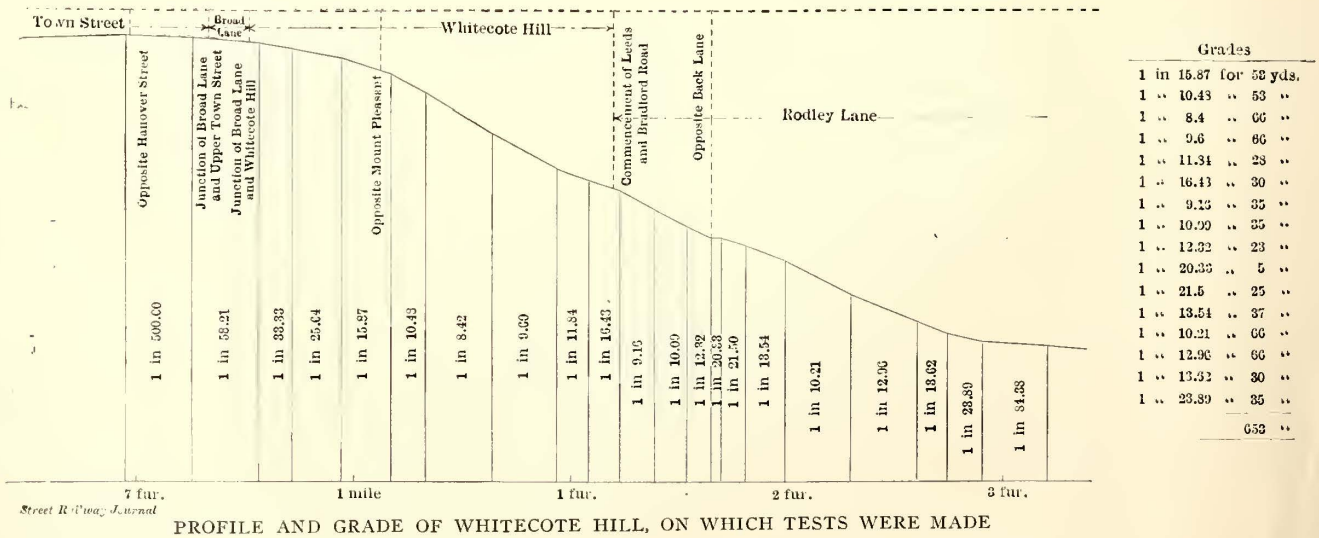
RESULT.

Speed m.p.h.	Amps. per magnet.	Distance to stop.
11.4	39	104 feet.
15.0	39	229 "

It is interesting to note in connection with condition of rail, that the preceding week, when the brake was under the inspection of Mr. Baker, of Birmingham, and Mr. Simpson, of Preston, the results were as below:

Speed m.p.h.	Amps. per magnet.	Distance to stop.
17.9	37½	137 feet.
18	37½	126 "

In this case the rail was wet and rather greasy, which enables better stops to be made than when the rail has a coating of nearly dry, black deposit. See also remarks below regarding tachometer belt.



PROFILE AND GRADE OF WHITECOTE HILL, ON WHICH TESTS WERE MADE

TEST NO. 6.

High speed stops by brake energized by motors.

RESULT.

Speed on application of brake.	Amps. per motor. Max. observed. Kick only.	Volts per motor. Max. observed. Kick only.	Distance to stop.
19.3	84	700	109 feet.
17.8	90	663	64 "
21.6	102	803	115 "
25.4	110	663	198 "

Up to this point the car had 18 passengers on board. Twelve now alighted to observe the stops from the road.

Speed on application of brake.	Amps. per motor, Max. observed. Kick only.	Volts per motor. Max. observed. Kick only.	Distance to stop.
23.6	90	829	152 feet.
27.0	94	893	246 "
26.3	84	918	231 "

It was noticed more so on the last two stops that the tachometer belt was slipping, as in spite of running over the brow of the hill on full power for 150 yds., the reading indicated as noted above. It was generally agreed that a more correct estimate of speed would have been 30 miles per hour.

Again, as compared with last week, the state of the rail as it affects to-day's stops are interesting, although the speeds recorded to-day are low, due to tachometer belt, already noted.

Speed on application of brake.	Amps. per motor. Max. observed. Kick only.	Volts per motor. Max. observed. Kick only.	Distance to stop.
19.0	70	561	83 feet.
19.5	90	561	74 "
19.7	80	446	60 "
24.0	80	765	132 "

The improvement here shown, as the test proceeded, indicates as was observed at the time, that the blocks had scraped the rail clean. This did not happen to the same extent to-day, as deposit was dry and affected the braking in a similar manner to what might be expected if rail was slightly blackleaded.

TEST NO. 7.

Car No. 270.—Coast down hill with brake energized by motors and note current required.

RESULT.

Speed m.p.h.	Amps. per motor.	Max. volts per motor.
10 (estimated)	6 (fairly steady) Maximum 8.	153
5 "	3 to 6 generally	120

TEST NO. 8.

Car No. 270.—Make high speed on rheostatic brake, that is, motors only. (Brake disconnected.)

RESULT

On 1 in 10.2 to 13 grade, lower part of hill.

22½ In spite of careful operation of controller, wheels skidded almost continuously for approximately 150 yds. until bottom of hill was reached.

19.0 Same result as recorded above.

TEST NO. 9.

Car No. 270.—Coast down on motors. Note high current.

RESULT.

This was not done, but the result of same test on Car No. 87, made after coasting with magnets (No. 2 test above), will be accurate, as the equipments on both cars are exactly alike, and both cars are same weight.

TEST NO. 10.

Car No. 270.—Endeavor to make stops by reversing motors.

RESULT.

As time was getting short this was, by common consent, not carried out. It may be said, however, that on previous trials a stop could not be made by reversing. Test carried out at suggestion of Board of Trade with car loaded with three tons of iron, afforded an indication of the retarding force required on a grade of this kind (1 in 8.4). If car was allowed to gain an initial speed of about 5 m.p.h., and first notch of controller (power side) applied (motors reversed), car continued to run forward. On application of second notch car gradually came to a stop and remained stationary. On application of third notch car commenced to move slowly back. Any attempt to make a stop resulted in wheels slipping and revolving in reverse direction, with reduction of retarding power, and hence worse result.

On the lower part of the hill, when coasting with brake (manually applied), at about 6 miles per hour, the electro-magnetic brake was applied in addition. Result—a very sudden stop. A similar result would be obtained if all three brakes were applied simultaneously.

As it was now late, and Car No. 87 with wheel attachment refitted had not been completed, tests proposed in three of programme were abandoned.

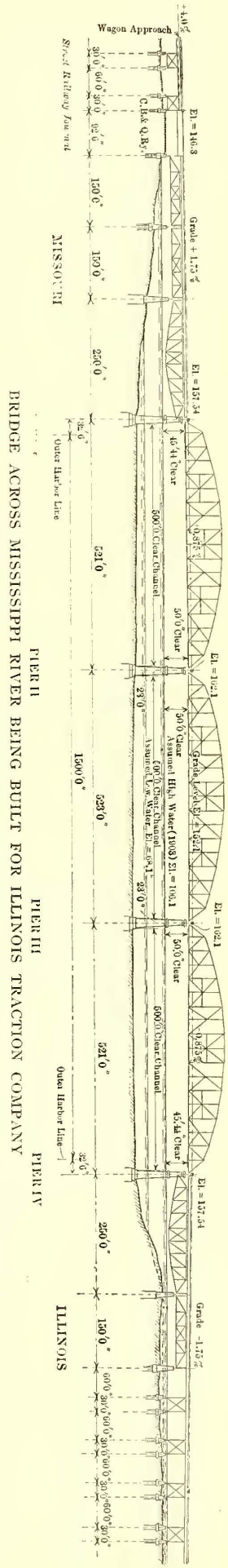
Iquitos, Peru, has a narrow-gage steam railroad, used principally for hauling freight, called Ferrocarril Urbana de Iquitos. A fifteen-year concession has also just been granted the Empresa Electrica, for a tramway, and the material has already been ordered, mostly from the United States. No name has as yet been decided upon, the concession having been given the Empresa Electrica, or Electric Enterprise, for both light and railroad.

ST. LOUIS BRIDGE OF THE ILLINOIS TRACTION SYSTEM

Frequent reference has been made in this publication to the bridge to be erected across the Mississippi River at St. Louis by the St. Louis Electric Bridge Company, an organization subsidiary to the Illinois Traction System. The bridge proper will consist of three spans, the middle one 523 ft. and the other two 521 ft. long. Steel approaches on each side will lead up to the main structure. A temporary approach on the Illinois side will carry the tracks and wagon way into Venice on a 4 per cent grade. Eventually, however, the approach for the car tracks will be extended at a grade of 1¾ per cent across several railroad tracks and to Madison.

On the St. Louis side the wagon way and car tracks will be carried at a 1¾ per cent grade over the Chicago, Burlington & Quincy Railroad. The wagon way will then be carried down to Salisbury Street at a 4 per cent grade. The car tracks will continue at a grade of 1.75 over other railroad tracks and over Broadway to Ninth Street. All piers will be of concrete with stone facing and granite coping. Those supporting the main span and the two adjacent ones under the approaches will be carried down 60 to 65 ft. to bed rock. Other approach piers will be supported on piles.

The bridge has been designed for present steam railroad train loading without steam locomotives, or for two 120-ton electric locomotives, and will be heavier than either of the two bridges now spanning the river at St. Louis. In general outlines it is similar to the Merchants' bridge, but is of somewhat different construction. The wagon ways will probably be located in the center, but as traffic increases they will be placed outside the trusses on cantilever supports. Ralph Mojeski, of Chicago, as consulting engineer for the bridge company, designed the structure. The first caisson was sunk at Venice on Dec. 8. About 150 men are to work on the project during the winter, but the force is to be increased to 250, the maximum efficient number, with the advent of spring weather.



LARGE ELECTRIC LOCOMOTIVES FOR HEAVY SERVICE

BY BELA VALATIN

An account was published, on page 848 of the Street Railway Journal for Oct. 26, of the new 15-cycle single-phase electric locomotive built for the Pennsylvania Railroad for test purposes. The periodicity adopted—15 cycles—has been repeatedly recognized in numerous recent discussions, to be the most favorable as regards the weight and properties of the electrical equipment of the rolling stock generally, and, according to many experts, is especially desirable for single-phase motors, rather than the hitherto universally accepted periodicity of twenty-five cycles. This, by the way, is the periodicity in use on the large three-phase railway lines of Europe, the Valtellina and the Simplon roads, and is that to be used for the Giovi & Savona-San Giuseppe lines, just under construction.

It will surely be interesting to experts to compare the records attained by this single-phase locomotive and those on the New Haven road with the results obtained with three-phase locomotives.

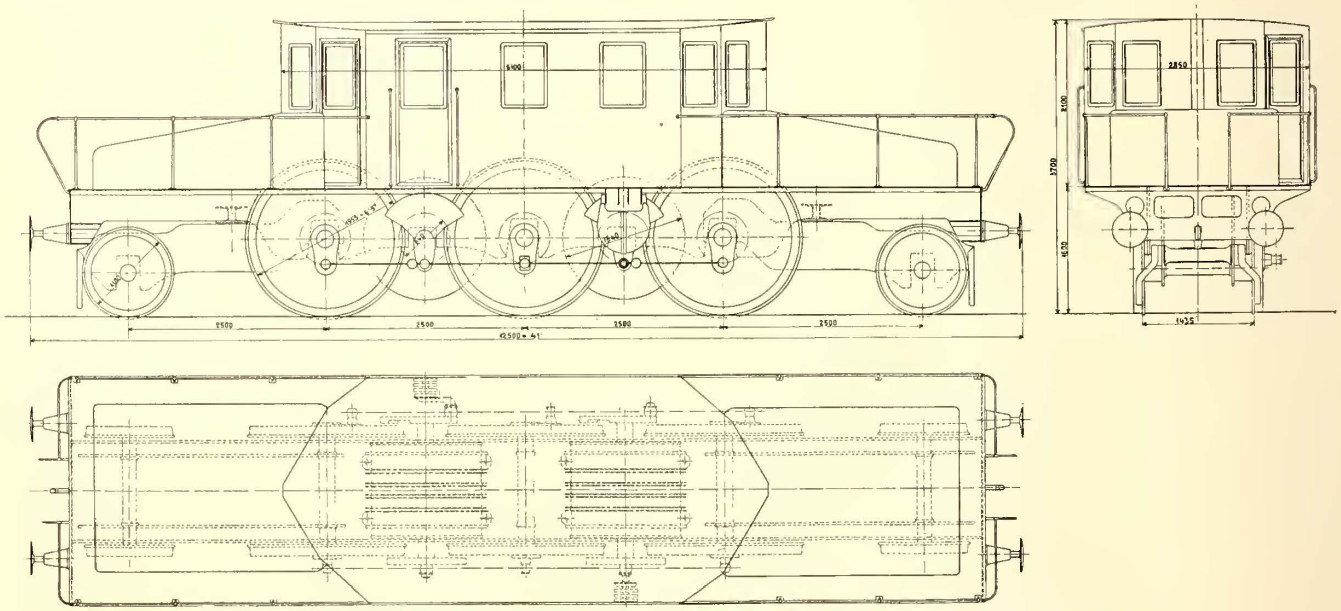
diameter of the drivers is 72 inches. From these data the speed of the motor must be 236 r. p. m. The chief data of the two motors are then, as shown in Table I:

TABLE I.

	Single-phase motor.	Three-phase motor.
Rated capacity in horse-power	500	1100
Weight, pounds, G	19,500	22,000
Revolutions per minute, n	236	220
Weight factor $\left(\frac{G \times n}{2200 \times 100 \times \text{HP}}\right)$	42	20

From this table it appears that the weight factor of the single-phase motor is more than double that of the corresponding three-phase motor; that is to say, the three-phase motor will develop more than double the power of the single-phase motor at the same weight and number of revolutions.

Very interesting results are also reached if we consider the whole locomotive. The diagram below was made for this purpose. To confine the comparison to construction actually carried out the type of locomotive represented by the Italian model previously mentioned has been adopted. The mechanical part of the locomotive would be changed only in so far as the wheel diameter would have to be increased



PLAN AND ELEVATION OF THREE-PHASE LOCOMOTIVE FOR ITALIAN STATE RAILWAYS

The latter are now built with three ranges of speed, as readers of this paper know.* The 8-pole motor of a locomotive of this type, built by the Ganz Electric Co. for the Italian State Railways, has a capacity, on one hour rating, of 1500 hp, at a weight of 13.4 tons (metric), and at 220 r. p. m. While building new locomotives of the same type the manufacturers have recently found it possible, through some changes in the design, to increase the rating of the motors by 20 per cent to 1800 hp, while the external dimensions and the speed of the motor remain unaltered. Another 8-pole motor of similar construction, designed by the Ganz Electric Co., developing 1100 hp on the one hour rating at 3000 volts, 15 cycles and 220 r. p. m., weighs 10 metric tons. Neither of these motors has forced draft.

This last motor seems suitable for a comparison with the single-phase motor of the Pennsylvania locomotive, since neither the weights, nor the speeds of the two motors differ materially. The capacity on the one hour rating of each motor of the Pennsylvania locomotive is stated to be 500 hp, the rated drawbar-pull is given as 14,700 lbs., and the

*See Street Railway Journal, April 6, 1907, page 575.

to 77 ins., so that the speed of the locomotive might be the same as that of the Pennsylvania locomotive at the rated capacity. The two motors are the 8-pole 1100 hp three-phase motors above described, and may be run at half their standard speed in concatenation, in which case one of the motors has to be commutated to low-tension in the same manner as the 12-pole motor of the three-speed locomotive.

The weight of the locomotive, as actually carried out, was 62 metric tons. In consequence of the larger drivers the mechanical part of the locomotive proposed for comparison would be increased by about 3 tons, from 30 to 33 tons, metric. The weight of the motors themselves would be only 20 tons, as against 25 tons for the motors of the three-speed locomotive, so that the total weight of the locomotive would be 60 metric tons, equivalent to 66 American tons.

If we allow a departure from the condition that the motors of the two locomotives compared should have the same number of revolutions, and, for three-phase, adopt a six-pole motor or a four-pole motor, that is to say, motors of one and one-half times or double the number of revo-

lutions, the weight of the motors decreases quite considerably. At the same time the wheel diameter also increases, and with it the weight of the mechanical part of the locomotive. The locomotive proposed for comparison, therefore, is far from being the most favorable design which might be put forward from the point of view of constructional weight for three-phase currents. On the other hand, with single-phase motors, a reduction of the total weight could hardly be attained through an increase of motor speed and decrease of wheel diameter—provided the gearless arrangement with the motors mounted on the shaft is retained—on account of the large dimensions of the motors, which put a limit to the minimum diameter of the wheels. On the other hand, if an arrangement of driving by cranks and connecting rods should be adopted, as in the three-phase locomotive, great constructional difficulties arise in consequence of the increased distance between axles, the greater difference in the height of axles and shafts, etc.

Table II gives the chief data of the two locomotives under comparison:

TABLE II.

	Single-phase locomotive.	Three-phase locomotive.
Total weight of locomotive in American tons.....	140	66
Adhesive weight in tons.....	100	46
Weight of motors in tons.....	37	22
Rated capacity of motors in horse-power.....	2000	2200
Tractive effort on the one-hour rating in pounds.	14,700	16,170
Length over all in feet.....	62	41
Speed in miles per hour at rated capacity.....	50	50

From these data it appears that the locomotive of the Pennsylvania Railroad, at an approximately equal capacity, has a weight more than double that of a corresponding three-phase locomotive. Concurrently the hauling power of the locomotive is less than that of the three-phase locomotive, because, to arrive at the paying train-weight, double the amount has to be deducted from the total train-weight for the idle weight of the single-phase locomotive, as for the three-phase one. This is of importance, especially if there are heavy grades on the road. If, for instance, the railroad has a constant grade of 1 per cent, that is to say, one where the motors may not be loaded beyond their rated capacity, the Pennsylvania locomotive will be able to haul 267 American tons, beside its own weight, while the three-phase locomotive will haul 382 tons, beside its own weight, or 43 per cent more. The speed in both cases is fifty miles per hour.* When the long grades of the line are higher than 1 per cent this ratio becomes yet more unfavorable for single-phase current. For instance, the single-phase locomotive compared, may, on a constant grade of 2 per cent, haul 123 American tons, whereas the three-phase locomotive will haul 212 tons, or 72 per cent more, or if the three-phase locomotive exercises only the same tractive effort as the single-phase locomotive considered, 197 tons, or still 60 per cent more.

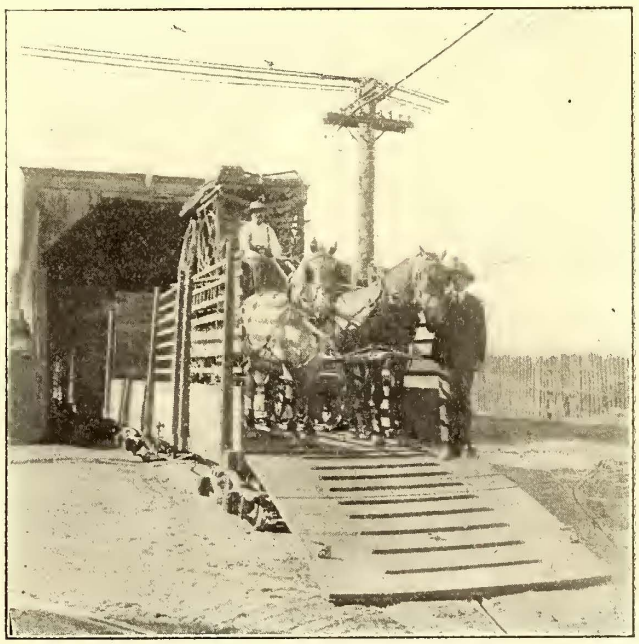
Table II also shows for the single-phase locomotive, a considerably greater weight on drivers, which, on the basis of a coefficient of one-fifth, yields a maximum tractive effort of 40,000 lbs. However, if we consider that so high a maximum with a tractive effort, on the one hour rating, of only 14,700 lbs., is scarcely needed, and, with other electric locomotives (for instance, large d. c. locomotives), is never called for; if we further consider that three-phase locomotives will give a higher tractive effort for the same adhesive weight, than single-phase locomotives, owing to the even character of the torque of the three-phase motor as contrasted with the pulsating torque of the single-phase motor, we shall conclude that this circumstance does not represent a disadvantage of three-phase operation. At the same time it should be noted that it would be easy to design a three-phase locomotive, which, at the same total weight (66 tons), would utilize its entire weight for adhesion, and should the requirements regarding maximum pull be still higher, the weight could be further increased by the addition of ballast weights. Even then the locomotive would weigh only about half as much as the single-phase locomotive considered, while it could, without trouble, develop for a short time the maximum tractive effort required.

The maximum tractive effort of the Pennsylvania locomotive is not so much a consequence of its motor capacity, as of its great construction weight, which is a disadvantage, and cannot be done away with because of the great weight of motors and transformers. It may be said, therefore, that, roughly speaking, half the weight will suffice to turn out a three-phase locomotive of the same, or rather more power than that of a corresponding single-phase locomotive.

*The train resistance in this calculation has been taken at 16 lbs. per ton on the level.

TRANSPORTING TROUBLE WAGONS ON CARS

The accompanying illustration shows the method employed by the United Railways Company, of St. Louis, for getting a trouble wagon and team from one portion of the system to another by transporting them over its lines. A trip that would require two or three hours in the ordinary manner is frequently made on the car in half an hour. In one instance the team and wagon were transported to Creve Coeur Lake in about an hour. With the horses drawing the wagon at least three-quarters of a day would have been consumed. The ends of the car employed are hinged in such a manner that when thrown down they serve as a walkway for the horses. Backing onto the car is avoided, as the team can be driven on at one end and off at the other.

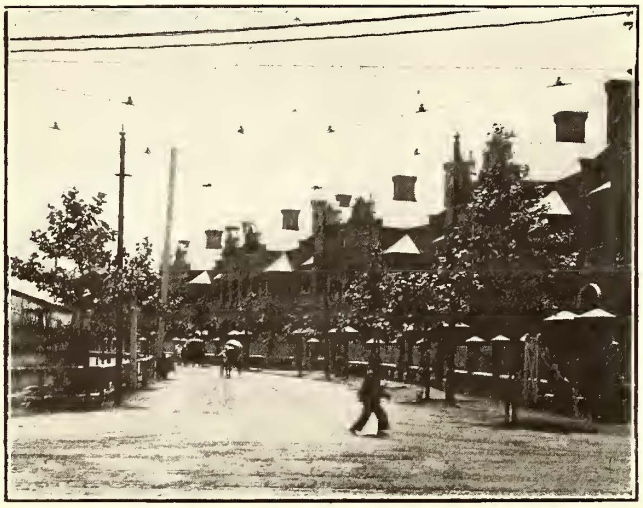


CAR USED FOR TRANSPORTING LINE WAGON IN ST. LOUIS

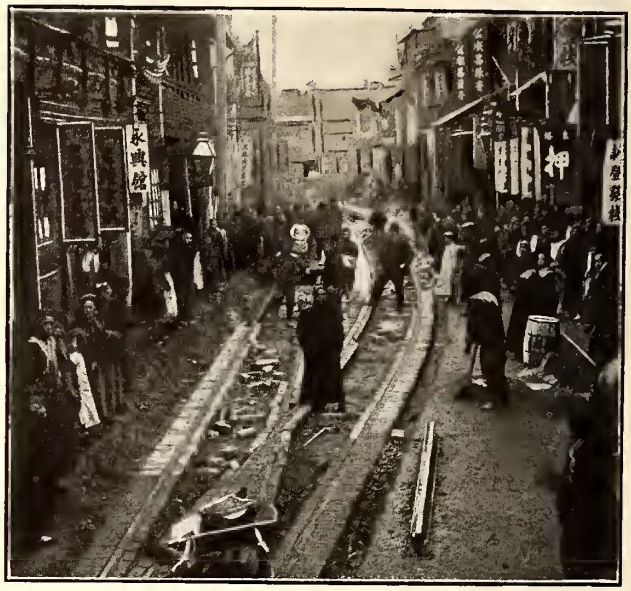
Gaceta de Madrid states that the Spanish Director General of Public Works has granted a concession to La Compania General de Tranvias y Ferrocarriles Vicinales, of Alicante, Spain, to install electric traction on the tramways in Alicante, of which they are concessionaries.

SHANGHAI TRAMWAY NOTES

The establishment of a tramway system of the first magnitude at a distance from home of some 12,000 miles is no small undertaking, and its engineering features call both for careful forethought at home and for technical skill, resource and a nice appreciation of the labor problem on the spot. The importance of the Shanghai Tramways is



A VIEW OF THE LINE IN THE RESIDENTIAL DISTRICT



INSTALLING A TURN-OUT IN ONE OF THE MAIN STREETS

perhaps best indicated by the fact that their mileage, including the lines in the international and French concessions, is only exceeded by about a dozen of the hundred and odd systems in the United Kingdom, and is practically identical with that of the tramways in Leicester, England, a city having a population of a quarter of a million. The population of Shanghai is nearly a million, and more than one-half of the entire foreign trade in China passes through it. It ranks already as the eighth shipping port in the world, its trade having increased from £45,000,000 in 1902 to £70,000,000 in 1906.

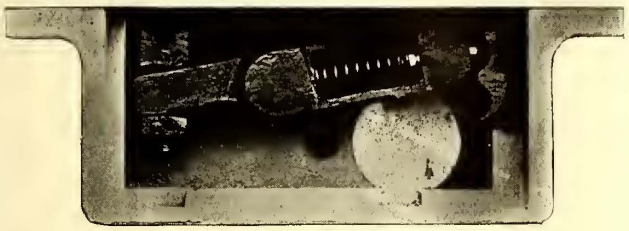
The original concession was obtained by Bruce, Peebles & Company, Ltd., of London and Edinburgh, and transferred to the Shanghai Electric Construction Company, Ltd. The system has been designed throughout according to modern practice and departures from standard apparatus have been avoided as far as possible. It is obvious that this is a very important matter, in view of the enormous distance separating the scene of operation from the nearest available factories. It is a small matter to replace a defective or damaged part when the factory is within a few hours rail journey, but it is quite another matter when six weeks are occupied in transit.

At the time of writing some nineteen months have elapsed since the ground was broken and the work of construction commenced. During this time the progress made would be no discredit even to a system in the heart of a manufacturing country. Nearly thirty miles of track have been completed, and the difficulty of the work has been accentuated by the fact that some of the streets are both narrow and tortuous and the population very dense. Nearly all the routes in the international concession are now completed, the only items yet unfinished being one or two crossings, bridges, etc., where special work is necessary.

AN INTERESTING PIECE OF SPECIAL WORK BEING INSTALLED BY CHINESE LABORERS

The generating plant which the Municipal Council in-

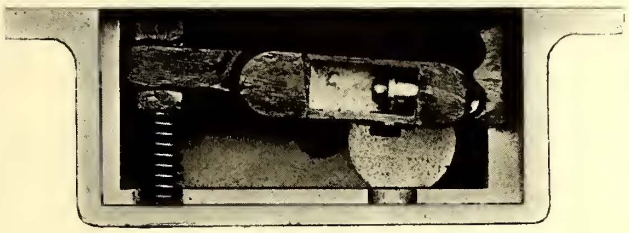
stalled as an installation for the supply of electricity to the tramways was shipped some months ago from the works of the manufacturers, Bruce, Peebles & Company, Ltd., Edinburgh, and is now erected on site. It includes at present two 600-kw railway generators and one 300-kw motor gen-



SPRING LOCK FOR TONGUE SWITCH

erator. About 100 cars will be required for the operation of the system and these are mostly delivered. They are specially adapted to the peculiar requirements of the traffic, having separate accommodation for Europeans and natives and being of the semi-convertible type, suitable for all variations of the climate. A very fine car house with ample repairing facilities has been built.

One of the illustrations shows the overhead system as constructed in the residential quarter of the city, while the



SPRING LOCK FOR TRAILING SWITCH

two other views show some of the special work in the main streets of the city, which has all been undertaken by Edgar Allen & Company, Ltd., of Sheffield, as sub-contractors. The points and crossings were all in Allen's Imperial manganese steel and fitted with Allen & Warlow's three-way mechanism, as shown in the other illustrations. This mechanism enables the switch to be worked in three ways, either as a spring switch set always to the left—as usual in England—or to the right as in the United States, or to be set in either direction. The special work was constructed at Sheffield ready for laying on site, including the rails and accessories.

The entire work of constructing the tramways is being carried out by Bruce, Peebles & Company, Ltd., as main contractors, under the supervision of Harper Bros., of London, as consulting engineers.

RECENT WORK OF THE ASSOCIATION

During the last week the secretary of the American Street & Interurban Railway Association has issued to the member companies the official report of the meetings at Atlantic City of the Accountants and Claims Agents' Associations. Both are more voluminous than last year and include handsome engravings of the presiding officers. Distinctive colors have been adopted this year for the covers of the proceedings of the different associations. Those of the accountants are bound in orange as in previous years, those of the claim agents in green, those of the engineers in brown and those of the American in gray. The proceedings of the two latter associations in pamphlet form will be ready for distribution within a week and cloth bound copies will be sent out to the members about Jan. 18.

Considerable attention has been given during the past year to the enlargement of the facilities of the association for collecting and distributing statistics, and from now on the secretary will be assisted by a statistician who has had several years of practical experience in this line of electric railway work. The association already has a valuable statistical library, and this will be enlarged from time to time so that eventually it will contain copies of practically all governmental, state and municipal laws, reports and documents of general value to the members, as well as copies of various books, pamphlets, reports and other statistical data bearing upon the general subject of street and interurban railways.

Considerable attention has been devoted to the question of a suitable badge to be worn by associate members and several designs have already been submitted to the secretary. It is expected that the executive committee will take some action in this matter at its January meeting.

At the 1907 convention the executive committee was requested to take steps toward the organization of a fourth affiliated association which would take over all of the general work of the American Association relating to transportation, traffic and operating, leaving the latter free to devote its time to executive matters and questions of broad policy. It is expected that this new association will be organized in the near future and a communication relative to this matter will soon be sent to the member companies. A communication will also be sent to them shortly relating to the work accomplished since the Atlantic City convention in connection with the classification of accounts, in regard to which the committees of the association have been in conference with the Interstate Commerce Commission.

In a letter just issued to members the secretary and treasurer says: "The report of the treasurer for the year ending Oct. 1, 1907, showed total receipts of approximately $25,000 and expenditures of practically the same amount as the receipts. The expenditures during the year 1907-1908 will probably be somewhat more than those of the year 1906-1907, as the work of all the associations is becoming broader and more comprehensive. It is therefore quite essential that the old member companies continue in their support and that the membership be increased during the coming year. During the year just past the membership increased approximately 15 per cent, and it is expected that with a more active campaign for membership the increase during the coming year will be considerably greater."

President Simmons of the Engineering Association has announced the following committees:

Standardization—W. H. Evans, master mechanic International Railway, Buffalo, N. Y.; H. A. Benedict, electrical engineer United Traction Company, Albany, N. Y.; R. C. Taylor, superintendent motive power Indiana Union Traction Company, Anderson, Ind.; H. H. Adams, superintendent of shops United Railways & Electric Company, Baltimore, Md.; M. O'Brien, master mechanic United Railways Company of St. Louis; J. M. Larned, engineer maintenance of way Pittsburg Railways Company, Pittsburg, Pa.; H. W. Blake, editor STREET RAILWAY JOURNAL, New York City; C. B. Fairchild, Jr., editor *Electric Traction Weekly*, Cleveland, O.; L. E. Gould, editor *Electric Railway Review*, Chicago, Ill.

Control—E. W. Olds, superintendent rolling stock The Milwaukee Electric Railway & Light Company, Milwaukee, Wis.; G. J. Smith, master mechanic Kansas City Railway & Light Company, Kansas City, Mo.; P. N. Jones, electrical and mechanical engineer Pittsburg Railways, Pittsburg, Pa.; J. S. Pevear, Twin City Rapid Transit Company, Minneapolis, Minn.; H. Donovan, master mechanic Washington, Baltimore & Annapolis Electric Railway, Baltimore, Md.

Maintenance and Inspection of Electrical Equipment—L. L. Smith, master mechanic Chicago & Milwaukee Electric Railroad, Highwood, Ill.; W. D. Wright, master mechanic The Rhode Island Company, Providence, R. I.; E. T. Munger, master mechanic Metropolitan West Side Elevated Railway, Chisago, Ill.; C. C. Long, electrician United Traction Company, Reading, Pa.; L. W. Jacques, master mechanic Ft. Wayne & Wabash Valley Traction Company, Ft. Wayne, Ind.

Way Matters—Charles H. Clark, engineer of way International Railway, Buffalo, N. Y.; Thomas K. Bell, chief engineer Wilkes-Barre & Wyoming Valley Traction Company, Philadelphia, Pa.; C. A. Alderman, J. G. White & Co., New York City; E. O. Ackerman, engineer of way Columbus Railway & Light Company, Columbus, O.; G. L. Wilson, engineer and roadmaster Twin City Rapid Transit Company, Minneapolis, Minn.; C. B. Voynow, assistant engineer Philadelphia Rapid Transit Company, Philadelphia, Pa.; Martin Schreiber, engineer maintenance of way Public Service Corporation of New Jersey, Newark, N. J.

Car Wiring—George W. Palmer, Jr., Boston, Mass.; C. B. King, manager London Street Railway, London, Ont.; L. P. Crecelius, Public Service Corporation of New Jersey, Newark, N. J.; Hugh Hazelton, consulting engineer, New York City; S. M. Coffin, master mechanic Mobile Light & Railway Company, Mobile, Ala.

THE LOUISVILLE STRIKES

BY J. T. FUNK,
General Superintendent Louisville Railway Company

So much space has been given in the railway and daily papers to the strikes upon our system during the last ten months that a summary of the principal events connected with them may be of interest.

The Amalgamated Association of Street Railway Employes was organized in the city of Louisville on or about Jan. 10, 1907. The agitators at once began to work up dissatisfaction among the employees of the Louisville Railway Company, especially the motormen and conductors, and succeeded in ordering a strike on about March 12. This strike lasted five days, at the end of which time a contract was entered into between the railway company's officials and members of the Amalgamated Association—a contract which never was carried out by the members of the association, and caused dissatisfaction from the date of its adoption.

The second strike was ordered on Nov. 15, 1907, and lasted for twelve days. During this time there was a good deal of rioting, but the excellent police force of this city performed its duty so well that but little damage was done to persons or property. This can be accomplished by any police force that will take an impartial stand as did the authorities of this city, because all that this or any railway company needs or wants is that protection which is guaranteed it under the law. The strike breakers which unfortunately it is necessary to employ on such occasions, under the guidance of Mr. Reed, of Chicago, performed every duty which they were called upon to do, and behaved themselves in every particular. Owing to the fact, however, that about one-third of the operators on the cars remained loyal the services of the strike breakers were needed only in the capacity of assisting in the operation of cars. From the very first, cars were run and each day showed an increase in number operated. Finally on the twelfth day, when the collapse came, the union surrendered unconditionally and the company once more was allowed to manage its property as it had done up to the time of the organization of the union.

It is just one month since the strike ended and there are as many cars running in the city of Louisville to-day as before the strike, with a force larger than when the strike began.

About 50 per cent of the old men were taken back, all promising to drop the union and have nothing further to do with such organizations. The other 50 per cent are now hunting places of employment, and seventeen are held over to appear before the grand jury of Jefferson County.

Too much credit cannot be given the good people of this community, who lost no opportunity to patronize the cars while they were running. This had a very depressing effect upon the agitators. Although many of the unions boycotted the cars the people rode when they were given an opportunity.

There is only one way to handle a strike, and that is to fight until victory is won. To concede anything to such organizations will lend encouragement to their cause and bring renewed trouble. It is either run your own business or turn it over to the amalgamated union.

Too much credit cannot be given to the loyal men who so nobly stood by the company. From all appearances now it will be very many years before there will be another strike in the city of Louisville. At best strikes are bad things and should be avoided as long as possible, but when one is forced there should be no let up on the part of the company until the enemy is routed and the fight completely won.

I desire to acknowledge the many words of kindness expressed by a large number of the railway officials throughout the country, and sincerely hope that none will be called upon to combat two strikes in one year, as the Louisville Railway Company has been compelled to do.

SINGLE-PHASE TO BE ADOPTED ON THE NEW CANAAN BRANCH

The New York, New Haven & Hartford Railroad Company has decided to change the equipment of its New Canaan branch from 600-volt direct current to 11,000-volt single-phase. This branch is about seven and one-half miles in length and extends from Stamford, Conn., on the main line, to New Canaan. It was equipped with direct current about seven years ago. The service will be conducted by two motor trains, each consisting of a 60-ton motor car and a 30-ton trail car. The motor car will be the standard 78,000-lb. coach of the New Haven Company, reinforced to carry the electrical apparatus which is attached to the car body, and equipped with four No. 603 GE-A motors of 125-hp nominal capacity. No provision is being made for operating these motors on a direct-current circuit, so that the equipment will be purely single-phase. The company is changing over the overhead construction on the line to a 11,000-volt single catenary, which will be used instead of the double catenary employed on the main line.

The Compañia Electrica y de Ferrocarriles de Chihuahua, the merger corporation that takes over the properties of the Ferrocarril Mineral de Chihuahua—the steam railroad to Santa Eulalia and the concession for aerial tramways in that town connecting the railroad and mines—the Cia. de Ferrocarriles Urbanos de Chihuahua, the present street railway system which is being equipped with electricity, and the electrical department of Cia. Industrial Mexicana, which supplies electric lights and power in the city, will take charge Jan. 1. A. C. Nash, now general manager of the Mineral Railroad and the street railway company, will occupy the same position with the new corporation.

CORRESPONDENCE

TURBINE ECONOMIES

SCHENECTADY, N. Y., Dec. 24, 1907.

Editors STREET RAILWAY JOURNAL:

My attention has been called to a letter of Mr. J. R. Bibbins, published in your issue of Dec. 14, in which comparison is drawn between reported performances of 7500-kw Parsons turbines in New York and 8000-kw Curtis turbines in Chicago. In reducing the reported results to the same conditions Mr. Bibbins applies certain corrections in the case of the Curtis machine which he says are advocated by its builders. The correction thus arrived at is not correct and I desire to put this comparison in correct form on the basis of existing published data.

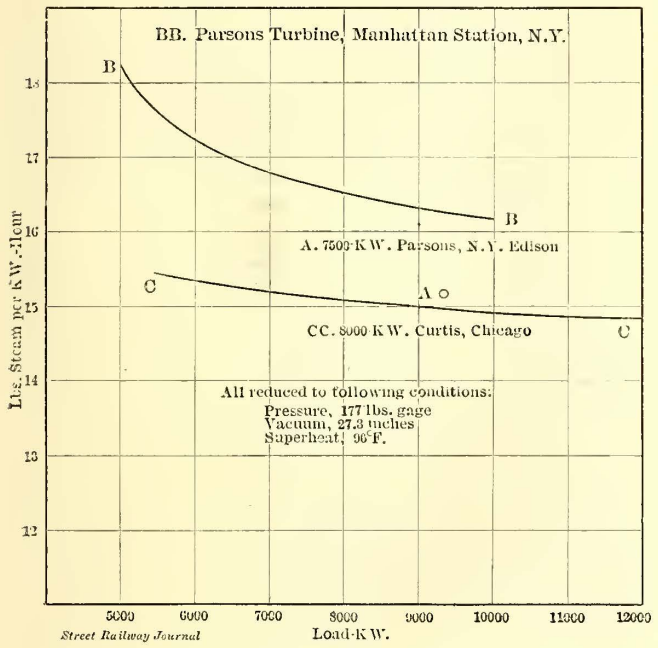


FIG. 1.

Point A.—Test of N. Y. Edison Parsons turbine as taken. See ELECTRICAL WORLD, Oct. 12, 1907.
Curve BB.—Is derived from tests published in the *Electric Journal* of July, 1907, results being reduced to conditions of N. Y. Edison tests by constants published in connection with the test in ELECTRICAL WORLD, Oct. 12, 1907.
Curve CC.—Taken from test curves made by Prof. Storm Bull and Prof. L. P. Breckenridge in February, 1907.

In the case of the Curtis machine tested in Chicago it is necessary to make no assumption concerning correction factors. This machine was tested daily for nearly a month by Prof. L. P. Breckenridge, of the University of Illinois, and Prof. Storm Bull, of the University of Wisconsin, and during this time all conditions of load, initial pressure, vacuum and superheat were thoroughly investigated and curves were drawn from which results for almost any condition can be taken without appreciable correction.

The accompanying curve sheets show load water rate curves of this 8000-kw machine taken from the curves in this report, and in comparison show, first, the results of the New York Edison test reduced to similar conditions, and second, the results of the test of a similar Parsons machine made in the Manhattan station of the Interborough Rapid Transit Company and published in the *Electric Journal* for July, 1907.

The report of the New York Edison test in question was published in the *Electrical World* of Oct. 12, 1907, and in this report rates of correction were given for variations of vacuum, initial pressure and superheat. These rates I have used in making the comparisons shown by the accompanying curves.

Fig. 1 shows the actual result reported in the New York test of the 7500-kw Parsons turbine and above it the results of the test of the Parsons turbine in the Manhattan station reduced to the same conditions by the constants mentioned above, and in comparison with this it shows the performance of the Curtis turbine in Chicago under the same conditions, taken from test reports without appreciable correction.

Fig. 2 shows the same performance of the Parsons turbines reduced by the constants above mentioned to conditions which fairly represent the average of daily service under which the Chicago machine operates. In this case also the performance of the Curtis machine is taken from actual test reports without the necessity of appreciable correction.

This latter comparison illustrates very clearly the superiority of the Curtis turbine under conditions of high vacuum and shows also the large gains which good vacuum affords in a machine designed to use it.

There is good reason to believe that these comparisons do more than justice to the Parsons machines, first, because the corrections made give credit for considerable improvements on account of increase of initial pressure, while such improvement cannot be appreciable in a machine which governs by virtual throttling, and second, because the rate of improvement for vacuum, while probably correct for a range between 27 and 28 ins., is presumably too large for correction to 29 ins.

The reason for the large difference in the performances of these two Parsons machines has not been explained and it has been generally understood that the turbine parts of the two machines are practically identical. It would seem probable that one of the tests is incorrect or else that the New York Edison test was run with a closer adjustment of leakage clearance around balancing rings.

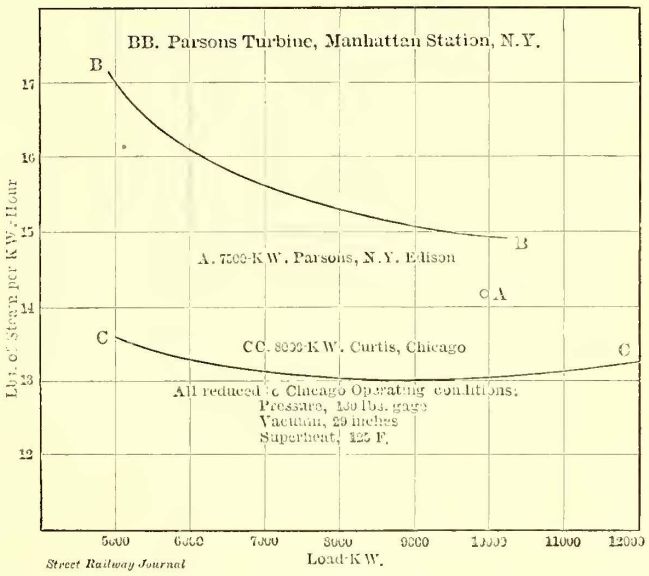


FIG. 2.

Point A.—Result N. Y. Edison test corrected to regular operating conditions of Chicago turbines by constants given in the test report, ELECTRICAL WORLD, Oct. 12, 1907.
Curve BB.—Test of Parsons turbine in Manhattan Station of the Interborough Rapid Transit Company, New York, published in the *Electric Journal* of July, 1907, results corrected to Chicago operating conditions by the same constants as point A.
Curve CC.—Taken from test curves made by Prof. Storm Bull and Prof. L. P. Breckenridge in February, 1907.

In the end of his letter Mr. Bibbins deprecates the cultivation of extreme operating conditions in turbine plants

and in this presumably refers to the use of high vacuum. Increased vacuum affords very great increase of available energy and with a turbine which does not leak air, involves in most cases little additional expense. Since a properly designed Curtis turbine affords high efficiency to extreme vacuum ranges, it is folly to use low vacuum where high vacuum can be produced. In many large plants where Curtis turbines are used vacuum of 29 ins. or over is carried almost throughout the year. In the Chicago plant where the above mentioned test was made, vacuum generally exceeds 29 ins. and sometimes reaches 29½ ins. The auxiliaries in this station involve a loss of 0.7 per cent.

The greatest advantage of the turbine over the reciprocating engine lies in the fact that it is efficient in the lower ranges. In reciprocating engines we gain only about 20 per cent by condensing as compared with non-condensing conditions, while in a properly designed turbine we gain 100 per cent. It is certainly not good engineering to throw away these advantages by binding ourselves to vacuum conditions which have prevailed in reciprocating engine practice where increase of vacuum affords no important improvement.

W. L. R. Emmet.

LABOR UNIONS AND MUNICIPAL OWNERSHIP

Brisbane, Queensland, Australia, Nov. 27, 1907.

Editors Street Railway Journal:

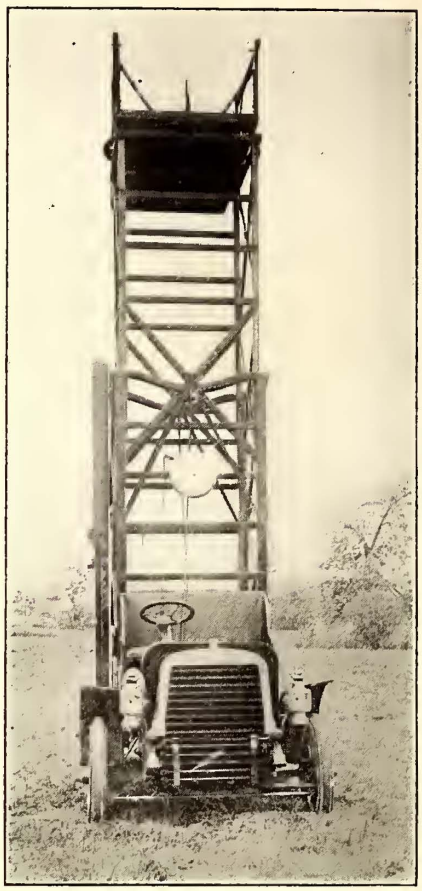
I was much interested in reading the editorial entitled "Labor Under Municipal Ownership," on page 121 of the Street Railway Journal for July 17, but from one of your conclusions I most strongly dissent. You say "So far as labor unions are concerned they must, from necessity, stand with the great bulk of the citizens against municipal ownership." Australia is known the world over for its socialistic tendencies and so-called advanced legislation. The rallying cry of the labor unions from one end to another of Australia and New Zealand is "Socialism in our time," and they are most strongly in favor of governmental or municipal ownership of all public utilities. It is a great pity that some members of the municipal ownership committee of the National Civic Federation did not visit Australia, for I am sure a careful study of conditions here would have modified some of their views.

An American in Australia.

AN AUTOMOBILE TROUBLE WAGON

In many respects the automobile principle is almost invaluable for repair and trouble wagons. The machine can be kept in the car house or inspection shed for any length of time, but always ready for operation. It takes but a moment to start the motive power and the speed of which the machine is capable enables it to reach the locality where its services are needed in the shortest possible time. It does not have to travel on rails and be subject to blockades like the electric emergency car, and is much more rapid in its movement than the trouble wagon drawn by horses.

For several months the United Railways Company, of St. Louis, has had in operation an automobile trouble wagon which has proved so well adapted to the service that a larger and heavier machine of 40 hp is being built in the shops of the company. The old car is a Buick two-cylinder opposed 22-hp machine built to the order of the railroad company, and with a heavier frame than the ordinary type of car. It is kept at Eighteenth and Pine streets, in what might be termed the downtown district, and takes the place of two-horse drawn trouble wagons. During its first month of operation an odometer showed there was not a day that it did not make fifteen miles. During this period the repairs amounted to $1.50.



AUTOMOBILE WITH TOWER UP

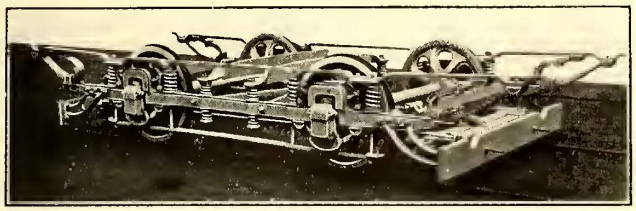
The automobile has been found to be especially adapted for use in repairing overhead construction during periods of heavy traffic. As it is built to run backward as well as forward and to make exceedingly short turns, it can move out immediately in front of an approaching car and then make a short turn and follow the car into position again. The tower is 22 ft. high when extended and 11 ft. 6 ins. when down, and the machine loaded with tools and materials for general repairs weighs 4850 lbs. The tires are 32 in. x 3½in. solid rubber, but those on the new car will be 32 in. x 5 in. It will be speeded to 20 m. p. h. In building the new car advantage will be taken of the experience

SIDE VIEW OF AUTOMOBILE WAGON

gained with the old one. As a result the new car will be much heavier, sufficiently so it is proposed to be used in pulling overloaded wagons off the tracks.

COMPENSATING TRUCK USED IN ENGLAND

The United Electric Car Company, Ltd., of Preston, Eng., has an electric railway truck known as the Preston compensating truck. The object in this design is to overcome oscillation and obtain easy riding, either when heavily or lightly loaded. With the heavy loads often carried, and more especially in England, where top covers are becoming universal, it appears necessary that some arrangement,



COMPENSATING TRUCK

other than that hitherto in use for lighter work, should be found whereby the body may be relieved of the severe shock and strain under heavy loading and its life prolonged. The spring arrangement in the trucks at present in use is such that all the springs are in action at all times, whether the truck is heavily or lightly loaded. The most important points in a truck, as far as springing is concerned, are at the journal box and at the extension ends; at the former to obtain easy riding by absorbing shock and reducing oscillation, and at the latter to give support to the ends of the body and prevent dropping of the platforms. In this truck the spring arrangement is such that some of the springs are in action all the time, and others only when the load increases beyond a certain limit. It is believed that this arrangement will make the truck eminently suited for the heavy rolling stock conditions prevalent in England.

The springs at the journal box are elliptical, and are two in number, the top one to carry a light load, and the bottom to come into action as the load increases. At the extreme end a new type of spring is used, both ends extending toward the extremity of the body and arranged with two steps; the forward end is under ordinary compression when light, and the rear end becomes compressed as the load increases, as at the journal boxes.

Some of the advantages claimed for this truck are: Easy riding either with light or heavy load; the weight being carried directly over and under the journal boxes, steady and easy running is obtained; it will carry a longer body than usual without oscillation; the journal box, having a divided oil well, allows a distance piece to be placed between the horn plates, thus preventing the horn plates from binding the journal box and causing unnecessary wear; relief from shock when the car is heavily loaded, as elliptical springs are easier and absorb shocks more readily than spiral springs.

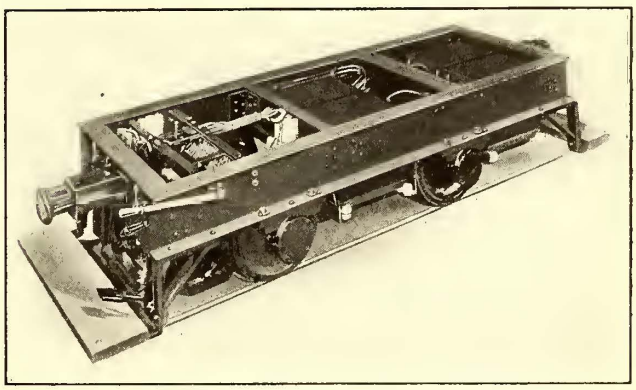
A STORAGE BATTERY AUTO-TRUCK FOR INDUSTRIAL RAILWAYS

The Westinghouse Machine Company, convinced by the results obtained during several years of continuous service at its own works of their fitness for industrial railway purpose, has put the storage battery auto-trucks on the market and is prepared to furnish them in capacities of from ten to forty tons. The trucks, though of extremely simple construction, are very substantially made of the best materials. A steel frame, thoroughly braced, is carried on four wheels, the journals of which run in roller bearings. The driving axle or axles, as the case may be, carry the motor, or motors, as in street railway practice. The motor is spring suspended from the frame at one end and connected to driving axle by suitable reduction gearing. A spring suspended cradle of angle iron carries the battery trays.

At the operating end of the truck are mounted the controller, brake, charging receptacle, cut-out switch and volt-ammeter. A convenient step and draw bar head are provided at each end. All the machinery is below the top of the frame and is covered by a heavy wooden deck for carrying the load. This deck is made in sections, so that any part of the mechanism is readily accessible. The motor is of the well known Westinghouse vehicle type, capable of standing heavy overloads. The controller is also of the Westinghouse vehicle type, giving four speeds in either direction. It is provided with operating and reverse levers, which are interlocking to prevent premature reversal, thus protecting the motor and the batteries.

The battery is contained in two or more trays of cells and is designed to operate at high rates of charge and discharge. A battery of smaller ampere hour capacity than is customary in similar work is employed on the truck, as it has been found that the time available for charging during the working hours is usually thrice the period of time that the truck is actually running. Charging is made so simple that the truck can easily be charged during these idle periods.

During a six months' test of the standard ten-ton truck herewith illustrated, the power required to charge the battery in regular and heavy shop service was accurately metered. It averaged 63 kw hours per month. At the high figures of 5 cents per kw hour the cost for the current would be only $3.15. The work done was recorded and averaged practically 700 ton miles per month, the loads running from a few hundred pounds to fifteen tons.



STORAGE BATTERY TRUCK WITH CELLS EXPOSED

These trucks used as locomotives on a level track and without any weight to secure adhesion can haul, on suitable cars, from one-half to their full rated capacity as a truck, depending upon the condition of the track and kind of bearings on the cars hauled. By placing sufficient weight over the drivers to secure adhesion, they are capable of handling from one to two times their capacity as a truck for a continuous period of not more than five minutes.

Standard trucks are made for six different gages, namely: 18, 21½, 24, 30 and 36 inches, and 4 feet 8½ inches. For track systems provided with turn tables they are made with rigid trucks. Where tracks are installed with curves the trucks for all gages up to 36 inches are provided with swivelled front axle, permitting free operation on curves as low as 12 feet in radius.

AUSTRIAN RAILWAY STATISTICS FOR 1905

Figures just published by the government of Austria show the total length of all electric railways in that country is 472-km. (292.6 miles), of which 70 per cent is standard gage and the balance narrow gage. About 50 per cent of this mileage is double track, due to the fact that practically all of the electric lines are operated in cities. However, only 7.3 per cent of the light steam railroads (corresponding to the service of American interurban lines) are double track. Passenger service only was given on 91.6 per cent of the electric railways, mixed service on 7.85 per cent and freight service only on .53 per cent. The rolling stock of the electric railways consisted of 5 locomotives, 172 snow plows, 1624 motor cars, 1248 trailers and 49 freight cars. The total seating capacity of all passenger cars was 106,170. The average annual train-km. was 124,453 per km. of track; average passenger-km., 1,891,029; average ton-km., 12,603. The average gross earnings per km. were 81,755 crowns ($31,720 per mile); average operating expenses, 51,956 crowns ($20,158 per mile); average interest on investment, 7.22 per cent. There were 22.7 employees per km. (36.3 per mile) of track.

A NEW LAMP TESTING METER

A new type of direct current lamp testing meter has just been placed on the market by the H. W. Johns-Manville Company, of New York. The movements are built on the familiar d'Arsonval pattern and so placed with reference to each other and the scale as to render the energy consumption directly readable at the intersection of the volt and ampere indicator needles. The special feature is that the operator is enabled to read at one glance the pressure, current and wattage on any lamp which may be inserted in a socket immediately above the meter. The instrument is equipped with three self-contained shunts, one of 150 capacity, having conveniently arranged binding posts, and a 1.5 and .75 ampere shunt, which are so connected within the base of the meter as to be readily thrown in circuit at will. In order to test a lamp it is only necessary to connect the attachment plug and cord to any lamp circuit, insert the lamp and read volts, amperes and watts without computation. The different shunts may be easily placed in circuit by the adjustment of a small screw-plug at the top and right of the instrument. The two smaller shunts have universal connections. The voltmeter may have either 150 or 300 volt scale or both. Another valuable feature of the instrument besides the multiple readings is the fact that accurate wattage measurement may be taken on a fluctuating load, it being required to observe only a single point for such readings. The instrument is self-contained and weighs less than fifteen pounds complete.

The Boston Elevated Railway Company is distributing $60,000 in gold among its employes. Nearly 4000 men will each receive $15. Payment will be made by giving a $5 and a $10 gold piece to each person entitled to a reward. Every employe who has been in the service for six months or longer, and who has rendered continuous and satisfactory service throughout the year will receive a reward. This is the fifth distribution of this nature that has been made by the company. The payment of this year's rewards will bring the total sum of money paid, in addition to regular wages, in recognition of faithful service up to nearly $300,000.

CATENARY CONSTRUCTION

A paper on "Overhead Construction for High-Tension Electric Traction or Transmission" is to be presented by R. D. Coombs, at a meeting of the American Society of Civil Engineers, Feb. 5, 1908. The paper is published on page 1136 of Vol. XXXIII of the proceedings of the society. The author discusses the question of span and sag in catenaries and presents the diagram shown herewith, giving the normal sag required for catenary spans. This diagram is based on a maximum tension of one-third of the ultimate strength of the wire, the load being the dead-load weight of the material, an ice load or film of ice ½ in. thick all around the exposed members, and the wind load. The latter is based on 15 lbs. per sq. ft., which would correspond to an indicated velocity of 100 m. p. h. or an actual velocity of 76.2 m. p. h. The construction on various recent foreign roads inclines to the use of bracket supports with a working conductor attached by loops to a secondary messenger so as to secure vertical flexibility. With this construction a bow pressure of 12 lbs. is used. The writer presents proposed specifications for a catenary construction with spans of 300 ft. He then compares the relative advantages of (1) the double catenary construction; (2) the simple catenary in which no messenger wire is used but which can be employed with the Mayer saddle suspension; (3) the single catenary, and (4) the single catenary with secondary messenger. He considers the last three superior to the first, but experience has not yet indicated which of the three is preferable.

In the same copy of the Proceedings, on page 1070, Joseph Mayer has a paper entitled "A New Suspension for the Contact Wires of Electric Railways Using Sliding Bows." This paper is also to be discussed at the meeting on Feb. 5. Mr. Mayer has made some improvements in his saddle suspender and describes them in his paper. He has also devised a strain adjuster for reducing the maximum tension in the contact wires. The adjuster permits longer spans than would otherwise be possible and can be set in the fall and spring. Mr. Mayer also discusses his pantograph collector which was described in this paper for Nov. 9, and appends a mathematical consideration of the subject of sliding bows and trolley wire suspension.

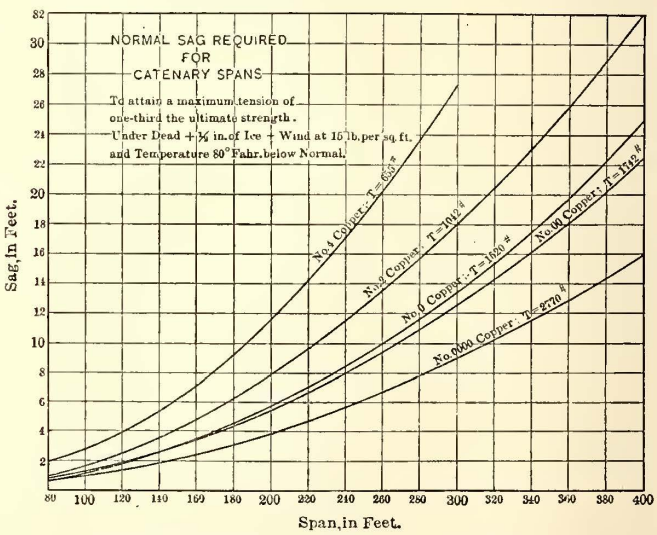


DIAGRAM SHOWING NORMAL SAG REQUIRED FOR CATENARY SPANS

The Sao Paulo Tramway, Light, Heat & Power Company will ask shareholders for permission to increase the capital from $3,500,000 to $10,000,000.

A NEW TYPE OF FARE REGISTER TO BE USED ON THE NEW YORK PAY-AS-YOU-ENTER CAR

The pay-as-you-enter cars to be installed on the New York City lines are to be equipped with an entirely new device for collecting and registering the fares. This machine is known as the "T. E. C. Registering Fare Box" and

THE REGISTER AS IT APPEARS READY FOR INSTALLATION, SHOWING THE NICHE AT THE SIDE FOR EXPOSING THE REGISTER NUMERALS AND THE LEVER FOR HAND REGISTRATION

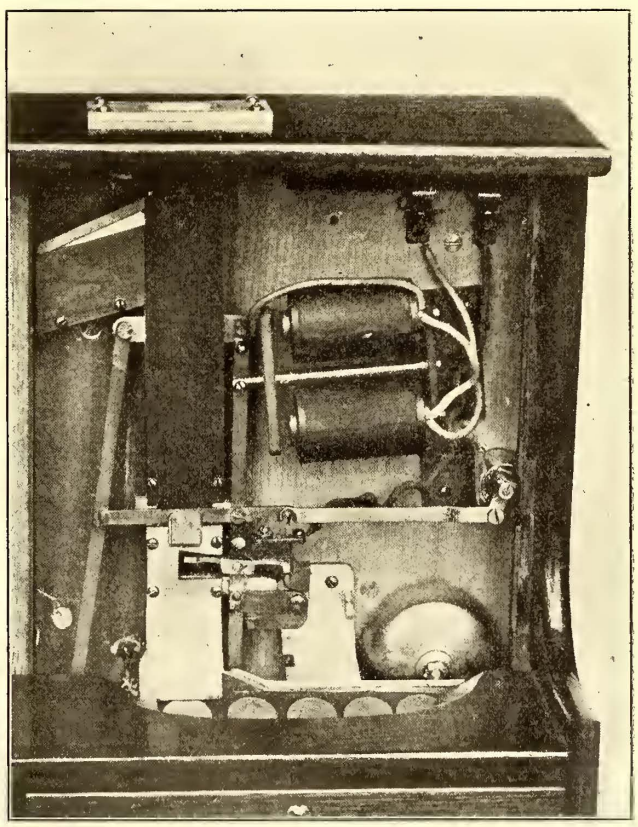
presents several interesting features particularly desirable for prepayment cars. The chief object attained is that the conductor does not have access to the money until it has been registered, but immediately upon its registration he can take all he needs to make it available for change. This eliminates the use of the old-time fare boxes in which the money dropped by the passengers was unavailable for use as change by the conductor.

The fare is dropped into a slot at the top of the box, as shown in the illustration, and is instantaneously registered and exposed to the conductor's view, which of course enables him to detect bad coins and see who put them in. The last three or four nickels registered always remain in sight so that it is possible for the conductor to detect the bad coin not only upon its registration, but even after the two or three following passengers have dropped nickels into the box. The coins thus exposed for inspection are pushed one at a time into the top drawer to which the conductor has access in making change.

The mechanism for registering, exposing and placing the coin in the cash drawer is very simple. When the coin is dropped into the slot it falls to the bottom of the tube to bridge a gap in an electric circuit. The closing of this circuit operates a lever which pulls the register mechanism and actuates the device at the bottom of the tube to permit the coin to be exposed. This mechanism is very simple, the only part that might require renewal after extended use being the dry batteries operating the mechanism, which are placed in a drawer below the cash box. It has been found that over 175,000 registrations can be made without exhausting the batteries. The same number of registrations has also shown no appreciable wear of the fare registering mechanism.

An important feature of this register is that it can be used to collect fares even if the registering apparatus should get out of order for one reason or another. In that case, the money dropped in the slot does not follow the route already described, but falls down a side chute into a locked receptacle to which the inspector only has access. For this reason, if the register apparatus should fail to work there is no necessity for taking nickels directly from the passengers. On the other hand, if money is found in this drawer it indicates that the automatic registering apparatus is out of order, or has been during the previous trip. It should be mentioned, however, that in case anything happens to the automatic registration the conductor can still register the coins by unlocking the cash drawer and pulling out the rod shown projecting from the side of the register. Since only the conductor has the key to this change drawer no one else can work the register mechanism in this manner, thus preventing mischief makers from ringing up false fares.

The New York City Railway Company has ordered 325 of these machines, one of which will be placed on each

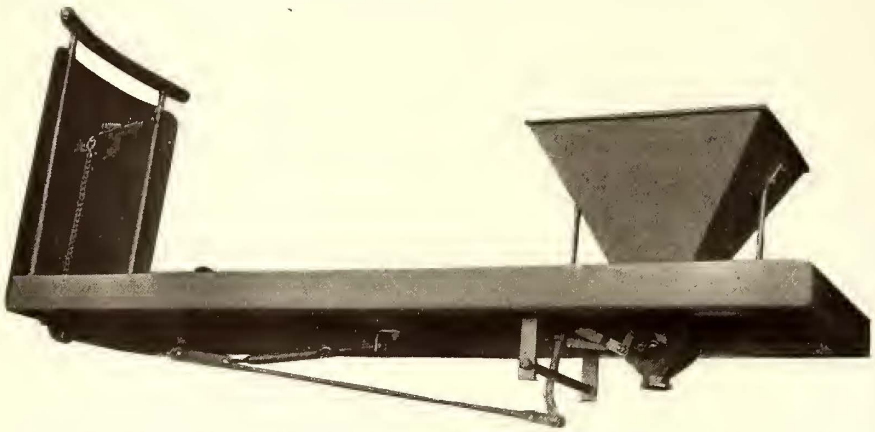


INTERIOR OF REGISTER, SHOWING ELECTRICAL MECHANISM, THE SIDE CHUTE TO THE LOCKED DRAWER AND THE PLACE WHERE THE COINS DROP BEFORE GOING INTO THE CASH DRAWER

platform of the new pay-as-you-enter cars, to be put in service on Madison Avenue. The register will be located just inside the railing in front of the conductor, who will be ready to make change for any one who is not prepared with his nickel fare. The device is encased in quartered oak and is made by the Device Transportation Equipment Company, of New York.

A SANDER FOR CONTINUOUS AND INTERMITTENT FLOW

When operating on a slippery track it is desirable that the motorman should be able to confine all his attention to the power and braking apparatus, and not be obliged to jump on the sand plunger all the time to get continuous sanding. This trouble is eliminated by the United Electric Car Company, of Preston, Eng., in its new sander, which is arranged to sand intermittently through a foot plunger and continuously through a platform lever and chain connected to the sander. The sanding mechanism is built to be capable of working any kind of sand, and is also said to be waterproof.



SANDER ARRANGED TO BE OPERATED INTERMITTENTLY OR CONTINUOUSLY

Under ordinary conditions the sander is operated as follows: The platform plunger is pressed down, causing a sand thrower to move in one direction to push sand off the shelf at the bottom of the hopper. When the plunger is released from pressure, it returns to its normal position and again forces sand off the shelf, thus giving two throws with one foot movement. In this case the shelf does not move, but the sand is discharged by the sand thrower, which moves over the shelf.

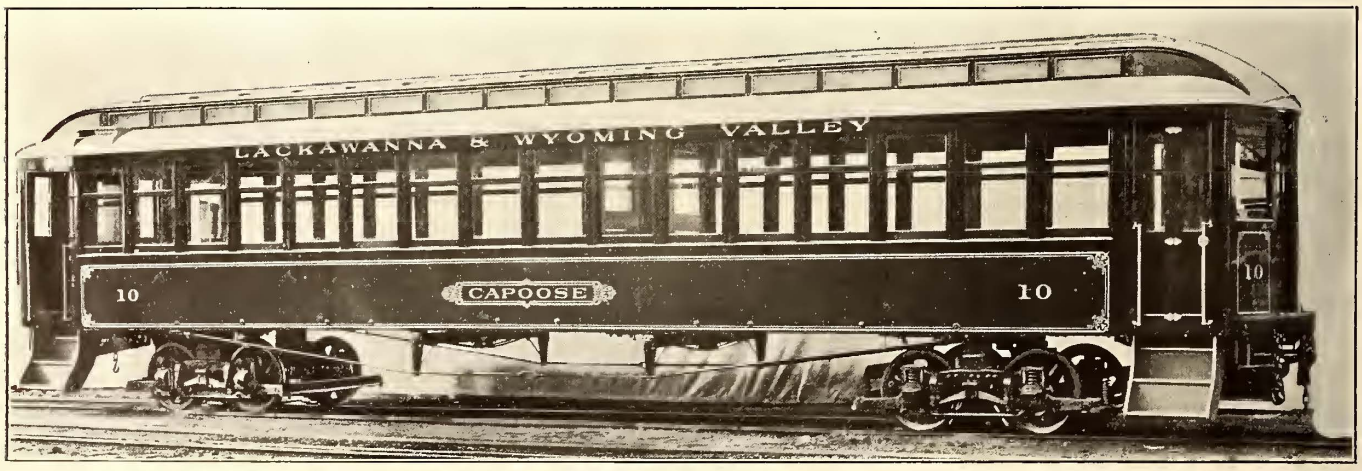
When a continuous flow is needed, as in emergencies, the motorman pulls the platform lever over to a notch in a special casting. This makes the connecting chain bring the pull rod over so much further than when the plunger is used that the sand shelf is caused to tip slightly, thus permitting sand to flow as long as the motorman keeps the chain under tension. The emergency mechanism, of course, can be placed wherever it is convenient to grasp the lever, since the main point is to secure the extra travel of the pull rod for any desired time.

CHILDREN'S ENTERTAINMENT AT CINCINNATI

Officials of the Cincinnati Traction Company, Cincinnati, Ohio, have decided not to give the children of the employees an entertainment in the music hall, as has been the custom for the past several years during the holiday time. Vice-President Foraker stated that the number has grown so large from year to year that the officers dreaded the responsibility of having them gather in the building for even the time required to give the programme. Last year the number reached 3700 and it was necessary to have two performances. Instead of this feature the company will have the little folks as guests at the Zoo some time during the summer. There they will have plenty of room and no danger from fire or other mishap, as might occur at the music hall. It was stated that this decision had been arrived at soon after the entertainment a year ago.

NEW ROLLING STOCK FOR LACKAWANNA & WYOMING VALLEY RAILWAY

The car shown in the accompanying illustration is the latest type to be adopted by the Lackawanna & Wyoming Valley Railroad Company, which has its headquarters at Scranton and operates the property of the Lackawanna & Wyoming Valley Rapid Transit Company, connecting Wilkes-Barre, Pittston and Scranton. The car is of the combination passenger and smoking type, the length of the compartment for smokers being 18 ft. 1 in. The seats are all transverse, even to the seats next to the bulkheads, following steam practice. The inside finish is of mahogany and the ceilings of 5-ply poplar veneer. Some of the dimensions are as follows: Length over end panels, 42 ft. 3¾ ins.; over crown pieces, 51 ft. 2 ins.; width over sills, including sheathing, 8 ft. 10 ins.; height from floor to ceiling, 8 ft. 5 ins.; from under side of sills over trolley board, 9 ft. 6¼ ins.; size of side rails, 7⅛ ins. x 7 ins.; end sills are composed of two 5-in. channels, sill plates of 6-in. channels. The car was built at the works of the John Stephenson Company, Elizabeth, N. J., and is shown without motors. It will be equipped for third-rail operation, like the other cars used on this line.



EXTERIOR OF NEW CAR FOR THE LACKAWANNA & WYOMING VALLEY COMPANY

LONDON LETTER

(From Our Regular Correspondent.)

The annual dinner of the Tramways & Light Railway Association was held during the past month at Princes' Restaurant, London, the chair being occupied on that occasion by the Duke of Argyll, who was supported by the Earl of Kerry, Lord Vaux of Harrowden, the Hon. Arthur Stanley and many others interested in electric traction matters. In proposing the toast "The Tramway Industry," the Duke of Argyll, who is now the honorary president of the association, stated that there were more than 300 tramway and light railway undertakings in Great Britain, the total capital of which amounted to £60,000,000, the total mileage open for traffic being more than 2200 miles, served by more than 11,000 cars. The total number of passengers carried last year was 2236 millions or more than 6,000,000 per day, and the total receipts on the whole of the undertakings amounted to more than £10,500,000. The duke went on to refer to the great benefit that tramways were to large cities, such as Glasgow, with which he was very familiar, and mentioned the fact that one could now take a car in that city and go as far as the beautiful shores of Loch Lomond, some twenty miles away. In closing his subject, he proposed the toast of "The Tramway Industry" coupled with the name of E. Garcke. Mr. Garcke, in his reply, referred to the lessening rivalry that now existed between municipalities and companies, and stated that it was now possible for members of a municipality to meet and discuss difficulties in a friendly spirit with company managers, and in many cases agree on mutually useful arrangements. He naturally made a special plea for more lenient legislation with regard to tramways in the more sparsely populated portions of the country, and stated that some of the conditions imposed upon them were too onerous. Other speeches were made by Sir Alexander Kennedy, Ralph Littler, Stephen Sellon and the Hon. Arthur Stanley, all of whom spoke encouragingly of the good work being done by the association. In the afternoon, members, at the invitation of A. L. C. Fell, were conveyed to Greenwich by special car to inspect the new power house of the London County Council, and were there met by J. H. Rider, electrical engineer of the Council, who showed them over the power station, including the additions now in progress of erection.

Two important extensions of the Edinburgh cable car system are being carried out at present, one being the cabling of the Gilmore Place route, where, until recently, the antiquated horse-drawn cars formed the means of conveyance, and the other the laying out of a new route in the Broughton district. Both contracts are in the hands of Dick, Kerr & Company, and it is expected that the track at Gilmore Place will be completely formed by January. The route is over level streets, and the track will be double throughout, with interlacings where the narrowness of the streets makes this necessary.. The cars on the new route will travel at the usual eight to ten miles an hour, and once the service is in working order the residents in Craiglockhart and Merchiston districts will find it is a great boon. Satisfactory progress is also being made with the other route.

The Draft Order embodying the York Corporation's scheme for a system of electric tramways has been deposited with the Light Railway Commissioners of the Board of Trade. It sets out the routes which the proposed tramway is to cover, and states that if the whole of the railway is not completed within five years from the commencement of the Order the powers of the corporation shall cease. There is, however, a provision that the Board of Trade may allow an extension of time. The corporation is required to submit plans of the railways, before beginning the construction, to the Board of Trade, and also permit the plans to be inspected, if required, by owners or occupiers of land and buildings along the routes.

A peculiar accident occurred recently in connection with the Belfast Tramways, which very fortunately had no serious result. A car from Cliftonville on one of the steepest grades in the city had been stopped, the motorman and the conductor having left the car, which contained no passengers and which had a few minutes to spare. It seems that a boy about ten years old, in a spirit of mischief, it is presumed, climbed onto the front platform and released the brake. The car ran down the gradient, successfully negotiated a sharp bend at St. James' Church, and finally dashed down the hill and ran into another car at the bottom of Donegal Street. Some of the passengers in this car were slightly injured, but they were all able to proceed to their homes. The boy was charged at the police court with having wilfully and maliciously let go the brake to the danger of the public. The corporation solicitor stated that the car ran a distance of almost two miles at a terrific rate and that it was a miracle that a disaster had not occurred. At the present writing the result of the enquiry is not known.

We referred last month to the serious accident which occurred on the Halifax system of tramways, and we have now to report that the resignation has been proffered and accepted by the tramway committee of the general manager, F. Spencer, and of the superintendent of rolling stock, C. H. Spencer. It is now intended to combine the position of tramway manager and electrical engineer, and Mr. Rogerson has been, or shortly will be, appointed to the combined position. It has also been decided to instruct the tramways manager to place an additional employe on each car on about half a dozen of the various steep routes in the city, this employe to have charge of the brakes while the car is on these dangerous down-grades.

It would appear that another attempt is to be made to provide electrical energy in bulk for London. We have referred from time to time as to the fate of past schemes, which have all failed to pass through Parliament, and notice has now been given of another bill which is to be promoted next session for the incorporation of an electrical supply company, which is intended to carry on operations not only in the county of London, but in the neighboring counties. Powers are to be sought to enable the company to supply energy in bulk or otherwise to any local authority or distributing company and to railways, tramways and other public works, and for all public and private purposes. It will also be endeavored to secure powers to authorize the company to buy out other authorized distributors by the transfer of the whole of its undertakings and rights to the proposed company. It is proposed to establish a large generating station at Barking, on the Thames side, and necessarily the company will apply for rights for the opening of streets for the laying down of the necessary electric conduits and cables.

At the annual social gathering of the employes of the Glasgow Corporation Tramways Department, the Lord Provost stated that at the present time there were 180 miles of single track in Glasgow and a staff of more than 5000 persons in department, serving with these facilities a population of no less than 1,000,000 people. So much of the debt had already been paid off that there is now only $1,500,000 owing on the tramway work, and before very long there will probably be no debt at all, if the department continued as now without additional capital expenditures and left fares as they are. He also desired to see other tramway routes across the river before long, and with continued prosperity hoped that the department would in time accumulate sufficient funds to be able to build these bridges when required. He concluded by stating that the financial aspect of the tramway department was one of the most pleasing with which those who were associated with municipal enterprises in Glasgow had to do.

After years of negotiations betwen the Richmond Town Council and the London United Tramways Company, the company has succeeded in overcoming the objections of the council and its cars will, when the lines are completed, run over Kew Bridge, so that the public in their visits to Kew Gardens by means of the tramcars of this company will not have to dismount on the Middlesex side of the river, but will be able to continue their journey across the river to any of the gates of the famous gardens, and so on to Richmond. The Richmond Town Council has now decided formally to ask the tramways company to promote a bill in Parliament next session seeking powers to construct tramways across Kew Bridge, one of the features of the agreement being that the horse tramway line in Kew Road shall also be electrified on the underground system.

The Leeds City Council has voted to combine in future the tramways committee and the electricity committee. It is only recently that the Council passed a resolution appointing an electricity committee, and this resolution has now been rescinded and the appointment of the new committee, which will be termed in the future the tramways and electricity committee, duly passed. It is explained that there is no desire to set up any friction, but the object of the present resolution is to co-ordinate two great departments and to work them for the common good of the citizens. There is a good deal of discussion relating to the matter. Both the tramway manager and the electrical engineer are men of the highest capabilities, and how far they will interfere with one another's work remains to be seen.

We have referred in this column several times to the fact that none of the transportation companies in London are at

present in a paying condition, and that some drastic action would sooner or later have to be taken to bring them to their old state of prosperity. Conferences have been held between the various 'bus companies, tube companies and railway companies, and various suggestions have been made and concessions granted on both sides. Action by the 'bus companies has now been taken and a very substantial increase in the fares has been made. The 'bus companies, however, do not wish it to be understood that the fares have been increased, but rather that a general shortening of the fare stages has been decided upon. Whether this will be successful or not remains to be seen, as from all accounts the work does not appear to have been particularly well done, and some of the stages shortened are arousing an immense amount of indignation on the part of passengers. For a great many years now such a stage as that between Charing Cross and the Bank has been one penny, and now, that passengers are demanded twopence for it, naturally an indignant protest is made. In the meantime, the London County Council holds absolutely aloof from any of these arrangements and pursues its own path in the matter of fares with apparent success.

The Oxford City Council has again taken up the matter of the electrification of its tramways, and recently paid a visit to Hastings, where the Dolter system has been in operation for some six months, successfully, it is claimed by the Dolter Company. If the committee is satisfied with the inspection at Hastings, it is to be supposed that the members will then permit the National Electric Construction Company to proceed with the work on this system as already arranged. There still is doubt, however, as to what the Council will actually do in the matter, though some decision is expected before very long.

It is gratifying to know that the dispute between the London County Council and its tramway employes over the question of medical examination is practically settled, both sides having adopted a conciliatory attitude. A modified form of examination has been decided upon and has been accepted by the Society of Employes, and the tramways committee has also promised that any man who fails to pass the required medical tests, so far as driving is concerned, shall be given suitable occupation at not less than the minimum rate of pay in some other department. It has been decided by the Council to purchase that portion of the Paddington & Harrow Road Tramway which lies within the county, this being one of the last tramways in London owned by a company. The newly electrified line from Holborn, down Gray's Inn Road, to King's Cross is now in operation, and is much appreciated, though at present passengers for all parts of north London have to change cars at King's Cross. The new tramway route on the south side from Newland, via Peckham Rye, to East Dulwich Green has also been opened, and the new connection to the West End by way of the bridges is much appreciated by these populous districts. Permission is to be sought from Parliament for the construction of several new lines, the most important of which will be the electrification on the conduit system of the tramways from Finsbury Park to the Nag's Head, Holloway Road, and from King's Cross via Caledonian Road to Holloway Road, this latter section connecting with the Gray's Inn Road portion mentioned above as having recently been put in operation. A number of other shorter lines of more or less importance as connecting lines will also be applied for, but it is unnecessary to elaborate upon these. An interesting feature of the King's Cross to Holloway Road section relates to the schemes to be submitted for the construction of a new bridge 60 ft. wide across the Metropolitan Railway at King's Cross, so that direct connection can be had between Gray's Inn Road and Caledonian Road without having to negotiate the awkward corner at Kings' Cross Station. This bridge will have to be constructed with the sanction of the Metropolitan Railway, as it will pass exactly through the King's Cross Station of that railway company if constructed. A. C. S.

SINGLE-PHASE DISCUSSION BY A. I. E. E.

At the meeting of the American Institute of Electrical Engineers which is scheduled for Jan. 10, 1908, a paper will be presented on single-phase distribution by W. S. Murray, electrical engineer of New York, New Haven & Hartford Railroad, and a paper on "A New Single-Phase Railway Motor," by Ernst Alexanderson, electrical engineer, General Electric Company, Schenectady.

THE CLEVELAND SITUATION

At the meeting of the city and traction representatives Friday, it developed that City Engineer Hoffman and C. H. Clark are still at work on the track valuations, although it was supposed that they had been superseded the preceding week by Messrs. Bunning and Ross. These gentlemen have been acting as a sub-committee instead. They decided on a basis of valuation for excavating and on some other points upon which the original members could not agree. The figures agreed upon were as follows: Excavating without encountering concrete, $1,681.82 per mile; with concrete foundation, $2,217.52; with crushed stone under ties and concrete foundation, $3,157.77. Under instructions from the Mayor, Messrs. Hoffman and Clark will use these figures, providing President Andrews agrees. Mr. Goff made this a condition, as he is taking everything into consideration before agreeing to figures of any kind. Mayor Johnson said he thought if they would use them, they would come within $150,000 or $200,000 of an agreement and that he and Mr. Goff could settle the matter if they got within that limit.

There was also some discussion as to the values to be placed upon rails used for various lengths of time. Mr. Clark still adheres to his original statement that good rails will last twenty years, but the Mayor repeated his assertion, made several weeks ago, that there was not a rail in Cleveland that had been in service twenty years. Mr. Hoffman figures that fifteen years is the life of a rail, although Mr. Clark stated that some of the rails on Payne Avenue had been in use seventeen years. Some discussion also resulted from the prices of scrap that were quoted. Mr. Clark wanted to put the price at $13, saying that his company in Buffalo had received that figure only a few days ago for quite an amount of old rails. Mr. Hoffman said he had been quoted $11 within the last week by three different dealers. A compromise price of $12 was agreed upon. In regard to information relating to the dates of laying rails on different lines, Secretary Davies wrote the Mayor that Mr. Clark had secured all his information from the company's books, and he stated further that he would have this information put in shape for the representatives of the two interests. Upon this will depend, to some extent at least, the valuation of the tracks. Scrap, other than rails, will be estimated at 60 per cent of the original weight of the iron.

At the meeting on Tuesday morning of last week, the list in schedule M, which includes many miscellaneous items not covered by the other schedules, was taken up for consideration. Among other things, it showed sixteen shares of Forest City Railway stock, rights of way on boulevards, leases in various amusement parks and the contract for street car advertising. The Mayor gave this schedule close attention to ascertain, if possible, whether it contained any items that were covered in the other schedules. In the first place, he suggested that the rights of way on boulevards might be considered a liability instead of an asset, but the officials of the company insisted that they are assets and should be so considered. He also argued at first that the company's interest in the Electric Package Company is a franchise value, but afterward changed his views on the matter. President Andrews said that the property is not large but that the business is, and that several express companies have been anxious to secure it.

Paving of the devil strip on the Broadway line was included as an asset. This is now in litigation, it was stated, and the decision will show whether the company or the city will pay for the work. An item of $2,000 as a contribution to the shelter house on the Public Square was looked upon as belonging to the legitimate expense account rather than an asset by both the Mayor and Mr. Goff. Many small items are also included in this list, such as conductors' uniforms and badges, interest, insurance, water rent and prepaid car licenses.

Mayor Johnson mentioned some claims against the Forest City Railway Company and was informed that they had been placed among the accounts receivable. Mr. Goff thanked the Mayor for having called attention to anything that had been seemingly overlooked. It was suggested that a date for determining the value of the stock should be fixed, and the Mayor stated that Jan. 1, 1908, would be a good date to reckon from as nearly as possible.

Overhead charges, such as engineering, work of architects and other things of this kind were included in schedule N, which was taken up for consideration. This also contained an item of contractors' profits. The Mayor objected to this in all

cases where work was done by direct labor, and Mr. Goff stated that he and the Mayor were agreed that such profits should not be computed unless the labor was done under contract. President Andrews was not ready to give an opinion on this point when asked by the negotiators. In regard to the incorporation fee, Mayor Johnson held that the charge might be less than the $23,000 listed, as the property could be reproduced for less than $23,000,000, the capital stock of the old company. The principle of making a charge is right, he said, but the amount might be less. The whole cost of incorporating might exceed the amount charged up for fees, he admitted. Mr. Goff thought that he and the Mayor could agree on this point without trouble.

Mayor Johnson objected to a charge for attorneys' fees for drafting ordinances and legal expenses in securing consents and franchises. He said these items always follow litigation, and all reference to fights should be eliminated from consideration in these negotiations. The figures were not put in the report and the items were passed for the present. An item for the expense of an expert accountant was eliminated by the Mayor and Mr. Goff. The committee that handled this matter included almost everything that had value, as should be done, but there will probably be some differences of opinion over some of them, as they were passed for further consideration.

Mr. Goff, in an indirect way, mentioned the price of 60 for the Cleveland Electric stock at one of the meetings and some of the local papers took the matter up, but it is believed that he had no intention of committing himself on this matter, but merely took this as an illustration in discussing another point. Mayor Johnson did not take the matter up at all, as he would have done had he thought that Mr. Goff was paving the way to naming a leasing figure.

The Municipal Traction Company has had a large force of men at work for several days getting the West Sixty-Fifth Street line in shape to connect with the Cleveland Electric tracks on the West Side, as per agreement between the Mayor and Mr. Goff several days ago. The tracks were almost ready for regular operation Saturday. Only a single track will be operated on Sixty-Fifth Street at first.

The holidays interfered to some extent with the negotiations. Mr. Goff and some of the other men wanted to be absent from the city the entire week, but on objection from Mayor Johnson they gave up and spent most of their time in hard work. City Solicitor Baker was away the greater part of the time and the consideration of the date of the expiration of franchises was delayed quite a little, since some of the briefs had been filed and Attorney Tolles was ready to go ahead with the work.

William Barclay Parsons, chosen as an expert by Mr. Goff, had a private audience with Mayor Johnson last week. The Mayor objected to this, as he had promised that everything should be public, and said he might give the newspapers the substance of what was said at the meeting.

The committee named to decide on the time of the expiration of the various franchises has held one or two meetings, attorneys being present for both the old and the new companies. The Cleveland Electric attorneys brought up the point that the grants to the crosstown lines, with transfer requirements to other lines, operate to extend the grants on the latter notwithstanding the decision of Judge Taylor, of the United States Court. The attorneys argued that the United States Supreme Court, in its decision on the Central Avenue and Quincy Street grants, did not sustain the reasoning advanced by Judge Taylor in his decision. The attorneys for both sides were directed to prepare briefs, both on this decision and that of Judge Chapman. This they promised to do. It is altogether probable that the work in this line will be difficult and that the committee will take sufficient time to arrive at a proper conclusion of the franchises of all the lines.

At a public meeting held Monday afternoon Mr. Goff brought up the subject of financing a street railway project on the basis proposed by Mayor Johnson, by stating that a holding company to take over the properties of the Cleveland Electric must be able to give them proper attention and extend the lines where they are needed. The Mayor explained the plan he had of raising money among the people of Cleveland through popular subscription, and stated that the Forest City Railway Company would be able to secure enough that way to carry out its plans. Mr. Goff asserted that the Mayor could not raise $200,000 in the entire United States on his plan for the Forest City Railway Company at this time. He suggested that bankers be called in and consulted, as they are the men who know the conditions and have some idea of how difficult it is to do these things.

Mayor Johnson, however, insisted that it would not be a big task to secure $10,000,000 or $12,000,000 now in the savings banks for the stock of the company. He said that there is $177,000,000 in the banks drawing 4 per cent interest, and he believed that the people would prefer to have it making them 6 per cent. The Municipal Traction Company, he said, is making about 9 per cent now, and he could not see why a holding company with the entire system would not do very much better than the one line that is now in operation on the West Side.

Mr. Goff again suggested that the security franchise should provide for six tickets for a quarter in order to make it easier to get money at a low rate, in case it became necessary to finance any improvements. He said that the stronger the franchise, the easier it would be to secure money cheaply when needed. Upon this depends to a great extent the success of the holding company plan on the low fare that is proposed. The Mayor mentioned Columbus as a city where the system is operated at seven tickets for a quarter, with profit. Mr. Goff told him that the lines were very much shorter, but the Mayor insisted that this would be made up by the denser population of Cleveland.

J. J. Stanley and W. T. Cook made their report on the valuation of the rolling stock. The total showed 848 cars, and for valuation purposes they were divided into thirty-two groups. The aggregate value placed upon the whole number is $2,634,563.23, or $330,507.17 less than the valuation made by Mr. DuPont more than a year ago. A second report included the rolling stock which is not used for profit. This was placed at $154,764.71, or $70,404.71 more than the former valuation. This makes eight of the fourteen schedules that have been reported upon up to Monday evening. All the reports, with one or two exceptions, show a decrease over the former valuations. The total values agreed upon by the committees so far amount to $8,386,048. Franchise and other values will bring this amount up to a much larger sum. Mayor Johnson said that the remaining six schedules last year showed a valuation of $4,740,000. This would make a little more than $13,000,000 on the same plan that was followed at that time.

The street railway meeting Monday morning was short and related largely to the track valuations in the hands of Messrs. Clark and Hoffman. In one place there was an item of 5 cents a foot or $250 a mile charged by the city for cleaning the streets after track laying had been completed. The Mayor wanted to know what had been charged for sweeping alone. Mr. Clark in reply said he thought that the charge made was $100 a mile.

EXPERIMENT IN FARE COLLECTION IN PITTSBURG

An experiment of the pay-as-you-enter principle of fare collection was tried Dec. 30 in Pittsburg on the ordinary cars without the regular platform equipment or the necessary exit and entrance doors. The result was that on the morning of the test a great deal of difficulty was experienced in putting the system in force, especially as the cars in Pittsburg do not have long rear platforms, and most of them have no forward exit. After a few hours the order was rescinded and the conductors were authorized to collect fares in the former way. The experiment indicated that the pay-as-you-enter system cannot operate successfully without the properly equipped pay-as-you-enter car.

LAST CHAPTER OF THE CHICAGO TRACTION TROUBLES

The different interests in the Chicago Union Traction reorganization have come to an agreement, and under "legal notices" the Chicago daily papers print one page advertisements describing the property of the company and annnouncing the sale of the properties to the highest bidder Jan. 25, 1908. As a result of the settlement orders and decrees as follows were entered by Judge Grosscup:

That all of the present Union Traction properties be put on the auction block and sold, under foreclosure, to the highest bidder.

That pending and in aid of this sale the receivers of the properties execute a lease of them to the Chicago Railways Company, turning the properties over to it.

These orders were issued with the expectation of bringing about the following results:

Within a few days the Union Traction Company is to pass out of existence and the Chicago Railways Company take its place.

The railways company will accept the ordinance of Feb. 11, 1907, allowing it to operate on the north and west sides.

It will raise $12,000,000 with which to rehabilitate the present Union Traction lines, in accordance with the demands of that ordinance.

Out of the $61,000,000 concerned only one claimant for $10,000 objected to the settlement. This was Attorney Henry Crawford, who held receivers' certificates. He was told that if he could make good his contention his claim would be settled.

Judge Grosscup on being asked what the settlement means replied:

"What the entry of these orders means is that 2,000,000 people, constituting the city of Chicago, at last have come to an understanding with some 20,000 people, constituting the creditors, bondholders and stockholders of the old Union Traction System, whereby, as nearly as human judgment can reach such results, the 2,000,000 get what is due to them as a community; the twenty odd thousand get what is due to them as a body, and each of the 20,000 gets what is due to him as an individual.

"A settlement on so large a scale, involving so much feeling, is always difficult. It was the ordinance of February last that made such settlement possible. The extension ordinance of last September saved it from disaster. The agreement to-day practically closes it.

"And when we remember what just complaint the 2,000,000 had; when we remember that nearly every one of the twenty odd thousand was himself the victim of the same wrong; when we remember that among these 20,000 there were more than a score of direct conflicting interests, each in itself a lawsuit involving millions; when we remember how easy and quickly done it might have looked to have wiped the slate of the whole difficulty by simply giving the new franchise to some outside people or to some syndicate of big men in the old companies—selling to them the tangible property of the old company at what it might bring at public sale—the dominant feeling that possesses to-day is one of thankfulness—sincere thankfulness—that held to sober second thought the American people can be trusted to deal with each other in an enlightened spirit of fair play.

"Mistakes have been made—I can put my finger on dozens of my own. But the central idea has been carried out."

The consent of practically all the bondholders was necessary to make the reorganization plan secure. This was the holding of the United States Court of Appeals. At the settlement it was shown that of the $25,699,000 of outstanding bonds $22,461,500 had been deposited in aid of the plan and no objections had been heard from any of the holders of the remaining $3,237,500. Consent to the settlement was obtained from 80 to 90 per cent of the stockholders.

The formalities remaining to be carried out are: The receivers of the Union Traction Company must execute a lease of these properties to the Chicago Railways Company, which in turn must be accepted by the officials of the railways company. When the lease is properly signed the railways company can take possession of the lines, accept the city ordinance and proceed to operate the present Union Traction System. The rental to be paid is nominal—$1,000 a year.

The advertisements previously referred to under the law must run for thirty days. When the thirty days have expired Master in Chancery Bishop is to sell the properties to the highest bidder from the steps of the government building. Only one bidder is expected—the Chicago Railways Company. It will bid the amount of the bonds it represents, or $25,699,000, and as any other bidder would have to put up cash none is looked for. Then the master is to issue a mortgage foreclosure deed to the Chicago Railways Company and it will have the legal title to the properties as well as actual possession under the lease from the receivers.

The Chicago Railways Company has only a nominal capital of $100,000. It is organized simply as an operating corporation. Its officers are: Frederick H. Rawson, president; W. N. Eisendrath, secretary; Albert S. Sprague, Charles G. Dawes, Chauncey Keep, A. C. Bartlett, Charles H. Hulburd, directors.

As a result of the settlement the board of supervising engineers has begun active work on plans for establishing the twenty-one through routes between the north and west and the south side systems, as provided for in the traction ordinance.

Bion J. Arnold, president of the board, in speaking of the settlement said: "We are much pleased that the troubles of the Union Traction Company have been settled at last, and we feel greatly encouraged now as regards the north and west side lines. We will soon be making as good progress over there as on the south side. We are already getting into shape to start a few through routes as soon as possible after the Chicago Railways Company takes possession. We are doing as much as we can in advance and believe some of the routes will be established in February. In every case there will have to be some slight deviation from the through routes as laid down in the ordinances and we are considering now just what these should be. The reason is that owing to the narrowness or weakness of bridges or inadequate curves the big double truck cars could not be run over the prescribed routes from one end to the other. These details we are deciding on now as nearly as possible, so that there will be little delay when the new company takes hold."

The rehabilitation of the north and west side systems, it is estimated, will within the next three years cost $25,000,000. Ninety miles of track must be reconstructed, forty-eight miles of old cable track must be rebuilt and about 800 additional double truck cars will be required to comply with the ordinance. New car barns, power stations and sub-stations will probably be built and feeder and transmission systems installed.

Henry A. Blair, one of the receivers of the Union Traction Company, is reported to have stated that two syndicates had agreed to advance $17,000,000 in cash. One known as the rehabilitation syndicate will furnish $12,000,000 on first mortgage bonds as security. A reorganization syndicate has agreed to furnish $5,000,000 to be secured on 6 per cent collateral notes. The board of directors of the new railways company has approved the plan, but details are withheld for the present. If rehabilitation costs up to $25,000,000, as is possible, additional moneys must be obtained. No serious difficulty under this head is anticipated by Mr. Blair.

NEW SUBWAY APPROVED FOR NEW YORK

The Public Service Commission of the first district of New York, at a public meeting Tuesday, Dec. 31, approved the route for a new $60,000,000 subway in Manhattan, and authorized the engineer and counsel to take the necessary steps preliminary to presenting the plans to the Board of Estimate. It is probable that the plans will be ready for advertising about March, though whether they will be advertised or not may depend on whether the Elsberg law has been amended by then. The new subway, if it is built, will follow the lines of parts of five of the routes laid out by the old Rapid Transit Commission. It is the most direct route ever planned. The general route is given in the resolutions adopted by the commission, which were as follows:

Whereas, In the opinion of the commission, a rapid transit system in the Boroughs of Manhattan and the Bronx should be laid out and offered for bids; and,

Whereas, The rapid transit system which, in the opinion of the commission, seems best to meet the requirements of the people of the City of New York is one described as beginning at a point under Battery Park, running thence northerly through and under Greenwich Street, Trinity Place and Church Street to Vesey Street, thence easterly through Vesey Street to Broadway, thence northerly along and under Broadway to Canal Street, where connection will be made with a crosstown line hereinafter described; thence northerly to a point near East Tenth Street, where the line curves generally in a northeasterly direction and under private property and across East Eleventh Street to Fourth Avenue, East Twelfth Street, East Thirteenth Street, and East Fourteenth Street to Irving Place; thence northerly along and under Irving Place to Gramercy Park; thence northerly under Gramercy Park to Lexington Avenue; thence northerly under Lexington Avenue to the Harlem River and under the Harlem River to a point near the intersection of Park Avenue and East 138th Street, where the lines will diverge, the easterly line continuing east along East 138th Street to the Southern Boulevard; thence in a generally northerly direction along the Southern Boulevard to Westchester Avenue; thence in a generally northeasterly direction along Westchester Avenue to the Eastern Boulevard or Pelham Bay Park; the westerly line to begin at a point near the intersection of Park Avenue and East 138th Street and running northerly along Mott Avenue to 151st Street; thence northwesterly along 151st Street to Gerard Avenue; thence northerly along Gerard Avenue to the intersection of Gerard Avenue and Jerome Avenue near Clark Place, from which the line is to extend northerly along and under Jerome Avenue to Woodlawn Cemetery. Also a crosstown line on Canal Street, connecting at Broadway with the other parts of this system, and beginning at the intersection of Canal Street and West Street, and thence running easterly under Canal Street and, with proper connections at Broadway to the Manhattan Bridge approach, where connection can be made with the Fourth Avenue route in Brooklyn already authorized; and,

Whereas, Portions of this system have been laid out as separate routes by the former Board of Rapid Transit Railroad Commissioners and approved by the Board of Estimate and Apportionment and the Mayor and consented to by a majority in value of the owners of abutting property or by the Appellate Division of the Supreme Court, in lieu thereof; and,

Whereas, The construction of such a system will require the modification of certain of the said routes.

Now, therefore, be it resolved, That the question of the legality and feasibility of such a system be referred to the counsel and chief engineer to the commission for a report and to prepare the necessary plans and papers for submission to the commission.

The line would be wholly independent of the present subway. It would pass underneath it in the neighborhood of Twelfth Street. The route calls for its passing under private property about there, which would greatly aid in keeping the line straight. There would be four tracks to the Harlem River and three beyond, at least on the westerly branch. Downtown the line would avoid the present subway in lower Broadway below the postoffice by swinging round into Vesey Street and going beneath Church Street. It would pass the terminal of the McAdoo lower tunnels, and at Ninth Street it would touch another terminal of the McAdoo system.

In a report on the route the special committee on additional subways, consisting of Commissioners Eustis and Maltbie, says in part:

The line thus planned could be connected with the New York Central Railroad at the Mott Haven station, at 138th Street, and at Forty-second Street, and suburban trains could be run through to the Battery via Broadway—a more direct route to downtown Manhattan than by the present subway. At this very moment, before the Grand Central Station has been reconstructed and while traffic is being so seriously interfered with by this reconstruction, that the number of persons using the Grand Central Station is very much less than it will be when the station has been rebuilt and the trains are again running upon schedule time, the present subway is congested by New York Central traffic. The proposed line would relieve this congestion and help handle the additional traffic that will come when the New York Central has completed its work of reconstruction and its lines have been electrified.

The proposed line will aiso run close to the Steinway tunnel at Forty-second Street and the Blackwell's Island Bridge at Fifty-ninth Street, so that a connection may be made with the crosstown subway under Fifty-ninth Street, planned by the Rapid Transit Commission. By either route the residents of Queens will be able to reach the lower portion of Manhattan much more expeditiously than at present.

The crosstown spur through Canal Street would connect with the Manhattan Bridge, and there would be a turnout from the main north and south line, so that trains from the Bronx could be run over the bridge and the Fourth Avenue subway in Brooklyn, which the commission has already approved.

GOV. HUGHES RECOMMENDS RAILWAY LEGISLATION

Recommendations for amendments to the laws governing banks and trust companies, largely along the lines suggested by the Hepburn Commission; radical election reforms, including the adoption of the Massachusetts ballot and a law making direct nominations at primaries permissive; for the repeal of the Percy-Gray anti-betting law and the substitution of a law making betting at race tracks a prison offense, and amendments to the Public Service Commissions act, which will bring telegraph and telephone companies under its control, are the most striking features of Governor Hughes' annual message, which was received and read in both houses of the Legislature at the opening session Jan. 1. In many instances his recommendations are for legislation which was defeated at the last session despite the fact that it had been urged not only in his annual message last year, but in messages subsequently sent to the two branches of the Legislature. In regard to the Public Service Commission and the need for subways in New York the Governor said:

"The Public Service Commissions law has provided for the investigation and redress of grievances in connection with the operation of railroad, gas and electrical corporations. The necessity of having such an administrative board with adequate powers so that complaints may be heard and determined upon their merits, and that there may be suitable machinery for enforcing the rules of law requiring impartial and proper service upon reasonable terms, according to the exigencies of each particular case, cannot be gainsaid. No change is suggested in policy or structure, but such amendments as experience may show to be advisable to improve the text, to facilitate administration or more fully to carry out the intent of the act, should be supplied.

"I recommend, however, an enlargement of the scope of the act. In view of the tasks to be assumed with respect to corporations already under supervision, it was not thought best at the outset to extend the act to other corporations. It should now be extended to telephone and telegraph companies, and they should be brought under appropriate regulation as to rates, service and other matters, similar to that which obtains in the case of the corporations at present subject to the law.

"It is not advisable that separate commissions should be created; efficiency and economy will be promoted by concentration of supervisory powers. The increased labors of the public service commissions may be met by suitable departmental organization. But to avoid the overburdening of the commissions when organization is being perfected and precedents in various classes of cases are being established, I recommend that this extension of jurisdiction shall take effect on Oct. 1, 1908.

"Through the work of the Public Service Commission of the First District existing facilities will be availed of to their utmost capacity to improve conditions of transit. But the natural increase in the demands for service, which is incident to the rapid growth of the city, necessarily outstrips any possible improvement in the facilities at present available.

"The construction of new lines, particularly of new subway lines, is imperatively demanded. With respect to this matter the Public Service Commission is subject to the provisions of the Rapid Transit act. By the referendum of 1894 the plan of municipal construction of rapid transit lines was decided upon, and there is no provision for building such lines with private capital except in the case of certain extensions of, and additions to, existing lines.

"It is urged, however, that the city's indebtedness has reached such an amount that there is not a sufficient margin available to enable the city to provide for the construction of needed subways. The Charter Revision Commission recommends that the constitution should be so amended as to exclude from the computation of the city's debt limit all bonds or evidences of indebtedness issued for purposes which produce revenues in excess of their maintenance charges. I concur in this recommendation, and I present it to you for appropriate action, looking to the submission to the people of the proposed amendment in suitable form.

"In the meantime the question whether any changes in the Rapid Transit act should be made in order to facilitate subway construction should receive your most serious consideration."

MEETING OF THE PENNSYLVANIA STREET RAILWAY ASSOCIATION

A meeting of the executive committee of the Pennsylvania Street Railway Association was held in Philadelphia recently to organize for active work during the coming year. The association is one of the oldest of the state bodies, but has been rather inactive since 1904 until last winter, when the street railway companies of Pennsylvania decided that considerable mutual benefit could be secured by more active co-operation. At the meeting in Philadelphia R. P. Stevens, of Allentown, was elected vice-president of the association to succeed E. E. Young, of Johnstown, and Charles O. Kruger, general manager of the Philadelphia Rapid Transit Company, was elected a member of the executive committee in place of William B. Given, who has recently moved from Columbia to Chicago. The other officers of the association are F. B. Musser, of Harrisburg, president; Charles H. Smith, secretary, and Capt. W. H. Lanius, treasurer. The executive committee consists of the president, secretary and John A. Rigg, E. H. Davis and C. O. Kruger.

About eighteen street railway companies were represented at the Philadelphia meeting of the association, and it is proposed to hold another meeting of the executive committee in Philadelphia this week to see whether all of the electric railway companies of the state cannot be enrolled in the association. One of the subjects to be taken up by the association early next year will be to meet the railway commission of Pennsylvania, which will go into office Jan. 1, 1908, and discuss the question of a standard classification of operating accounts.

President Mellen, of the New York, New Haven & Hartford Railroad, says the delay in building the New York & Portchester Railroad through the Bronx and into Connecticut is due primarily to the opposition of taxpayers along the route. The line is to be operated by the third-rail.

NEW PUBLICATIONS

The Car Wheel: Giving the Results of a Series of Investigations of the Physical and Other Qualities of Steel and Cast Iron Wheels. By George L. Fowler. Published for private distribution by the Schoen Steel Wheel Company, Pittsburg, Pa., 1907. Boards, 6 in. x 19 in., 161 pages.

About three years ago, before the manufacture of Schoen solid rolled and forged steel wheels was begun on a commercial scale, Mr. Fowler undertook to make some tests to determine the relative physical and chemical qualities of these wheels as compared with standard brands of steel-tired and cast-iron wheels then in use. This investigation, started with the sole object of finding what standards of quality and service would have to be met by the new product, developed later into an elaborate series of experiments involving not only a study of the qualities of the various wheels to resist wear and breakage in service, but also to determine what stresses the wheels were actually subjected to. The results of all of these investigations are here collected and made public, primarily, of course, as an exposition of the many superior qualities claimed for the solid-steel wheel. Nevertheless, many interesting and valuable data having little or no direct bearing on the relative merits of the wheels tested, are presented.

From the standpoint of the electric railway man, perhaps the most interesting chapters are those on the coefficients of friction between wheel and rail when spinning and skidding, and on the areas of contact between wheel and rail. The tests to determine the relative coefficients of friction of steel and cast iron wheels were made in the laboratory under conditions approaching as nearly as possible those of actual service, and these were later checked by experiments made with a loaded car running on a track. Tests were conducted under loads varying from 2000 lbs. to 30,000 lbs. for both skidding and spinning. The steel wheel had a greater resistance to both motions under all loads; at 30,000 lbs. load it was 10 per cent higher for spinning than that of the cast-iron wheel under the same load and about 9 per cent higher for skidding. The higher resistance to spinning is explained by the fact that with the steel wheel there is mutual compression in both the rail load and the wheel. In spinning this compression is progressively continuous around the wheel whereas with the hard and almost incompressible chilled cast-iron wheel no such continuous compression takes place, the only resistance being that due to abrasion. The higher coefficient of friction for skidding than for spinning in all cases is explained on a similar hypothesis—that in skiding a progressive wave of compression in the rail head must be set up. The tests with a loaded car indicate that in skidding a short distance at low speed the cast-iron wheel is more apt to develop a flat spot than is a steel wheel. However, if the skidding continues for some distance at a high speed, the wheel becomes heated and then the steel wheel is the first to yield, unless the hard surface chill of the cast-iron wheel has been worn through. An explanation of these facts is afforded by the relative rate of abrasion of chilled cast-iron wheels and steel wheels. Contrary to common assumption the hard cast-iron wheel can be ground away nearly five times as fast as the steel wheel, if both are kept cool.

The area of contact between wheel and rail was the subject of an elaborate series of tests. The results are interesting, as having a possible bearing on the cause of corrugated rails. Under any load above 20,000 lbs. a permanent set took place in the rail, but no permanent set was observed in either cast iron or steel wheels under loads as high as 150,000 lbs. The maximum intensity of pressure at the center of the area of contact is calculated to be nearly 170,000 lbs. under a load of 20,000 lbs. The effect of difference of diameter of wheels of the same material on the area of contact is negligible within the limits of practice. The tests indicate that in service the hard unyielding cast-iron wheel inflicts more measurable damage on the rail than the more elastic steel wheel, and that the cast-iron wheel under the shoeless to which it is subjected, will disintegrate and fail sooner.

Some interesting records of the wear of Schoen solid steel wheels in service on the lines of the Brooklyn Rapid Transit Company are given in the last chapter. From 8500 to 9750 miles were obtained per 1/16 in. of wear under motor passenger cars on the surface lines, and 10,850 miles per 1/16 in. of wear under elevated motor cars. Wheels are still in service with tread and flange in good condition after having worn down 3/8 in. and more without turning.

BOOKS RECEIVED

Standard Handbook for Electrical Engineers. By R. C. Beardsley, Louis Bell, H. M. Hobart, Otis Allen Kenyon, Edward Lyndon, A. S. McAllister, Kempster B. Miller, William H. Onken, E. F. Roeber, George Shaad. Twenty sections: Units, circuits, instruments and measurements, materials, magnets, transformers, generators, motors, batteries, central stations, transmission and distribution, illumination, electric traction, electrochemistry, telephony, telegraphy, miscellaneous applications of electricity, wiring, standardization rules, tables and statistics. Bound in flexible morocco; handy pocket size; 1300 pages and 1300 illustrations. Price, $4 net, postpaid. New York: McGraw Publishing Company.

STREET RAILWAY PATENTS

UNITED STATES PATENTS, ISSUED DEC. 17, 1907.

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 140 Nassau Street, New York.]

873,703. Electrically Propelled Car or Locomotive: Edward H. Anderson, Schenectady, N. Y. App. filed April 5, 1906. An electric railway in which the current is supplied to the locomotive at high-voltage alternating current, during normal running, and at low-voltage direct current while in the city limits. Relates to controller circuits.

873,705. Insulating Covering or Sheathing for Contact Rail Conductors: William H. Baker, Lockport, N. Y. App. filed Oct. 19, 1905. An insulating sheath adapted to embrace the rail and having a locking piece or key serving to keep the sheath in place on the rail.

873,706. Motor Truck; Asa F. Batchelder, Schenectady, N. Y. App. filed May 28, 1906. The electrical and mechanical features co-operate to produce a truck which is simple, durable and has a maximum electrical and mechanical capacity.

873,720. Switch Stand; Arthur D. Cloud, Chicago, Ill. App. filed Sept. 27, 1906. Provides means for locking open an automatically closing switch and a magnet circuit having opening and closing devices for releasing said locking means and controlled by the passage of a train from a sidetrack upon the main track.

873,761. Railway Switch Structure; Henry R. Luther, Newton, and Frederic F. Stockwell, Jr., Somerville, Mass. App. filed April 20, 1906. The object of this invention is to so form and arrange the various parts of the switch structure that they may be assembled with little or no machining.

873,805. Controller; Emmett W. Stull, Norwood, Ohio. App. filed March 31, 1906. Means for preventing the sparking or destructive arcing which occurs between the fingers of the controller.

873,821. Insulated Rail Joint; Benjamin Wolhaupter, New York, N. Y. App. filed Aug. 7, 1906. A joint supporting base adapted to be engaged by the rails, and means for yieldingly maintaining a separation of the rails from the base.

873,839. Automatic Signaling Device; Louis Caputo, East Boston, Mass. App. filed Aug. 23, 1907. Signal circuits are completed through conductors between the track rails engaged by trolley wheels depending from the train.

873,912. Railway Track Structure; Frederic F. Stockwell, Jr., Somerville, and Henry R. Luther, Newton Center, Mass. App. filed Nov. 11, 1903. Relates to a process of casting crossing plates, switch-frogs, etc.

873,955. Trolley Head; Charles C. McClintock, Englewood, Col. App. filed June 25, 1907. The trolley harp is swivelled on a vertical axis and prongs or deflectors are provided constituting a wire guard.

874,042. Block Signaling Apparatus; John D. Taylor, Edgewood Park, Pa. App. filed Aug. 24, 1907. Provides block signaling apparatus having a transformer especially designed for supplying alternating current to the track circuit of the system in a quantity to suit the requirements of the particular track section with which it is connected.

874,054. Air-Brake System; Frank H. Dukesmith, Meadville, Pa. App. filed May 6, 1905. Provides a system wherein the engineer may control the locomotive driver and tender brakes separately from the train brakes or in unison therewith as may be desired.

874,085. Rail-Bond for Rail-Joint Circuits; William E. Karns, Parkers Landing, Pa. App. filed Jan. 29, 1907. Spring plates fitting between the abutting ends of the rail.

874,186. Magnetic Brake; Frederick G. Haldy, Stamford, Conn. App. filed June 17, 1907. A magnetic clutch having a pair of discs with intermediate bar electromagnets having their opposite poles presented to their respective discs.

874,196. Detector Bar; Casper Herringer, New York, N. Y. App. filed Aug. 13, 1907. A detector bar designed and adapted to move into two detecting positions, one position being against the tread of a wheel and another position being against the side face of a wheel. Means for guiding the bar in said movement.

874,219. Brake for Power-Driven Vehicles; Joseph N. Mahoney, Brooklyn, N. Y. App. filed Oct. 30, 1905. An electrical vehicle brake having a spring normally under tension by reason of a gear connection from the operating motor. Has hand-controlled devices by which the spring is released to apply the brake.

874,229. Controlling Mechanism; John J. Nef, Chicago, Ill. App. filed Sept. 15, 1905. A governor for fluid pressure brake systems. Designed to open the circuit of the pumping motor abruptly when a certain pressure is attained. Has a piston acting on spring cam mechanism.

874,345. Trolley; George Keresztes, Pittsburg, Pa. App. filed Sept. 6, 1907. The trolley wheel consists of a long spirally grooved roller, the spirals converging toward the center where a groove of deeper cross-section is provided.

874,372. Electrical Signaling Device; James P. Williams, Latonia, Ky. App. filed June 6, 1907. Special trolley conductors between and beside the usual track rails and which are engaged by depending brushes on the train.

PERSONAL MENTION

MR. JACK ABBOTT, of Jackson, Tenn., has been appointed general manager of the Jackson Electric Railway, Light & Power Company, to succeed Mr. F. G. Proutt, resigned.

MR. S. NEWTON SMITH, of New York, well known in that city because of his active financial interest in the Kings County Elevated Railroad, now part of the Brooklyn Rapid Transit Company's system, is dead.

MR. T. R. GABEL, general manager, and Mr. C. A. Allison, chief engineer, of the Los Angeles-Pacific Railway Company, of Los Angeles, Cal., have resigned from the company and will engage in private enterprises. Their successors have not yet been appointed.

MR. CHAS. F. TURNER has been appointed superintendent of motive power of the Columbus, Delaware & Marion Railway Company, of Columbus, Ohio., and as such will have supervision over power houses, sub-stations and all rolling stock of the company.

MR. J. J. DOYLE has resigned as general superintendent of the Eastern Ohio Traction Company to become superintendent of maintenance and overhead systems of the Washington, Baltimore & Annapolis Electric Railway. Mr. Joseph Emory succeeds Mr. Doyle with the Eastern Ohio.

MR. E. V. McGRATH, who has been in the service of the Rockford & Interurban Railway Company, of Rockford, Ill., has accepted the position of chief clerk to Mr. J. E. Broyles, joint freight agent at the Columbus, Ohio, interurban station. Mr. McGrath succeeds Mr. E. C. Shilling, who resigned to enter other service.

MR. LOUIS H. CUSHING, who has been superintendent of the Taunton & Pawtucket Street Railway Company for some time past, has resigned from the company to become associated with the Dexter Machine Company, of Attleboro. Previous to coming to Attleboro Mr. Cushing was identified for seven years with several street railway companies operated by the Shaw interests of Boston.

MR. CHARLES R. HANNAN, New England financial representative of Swift & Company, is dead. Mr. Hannan was born in Rochester, N. Y., in 1856, but had spent most of his life in the Middle West. He was prominent in many financial undertakings, having an interest in promoting a number of electric railway properties, among them the Detroit & Toledo Short Line.

MR. JAMES McCREDIE has been appointed secretary and treasurer of the Hudson Valley Railway, and Mr. Arthur J. Gies, who has been auditor of the Hudson Valley, has been appointed as assistant secretary and treasurer. Mr. McCredie has been secretary and treasurer of the United Traction Company for several years, and his election to the same office in the Hudson Valley Company brings the business of that department under one head. This is the policy of the Delaware & Hudson Company in regard to its subsidiary lines. In the past Mr. F. F. Pruyn, of Glens Falls, has served as treasurer of the Hudson Valley and Mr. H. J. Speck, of Troy, as secretary.

DR. COLEMAN SELLERS, a distinguished engineer and scientist, formerly chief engineer of William Sellers & Company, Inc., of Philadelphia, from which he retired in 1886, died at his home in Philadelphia, aged 81, on Dec. 28. Dr. Sellers represented America on the international board of five engineers to consider the question of developing electricity at Niagara, of which board the late Lord Kelvin acted as chairman. Subsequently Dr. Sellers acted as consulting engineer of the Cataract Construction Company, chief engineer of the Niagara Falls Power Company, and chief mechanical engineer of the Canadian Niagara Power Company. He was a member of many of the principal engineering associations here and abroad.

MR. PAUL H. EVANS, who for three years was chief engineer and purchasing agent of the Mexico Electric Tramways, Ltd., and during the past year chief engineer only, has severed his connection with the company and will, after traveling abroad on the Continent for a few months' rest and recreation, devote himself to his private interests in Mexico City. Mr. Evans was, prior to his connection with the Mexico Tramways, which he entered at the time Mr. W. W. Wheatly became president and general manager, chief engineer of the Mexican General Electric Company, which is the branch office of the General Electric Company, of Schenectady, N. Y. Mr. Evans was connected with this company for seven years. Prior to Mr. Evans' connection with the General Electric Company he was with the Atlanta Street Railways.

MR. ARTHUR W. JORDAN, who has been connected with the traffic department of the Schoepf syndicate lines, since the syndicate came into possession of the old Appleyard lines, has accepted the position of general passenger agent of the Chicago & Joliet Railway, with headquarters at Joliet. The appointment carries with it the management of Delwood Park, near Joliet, which is owned and operated by the company. Mr. Jordan will leave Columbus the first of the year to assume his new duties. Mr. Jordan came to Columbus from Grand Rapids, Mich., where he was connected with the management of the city railway company in a confidential capacity, to take charge of the traffic department of the old Appleyard lines. During the receivership of the lines he was general passenger and freight agent. After the lines passed into the hands of the Schoepf syndicate he was general passenger agent for a time, and was later appointed assistant general passenger and freight agent. This position he held until last November, when he retired.

MR. H. C. DONECKER has recently been appointed to the position of office manager of the American Street and Interurban Railway Association. Mr. Donecker has had a number of years practical experience in various lines of street railway work. He was first associated with the Lorain Steel Company (then the Johnson Company), of Philadelphia and Johnstown, Pa., during the years 1890 to 1894. He then became connected with Hon. Tom L. Johnson and his brother, Mr. Albert L. Johnson, in the construction and operation of the Nassau Railroad. Leaving there early in 1899, he went west with Mr. J. J. Coleman who at that time assumed the general managership of the newly formed St. Louis Transit Company. Mr. Donecker remained with that company until late in 1900, when he became connected with Col. Giles S. Allison, of the Security Register Company, of St. Louis, and remained engaged in that work until the first of the year 1906, at which time he entered the services of Ford, Bacon & Davis, of New York City, where his work has been practically entirely of a statistical nature. Mr. Donecker's experience and his training as a statistician will undoubtedly be of great value to the association.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement, "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes. † Deficit. ‡ Including Rapid Railway system, Sandwich, Windsor & Amherstburg Railway, and Detroit, Monroe & Toledo Short Line Railway.

COMPANY.	Period.	Total Gross Earnings.	Operating Expenses.	Net Earnings.	Deductions From Income.	Net Income, Amount Available for Dividends.
AKRON, O. Northern Ohio Tr. & Light Co.	1m., Nov. '07	146,123	88,180	57,943	43,351	14,591
	1 " " '06	133,388	79,341	54,047	41,014	13,033
	11 " " '07	1,761,198	1,013,469	747,730	469,880	277,849
	11 " " '06	1,561,632	924,568	637,064	442,161	194,903
CHAMPAIGN, ILL., Illinois Traction Co.	1m., Nov. '07	335,889	*195,596	140,294	.....	.....
	1 " " '06	267,296	*147,182	120,114	.....	.....
	11 " " '07	3,427,210	*1,928,521	1,498,689	.....	.....
	11 " " '06	2,710,943	*1,482,376	1,228,567	.....	.....
CHARLESTON, S. C. Charleston Con. Ry., Gas & Elec. Co.	1m., Nov. '07	62,551	40,543	22,007	13,493	8,514
	1 " " '06	56,774	34,722	22,053	13,017	9,036
	9 " " '07	545,212	344,998	200,213	121,627	78,587
	9 " " '06	488,935	303,725	185,210	117,000	68,210
CHICAGO, ILL. Aurora Elgin & Chicago Ry. Co.	1m., Nov. '07	108,653	63,192	45,461	29,058	16,403
	1 " " '06	96,722	56,817	39,904	26,158	13,746
	5 " " '07	673,627	351,453	322,174	135,282	186,892
	5 " " '06	599,542	306,888	292,654	126,967	165,687
Chicago & Milwaukee Elec. R.R. Co.	1m., Nov. '07	87,982	38,356	49,627	.....	.....
	1 " " '06	81,143	39,905	41,238	.....	.....
	11 " " '07	972,712	406,027	566,686	.....	.....
	11 " " '06	803,591	333,285	470,306	.....	.....
CLEVELAND, O. Cleveland, Painesville & Eastern R.R. Co.	1m., Oct. '07	24,858	*14,925	9,933	6,796	3,137
	1 " " '06	22,916	*12,848	10,068	7,108	2,960
	10 " " '07	246,940	*133,174	113,767	70,460	43,307
	10 " " '06	230,553	*123,203	107,350	69,639	37,711
Cleveland, S. W. & Columbus Ry. Co.	1m., Oct. '07	65,793	38,296	27,497	.....	.....
	1 " " '06	56,499	31,642	24,857	.....	.....
	10 " " '07	634,684	365,075	269,609	.....	.....
	10 " " '06	539,133	304,430	234,703	.....	.....
Lake Shore Elec. Ry. Co.	1m., Oct. '07	78,460	*45,937	32,523	25,188	7,335
	1 " " '06	71,814	*39,175	32,639	22,812	9,827
	10 " " '07	799,848	*431,957	367,891	243,430	124,461
	10 " " '06	736,619	*400,903	335,716	208,590	127,126
COLUMBUS, GA. Columbus Elec. Co.	1m., Oct. '07	30,634	*16,291	14,343	10,478	3,865
	1 " " '06	26,482	*14,399	12,083	7,783	4,300
	12 " " '07	330,158	*179,472	150,687	120,003	30,684
DETROIT, MICH. Detroit, Jackson & Chicago Ry.	1m., Nov. '07	36,639	*29,731	6,908	16,575	†9,667
	10 " " '07	360,108	*288,688	71,420	156,375	†84,955
‡Detroit United Ry. Co.	1m., Nov. '07	529,195	*340,527	188,668	118,034	70,634
	1 " " '06	484,055	*334,361	149,694	105,862	43,832
	11 " " '07	6,215,596	*3,836,748	2,378,848	1,263,830	1,115,018
	11 " " '06	5,590,982	*3,395,993	2,194,989	1,136,296	1,058,693
DULUTH, MINN. Duluth St. Ry. Co.	1m., Nov. '07	72,813	41,015	31,798	17,912	13,885
	1 " " '06	65,393	41,271	24,122	17,851	6,271
	11 " " '07	772,993	392,099	380,893	195,639	185,254
	11 " " '06	702,285	377,200	325,085	194,345	130,740
E. ST. LOUIS, ILL. East St. Louis & Suburban Co.	1m., Nov. '07	187,954	97,863	90,091	.....	.....
	1 " " '06	169,816	87,298	82,518	.....	.....
	11 " " '07	1,970,041	1,026,183	943,858	.....	.....
	11 " " '06	1,766,358	879,714	886,644	.....	.....
EL PASO, TEX. El Paso Cos.	1m., Oct. '07	46,474	*31,500	14,974	5,259	9,714
	1 " " '06	34,630	*27,126	7,504	3,932	3,572
	12 " " '07	486,719	*368,904	117,814	57,762	60,053
	12 " " '06	367,993	*255,554	112,439	46,588	65,851
FT. WAYNE, IND. Ft. Wayne & Wabash Valley Tr. Co.	1m., Oct. '07	114,883	63,872	51,011	.....	.....
	1 " " '06	93,359	55,653	37,705	.....	.....
	10 " " '07	1,052,505	620,884	431,621	.....	.....
	10 " " '06	898,284	548,407	349,878	.....	.....
FT. WORTH, TEX. Northern Texas Tr. Co.	1m., Oct. '07	114,460	*60,664	53,795	11,386	42,409
	1 " " '06	93,458	*63,202	30,256	9,942	20,314
	12 " " '07	1,039,275	*615,522	423,753	127,247	296,506
	12 " " '06	831,467	*528,191	303,276	119,292	183,984
GALVESTON, TEX. Galveston-Houston Elec. Co.	1m., Oct. '07	89,940	*57,329	32,611	13,254	†19,357
	1 " " '06	76,013	*50,133	25,880	11,958	13,921
	12 " " '07	1,037,765	*645,142	392,623	150,634	241,988
	12 " " '06	885,980	*561,619	324,361	145,533	178,828
HOUGHTON, MICH. Houghton County St. Ry. Co.	1m., Oct. '07	20,652	*13,615	7,037	3,973	3,064
	1 " " '06	19,353	*12,058	7,295	3,916	3,379
	12 " " '07	248,881	*154,823	94,058	47,405	46,653
	12 " " '06	222,794	*145,142	77,653	46,649	31,004
JACKSONVILLE, FLA., Jacksonville Elec. Co.	1m., Oct. '07	33,697	*22,538	11,159	4,943	6,216
	1 " " '06	26,844	*17,481	9,364	3,404	5,960
	12 " " '07	393,330	*251,565	141,765	46,991	94,774
	12 " " '06	307,159	*193,595	113,565	40,469	73,095
KANSAS CITY, MO. Kansas City Ry. & Lt. Co.	1m., Oct. '07	559,822	271,191	288,632	153,575	135,057
	1 " " '06	531,672	250,023	281,649	150,244	131,404
	5 " " '07	2,647,648	1,344,188	1,303,460	773,466	529,994
	5 " " '06	2,406,770	1,184,232	1,222,538	724,194	498,343
LEXINGTON, KY. Lexington & Interurban Rys. Co.	1m., Oct. '07	52,538	31,459	21,079	.....	.....
	1 " " '06	46,663	28,640	18,023	.....	.....
	10 " " '07	473,321	297,766	175,555	.....	.....
	10 " " '06	441,432	288,377	153,055	.....	.....
MILWAUKEE, WIS. Milwaukee Elec. Ry. & Lt. Co.	1m., Nov. '07	335,026	169,585	165,441	100,435	65,005
	1 " " '06	308,753	144,065	164,687	92,272	72,416
	11 " " '07	3,563,912	1,798,565	1,765,347	1,082,445	682,902
	11 " " '06	3,244,223	1,576,645	1,667,578	976,641	690,937
Milwaukee Lt., Ht. & Tr. Co.	1m., Nov. '07	64,009	29,585	34,423	36,765	†2,342
	1 " " '06	54,330	23,352	30,978	28,797	2,181
	11 " " '07	767,268	328,942	438,326	379,686	58,640
	11 " " '06	646,602	252,381	394,220	296,298	97,922
MINNEAPOLIS, MINN. Twin City R. T. Co.	1m., Oct. '07	515,178	255,587	259,590	132,642	126,949
	1 " " '06	473,821	226,436	247,386	114,758	132,627
	10 " " '07	5,055,451	2,436,024	2,619,427	1,169,383	1,450,043
	10 " " '06	4,691,259	2,177,485	2,513,773	1,118,911	1,394,862
MONTREAL, CAN. Montreal St. Ry.	1m., Nov. '07	296,184	182,638	113,547	41,655	71,892
	1 " " '06	263,260	174,933	88,327	39,276	49,051
	2 " " '07	608,083	347,213	260,870	84,944	175,926
	2 " " '06	545,083	331,174	213,909	79,886	134,023
NORFOLK, VA. Norfolk & Portsmouth Tr. Co.	1m., Oct. '07	258,515	158,954	99,561	.....	.....
	1 " " '06	142,152	92,451	49,701	.....	.....
	10 " " '07	2,235,812	1,359,622	876,190	.....	.....
	10 " " '06	1,417,906	926,282	491,623	.....	.....
PEEKSKILL, N. Y. Peekskill Lt. & R.R. Co.	1m., Nov. '07	14,724	*7,996	6,728	.....	.....
	1 " " '06	12,236	*6,514	5,722	.....	.....
	11 " " '07	154,947	*84,493	70,454	.....	.....
	11 " " '06	133,199	*70,226	62,973	.....	.....
PENSACOLA, FLA. Pensacola Elec. Co.	1m., Oct. '07	20,046	*15,063	4,983	3,594	1,389
	1 " " '06	11,195	*8,753	2,442	3,157	†715
	12 " " '07	221,610	*145,533	76,077	40,012	36,064
PHILADELPHIA, American Rys. Co.	1m., Nov. '07	231,359	.....	.....	.....	.....
	1 " " '06	217,229	.....	.....	.....	.....
	5 " " '07	1,339,902	.....	.....	.....	.....
	5 " " '06	1,255,957	.....	.....	.....	.....
PLYMOUTH, MASS. Brockton & Plymouth St. Ry. Co.	1m., Oct. '07	9,057	*7,191	1,866	1,775	91
	1 " " '06	8,708	*5,892	2,816	1,796	1,020
	12 " " '07	118,071	*83,839	34,232	21,425	12,806
	12 " " '06	110,490	*70,244	40,246	21,859	18,388
ST. LOUIS, MO. United Railways Co. of St. Louis.	1m., Nov. '07	871,075	579,509	291,566	231,314	60,252
	1 " " '06	846,191	511,088	335,103	231,918	103,185
	11 " " '07	9,958,735	6,485,975	3,472,760	2,546,529	926,231
	11 " " '06	9,412,763	5,855,676	3,557,087	2,550,050	1,007,037
SAVANNAH, GA. Savannah Electric Co.	1m., Oct. '07	51,313	*38,135	13,178	12,284	894
	1 " " '06	43,835	*31,911	11,924	11,300	624
	12 " " '07	591,417	*401,693	189,725	141,966	47,758
	12 " " '06	622,077	*379,554	242,523	133,920	108,603
SEATTLE, WASH. Seattle Elec. Co.	1m., Oct. '07	358,685	*231,588	127,097	41,272	85,825
	1 " " '06	286,103	*179,552	106,551	27,807	78,744
	12 " " '07	3,827,828	*2,574,822	1,253,006	409,335	843,671
	12 " " '06	2,970,846	*1,877,989	1,092,857	316,760	776,097
SYRACUSE, N. Y. Syracuse, R. T. Co.	1m., Nov. '07	107,362	65,315	42,047	26,949	15,098
	1 " " '06	93,248	55,557	37,691	24,243	13,448
	11 " " '07	1,150,150	655,078	495,072	284,798	210,274
	11 " " '06	994,946	568,668	426,278	255,557	170,721
TAMPA, FLA. Tampa Elec. Co.	1m., Oct. '07	45,572	*35,244	10,328	474	9,855
	1 " " '06	39,385	*24,334	15,050	182	14,868
	12 " " '07	519,503	*387,821	131,682	6,292	125,389
	12 " " '06	461,731	*267,675	194,056	3,138	190,918