Street Railway Journal

VOL. XXVI. NEW YORK, SATURDAY, DECEMBER 23, 1905. No. 26.

PUBLISHED EVERY SATURDAY BY THE

McGraw Publishing Company

MAIN OFFICE:
NEW YORK, ENGINEERING BUILDING, 114 LIBERTY STREET.

BRANCH OFFICES:
Chicago: Monadnock Block.
Philadelphia: 929 Chestnut Street.
Cleveland: Cuyahoga Building.
London: Hastings House, Norfolk Street, Strand.

Cable Address, "Stryjourn, New York"; "Stryjourn, London"—Lieber's Code used.

TERMS OF SUBSCRIPTION

In the United States, Hawaii, Puerto Rico, Philippines, Cuba, Canada, Mexico and the Canal Zone.

Street Railway Journal (52 issues).....$3.00 per annum
Combination Rate, with Electric Railway Directory and Buyer's Manual (3 issues—February, August and November) $4.00 per annum
Both of the above, in connection with American Street Railway Investments (The "Red Book"—Published annually in May; regular price, $5.00 per copy).....$6.50 per annum
Single copies, STREET RAILWAY JOURNAL, first issue of each month, 20 cents; other issues 10 cents.

To All Countries Other Than Those Mentioned Above:

Street Railway Journal (52 issues), postage prepaid..... $6.00
25 shillings. 25 marks. 31 francs.

Remittances for foreign subscriptions may be made through our European office.

NOTICE TO SUBSCRIBERS

REMITTANCES.—Remittances should be made by check, New York draft, or money order, in favor of the STREET RAILWAY JOURNAL.

CHANGE OF ADDRESS.—The old address should be given, as well as the new, and notice should be received a week in advance of the desired change.

BACK COPIES.—No copies are kept on sale beyond fifteen months from date of issue, except in bound volumes.

DATE ON WRAPPER shows the month at the end of which the subscription expires.

NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8000 *copies are printed. Total circulation for* 1905 *to date,* 416,350 *copies, an average of* 8164 *copies per week.*

The Philadelphia Subway

The opening of the Philadelphia Subway on Monday of this week constitutes a most important step in the history of transportation in that city. We doubt whether one person in 1000 among the inhabitants of Philadelphia has had any adequate conception of either the extent of the work which has been conducted under Market Street during the past two years or the effect which the Philadelphia Subway must have upon the development of the city. Unlike the work on the first subway sections in New York, the Market Street tunnel was constructed without serious interference with the surface of the street or the traffic upon it. As a result of this method, which is also being followed on the later sections of the New York Subway, the general public sees nothing except a few inconspicuous openings at occasional intervals for the removal of earth, until the preparations are completed for the actual transportation of passengers.

The effect of the new tunnel on the transportation problem of Philadelphia will be even a greater revelation to the citizens than the appearance of the work itself. Street transportation in Philadelphia, as in most of the other large cities in this country, has passed through a clearly defined cycle, although its course has been more marked in Philadelphia than elsewhere on account of the narrowness of most of the streets. This cycle commenced with the introduction and expansion of the horse railway system until its carrying capacity was practically reached, then followed the tremendous gain in both carrying capacity and speed through the introduction of electricity, and finally the congestion by cars and other vehicles of the main arteries, until the speed of the electric cars was reduced practically to that during the former horse régime. In Philadelphia the only solution to this problem was the subway, which, with its four tracks, promises a practically unlimited opportunity for transportation development, east and west. It will be many years before the capacity of the present tunnel is reached, and by that time other subways built by the company will probably parallel it, and still others will be supplying the need for north and south travel.

Turning now from the transportation aspects of the Philadelphia Subway to its constructional features, several radical departures from similar systems elsewhere will be noticed. The first of importance is the elimination of all track ballast. The local or outside tracks in the subway are laid in concrete on cast-iron chairs, while the express tracks are on wooden blocks, which in turn rest on steel and concrete stringers. So far as we know this is the first time that the use of stone or gravel ballast in underground work has been abandoned, and the resulting advantages from a sanitary standpoint are obvious. It is the belief of the officials of the company that a large proportion of the smell in a subway comes from the collection on the stone ballast of various kinds of refuse, but particularly of iron dust from the wheels and brake-shoes. This dust becomes sticky and odorous through the drippings of oil from the various bearings. The composition of this mixture renders it almost impossible of removal in any way short of the direct application of water with the assistance of a brush, a method which is perfectly feasible in the Philadelphia Subway. Just what effect this construction will have upon the noise in the subway cannot yet be determined, but the experience of the company with surface car operation on a rigid

concrete sub-construction seems to indicate that the noise will not be appreciably greater than on a ballasted track. It should also be remembered that the express tracks are on what is practically a tie support.

In another feature the Philadelphia Subway represents an interesting departure from its predecessors, and that is in the introduction of an extensive system of ventilation. Arrangements have been made with owners of property along the route by which stacks from 60 ft. to 300 ft. in height are used to exhaust air from the tunnel. At present it is thought that natural draft will suffice, but this can be supplemented by exhaust fans if necessary.

It is not possible to discuss to any extent the design of the cars adopted for subway operation, as express trains will not be in service for some time, and the side doors provided in the cars will not be used at first. Nevertheless, this provision for future station congestion will undoubtedly prove valuable later, while the adoption of pneumatically-operated platform doors gives added evidence to the efficiency of this method, which was used first, as we remember it, on the Illinois Central cars, and later on the Boston Elevated.

The Future of the American Street and Interurban Railway Association

The Massachusetts Street Railway Association, which is one of the leading, as well as one of the oldest, among the State street railway organizations of the country, held, on Dec. 13, a most interesting meeting, which was devoted to a discussion of the future policy of the American Street and Interurban Railway Association. The speakers of the evening were J. E. Rugg, superintendent of surface transportation of the Boston Elevated Railway Company, and W. Caryl Ely, president, and Bernard V. Swenson, secretary and treasurer, of the American Street and Interurban Railway Association. Mr. Rugg gave some reminiscences of the first meeting of the American Street Railway Association, of which he was one of the organizers. The addresses of Messrs. Ely and Swenson were devoted to outlining the reasons for the reorganization of the association at Philadelphia last fall, and to describing the work which it proposes to do and the methods by which it will be accomplished. A short article referring to the meeting was published in the last issue, but the subject is one in which so much interest is being felt at present that the addresses are printed at length elsewhere in this issue.

The history of the American Street Railway Association is one of which no member need feel ashamed, but with the change in methods which has attended the street railway industry since the establishment of the association, and these changes are described clearly in Mr. Ely's address, its reorganization became a necessity. The first year of the life of any association of this kind, which is dependent for support upon the principle of co-operation among those engaged in the same industry, must necessarily be a somewhat critical period. Those who have followed closely the reasons which led up to the organization of the American Street and Interurban Railway Association and understand its plans for future work, are satisfied that it is worthy of most hearty support. To those who are not as well acquainted with its purpose, the addresses at Boston will prove most instructive.

The association requires during the year not only the support of the street and interurban railway companies, but also of all individuals who are interested in the electric railway industry. Under the new constitution, such persons can join as associate members. This is a departure from the former plan, and for this reason may not be generally understood. Associate membership entitles a person to receive a copy of the annual printed proceedings of the association, and this privilege alone is worth the annual dues. There is no reason why the association should not receive many applicants for associate membership from officials and others who are connected with companies which are active members of the association. The proceedings of the association will contain technical information of the highest value, and in a much more complete and convenient form than the reports which appear in the technical papers immediately after the meetings. Such a file of volumes should be invaluable to any man who is engaging in the industry as a life's work, even if associate membership in the association did not carry any other privileges. President Ely announced that he hoped that the associate members would include 1000 persons before the close of the association year, and when we consider the number, both of those actively engaged and those indirectly interested, in the industry, who ought to welcome the opportunity of allying themselves individually with the association, this estimate appears extremely moderate.

Proportioning Car-Resistance Steps

When one considers what a small amount of trouble it is to properly proportion the different steps of the resistance in the motor circuit of a car, he wonders the more at the great number of cars that do not have their resistance leads connected as they should be. To the passenger the effect is very evident. The car, instead of having a smooth acceleration, starts with one or two jerks. If the car is traversing city streets where the stops are frequent, this effect becomes very annoying, and no doubt induces many to walk to their destination rather than submit to the rough usage they know they will experience if they board a car.

The effect on the motor and on the car in general is not so evident, but could the percentage of repair costs for a year due primarily to wrongly proportioned resistance steps be isolated, the impression on the management would often result in more attention being given to this small but important detail. The effect on the electrical equipment could be shown in a rather impressive manner by placing an ammeter in the motor circuit. On some cars, where practically all the resistance is cut out on one point, the needle would indicate several times the normal current. The excessive amount of current is a good indication of the strain put on every part of the car, and where this strain is several times that for which the car is built, or several times that for which there is any occasion, it is no wonder that there are numerous breakages of parts and loosening up of nuts. The working loose of these, of course, permits the parts of the car body to loosen up, and in a year or two what might have been a solid car is ready to be sold as a children's playhouse. And all this is due to a little carelessness about connecting resistance leads into their proper places. Where all the resistances under a car are connected in series, it is at the most not more than a one-hour job to disconnect them and then connect them properly, and on a comparatively large per cent of cars we believe such an hour would be well spent. Besides the harm resulting to the equipment and discomfort of the passengers due to the causes outlined, there is always a good chance that the wheels will be started slipping on the point that the jerk occurs, and this interferes with rapid acceleration, necessary to good operation in large cities.

D. C. Operation at Higher Voltages

The letters from Mr. Sprague and Mr. Mudge, published in this issue, are interesting contributions to the knowledge whieh we have on heavy electric railway work. Mr. Sprague, who has long been known as an advocate of higher voltages for direct-current operation, states unequivoeally that he is willing to recommend under present conditions a working pressure, even on a third rail, of not less than 1500 volts, and predicts that even this is not the limit of d. c. operation. Mr. Mudge has something to say about European practice with high-voltage d. c. machines, and in referring to the New Haven order, enters a mild protest against unwarranted enthusiasm over the a. e. eommutating motor.

In certain respects there is just now a curious resemblance in the traction field to the situation which existed in the lighting field fifteen years ago. Electrical engineers were then divided into two camps, each well fortified and with its artillery trained upon the other. It was war to the knife and no quarter asked or given. The lines of attack and defense were laid out then very much as now. The battle cry of the a. c. legions was efficiency and economy in distribution, to which the d. c. contingent responded by shouts for standard apparatus and conservative methods. The conflict, at first fast and furious, gradually merged into forays on the one side and a financially fortified trocha for defense on the other, and has now developed into a condition wherc the field and economic limitations of each system of distribution are pretty clearly recognized by all.

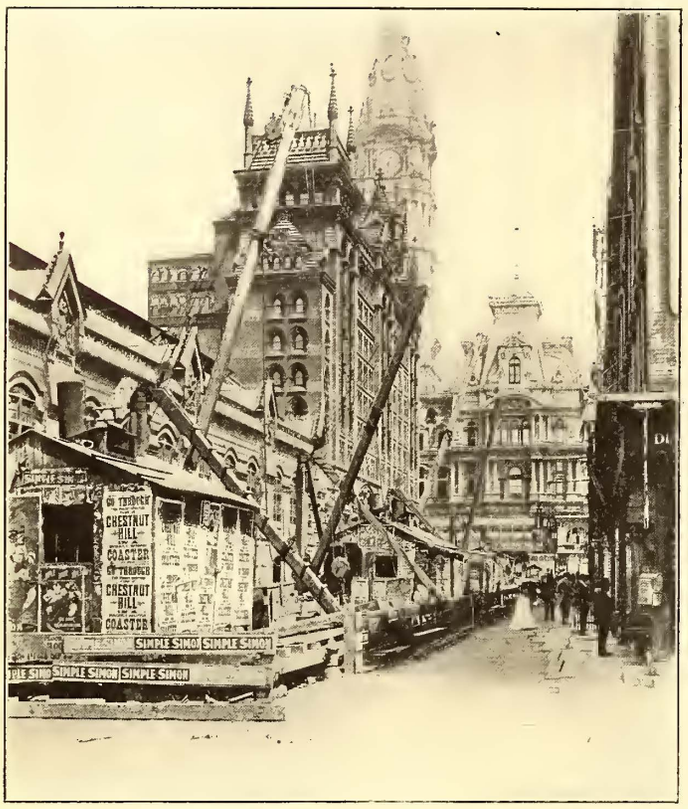
It requires no great foresight to predict in the present case a somewhat similar campaign, and it remains to be seen whether the same parallel will apply to the final result. So far as the New York, New Haven & Hartford Railroad case is concerned, the real issue involves very much more weighty considerations than the mere sale of a. c. locomotives on an unexpectedly large scale, or a change of motive power on a large suburban division. If these locomotives prove thoroughly successful from an operative standpoint, direct-current operation on a large scale will receive a serious check. Granted success with the alternating motors, and the advantage of distribution lies so far on the side of the alternating current that comparison is a waste of good ink. It is not a question of distribution at 500 volts, or 1000 volts, or 1500 volts, but at 3000 volts, or 10,000 volts, or 15,000 volts, together with the abolition of rotary converter sub-stations, and all the losses and eomplications thereby implied. We readily grant with our two correspondents that the last word on direct-current voltages has not yet been said. It may be perfectly feasible to build successful traction motors on a large scale for the direct use of 1000 volts or 1500 volts. At present they are not included in the standard apparatus commercially available, and it must be proved, first, that they ean be successfully constructed, and second, that they will be as good and as cheap to maintain as either the a. c. or present d. e. motors.

The question of distribution is all-important in the larger field for electric traction. The key to the situation is high voltage on the working conductors, and whether this is attained by direct or by alternating current is a matter altogether subsidiary. At the present time the a. c. distribution has the best of the contention on this score, for which reason it is being pushed to the front. If it prôves feasible to distribute direct current at very high voltage, as Mr. Sprague and Mr. Mudge suggest, the advantage of so doing is not lightly to be put aside, since, unquestionably, commutation presents less difficulty in d. c. than in a. c. motors, other things being equal. Whether a 1500-volt d. c. motor will give better facilities for commutation than a 300-volt or 500-volt a. c. motor is, however, quite another question, which can be answered only by experience. Commutation is admittedly the chief difficulty in a. c. traction motors, and experience with them has so far been too limited to enable a proper judgment of the commutation matter to be formed. This, indeed, is the essential thing to be demonstrated in the case of the New York, New Haven & Hartford locomotives. There are now enough a. e. roads in operation to make it certain that in moderate sizes the motors perform at least respectably well. But there is a wide difference between commutation on a 50-hp motor and in one five or ten times as large, the same sort of difference that exists as between a 5000-volt arc dynamo and one of similar voltage for large current. In each case the question is not of theory, but of fact, and the fact is to be determined by building the machines. This test is now soon to be applied, and then more will be known about the matter.

Meanwhile d. e. traction has most assuredly not been frightened from the field. The recent award of several contracts, particularly the one for the line to Atlantic City, noted in our last issue, shows plainly enough that there is ample assurance of success with the means now at hand. Granted that the present d. c. apparatus can make a thorough operative and commercial success of the Atlantic City line, which no one is disposed to dispute, there is no good reason for delaying the work for the sake of a possible future advantage. If the time comes when it will pay to change the equipment to the alternating type, the change will doubtless be made, and meanwhile the road will be earning dividends. With the very great present use of d. c. apparatus, the situation is certainly not one that demands precipitate action, for, even granting the success of the great experiment now under way, it will take a good many years to work a complete revolution in methods, and meanwhile the present apparatus will be earning the cost of its own replacement. A road well equipped with the standard apparatus of to-day is in position to give a good many years of useful and profitable service, whatever turn affairs may presently take. It is in new work, the exploitation of a new field, that the alternating-current motor, granted its success, will find immediate and profitable application, just as the polyphase system found its field in electric power transmission a decade since, without to any considerable extent interfering with existing direct-current plants. The immediate effect of the a. c. motor would be to fill a useful place of its own and to improve d. c. practice. We see this plainly in the letters from Mr. Mudge and from Mr. Sprague. The advent of a 1000-volt d. c. system for traction would be a good thing in and of itself, quite apart from its effect on a. c. railway work. So far as we can see, the art will be greatly advanced, whatever the outcome. If the a. c. motor is able to push its d. c. confrere up stairs, into the region of economical working voltage, so much the better for the railway business at large. What the practical railway man wants is a cheaper and more efficient system of equipping long lines than now exists. The particular kind of apparatus by which the result is achieved is a matter of comparative indifference, for he will probably have to make considerable changes in his equipment in any event. Therefore, he looks at the present discussion cheerfully and without fear of the final result.

THE OPENING OF THE PHILADELPHIA SUBWAY

On Monday, Dec. 18, the first section of the Philadelphia Subway was officially opened by the operation of surface cars



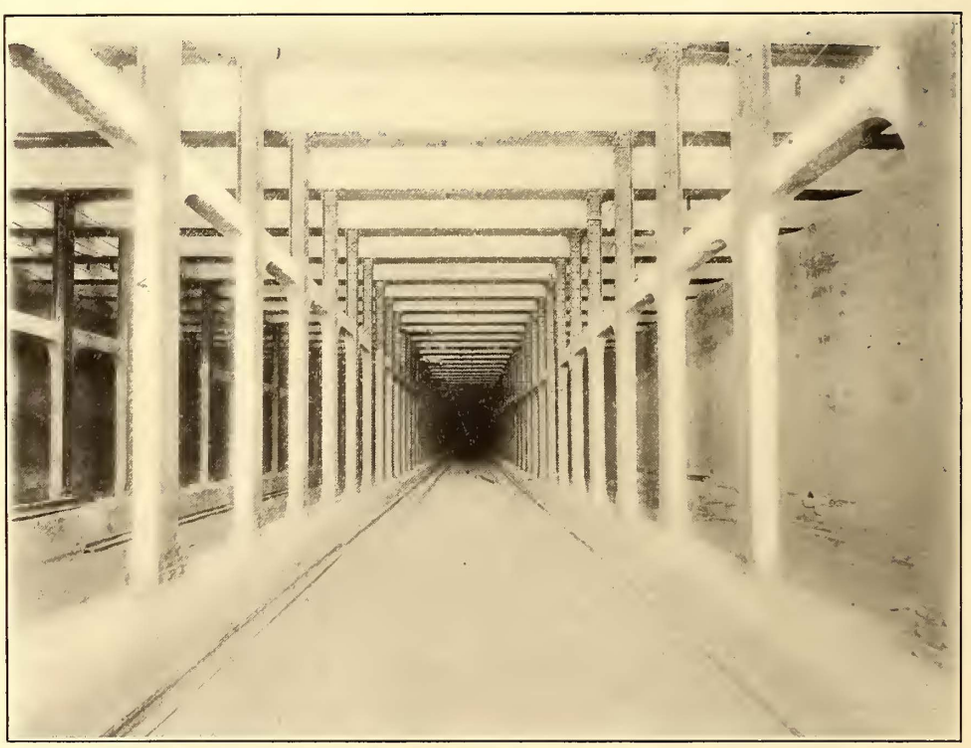
DERRICKS ON SOUTH SIDE OF MARKET STREET AT FIFTEENTH STREET LOOKING TOWARD CITY HALL

on a 5-minute schedule. These cars belong to one of the divisions of surface cars which run out Market Street, and the section of subway now in use extends under Market Street from Fifteenth Street to the Schuylkill River. After leaving the subway the cars cross the river on the new bridge erected by the Philadelphia Rapid Transit Company, connecting Philadelphia and West Philadelphia.

The subway is not entirely completed from Fifteenth Street west, as there are to be four tracks, two for express trains and two outside for surface cars, which enter the subway system at Thirtieth Street. For the express service the company will employ trains made up of all-steel cars, which after crossing the Schuylkill River will continue out Market Street on an elevated railway structure as far as Sixty-Third Street. The completion of the elevated structure, however, has been delayed by the strike in the building trades, so that it will not be possible to put the elevated trains in service for some considerable time. It was thought desirable, therefore, to utilize the subway for surface cars immediately and thus relieve that portion of Market Street between Thirtieth Street and Fifteenth Street of part of its traffic. The local tracks in the subway will then be used by trolley cars as far east at the Nineteenth Street station, where the cars will cross over on to the express tracks. They will then use these tracks to Fifteenth Street.

On Dec. 16, the Saturday preceding the opening of the subway, a number of prominent railway engineers and managers, city officials and others interested in elevated and underground traffic made an informal inspection of the subway. They were the personal guests of John B. Parsons, president of the Philadelphia Rapid Transit Company, and about 500 were present. The subway was entered at the Fifteenth Street and the Nineteenth Street stations. No attempt was made to run cars, as the guests preferred to walk through the underground passage, which was lighted by temporary fixtures as well as by the permanent lighting system of the tunnel. At 1 o'clock an elaborate lunch was served at the Nineteenth Street station, which had been temporarily enlarged by extending the platform over the westbound track. On Sunday, Dec. 17, the Philadelphia Rapid Transit Company extended a general invitation to the citizens of Philadelphia to visit and inspect the subway, and more than 50,000 people took advantage of this opportunity. Many of them walked the entire distance from Fifteenth Street to the Schuylkill River.

An extended account of the subway and elevated plans of the Philadelphia Rapid Transit Company was published in the Philadelphia convention section of the issue of the Street Railway Journal for Sept. 23, 1905. As will be remembered, the present completed subway section between Sixteenth Street and the portal at Twenty-Third Street is a small portion only of the proposed system. When completed there will be an elevated railway from the Schuylkill River to Sixty-Third Street. The subway is to be extended east around the City Hall, and thence under Market Street to Water Street, where it will emerge through a portal on to an elevated structure which runs north on Water Street and east on Arch Street to the Delaware River, and then south along the river front, a distance of a little over ½ mile. This portion of the subway will be double-tracked and is intended for express trains only.



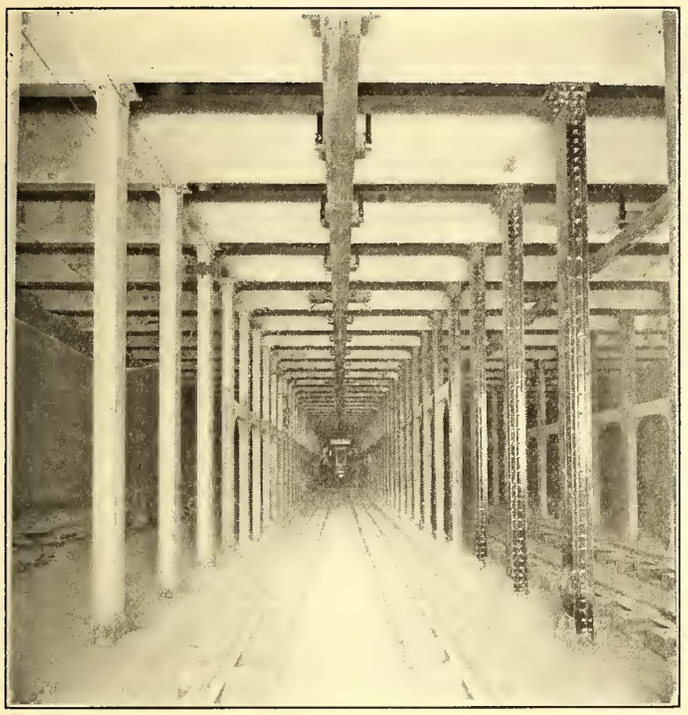
VIEW TAKEN SEPT. 26, 1905, BEFORE TRACKS WERE LAID, SHOWING REINFORCED CONCRETE STRUTS BETWEEN COLUMNS

The two outer tracks in the subway, which are to be used by the trolley cars, will branch off from the present subway at the

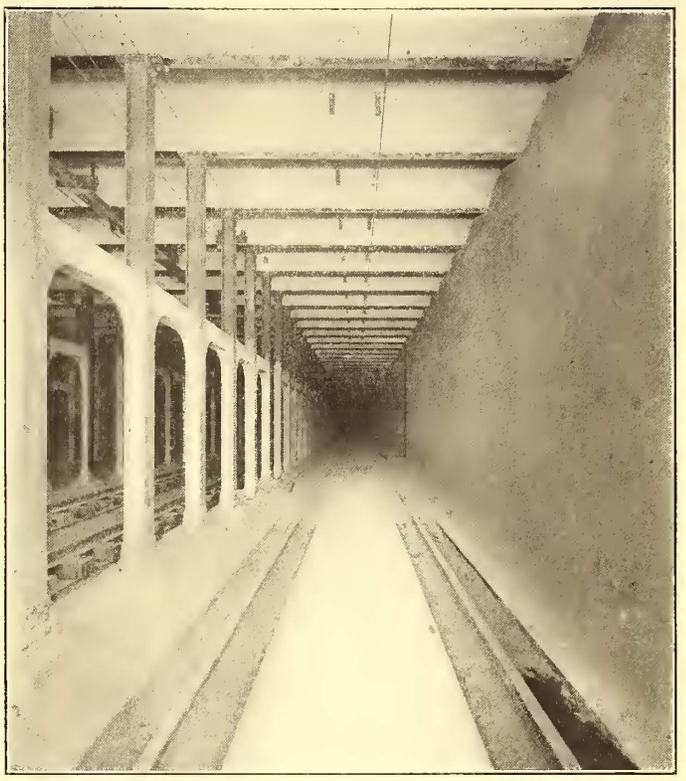
City Hall and will make a loop through the business district via Walnut Street, Fifth Street and Arch Street. In this way the trolley cars bound east from West Philadelphia will run on the south outside track in the present subway, and after making the loop described will return west by the north outside track.

SUBWAY CONSTRUCTION

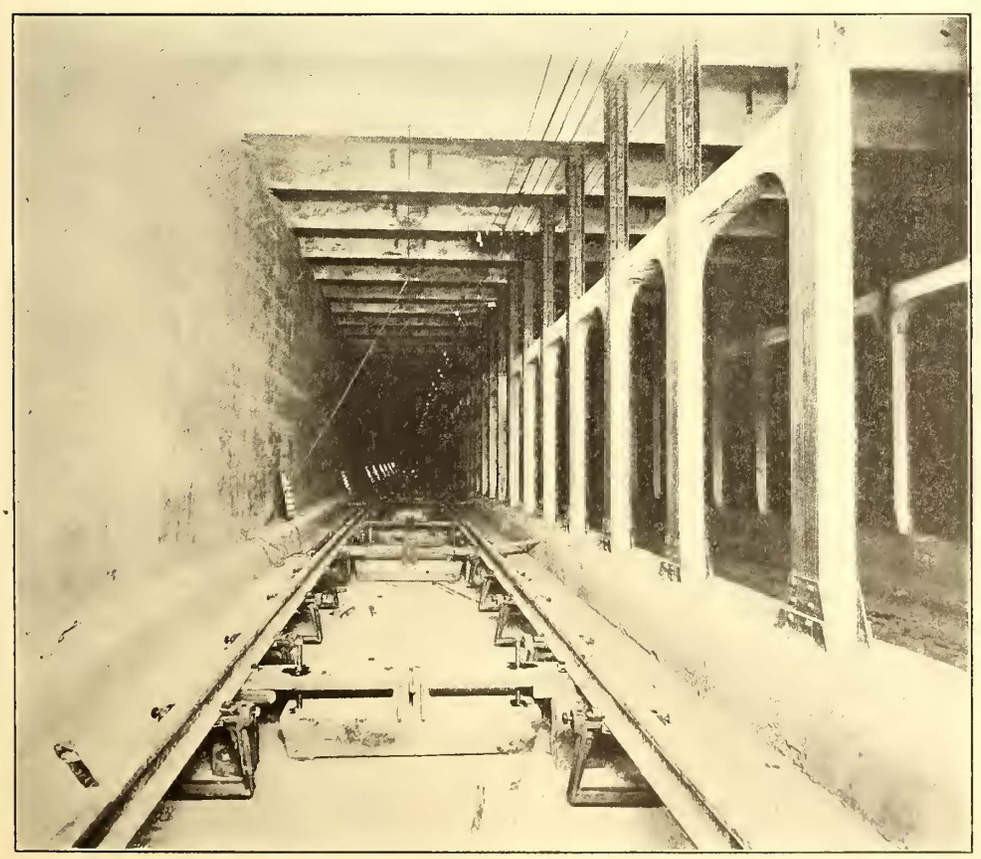
The subway structure on the present section has a width of 48 ft. 6 ins. in the clear between walls, and is 14 ft. 6 ins. high in the clear, above the tops of the rails. Three intermediate lines of columns support the roof, which is designed to support the heaviest street traffic liable in any municipality. The roof is formed of concrete arches, supported on steel I-beams, 5 ft. apart, placed across the subway; the side walls are of concrete, reinforced with steel rods, and the floor is of concrete alone. Terra cotta ducts, with manholes at frequent intervals, are built in the south wall, forming the conduits for the cables conducting electricity for the operation of the railway and lighting the subway and stations. The roof over its entire length is waterproofed with asphaltic mastic, 1 in. thick. The side walls are waterproofed where necessary with layers of burlap, coated with a compound consisting of the residuum from the refining of petroleum.



LOOKING UP AN EXPRESS TRACK. A THIRD RAIL WILL BE USED LATER INSTEAD OF THE OVERHEAD WIRE SHOWN



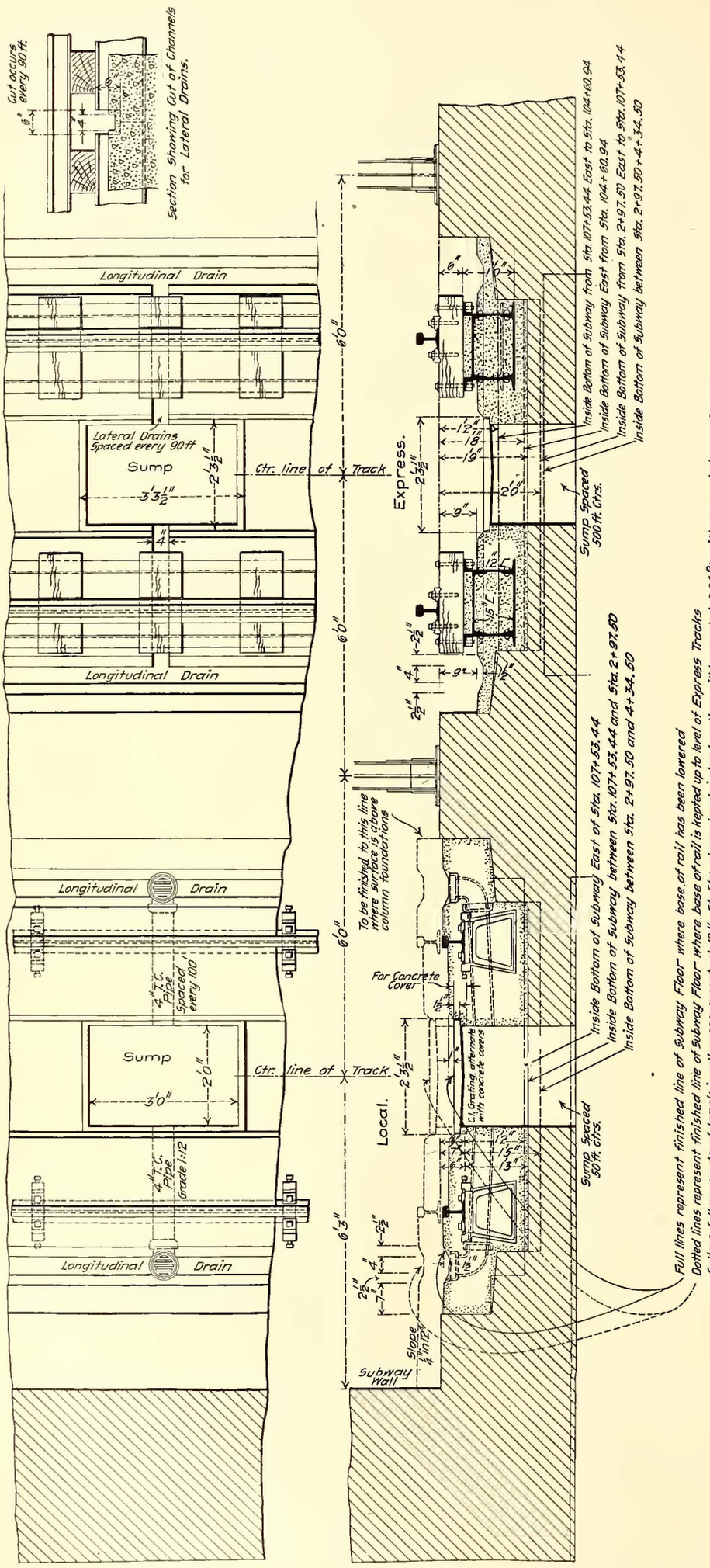
METHOD OF LAYING LOCAL TRACK IN TRENCH, WHICH IS AFTERWARD FILLED UP WITH CONCRETE



LOCAL TRACK BEFORE CONCRETE IS FILLED IN

The conditions as to underdrainage permitted the placing of subdrains below the floor of the subway, by which any appreciable head of water against the side walls is prevented. This increased the dryness of the structure and permitted the omission of the waterproofing on the parts of the side walls where they have been made thick to promote facility of construction by the adopted method.

The underdrains include two lines of terra cotta pipe, one under each outside track, with laterals passing to the exterior of the side walls every 50 ft. The main drains lead to a pump well at Twenty-Second Street, where the water is discharged into a sewer by electrically-driven centrifugal pumps



SECTION OF PHILADELPHIA SUBWAY AND PLAN OF TRACK CONSTRUCTION FOR LOCAL AND EXPRESS TRACKS

regulated automatically by floats.

The stations on the present section are located at Fifteenth Street, Nineteenth Street and at the east end of the Schuylkill River Bridge, near the line of Twenty-Fourth Street. The latter station is designed to make connection with the Baltimore & Ohio Railroad station, and, with the Fifteenth Street station, is for both express and local trains. The stations at Nineteenth and Twenty-Fourth Streets are intended for the trolley cars only. The stations are to be finished in glazed tile, probably of a buff color.

Ground was broken for the subway work on April 6, 1903, at Twenty-Third and Market Streets to begin the reconstruction of the sewerage system, which necessarily preceded the work on the subway proper.

LIGHTING

The lighting circuits in the subway are entirely separate from the power circuits. The subway lighting system is divided into sections about ½ mile in length, and the lamps at each station and for a distance half way to the next station on each side are supplied on a 110-volt circuit from the transformer located in the station. Each transformer sub-station is provided with a throw-over switch by which the lamps can be connected, if necessary, in groups of five, on to the railway circuit.

TRACK CONSTRUCTION

The track is quite novel, as no ballast is used. The object is to keep everything in a perfectly sanitary condition, and the entire roadbed can be washed down with the hose and drained through sumps which are placed at frequent intervals. Different forms of construction have been used in the express and in the local track. In the latter the rails are mounted on cast-iron chairs, which, with the rails, are completely embedded in concrete. This form of construction has been employed for a number of years on the surface lines of the company with excellent results. The chairs or yokes are spaced 5 ft. apart and are provided at their upper ends with guide lugs in which are adjusting screws. The inside ends of these screws bear against holding blocks which grip the foot of the rail so that the rail is adjustable to exact gage by manipulating the screws. The rails are laid in a trench left in the concrete.

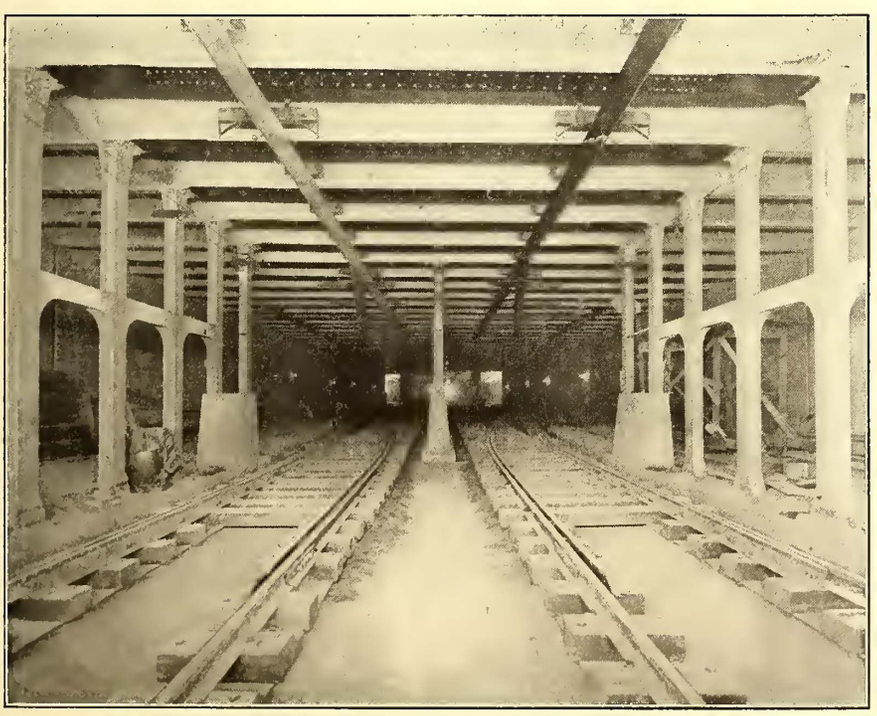
which forms the rest of the roadbed. They are then aligned and the concrete is filled into the trench even with the top of the head of the rail on the outside and with the lower part of the head of the rail on the inside. In this way, if a rail has to be replaced, it is only necessary to remove the concrete in the trench. Sumps are provided in the local tracks at average distances of 50 ft.

On the express tracks, except at cross-overs, the rails are mounted directly on yellow pine blocks 6 ins. x 24 ins. x 10 ins., to which they are attached by clips and screw spikes. These blocks are bolted to 12-in. channels, which are braced top and bottom at intervals by 15-in. channel braces. The longitudinal channels are set in concrete, as shown in the section on the opposite page. The sumps on the express track are placed 500 ft. apart. One rail of each express track has been reserved for block signaling. The other rail is bonded with a Mayer & Englund protected bond, and the two return rails are cross-bonded. The return circuit is then reinforced by a 2,500,000-circ.-mil cable. The local track rails are laid with the standard zinc joint of the Philadelphia Rapid Transit Company. The rails for both tracks are 90-lb. A. S. C. E. standard.

OVERHEAD AND THIRD-RAIL CONSTRUCTION

As the local tracks are to be used by trolley cars they are equipped with an overhead wire which is supported in a special flexible suspension. This consists of two 2-in. x ⅝-in. bars, which were set in the concrete roof of the tunnel while the latter was being built. To these bars are attached a 3-ft. 6-in. x 6-in. x 3-in. yellow pine timber, to which the wrought-iron brackets holding the flexible suspension are bolted. The double pull-off, which holds the trolley wire, is of the usual type, with two globe strain insulators, and is supported by a 5-16-in. steel span wire connecting the two brackets mentioned. The usual wooden guard plank is carried on the yellow pine timber above the trolley wire. A No. 0000 grooved trolley wire is used, and is held in a mechanical clip. A drawing of this suspension will be published in an early issue of this paper.

The express tracks and elevated structure will be equipped with a third-rail system. The type of third rail has not yet been selected. At present the express tracks will be equipped with the trolley system and will be used by the trolley cars until the elevated structure is completed.



CROSS-OVER NEAR NINETEENTH STREET STATION FROM EXPRESS TRACKS TO LOCAL TRACKS

VENTILATION

An interesting feature of the subway construction is the arrangement for ventilation which has been provided at different points. Ventilation is secured not only by the openings into the street at the different passenger stations, but also by special chambers which are connected to stacks outside. Arrangements have been made at the base of these stacks for the installation of fans if necessary, but in most cases it is thought that the natural draft will be sufficient. There are three of these stacks on the section now completed, viz., at Fifteenth Street, Nineteenth Street and Twenty-Second Street. Similar ventilation shafts will be constructed on private property on the section of the subway which will next be opened, viz., that east of Fifteenth Street.

VIEW DURING CONSTRUCTION NEAR PORTAL AT TWENTY-THIRD STREET, SHOWING CONCRETE BULWARKS

ROLLING STOCK

As already stated, the subway for the present will be used by surface cars, but an order for forty steel cars to be employed in express service has been awarded the Pressed Steel Car Company, which is now engaged on their construction. A plan of the seating arrangement of these cars will be published in an early issue. The cars are provided with side doors as well as end doors, although it is not the present purpose of the company to utilize these side doors. In case the traffic increases, however, so as to cause any considerable delay in station stops, the seats will be removed and the side doors will be used. The platform doors are arranged to be opened pneumatically, as in the latest cars of the Boston Elevated Railway Company.

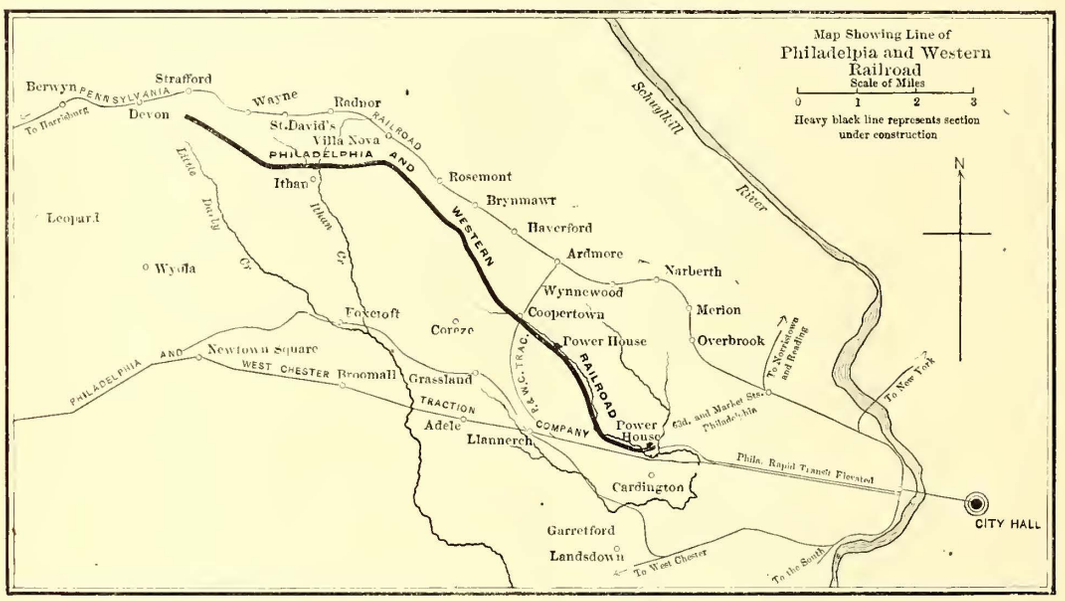
ENGINEERING

The engineering for the Philadelphia Subway was conducted directly by the engineering department of the Philadelphia

Rapid Transit Company, and was in direct charge of W. S. Twining, chief engineer of the company. Mr. Twining's principal assistant in this work was C. M. Mills.

THE PHILADELPHIA & WESTERN RAILROAD

The Philadelphia & Western Railroad Company, about which several items have appeared in recent issues, has now more than 11 miles of road actually under construction, and all work has been carried out in a most substantial manner. The route of the road is shown in the accompanying map. As will be seen, it extends from the termination of the Philadelphia Rapid Transit's subway-elevated line, at Sixty-Third and Market Streets, Philadelphia, to Devon Road, Strafford. Beginning at the end of the Rapid Transit Company's line, and extending westward, the grading is completed practically for about 6 miles. Grade crossings have been avoided, and there is a large number of heavy fills and deep cuts. All the culverts and bridge abutments are of concrete. Between Bryn Mawr and Villa Nuova, the company is building a steel bridge 400 ft. in length and 62 ft. above the small stream crossed. After crossing the west branch of the Ithan Creek on a fill and bridge 30 ft. in height, the road will run through a cut nearly a mile long and terminating on West Wayne Avenue, in Wayne. The last 500 ft. of this is through solid rock. Grading is being done for a loop at Strafford, which is the furthest point that cars will be run at the opening, and this will doubtless be the terminus of one-half the suburban service for some years to come.



MAP SHOWING ROUTE AND TERRITORY OF THE PHILADELPHIA & WESTERN RAILROAD

All the grading is being done for a double track throughout the 11 miles, and several side-tracks are planned at intermediate points. The heaviest grade will approximate 2.5 per cent, but this will be for a short distance only. Other grades will run from 0.5 per cent to 1.5 per cent, with some nearly level track for short distances. The country itself is hilly, rising from tidewater at Philadelphia to about 400 ft. at Wayne and 456 ft. at Malvern, 21 miles out. The curves will run largely at 1 deg. and 2 degs., with a few 3-deg. and 4-deg. curves, and a very few sharper. All of them will be safe for a continuous speed of from 55 m.p.h. to 60 m.p.h., and most of the road will be good for 70 m.p.h. or 75 m.p.h.

Both tracks will be of 80-lb. A. S. C. E. section rail, laid on 6-ft. x 8-in. x 8-in. ties on stone ballast. The third rail is of an inverted U-shape. It weighs 40 lbs. to the yard, and is laid in sections 30 ft. long.

The cars, which have been ordered from the St. Louis Car Company, will be about 51 ft. in length, and will be equipped with the multiple-unit control so that they may be operated in trains.

The power house is being erected at a point along Cobb's Creek, 3 miles from the Philadelphia terminus. The equipment has not yet arrived, but work on the building is progressing steadily.

The Philadelphia & Western Railroad practically parallels the Pennsylvania Railroad, being about 2 miles to the south of Merion and Narberth, on the latter road, and less than a mile from the Pennsylvania between Bryn Mawr and Strafford. Each town is passed through in the southern part, which is most built up and furthest from the steam railroad, until Wayne is reached, where the Philadelphia & Western runs along the high ridge to the south of the town, while the Pennsylvania runs through the geographical center. The new line, though, goes through a very desirable part, and, it is thought, will assist greatly to build up the heights.

Although no preparations have been made as yet to extend the construction beyond Strafford, the original charter gives the company the right to extend to Parkesburg, 44 miles out of Philadelphia, passing through Devon, near Berwyn, Paoli, Duffryn Mawr, Malvern, West Chester, Downingtown, Coatesville and Pomeroy. There is an electric railway in operation between West Chester and Downingtown, and another between Coatesville, Pomeroy and Parkesburg, but they would not form a part of the Philadelphia & Western, as their grades and curves would not permit, and they have only street railway charters, while the Pennsylvania & Western has a steam railroad charter.

With a population of about 12,000 within 1 mile of its line, between Philadelphia city line and Strafford, and a competitor running 116 loaded local trains (not mentioning nearly fifty more through express trains not stopping within the suburban territory mentioned), the Philadelphia & Western will have an excellent chance to show whether it can divert a huge slice of the Pennsylvania's business or whether it can increase the already abnormal traffic to still greater proportions.

CLEVELAND CHAMBER OF COMMERCE COMMITTEE ASKS FOR SECRET HEARINGS ON FRANCHISE RENEWAL QUESTION

The Chamber of Commerce Committee of Cleveland, appointed to investigate and work out the franchise renewal problem, has declined to accede to the suggestion made by Mayor Johnson and President Horace Andrews, of the company, that the investigations and deliberations be made in public. The committee believes it can best bring out the facts in detail if the parties giving information were free from the embarrassment that an open session would involve. The committee will receive and consider written communications from parties interested, and it will make an exhaustive study of statistics from all possible sources. It is the intention of the committee, however, to give out from time to time such information as is deemed advisable and practical.

CORRESPONDENCE

A NEW AND HIGHER STANDARD OF D. C. OPERATION

New York, Dec. 14, 1905.

Editors Street Railway Journal:

The hope of extended electric equipment and operation on the main lines of trunk railways, as distinguished from special problems such as terminals, tunnels and congested sections, lies not alone in the possibility of increased traffic or economy of operation, but in such limitation of capital investment as will keep the burden of interest account measurably below the savings effected.

A vital element in this investment is, of course, that relating to sub-stations and conductors. As to the latter, it is evident that greatly increased potentials are necessary to keep down their size, or with any given cost of conductor per mile to increase the distance between sub-stations, with resultant less aggregate investment in them and higher economy in operation. These are common requirements, no matter whether alternating or direct currents are used. The bearing of the increase of potential upon the problem is quite evident from a consideration of the following general facts: When the traffic increases directly as the mileage, the distance between sub-stations, with any given loss and size of working conductor, will increase directly as the increase of working potential; on the other hand, so long as the train load between sub-stations is not increased, this distance will increase as the square of the potential; but taking the average of service conditions on a trunk line, the allowable increase in sub-station distance will lie between these extremes. To illustrate: Doubling the working potential would probably on an average allow trebling the sub-station distances, and trebling the potential would very likely allow an increase to, say, five times in distance.

To meet the various economic requirements, and proceeding on the assumption that 500 volts to 600 volts is the limiting standard for d. c. operation, the principal energies of many engineers and manufacturing companies have of late been devoted to operation by alternating currents, with varying degrees of success as applied to railroads, with the abandonment of third-rail construction and adoption of a special type of overhead contact. These developments have resulted in a variety of designs for both polyphase and single-phase motors, and considerable divergence in views as to potentials, frequency and mode of construction and operation where the single-phase has been adopted.

It is not my purpose at present to enter into a discussion as to the comparative merits of the various systems, all of which have their field of usefulness. I have long advocated, and am keenly alive to the economic bearing of increased potentials, however obtained, but also mindful of certain practical features which must be considered in connection with them. I believe, however, that where alternating-current motor operation, with overhead construction, is adopted, there is little reason for halting at any moderate limit, but that such potential should be used as may be necessary, all things considered, to get a reasonably full measure of the possible economy of investment.

On the other hand, I have frequently pointed out that the limits of d. c. operation are by no means reached, and that 500 volts or 600 volts was an arbitrary standard which present possibilities in construction of apparatus no longer warranted maintaining when leaving the field of tramways to take up the consideration of trunk line applications.

The time has now come, I think, in view of the developments which are taking place on the terminals of the roads entering New York City, the interest which railway officials are taking in the subject, and especially because of the various claims which are from time to time made, when equipment engineers, in considering the practical application of electricity to the more serious problems of railway operation, shall have as a choice the possibilities of higher limits in d. c. as well as in a. c. operation.

To that end I beg, therefore, to announce that if in any case, after considering the various kinds of equipment possible, it should seem from an analysis of all elements entering into the problem that a comparatively high potential d. c. equipment would produce the best net results, I am prepared to engineer and carry to a successful conclusion a d. c. installation at a working pressure, even on a third rail, of not less than 1500 volts, which is at least two and a half times that ordinarily used.

I believe that it may be admitted that, although oftentimes having taken a somewhat radical and advanced position in electric railway matters, I have never made a public proposal which I have not been ready when called upon to carry out, and should conditions arise warranting an equipment such as is proposed, I propose to establish a new and necessary comparative standard in equipment possibilities. And I venture further to affirm that 1500 volts is not the limit of practical d. c. operation.

Frank J. Sprague.

THE NEW YORK CENTRAL-NEW HAVEN SITUATION

New York, Dec. 14, 1905.

Editors Street Railway Journal:

The decision of the New York, New Haven & Hartford Railroad to use a. c.-d. c. locomotives must, in the light of present single-phase development, be regarded as a decidedly experimental undertaking. The advocates of the single-phase system are naturally very enthusiastic in attempting to settle at a single stroke a problem which has been in course of evolution for almost a decade, and which has been brought nearer a solution by the advent of a commercial single-phase motor.

The words of warning sounded by a distinguished railway engineer are of more than ordinary interest and should receive careful consideration, as it seldom happens, in problems of this magnitude where a distinct change in existing methods is decided upon, that men of such recognized ability care to have their opinions made public, unless it is after some substantial results have been obtained. The only object of these few lines is to call attention to the non-committal replies to the article appearing in your issue of Oct. 21, and sent as answers to such specific charges as are made in this article, by those who are in possession of the facts in the case, and who are able to throw some light upon the factors which led to this probably epoch-making decision.

It is well known that direct currents have certain limitations compared with alternating currents, but the tendency of late seems to exaggerate these features to such an extent, and especially in problems of this nature, that those not intimately acquainted with the facts are led to believe that these limitations are of such a vital character as to positively and finally decide in favor of alternating current were suitable equipment apparatus of this latter type always available. This impression is not only absolutely false in a great many cases, but it would have a very detrimental effect upon the future development of the direct-current system unless the enthusiasm of the reformers is not occasionally moderated by opinions of older heads who have been through the mill and know full well that rational development along most lines of great commercial activity is naturally slow if it is to remain healthy.

There is no doubt that alternating current will play a most important part in the great problem of the electrification of steam roads, but it is quite worth our time to remember that any system capable of being so rapidly developed to the im-

portance of the present d. c. system, must have inherent virtues which are not going to die as easily as some of its apparent enemies seem to think.

That the direct-current system has reached or is anywhere near its final state of development, no conscientious engineer would prophesy, and just at this time, when we are being presented with results and tests of 1500-volt d. c. railway motors and rumors of 700-mile d. c. transmission projects, it would seem rather premature to consider 500 volts as either the standard or the limit.

The future of direct-current railway work should not be judged by its present development, as some of us are in the habit of doing, and the apparatus which is now supplied for 500-600 volts should only be considered as a stepping stone to the higher and more efficient pressures which are gradually coming into use. It is now practically possible to furnish reliable direct-current railway apparatus for twice this voltage, and with proper attention to the proportions and material of the magnetic circuit in the motors and the insulation and disposition of the controlling apparatus, no reason exists, whatever, why the advantages of high voltages should not be utilized in this system as they are in the alternating system.

Through recent applications and inventions the flexibility of the d. c. motor has been greatly increased. Commutation in direct-current circuits can be better and more easily taken care of than in alternating-current circuits, and the sensitive motor magnetic circuit when laminated throughout, combined with the practical application of the inter-pole with its enormous speed variations under good commutating conditions, suggest methods of control which would almost, if not entirely, eliminate the inefficient resistances now used in d. c. railway practice, and, even with these few modifications, the efficiency and flexibility of the present system would be greatly increased.

It is difficult to find a reasonable cause just why the impression exists that the development of the direct current in railway work is at or near the stopping point, and it is gratifying to see that the principal European electrical companies do not share in our skepticism as to the value of the direct-current system, but are ready to furnish apparatus for twice and, in some instances, three times the pressure some of us consider the limit. While the results of these new types of locomotives are anxiously being awaited, it appears to me that now is an excellent opportunity for those who are more or less acquainted with the facts relating to their choice, as well as those who are acquainted with both the a. c. and d. c. side of the situation, to register their opinions and save their feelings for some other time.

Charles A. Mudge.

THE DESIGN OF INTERURBAN CARS

Sheboygan Light, Power & Railway Company

Sheboygan, Wis., Dec. 11, 1905.

Editors Street Railway Journal:

The criticisms of the interurban car suggested by the writer in the Nov. 18 issue should prove to be of interest, and the writer is under obligations to the gentlemen who have been kind enough to discuss the matter. Mr. Bacon, in his communication, shows clearly that he had in mind a suburban car, while Mr. Giffen apparently had an interurban car in mind, but overlooked the fact that the car is proposed not for a road operating out of a large city, but for an interurban road having to travel a long distance between cities of moderate size, under which conditions there rarely occurs as much crowding as exists in suburban traffic.

The fact that nothing more serious could be charged against the design of the car than the rather trivial objections which are mentioned in both the communications, forms a strong recommendation for the plan suggested. A summary of the objections contained in the communications, as well as in your editorials, are as follows:

1. The difficulty of collecting fares.
2. Obstruction of view ahead.
3. Isolation of compartment.
4. Width of aisle.

All of the objections mentioned may be catalogued under one or another of these heads, and it may be of interest at this time to your readers to have another view of the situation:

1. In the collection of fares it should not be necessary for the conductor to enter the smoking compartment at all. Two or three hand holes in the partition will permit of the conductor collecting all fares in the smoking compartment without actually entering it. Mr. Bacon mentions the difficulty of collecting fares on the zone system, and thereby proves what has been referred to above, that he had in mind a car for suburban rather than interurban service.

2. The writer has not been aware of the fact that interurban cars have been constructed on any considerable scale with the object of giving a view ahead. As a matter of fact, the location of baggage and smoking compartments at the front end, and the location of heaters in the motorman's vestibule, are not particularly conducive to an uninterrupted view ahead, and the plan suggested in your issue of Nov. 18 has at least the merit that it gives half the car a clear and interrupted view, if that has any commercial value, which seems to be open to doubt.

3. The isolation of the compartment may no doubt be the cause of some neglect, and will require increased vigilance to keep it clean. As Mr. Giffen points out, if there is such neglect, then at least the location of the smoking compartment, in the proposed manner, has the merit of hiding the debris from the view of the more sensitive class of passengers. One of the objections named is referred to as the "cramped" position of the passenger in this compartment. In this connection it is curious to note that the plan as shown actually provides more room for the passenger's feet than he would have in a transverse seat, and such an objection, therefore, presupposes a too hasty comprehension of the design.

4. The fact that the aisle is not actually narrower than it would be without these compartments does not clear this form of design from the charges made against it, and it must be admitted that this design is weak in that regard, but it is so only on account of the fact, as Mr. Giffen points out, that in a loaded car a standing passenger may temporarily crowd between two seats. It is again apparent that this objection is more formidable on a suburban car than on an interurban car. The latter are not nearly as often crowded as the former, and the slight disadvantage of a narrow aisle, it seems to the writer, is very largely overbalanced by the convenience of the plan under normal operating conditions.

The objection referring to the inaudibility of the conductor's voice when calling streets, etc., may possibly be classified under this head. This objection is also made from the suburban standpoint, which can have little bearing in this case. The fact is that in city or suburban operation, the conductor, as a rule, pronounces the names of streets as if he were preoccupied in the mastication of a hot potato. In interurban service it is very rare indeed that a conductor is obliged to call the name of a stopping point. In the country the destinations are known to him, and in the city the calling of streets is occasionally attempted, but is quite useless, particularly if the man is a graduate from city or suburban service.

The writer is informed that there is a road at present contemplating the construction of cars along the lines similar to those proposed in the issue of Nov. 18. When these cars go into service the time will be ripe for a further discussion of the pros and cons of the question.

Ernest Gonzenbach.

THE POLICY AND AIMS OF THE AMERICAN STREET INTERURBAN ASSOCIATION

A short account was published in the last issue of this paper of the December meeting and banquet, last week, of the Massachusetts Street Railway Association, at which the subject of the addresses of the evening was the future of the American Street and Interurban Railway Association and the reasons which lead up to its organization. The speakers of the evening were J. E. Rugg, of the Boston Elevated Railway Company, who described the first meeting of the American Street Railway Association; Mr. Ely and Mr. Swenson. The date at which the last issue went to press precluded an extended report of these addresses, but in view of the general interest which attaches to the topic discussed, the remarks of the different speakers are given below:

MR. RUGG'S REMARKS

Twenty-three years ago to-night the first banquet of the American Street Railway Association was held, and twenty-three years ago to-day the constitution and by-laws of the association were adopted. It was a small beginning. If I recollect aright, one table accommodated all that were present at the banquet and a smaller hall than this accommodated all who attended. I suppose you are somewhat familiar with what caused or brought about this association, but perhaps it would not be out of place for me to say in a few words what I know about it. In the autumn of 1882, in September, a self-appointed committee of three (of which I was one) arranged for a vacation trip to go through some of the Western States and meet our friends in the street railway business. We went to Buffalo, where we met Henry M. Watson and S. S. Spaulding. We also stopped at Cleveland, Chicago, Louisville and Cincinnati, but there was no real object in our visit, except pleasure and association. The association was found to be pleasant, as we were all engaged in the same business, and after we got back it was arranged through correspondence that there should be an attempt made to form an organization. Mr. Littell, of Louisville, issued a circular over his own name to all the street railway companies in the country, asking them, if they favored the project, to communicate with myself in Boston. I was then superintendent of the Highland Street Railway and had been for ten years. Whenever these men came to Boston it was my pleasure to meet them and make their acquaintance, and it was thought perhaps it would be well for them to communicate their responses to me.

As soon as the circular was sent out there was quite a general response. Acknowledgments were received from perhaps a hundred gentlemen, managers of street railways from Montreal to New Orleans, and a very large proportion favored the scheme. There were only perhaps six out of all to whom letters were sent who did not favor it. It was decided that I should issue a call for a convention to be held at Young's Hotel on Dec. 12, 1882. The call was not issued until about two weeks before that date, and I know it was pretty close connection to get notice to New Orleans and back again before the convention was called. But the response was general, and we had a pleasant meeting of earnest men, working for the good of the business, and I think the constitution and by-laws which were adopted stand to-day. They were carefully considered and fully discussed in a two days' session.

That was the beginning, and you know what the result has been. The association has been growing; it has met the approval of street railway managers generally throughout the country, and to-day it is a strong body, officered by very strong and able men; but I want to say that no matter how strong and able the men are who are its officers to-day, or those of its successor, because it has followed the custom of most of the railroads that were in the formation, and absorbed and consolidated with other associations and made itself stronger and larger, there are no more able men to-day, no more earnest men in the official positions than were at that time placed at the head of the association. I am not speaking for myself, because I was not one. I was simply a helper; a pusher, trying to induce others; but these men who came to the front were much stronger and much abler men than I could ever hope to be. There were William H. Hazzard, H. H. Littell, Henry M. Watson and many others whose names I do not recall, but they are on record, and what they did and their success are on record as well.

I would like to be able to talk longer and say more, but there are other speakers to come. All I can say is that I am very glad to be here to-night and to meet so many men in the business which I have followed all my life and for which I have a great deal of regard. I feel that it takes the best men in the community to attend successfully to the business of public transportation. I wish to thank you for the opportunity and to wish the new association all possible success, and hope it may live long and prosper.

MR. ELY'S ADDRESS

I was greatly pleased to receive your invitation to be present here to-night, because it gave me an opportunity, in the first place, of meeting you all; in the second place, to observe your association and its membership; and, in the third place, to say something relating to the American Association, concerning which much has been done in the last two or three years, but about which something may yet remain to be explained and made clear to the satisfaction of all. It is a curious thing, a singular coincidence, that the American Association should have been born twenty-three years ago in this very building, on a Wednesday, and on the same day of the month, and that the coincidence should have been lost sight of, and not had in mind in the fixing of the date of this particular meeting.

At the risk of wearying you, I have felt that it would be well to take a running glance at the American Association and its history. Originating here, as has been described by Mr. Rugg, it seems to me we all ought to congratulate ourselves, and to unite in congratulating Mr. Rugg that he should be here upon this occasion, to stand in *loco parentis*, as it were, to the American Association at this time. It seems from an examination of the papers that the two documents upon which the organiation was founded were a letter which was in the form of a call signed by H. H. Littell, at that time superintendent of the Louisville City Railroad Company, and the acceptance, which was signed by Mr. Rugg, in fixing the date, in his capacity as superintendent of one of the Boston railways. In Mr. Littell's letter the statement of the purposes of the meeting which was called is as follows: "The formation of an association based upon well established principles governing similar organizations, the ideaof which shall be the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction, equipment and management of street railways, the establishment and maintenance of a spirit of fraternity among the members of the association by social intercourse, friendly interchange of information and ideas, to the end that the best service may be obtained at the lowest possible cost."

Among those actively associated with Mr. Littell in the fundamental work of the organization were Mr. Rugg, D. F. Longstreet, Thomas Lowry, Walter A. Jones, George B. Kerper, Henry M. Watson and Tom L. Johnson. In response to the call, which was issued by Mr. Littell, and the subsequent letter of Mr. Rugg, the meeting was held at this hotel on Dec. 12. It was called to order by Mr. Littell, and the Hon. Moody Merrill, president of the Highland Street Railway Company, of Boston, was elected chairman. Messrs. Woodworth, of Rochester, and Clegg, of Dayton, Ohio, were chosen as secretaries. On the following day the constitution and by-laws were adopted, and on that day, Dec. 13, the first meeting of the

association was held. The officers chosen were: President, H. H. Littell, of Louisville; first vice-president, Wm. H. Hazzard, of Brooklyn; second vice-president, Calvin A. Richards, of Boston; third vice-president, George B. Kerper, of Cincinnati; secretary and treasurer, William J. Richardson, of Brooklyn; executive committee, Julius S. Walsh, of St. Louis; Charles Cleminshaw, of Troy; Thomas Lowry, of Minneapolis; James K. Lake, of Chicago, and D. F. Longstreet, of Providence. I mention these names partly for the reason that so many of them have been so prominent in the street railway world from that time to this.

Coming to the objects of the association, they were defined in the constitution and by-laws as follows: "The acquisition of experimental, statistical and scientific knowledge relating to the construction and operation of street railways, and the diffusion of this knowledge among the members of the association, with the view of increasing the accommodation of passengers, improving the service and reducing its cost; the establishment and maintenance of a spirit of fraternity among the members of the association by social intercourse and encouragement of cordial and friendly relations between the roads and the public." The general scheme of the work of the association was the holding of an annual convention, at which reports of special committees were presented and papers were read and discussed. With the exception of the work of the special committees and the work of the secretary incidental to the printing and distribution of the proceedings, the entire work of the organization was performed at the annual conventions. In the early days of the association, a good deal of important work was done by the special committees, but as the time went on the special committees became fewer in number, and the work accomplished by them (except in certain notworthy instances, which constituted marked exceptions) grew less and less, and in the last few years very little of that work was done. So that, aside from the work done at the conventions and the work which was performed by the secretary and treasurer in collecting dues and assigning space to the manufacturers for their exhibits at the annual meetings, there was very little work done by the organization itself.

The association, during the time the special committees were active, devoted considerable attention to technical problems, such as questions of taxation, franchise rights, insurance, corporate control, patent suits, damage claims, municipal ownership, and other problems which were important, and from time to time were confronting the street railway interests. The association started with 31 members, grew in three years to a membership of 123, and by 1892 the membership had increased to 201. In 1893, 1894 and 1895 there were times of financial stress, and there was for some reason a lack of interest in the association, and the membership fell off, until in 1895 and 1896 very heroic measures were taken to rescue the association from what appeared to be danger of failure. From that time, within a few years after 1895, there was a considerable increase in membership, up to about 200 members, and with some slight variations the membership has been held at about that figure down to the present time. Unquestionably, it would have been very considerably increased had it not been for the consolidation of a great many companies in the great corporations which have been formed, in each of which several companies have been combined.

During the past ten years of the association the duties of secretary and treasurer, and the performance of the work that was associated therewith, have been very faithfully administered by Thomas C. Penington, treasurer of the Chicago City Railway, and the financial condition of the association has been good.

About the year 1893 the exhibit of the manufacturers of mechanical appliances pertaining to the business, which for some time had been assuming form, became the distinctive feature of the annual assemblages. This exhibit grew in size, until finally it became one of the most important features of the annual meeting. It became of great importance to the association for the further reason that the practice grew up of permitting the association to allot to the manufacturers space for their exhibits in the exhibit halls and to charge the manufacturers for that privilege. From that practice came quite a large part of the financial support of the association. Coupled with this growth of the manufacturers' exhibits, indeed, antedating it, there became established the custom of locating the conventions of the association in cities to which it was invited by the officers (quite often the president) of some one or more of the street railway companies of the particular city. With that practice there grew up that of responding to the compliment by making some popular street railway official in the city wherein the convention was held the president of the association for the following year. Possibly that had something to do with the fact that invitations were for some years frequent and easily obtained. But there came a time when, on account of the large number of persons attending the conventions (which brought, many times, several thousand) the burden of entertainment of the association on the part of the local companies became very, very onerous, amounting in those last years to many thousands of dollars; so that it came to pass that the compliment which was paid in return for the entertainment did not seem to counterbalance the expense involved, and the invitations about three years ago ceased entirely.

The dues which were paid by the companies for membership in the association were small, and the financial support was derived, as you have seen, largely from the sale of the space in the exhibit hall to the manufacturers and from the amounts contributed by the local companies toward the annual expenses of the conventions. When the invitations ceased, the last-named source of revenue ceased entirely, and then there was a feeling that the work of the association could not be prosecuted on a dignified and proper plane if the association were to become almost solely dependent upon the kindness and magnanimity and benevolent assistance, if you please, of the manufacturers' association, or the manufacturers themselves, because until two years ago there had been no association between the manufacturers. In the meantime there had been organized some eight years ago an association of street railway accountants known as the Street Railway Accountants' Association of America. That association had members largely composed of the auditors of the various companies throughout the country, and it devolved upon the different companies some additional expense, and the loss of the time of those who attended those conventions, for a period, during each year. Soon after there came other subsidiary associations. Two of them being formed and others in sight, that matter assumed a phase that was very important to the companies. This association had arrived at the point where it had its own expenses to pay; it had no place of meeting upon invitation in sight; it had the subsidiary organizations and associations to care for, and it became apparent to those who had been engaged actively in carrying on the organization, and who had happened to be placed in those positions by reason of election (possibly not of their own seeking) at the conventions from year to year, that something had to be done about reforming the method of work and of financing the organization, or the association might possibly find it necessary to discontinue the greater part of its work, or possibly be abandoned.

At that juncture it was decided to hold the convention at Saratoga Springs, and that the association should at that meeting hold its expenses down to the lowest notch, and defray all of the expenses except such portion as might be derived from the manufacturers. That was the last convention at which the association made any charge for the space allotted to the manufacturers' exhibit. At that convention the ques-

tion of reformation, reorganization, change in the lines of work and method of carrying on the work of the organization was very exhaustively canvassed, considered and agitated, and it was determined that it would be better, more dignified, more conducive to the attainment of proper results, if the manufacturers should be formed into an association whose duties and objects it should be to install and defray all the expenses of the annual exhibit, and to divorce that source of revenue from the association, and leave the association to care for itself and stand upon its own bottom in a dignified and proper way. That decision was arrived at as the common judgment and opinion of those who were present, upon consultation with many important men who were absent from that convention.

It happened that at that juncture I was chosen president of the association. I assure you that instead of having been voluntarily instrumental in this matter, it came upon me like a thief in the dark, and I was pressed into a service that has taken a great amount of time, and of the magnitude of which I had absolutely no conception at that time. It is no fad of mine; it is no fad of the men who have composed the executive committees during the last three years. An immense amount of painstaking and self-sacrificing work has been done by those gentlemen throughout the year, for the purpose of endeavoring to put that association where it belongs, in the first position among the technical societies of this country, and of the world.

Those gentlemen at Saratoga who took charge of the movement for the organization of a manufacturers' association worked hand in hand and shoulder to shoulder with the officers of the American Street Railway Association, and builded so well that the exhibit which has just been held at the Philadelphia convention deserved to rank almost as an exposition. Certainly, it did deserve to rank as an exposition of the appliances that are used in the street railway industry. It was most creditable to all concerned, and also to this association. At St. Louis there was no exhibit by the manufacturers. It was not deemed necessary that there should be, but the St. Louis convention followed the Saratoga convention, in that the association defrayed its own expenses entirely, except some entertainment which was afforded by the manufacturers' association.

Then came the meeting at Philadelphia, at which the measures which had been going on during almost three years culminated in the adoption of a new form of constitution and by-laws for the association. There was as little a departure from the old form as was possible to make and provide a new method for the prosecution of the work. It is hoped and believed that if all shall work together in the new organization, instead of the steady-by-jerks method of procedure which was afforded by simply meeting together once a year and then dispersing and practically letting the whole thing drop until the convention of the following year, work upon the problems that confront the street railway industry and its foremost members will be prosecuted intelligently, coherently, in a centrally directed way, throughout the year by the meeting of the convention and its committees, the secretary's office with an incumbent and proper assistants, and then such other instrumentalities as will be afforded by the subsidiary organizations, which will preserve their autonomy, but will be controlled and work under the direction of the central body. Assisting that will be the manufacturers' association, which will install its exhibits annually and pay the expenses therefor, and may provide such reasonable entertainment at the annual conventions as will meet with the approval of the executive committee from time to time.

This brief resume brings us to the work as completed at the Philadelphia convention. Since that time, the secretary who was chosen, Professor Bernard V. Swenson, has entered upon the discharge of his duties. An office has been secured at No. 60 Wall Street, in New York City, and the headquarters of the association have been opened there. The secretary, like the officers of the association, did not seek his position. The position sought the man, and his qualifications were the sole factor that brought about his appointment by the executive committee, which looked earnestly and with splendid advisers throughout the field, in its choice of secretary and treasurer. It is not my purpose to speak at this time of Professor Swenson and his qualifications, but I may say (and perhaps I ought to say) that in the judgment of all those who had anything to do with the selection and appointment, he is a man admirably qualified for the work, and I know I may say, from what I have seen of him, that he is a man whose work is in his heart, and whose heart is in his work.

Now we are face to face with the future. The expenses of the association from now on, if the work is prosecuted in the most careful and economical manner, will crowd the sum of $20,000. The fixing of the fees to be paid for membership in the organization was a branch of the work that occupied the attention of the executive committee for a considerable time, and upon which we sought the advice of different ones throughout the country. The scale of annual dues, given in the new constitution and by-laws, will provide sufficient moneys, if carefully handled, to defray our expenses, the expenses of the annual banquet being met by those who attend at the banquet, as has been considered proper should be done. As the association was previously carried on, $25 a year was paid by each company, and, in exchange for that $25, the association gave out two banquet tickets, which, at $8 or $10 a head (as was the charge at certain banquets) almost consumed the entire amount of the fee that the company paid for membership. Now we are all enlisted, I trust, for this work. There are two classes of membership provided for; the regular membership and associate membership. Any one interested in the street railway industry may become an associate member of the organization, receive its publications and all the benefits, except the privilege of taking part in the discussions upon the floor of the convention and voting therein, for the small sum of $5 a year, and it is the hope of the executive committee that during the next year at least 1000 associate members will be secured. I hope that in the next few months the response from New England will be as large as it is from the other parts of the country in this regard.

Now, with reference to the kind of work that is being carried on, the manner in which it is to be carried on, and the benefits that are to be accorded by the organization, that for the most part I shall leave to Professor Swenson, who will follow me. After careful investigation of the method and the conduct of the work for the past few years, I said, in my annual address at St. Louis, and again at Philadelphia, that it seemed to me that the broad fields of co-operative work were being neglected by the American Association. The American Association has in its membership the larger street railway interests of America, more than 200 companies throughout the United States, Canada, Mexico and even Porto Rico. Questions which affect us purely through our State legislation, purely State matters, will, of course, be best handled in the future, as in the past, by the State organizations.

I feel that I would not be doing my duty at this time if I should fail to congratulate this association upon the fact that in the years of its being, since 1888, seventeen years, it should have been able to hold as many as 182 separate meetings. You certainly are to be congratulated upon that, and surely the street railway business of the companies in Massachusetts and in New England must have been tremendously benefited by your association, and the work that was done at those meetings and between times. Now, while the work in Massachusetts, in New England, New York, Pennsylvania, Ohio, Indiana, and the other States, which is peculiarly State work,

may be best done, undoubtedly, by the State organizations, still it seems manifest that much can be done by the American Association in the way of acting in a measure in concert with the different State organizations, toward bringing into the different localities the benefits which obtain in others, and minimizing in each locality the injurious things that obtain. It is a fact that in looking at the street railway law and its administration in the different States of this country, one is struck very forcibly by the fact that if there had been co-operation among the street railway men in the different parts of the country, there might have been a far greater uniformity, not only of the statute law, but of the municipal law fixing the rights of the companies in franchises, and all sorts of municipal and State legislation.

The American Association, it is hoped, through a properly chosen committee upon State and municipal legislation, may still be able to do much to remedy these things, and to iron out these irregularities and these inconveniences that are surely present. When you come to think of it, gentlemen, this whole thing is yet in a formative state. There is no organization in this country so strong or so powerful that it can afford to stand alone, when in the same business there are many other organizations administered by capable and able men. In co-operation there is strength; everybody knows it; everybody practices it.

The American Street Railway Association and the industries which it represents to-day, has invested in it billions of dollars of capital. Hundreds of thousands of men are employed, and the operations of the business touch the daily life, comfort, convenience and necessity of all classes of citizens. To society and the law we owe duties, and to us society and the law owe duties. We are entitled in all parts of this country to fair treatment and just treatment. The best way to obtain it is to have a strong organization that is supported by a large membership, and that continuously through its organization and its method of work devotes an intelligent attention to all the problems of the day that confront the business. Mention has been made of some of the more important problems that confront us at this juncture, and in the course of my remarks at Philadelphia I mentioned the agitation in favor of municipal ownership that at that time had been making such progress in this country. Certain well-meaning, but misguided, representatives of the press seemed to have taken the idea that the principal object of our organization was to combat the principle of municipal ownership. No such position as that was assumed at Philadelphia, and no such position was advocated there.

I took occasion to point out certain facts that it seemed to those who had been consulted concerning the matter deserved investigation at the hands of this association, to the end that the truth might be known concerning the matter. It was not hinted at as the duty of this association to enter into an academic discussion with any man, or any set of men, concerning the principles of socialism, but it was suggested that we might very properly look into the facts which lie at the base of the proposition that municipal ownership of street railways in the municipalities of this country will be beneficial to all the citizens of the municipalities. The principal thing that is alluded to specially as a reason why municipal ownership of street railways in this country would be advantageous to the people is the statement that it works well in England, where it has been tried, and in other parts of Europe. Now, there are those who have made some important investigations concerning the working of municipal ownership in various cities in Europe, who hold an entirely different view as to the fact, and hold and entertain the opinion, and stand ready to justify it with facts and figures, that municipal ownership of public utilities is not working well in Europe. They further adhere to the opinion that even though it is working well there, and that fact could be established, that the conditions are so very different as to the communities involved and the service afforded, that it might not work so well here, even though it may be working well there. Whatever investigation has been made has, as I suggested, been very imperfect. There has never been prosecuted any inquiry in which those having a special knowledge of the business of conducting street railways have taken part. It was suggested that we might well devote some time to those facts, to the end that the truth should be ascertained.

Now, there are those among us who have expressed the opinion that it was useless to do that; that it is in this country a wave of popular sentiment which has arisen and is breaking over the country, and will expend itself without any particular injury, or that it will die away. Waves of popular sentiment in this country are not in the habit of dying away without doing something as the wave progresses, any more than epidemics are apt to die away without causing some havoc. I believe that it is for us to take some measures at this time to ascertain the facts, to the end that if we do no more, we will contribute those facts to this discussion. Since the Philadelpha convention, in many municipalities in this country the question of the public ownership of the public utilities in the different States has been made the principal topic and the principal issue in municipal elections.

The National Civic Federation in the United States has recently appointed a committee to make an investigation into municipal ownership, both in this country and Europe, and in making that investigation, to go into everything affecting it, the social conditions, financial conditions, and everything that affects the case, both here and there, to the end that the Civic Federation may inform itself upon the merits of the case and take whatever action it may deem desirable or best. Within the last few weeks we have had some conferences with various members of the sub-committee of twenty-one of the Civic Federation, looking to some kind of co-operative effort on our part, in connection with that investigation. It is believed that in some way this could be done, so that we would in a proper manner be represented in or about the investigation, which might be pregnant with great results, either of benefit or of injury to our business. That is about the situation, as far as any action or contemplated action on our part is concerned, touching the question of municipal ownership.

There are other questions of great importance affecting our business, which it would seem ought to be carefully considered from year to year by this association, and it is not only upon technical matters, but upon these broad problems of the day that the work of this association should be exerted. It would not seem to require argument; it would seem to follow as the night the day that intelligent work, every man and every company taking part, skilfully directing it and assisting in it, ought to be productive of great good and great benefit to the street railway industry.

Concerning the question of statutory law, and the possibility of effort from one part of the country being judiciously exerted in another part of the country, let me say that within the last three days there has come into the secretary's office in New York an inquiry from a very large street railway company concerning certain legislation that is proposed in a neighboring State. The inquiry will call upon the secretary's office for considerable work and considerable information concerning the status of statutory grants in this country. I undertake to say that there are large financial interests in the city of Boston that would have been very materially assisted in their investments in street railway properties outside of this State if there had been uniformity of the laws regulating such corporations and granting them their rights. There are States where it is impossible to obtain for an interurban railroad, no matter how greatly the public need may demand it, a franchise for a longer

term than twenty or twenty-five years. While that is not the condition in Massachusetts, or perhaps in any New England State, there are other things that are present in this section of the country not present in those sections, and things of benefit present there that perhaps may not be present here. Co-operation and intelligent investigation in the work must, it seems, be of great benefit to all of us.

I have said that which I came to say; I do not wish unduly to detain you. The new form of organization is afloat; it must be supported or it will fail. Its officers have entered upon the work of the year with a pledge to you and to themselves that they will do their duty to the uttermost and as best they may; but we may have a secretary's office in New York; it may be well equipped, and it may stay there until doomsday, but it will be of no avail unless it has your hearty support. The officers of the association, unaided by a large membership that works hard and earnestly throughout the year, can do hardly anything. If we are to have the benefits which should come from this organization, all along the line, we will only attain them by hard, united work and effort by the members of the street railway fraternity in New England, the Massachusetts Association and the New England Club, and every form of united and co-operative, as well as individual, work. I thank you for your attention, and I trust that we will surely receive the support of all who are here, and that the association will receive the earnest support of your association and its members.

MR. SWENSON'S ADDRESS

President Ely has addressed you upon the general subject of the history of the American Street Railway Association from its organization here in Boston just twenty-three years ago to-day to the close of the annual convention at Philadelphia, the last week in September of the present year. He has spoken of the close relations which have existed between the association and the street railway interests of this country and Canada and Mexico in the past. He has also pointed out the growth of the street railway interests during the past twenty-three years and the important part which the American Street Railway Association has played in this great development of properties. With the close of the Philadelphia convention the work of the reorganized association began, and it now becomes my pleasure to say a few words as to what the association is doing and what its plans are for the future.

As the name implies, the American Street and Interurban Railway Association is international in character, its membership comprising not only street and interurban railway companies in the United States, Canada and Mexico, but also companies which are operating such railways in the island possessions of our country. The word "Electric" does not appear in the title of the association, as it is an association of a certain general class of railways, irrespective of the means of motive power. The terms "Street" and "Interurban" have been considered as covering most comprehensively these classes of railways. The term "Street" refers to railways in cities, irrespective of whether they are operated directly on the public highway, on an elevated structure or in a subway. The term "Interurban," as applied to railways operating between cities, is quite specific in its usage and relates to the lighter type of railways which are now in general operated by means of electric power. The suburban roads of a city are so closely interrelated with the city and interurban lines that they are usually a part of one or the other of these systems, so that it was not considered necessary to designate them separately.

The first object of the association, as stated in the constitution, is "The discussion and recommendation of methods of construction, management and operation of street and interurban railways, and of safeguarding the interests of the same." This may be considered as covering the more general work of the association, particularly that relating to the annual convention, the reports of committees, and matters of this general class.

The second object is "The establishment and maintenance of a spirit of co-operation among the members, and the encouragement of friendly relations between the companies and the public." This is most vital to the interests of the association, and it appears to the speaker to be, in itself, a sufficient reason for the existence of the association. This co-operative principle enters into your every-day business, and is necessary to its successful conduct.

The third object is "The acquisition of experimental, statistical and scientific knowledge relating to the construction, equipment and operation of street and interurban railways, and the diffusion of this knowledge among the members." This means that the association is to carry on an investigating bureau of information, the primary object of which is not to be a mine of information which will have to be worked with pick and shovel, but rather that the material shall be tabulated, published and sent out among the members.

The membership in the association consists of two classes. The active members are the American street and interurban railway companies, or lessees, or individual owners of street and interurban railways. Each member is entitled to one vote, which is cast by the properly accredited delegate. The associate membership consists of individuals, co-partnerships and corporations who are actively identified with street and interurban railway interests, and other persons who, in the opinion of the executive committee, have had experience of such a nature as to render desirable their connection with the association. The privileges of the associate members are similar to those of the active members, excepting that they are not entitled to vote or to hold office, nor to have the privileges of the floor unless permitted by the association.

The active members must necessarily be considered as primarily constituting the association. It was for the mutual interests and advantages of the street railway companies that the American Street Railway Association was formed, and it was primarily for the interests of the American street and interurban railway companies that the association was reorganized in September of the present year.

The associate membership permits of a certain class of individuals, co-partnerships and corporations to become connected with the association. This is highly desirable, as there are many instances in which connections of great value to the association and to the member companies can be formed in no other way.

According to the constitution, the headquarters of the association are located in the city of New York, and the office of the secretary is maintained at these headquarters. This office has been opened at 60 Wall Street, where the association has three rooms on the sixth floor, containing 750 sq. ft. of floor area. The secretary has the services of an experienced office assistant, in addition to a stenographer. The representatives of the various street railway companies and of the different street railway associations of the country will be most cordially received at the association headquarters.

President Ely has spoken of the organization of the Accountants' Association, the Railway Mechanical and Electrical Association, the Claim Agents' Association and the Manufacturers' Association. In accordance with the scheme of reorganization, these various associations have now become directly affiliated with the American Street and Interurban Railway Association.

The Accountants' Association has been in existence for a period of eight years and has accomplished much work of importance. The Mechanical and Electrical Association was organized three years ago. At this year's convention in Philadelphia its name was changed to the American Street and In-

terurban Railway Engineering Association, and the constitution was so altered as to permit of the admission of maintenance of way engineers to membership. The Claim Agents' Association had its first meeting in St. Louis in 1904, and has already performed valuable service.

The Manufacturers' Association is somewhat different from the other affiliated associations in that it has no connection with the street railway interests directly. Its chief functions are the production of a most commendable exhibit at the annual convention, and the establishment and maintenance of mutually advantageous business and social relations between the street railway interests and the manufacturers.

The American Street and Interurban Railway Association is pledged to do all in its power to promote the welfare of the affiliated associations which have been organized with its approval to investigate technical matters connected with street and interurban railway construction and operation. Each of these affiliated associations (this does not include the Manufacturers' Association) is granted financial assistance, and is represented on the executive committee of the parent association. In addition, the latter association co-operates with the various affiliated associations in the editing, printing and binding of their proceedings, and in arranging for conventions and suggesting suitable subjects for investigation. It also files information for reference and distribution, and in every way endeavors to stimulate interest in all of the affiliated associations.

As in the past, a most important part of the work of the association will be that done by the various standing committees. These committees will consider such questions as are of broad and far-reaching influence among the street railway interests of the country. A committee of considerable importance in this connection will be the committee on papers, which will have the general supervision of all papers presented at the convention. It is expected that this will result not only in a large increase in the value of the papers presented, but also in a greater uniformity in the general character of these papers and their adaptation to the specific needs of the members of the association.

The annual conventions will be conducted along the same general lines as have been prevalent in recent years. The executive committee will select the place at which the convention is to be held, and will not depend upon the invitation of the local railway company to decide this question. As President Ely has remarked, the dignity of the association does not permit of its being dependent upon the invitations of the companies of various cities for a meeting place for its annual convention.

It is expected that with the reorganized association, and its affiliated associations, all working together, and with the committee on papers mentioned, that the conventions in the future will result in even greater good to the street and interurban railways of the country than they have in the past.

The various affiliated associations, as well as the American Association, have annual reports, which this year will each contain from 300 to 400 pages octavo. The reports of the affiliated associations are more or less technical, relating as they do to the specific fields of work for which these associations have been formed. The report of the American Association covers a broader field, and also contains the records of the general business of the convention. The editing of the proceedings of the 1905 convention has been carried on during the past two months, and it is expected that the various annual reports will be ready for distribution about the first of the year.

The idea of the establishment of an information bureau in connection with the work of the association has long been in the minds of many of the members who have been prominent in the work of the association. As far back as ten years ago, at the convention of the association held in Montreal in October, 1895, Joel Hurt, president at that time, in connection with some remarks relating to the saving of $200,000 for his company, due to certain information which he had received from various sources, made the following statement: "And it is as clear to me as the noonday sun that this institution needs a bureau of information."

The universal change to electricity as a motive power for street railways, in conjunction with other improvements in the industry, and with the general progress of the times, has resulted in a wide expansion of traction facilities in cities and a vast extension of suburban and interurban lines. This has in turn resulted in a readjustment of the attending conditions, with an ever increasing demand for information relating to the methods used and results obtained in conducting departmental work, and for statistics concerning investigations made in the interests of electric railway companies.

While the companies of greater mileage, for years past, have been accumulating information of much value along specific lines, the bureau will promote a more general interchange of such data between these companies than has been practicable up to the present time. Active investigations of such questions as insurance, taxation, franchise rights, municipal ownership, accident claims and statutory and municipal laws affecting electric railway companies are either now under way or will soon be taken up. The accumulation of data will be immediately available to all members of the association. The companies with greater mileage will thus be relieved of the constant inquiries by the companies with less mileage, and the information thus received, through the secretary's office, will be of greater value.

While the companies with less mileage can least afford to make experiments, they also can least afford to make mistakes. Although they may not be as vitally interested in municipal ownership, statutory laws, taxation and accident claims as are the companies with greater mileage, there will be available to them a large fund of information resulting from the long practical experience of such companies.

Active work has already been done on the subject of municipal ownership. The association will keep in touch with the municipal ownership investigating committee of the National Civic Federation. It is expected the work of this committee will be most comprehensive in its scope, and of great importance to the electric railway interests of the country.

The subject of insurance is now being considered, and the association has recently co-operated with the Fire Underwriters on the revision of the National Electric Code.

I cannot show the importance of these matters to greater advantage than to quote directly from the annual address of the president delivered by Mr. Ely at the St. Louis Exposition in 1904. The quotation is as follows:

> A careful inspection of the proceedings of the conventions of the last few years reveals the fact that most of the time of each convention has been occupied with the reading and discussing of papers embracing subjects which, for the most part, relate to the small technicalities of the business, and nearly all of which might have been profitably committed to proper auxiliary and subsidiary organizations. Broad fields of co-operative effort in the most important lines of our work have remained almost untouched. It becomes immediately apparent upon investigation and discussion of the situation that we might profitably enter upon the discussion of the greater questions affecting our welfare. The confusion of laws throughout the country affecting our corporations is a matter to which we might well devote attention. There are also such great questions as taxation; municipal ownership of street railways; franchise rights and obligations; statutory laws affecting our class of companies; municipal laws and ordinances, and other questions of importance to which your minds will readily refer. The collection and preservation of data tending to throw light upon the problems of great importance that confront us is also a matter deserving of attention, and in this regard it would seem that through the medium of the secretary's office and of appropriate standing committees many invaluable collections of data could be made and permanently preserved in

such form as to be conveniently accessible to any member of the association upon merely making request of the secretary. If the work of the secretary's office should be made continuous there would thus grow up in time a vast repository of valuable statistical and historical information, readily available as a matter of right to every member. This branch of the work alone, if properly prosecuted, would render membership in this association so valuable that it is difficult to understand how any street railway corporation would feel justified in remaining outside of this association.

It is the purpose of the association to issue bulletins at frequent intervals which will contain information concerning different matters of interest to members of the association. These bulletins will be the means of disseminating the data compiled at the association headquarters in connection with the various investigations carried on from time to time. They will be issued according to a standard size of page, which will be the same as that used in the annual reports. It is also proposed that suitable covers for the binding of these bulletins will be sent to the various members.

An important feature worthy of careful consideration is the scale of annual dues payable by active members. It is based upon the annual gross receipts, and represents the best judgment of the reorganization committee. While the new scale of dues is radically different from the old method of assessment, it has had the most careful consideration of the members of the association. It is believed to be fair and equitable to all classes. The association is taking its place among similar national organizations, and the new conditions of operation, resulting in increased usefulness, require larger expenditures than have been necessary in the past. Calculations based on last year's membership show that approximately $20,000 income may be expected the first year. This sum is none too large to carry on the important work now under way.

Before closing, I wish to say a few words in connection with the co-operation of the national association with the various State and sectional street and interurban railway associations. A number of associations of this general character have been organized at various times throughout this country and Canada, and many of them are now in a flourishing condition and are doing much work that is of great value. Prominent among these organizations are the State associations of Massachusetts and New York, the New England Street Railway Club, the Canadian Association and the interurban railway associations of Ohio and Indiana. A number of ways may be suggested in which these associations could co-operate with the national organization to the advantage of all concerned.

A scheme of interrelation which has worked out most profitably among other organizations having mutual interests is that of an association composed of the secretaries of the individual associations. By this scheme the secretaries of the various associations meet at stated intervals and discuss various matters of interest to the different associations. If such a scheme were launched in connection with the street railway associations it might serve as a general clearing house for carrying on various other schemes of interrelation, which will be considered later.

While many of the State associations have not yet arrived at the point where they have found it advisable to publish their annual reports, in many cases this will follow as a natural result of their future development. Several of these associations are now publishing their proceedings, a notable example being the New York State Street Railway Association. A scheme of interchange of the publications of the various associations might prove to be of great value to the members. This would be particularly true if some scheme of co-operation could be carried out with reference to the character of the papers presented at the meetings of the various associations. In like manner other information not in the nature of the annual report, such as bulletins showing the results of special investigations, might be interchanged to great advantage.

In order to make the papers of the various associations of greater value to electric railway people throughout the country, it would be well to have some general committee which would confer as to the papers to be presented and discussed at the meetings of the various associations. By this means important topics of vital interest would be considered and the different associations would not be overlapping each other's efforts, excepting where this would be deemed advisable.

Special investigations relating to different problems could be delegated to certain State associations, which would see that investigations were carried out and that the data obtained would be placed in proper form for publication. By means of bulletins this information could be sent to the members of the various associations. In this connection it might be possible to do some considerable work along the line of the interchange of legislative records and laws pertaining to street railway interests in the different sections of the country. If this could be done it would doubtless prove to be of great advantage to all concerned.

In connection with the general conference on papers, it could be arranged that certain special topics would be considered by the various associations at given meetings. It would not be necessary that these topics be the same for the different associations, but rather that the topics assigned should in all cases be such as are of special interest to the association given that particular topic.

To the end that the various associations might become more closely related, it would be advisable for each association to be represented at the annual convention of each of the other associations. It would also be highly desirable that the various associations send official delegates to the annual conventions of the American Street and Interurban Railway Association. These delegates should be prepared to present reports showing in brief the work which has been carried on by the various associations during the previous year.

In concluding my remarks on the association and the work to be done now and in the future, I wish to repeat what has been so forcibly brought to your attention by our president, that the American Street and Interurban Railway Association is now entering a sphere of greater usefulness than has heretofore been possible, and that it is vitally essential that its membership be largely increased, to the end that the greatest value and good be received by all companies.

The American Street and Interurban Railway Association does not belong to any one interest, or to any dozen interests. It is not the result of the ideas of one individual, or of the ideas of a dozen individuals. It is not the offspring of the president, although he has given much attention to it in the past, and is devoting much valuable thought and attention to it at the present period of its existence. Neither is it run for the benefit of any one interest or set of interests.

The reorganization of the association is the result of the labor of many persons throughout a period of more than two years; work undertaken and proceeded with throughout as of paramount importance to the street and interurban railway profession. Many busy men of large affairs have contributed greatly of their valuable time, and of their still more valuable experience and judgment.

The executive committee, the president and all associated with them stand ready to do everything in their power to make the work of the association of value to its members, but the success of their efforts must depend upon the street railway companies. It is your association. It is yours to make successful. It is yours to reap the benefits.

The Columbus Railway & Light Company expects soon to receive several cars equipped for the multiple-unit train control system, and it is the plan to operate two-car trains on several of the heaviest lines during rush hours.

RAILWAY EXHIBITS AT THE NEW YORK ELECTRICAL SHOW

Among the many excellent exhibits at the New York Electrical Show, whose opening was mentioned in these columns last week, were a number of special interest to street railway men.

The exhibit of the General Storage Battery Company, maker of the Bijur storage battery, proved quite an attraction to the technical visitors, besides the many laymen who were desirous of becoming acquainted with the construction and application of storage batteries.

The Electro Dynamic Company's inter-pole motors provoked considerable interest among the technical men present. The company showed one of its inter-pole motors driving an inter-pole generator, the current being used to light the booth sign. Demonstrations were given showing how this type of motor stands 100 per cent overloads without sparking, even when instantly reversed under such abnormal conditions.

The Kinsman Block System Company, of New York, exhibited its emergency control device which is used in the New York Subway to prevent the express trains running past danger signals. An emergency control device for steam locomotives was also shown.

The Gold Car Heating & Lighting Company showed some typical examples of its electric car heaters applied to car seating. Detached heaters were also exhibited.

The Clark Electric & Manufacturing Company displayed several of its clamps for high-tension transmission lines, such as are installed on important lines in Mexico, Brazil, Canada and other countries.

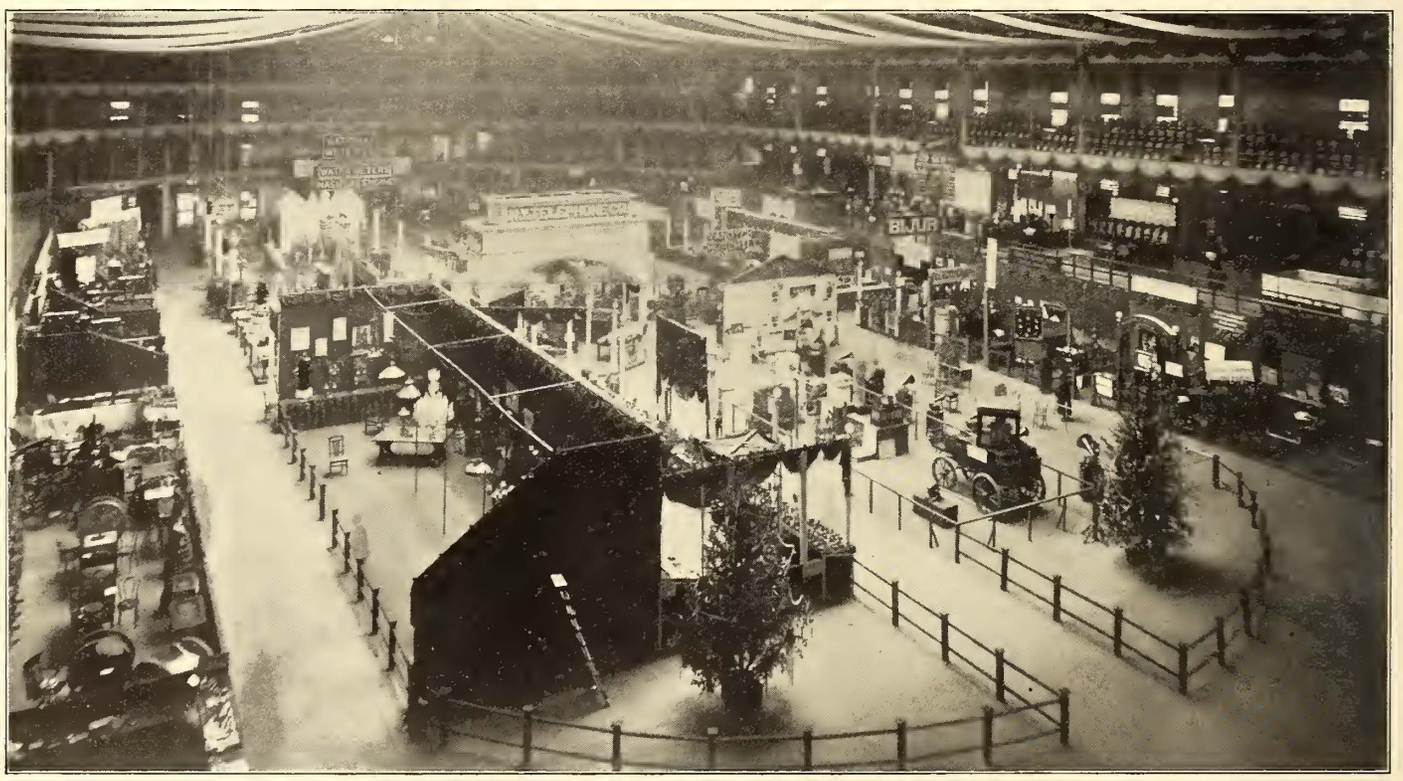
The National Battery Company made an interesting display of National storage batteries and accessories.

Guy M. Gest, the well-known conduit contractor, in common with the H. B. Camp Company and the American Vitrified Conduit Company, presented an exhibit of various styles of conduit, together with photographs of installations.

The National Carbon Company, of Cleveland, Ohio, made an exhibit of its dry and wet cells, as well as a number of carbon specialties. Its new expansion connection carbon brush, described in the Street Railway Journal of Oct. 28, was also shown.

Waterbury & Company were also on hand with a fine line of switchboard specialties, wires and cables.

The Magnet Wire Company and Peerless Electric Company had a combined exhibit of their electrical specialties.



THE NEW YORK ELECTRICAL SHOW IN MADISON SQUARE GARDEN, AS VIEWED FROM THE MAIN ENTRANCE

JANUARY MEETING OF THE NEW YORK STATE ASSOCIATION

President R. E. Danforth, of the Street Railway Association of the State of New York, has authorized the official call for a meeting of the association to be held Jan. 10 next in the rooms of the Schenectady Railway Benefit Association, at the Fuller Street station, Schenectady, N. Y. The meeting will be called promptly at 9:30 in the morning, and will adjourn the same evening. It will be in the nature of a conference, and the entire day will be devoted to a discussion of topics included under Accounts Nos. 6, 7, 8 and 9, namely, Maintenance of Cars, Maintenance of Electrical Equipment of Cars, Maintenance of Miscellaneous Equipment, and Miscellaneous Shop Expenses.

All member companies and non-member companies in New York State, and electric railway companies outside of the State, are earnestly requested to have a responsible representative from their mechanical departments at the Schenectady conference in January. Representatives of operating departments, whether members or not, are also cordially invited. However, the supply men and representatives of manufacturing concerns are not invited, and are asked to refrain from attending.

At the Schenectady meeting there will be two short papers, one on "Cleaning and Handling Cars in Car Houses," and one on "Layover Inspection vs. Night Inspection." Leaders will be appointed to open the discussion on each of these and other topics, and the meeting will then be thrown open and the fullest opportunity will be given for asking and answering questions and an interchange of opinions and ideas relating to the maintenance of cars and equipment. Delegates and representatives are urged to bring their figures with them. These will not be published unless the speakers release them for publication.

THE DECEMBER MEETING OF THE INDIANA ELECTRIC RAILWAY ASSOCIATION

The December meeting of the Indiana Electric Railway Association was held in the palm room of the Claypool Hotel, Indianapolis, Dec. 14. Previous announcements had been sent out by Paul H. White, secretary of the association, stating that a large delegation from the Ohio Association was expected, and that lunch would be served to the guests and members. The Ohio delegation present consisted of about twenty members, headed by Edward C. Spring, president of the association.

The meeting was called to order by President Henry at 11 o'clock. After the minutes of the previous meeting had been approved, H. A. Nicholl, general manager of the Indiana Union Traction Company, read the following communication:

The second meeting of the representatives of the freight departments of the various roads was held Dec. 11, at 1:30 p. m. Present: Messrs. Henry, Reynolds, Nicholl, Hixson, Noveil, Graston, Fletcher, McNown and White. The following resolutions were passed:

Resolved, 1. That a freight bureau be established, but having no power or authority to fix rates; 2. That the general manager or representative of the several roads meet and formulate plans and rules to regulate the joint freight bureau; 3. That a joint freight agency at Indianapolis be established.

The following matters to be submitted for consideration and regulation to the general managers' committee:

1. Joint agency expense; 2. Rates, percentage, etc.; 3. Interchange of cars; 4. Inspection; 5. Carload and less than carload shipments.

The chair appointed a committee consisting of Messrs. C. C. Reynolds, White and Graston to submit suggestions for suitable trail cars. The general managers' committee, consisting of general managers and other representatives, to consider the above-mentioned matters, will meet in Mr. Henry's office, Dec. 18, 1:30 p. m.

The regular programme was then taken up, and P. J. Mitten, superintendent of motive power of the Indiana Union Traction Company, presented the following paper, entitled "A Desirable Car for Interurban Service":

A DESIRABLE CAR FOR INTERURBAN SERVICE

The economy of employing the longest car practicable is apparent in view of its ability to transport the greatest number of passengers per conductor. Because of the necessity for entering cities, a car of more than 60 ft. over the buffers is not desirable. The overhang with cars of a greater length than this becomes dangerous to pedestrians on sidewalks, at curves, and hampers operation on account of fixed or practically immovable obstructions frequently encountered at the curb intersection.

To my mind, therefore, a desirable car for interurban service should be 60 ft. over bumpers, 8 ft. 6 ins. wide over side sills, 9 ft. 3 ins. from floor to under side of ceiling, 10 ft. from the under side of sill to top of roof, and should stand 3 ft. 6 ins. from the top of the rail to the under side of the sill. In external appearances the car should resemble as nearly as practicable that of the standard Pullman.

It has been demonstrated that if the front end of the car be wedge-shaped, the air resistance is most easily overcome, but, on account of the location of the motorman's cab and the controlling apparatus, this shape is practically impossible. The nearest feasible approach is to give the forward part of the front end of the car a cylindrical form, this form to be limited by an angle of about 85 degs. and a radius of 3 ft. 6 ins. The corners of the car should be rounded off to meet the circle on an 18-in. radius. This has been shown to be the most practical and economical design for the front end of a high-speed car.

To allow for egress from the front vestibule it will be necessary to place a 26-in. door in the right-hand corner, which, allowing for sufficient room for the motorman and apparatus, will make the vestibule 4 ft. from the extreme point to the sliding door leading into the main body of the car.

The rear end of the car should be built on a one-half oval-shape, the platform to measure 5 ft. at the deepest point. The steps should be 40 ins. wide and of proper height to suit local conditions.

Doors in both front and rear vestibule should be so hung as to prevent slamming. This may be accomplished by employing a small track or rod on which the edge of the door slides when folding. Thus, when the door is open, the hinge between the halves will be toward the platform, while the two outside edges will be toward the outside of the car.

The interior divisions should consist of smoker, passenger, toilet and heater compartments. The obvious place for the smoking compartment is in the forward part of the car, and should comprise one-third of the seating capacity. The seats should be longitudinal, heavily upholstered in leather, with ample springs to furnish a good resilient cushion. The space beneath these seats may be used for the storage of hand baggage. The floor of the smoker should be covered with inlay linoleum of small, neat design. A sufficient number of low flat brass cuspidors should be placed in this compartment. The partition between the smoking and passenger compartments should be constructed with plate glass windows and door, so as to permit an unobstructed view ahead for the passengers.

In the passenger compartment we would have the seats of the high, stationary back type, upholstered in dark green figured plush, with all metal parts perfectly plain. In this, as well as in the smoking compartment, there should be placed parcel racks at least 14 ins. wide, thus affording ample room for parcels, and avoiding the danger of the larger pieces toppling over on the passengers.

There is much reasonable argument in favor of the various positions for the toilet and heating cabinets, yet, to the writer, the location at the rear end seems least objectionable. In considering the location of the heater and toilet cabinets, is it not universally acknowledged that they should occupy positions on directly opposite sides of the aisle? To facilitate firing and emptying ashes, and to obviate any liability of dust flying about the interior of the car, the heater door should open directly onto the rear platform. The expansion chamber, pressure and water gage should be placed inside of the heater cabinet, the safety valve being so piped as to deliver the expelled water below the body of car, thus preventing damage to varnish, etc. By placing the toilet room directly opposite the heater, as suggested, we overcome the objection which arises from the fact that many persons are much embarrassed when entering the toilet room in full view of the other passengers.

The heater cabinet space should be relieved by an oval window on the outside of the car, glazed with green opalescent glass. This style of window should also be used in the toilet compartment, but the sash of this window should be arranged to swing open a short distance for ventilation. The door of the toilet room should be hung on spring hinges, and a sufficient number of coat hooks be conveniently placed inside this compartment. The interior finish throughout the car should be selected mahogany with very simple inlay. Care should be taken in designing this finish to eliminate all extravagant ornamentation and to present as flat a surface as possible, still retaining an artistic interior, thus facilitating cleaning and renovating. The ceiling, of full Empire, should be painted a light green, with some neat gold striping. The deck sash should form a half ellipse and should be glazed with green opalescent glass. This glass should also be placed in the upper sash of the side windows. The window sash, following steam road practice, should lift in opening, and should be supplied with counterweights or springs. All of the sash and the sliding doors should be glazed with polished plate glass. In this climate it is advisable to use storm sash during the winter months. These may be constructed in one piece to cover the double window and the transom sash.

With the present system of car ventilation, which is accom-

plished by opening the deck sash, it is necessary to have these sash work freely, as considerable annoyance is caused by rain and snow blowing in through crevices. This system of ventilation is also very unsatisfactory, due to the prevalence of drafts, which almost invariably blow directly downward on the passengers. Some system of ventilation other than the deck sash should be employed, and these deck sash should then be sealed.

Gentlemen, I have carefully considered the various features of a desirable car, and I am free to admit that there is much reasonable argument in favor of views opposite to those which I have presented, and when I have employed the expression "should be"—the words "to my mind" are always to be understood.

The reading of the paper was followed by an interesting discussion opened by General Manager C. D. Emmons, of the Fort Wayne & Wabash Valley Traction Company. Mr. Emmons thought Mr. Mitten had left out of consideration a very important feature on an interurban car, that of a baggage compartment. He agreed that the toilet room should be in the rear of the car, but the heater, he thought, should be located in the rear of the baggage compartment. After a recent trip over the line of the Indianapolis & Cincinnati Traction Company, he had concluded the cars of that line met his ideas of an interurban car very well, but he did want a view ahead, which these cars did not afford.

Mr. Nicholl stated he had given much thought to a car with a middle entrance, similar in this respect to the private car "Martha" of the Indiana Union Traction Company. He would have the main passenger compartment in front of the middle entrance, the rear portion of the car to be taken up by a smoking compartment nearest the center and a baggage compartment in the rear. One objection to such a car, he thought, would be that since the side sills would necessarily be cut, in order to locate the steps properly, the car might not be as strong as the usual type. It would also be somewhat inconvenient for the conductor to get through the car to attend to the trolley on the rear end. One strong feature of such a car, however, would be that it would give passengers a clear view ahead.

Mr. Emmons, in commenting on such a car as Mr. Nicholl suggested, thought that it could be loaded and unloaded as easily as the present end entrance car. The toilet, he said, could be placed in the front compartment and the heater in the rear. Concerning the width suggested by Mr. Mitten, 8 ft. 6 ins. over sills, Mr. Emmons thought this too narrow. The present interurban seats, he said, were not quite comfortable. On his line, the Fort Wayne & Wabash Valley Traction Company, they had some cars 9 ft. wide, which were, he thought, hardly wide enough.

Paul H. White, secretary of the Indiana Association, and general manager of the Indianapolis & Martinsville Rapid Transit Company, thought that a car should be amply large to carry the desired schedule and yet have the least dead load. In a 60-ft. car it was necessary to embody a great deal more material than in a shorter car, and this meant dead weight to be carried by the power house. He thought that a 50-ft. car would, with hourly service, carry traffic on most interurban lines, and such a car would round all curves easily. His idea was to use a small car with a motor equipment heavy enough to permit of hauling trailers when traffic was heavy. The use of a trailer, he said, doubled the capacity without doubling the weight, and moreover, a trailer cost less than a motor car and the cost of maintenance was not so great. He made the point that the operation of trailers did not mix up the schedule as did the addition of trains to care for heavy traffic. He thought a 60-ft. car quite desirable for heavy traffic, but did not believe any interurban company running into Indianapolis had such traffic as would demand the use of such a car the whole year around. In addition to the initial expense and the increased maintenance cost of a long car, he thought they had a tendency to rack and twist, and this was a point against their use.

C. C. Reynolds, general manager of the Indianapolis & Northwestern Traction Company, the cars of which are the longest entering Indianapolis, said that there were times during the day and seasons of the year when it looked ridiculous to haul around such large cars, but there were other times when the cars were not half large enough. He said a long car did not have much greater cost of maintenance and first cost than a short one. He had, however, not had much experience with short cars and did not feel competent to judge. Concerning the rounding of curves, he said that their cars, which were 60 ft. 8¾ ins. long, rounded with ease a curve of 36-ft. radius at Twenty-First Street and Senate Avenue, Indianapolis, and he thought a double-truck car could go around any curve that a short car could if side clearance permitted.

Theodore Stebbins, general manager for the receivers of the Appleyard syndicate, of Columbus, Ohio, when called upon, said he had given a great deal of thought to the ideal interurban car, but had never had occasion to build one. He thought the power on a car should be proportionate to the weight. He remarked that the car suggested in Mr. Mitten's paper was designed for operation in one direction only, while on his own lines the tracks were so arranged that it was necessary to operate cars from both ends. Regarding Mr. White's suggestion of putting enough motor capacity on a car to haul trailers when travel was heavy, he thought this would be objectionable in that it necessitated carrying the extra weight around when a car was used without a trailer. He said that one road entering Columbus ran its cars in trains. He was afraid, should this practice be generally adopted, that objections would develop from the public. He agreed that cars should be built to accommodate baggage, but he did not think that side doors in a baggage compartment looked well. As to the disposal of the baggage, he said he would like to see a car constructed with a place for the storage of baggage underneath the body between the trucks. This would involve the question of construction, but it would certainly get the baggage out of the way of the passengers. He thought it was a mistake to put a solid partition in front of passengers to prevent a clear view ahead. He thought such a view promoted travel.

Will G. Irwin, general manager of the Indianapolis, Columbus & Southern Traction Company, felt that in the construction of an interurban car a compartment should be provided for light express material. He thought that the time was coming when it would be advantageous to establish frequent express service that would compete with the service of the present large express companies.

F. D. Carpenter, general manager of the Western Ohio Railway, believed that an interurban car should be constructed especially to fit the road on which it was to be operated. On his road he found it necessary to add a baggage compartment on cars originally constructed without provision for baggage. The cars were originally 44 ft. long; the sills were spliced and a baggage compartment built on one end, making the car 52 ft. 6 ins. long. This gave a three-compartment car, which he thought was of a size well adapted for general use. He said he found quite a difference in the riding between long and short cars, the long ones riding the more smoothly.

C. A. Baldwin, superintendent of transportation of the Indiana Union Traction Company, said that the car Mr. Mitten proposed was intended to be a passenger coach only. He thought that the passenger, freight and express service should be kept separate, and that a 60-ft. car was preferable for passenger service alone. Combination baggage and passenger cars should be sandwiched in between cars intended for passenger service only, running probably at two-hour intervals. During that portion of the day when traffic was heavy, he thought the carrying of baggage should be abandoned entirely. Out of In-

dianapolis, for instance, he said at 4, 5 and 6 o'clock in the evening the cars were always crowded with passengers and that no attempt should be made to carry baggage at these hours.

President Henry said that his first interurban cars were provided with end doors for passage from one car to another. They had a smoking compartment in addition to the regular passenger compartment, and the general design of the car had been followed to this day. Mr. Henry did not want to put a smoking compartment in a car, but said he was compelled to do so. Mr. Henry thought the heater should be put in the front vestibule, where the motorman could take care of it. He said such an arrangement kept the coldest part of the car warm. Regarding electric heaters, one objection he had to them was the fact that sometimes the power was shut off when the car was out in the country, and the passengers then suffered.

Mr. Henry said he had hoped to hear something about advertisements. For himself, he would like to have the money resulting from them, but he did not want the advertisements. He had noticed that the cars in the best service did not have them. He hoped that the design of a center entrance car would be worked out, but he had never found any way to do it. The length of the car, he thought, was of least importance. On a small road from Shelbyville to Indianapolis, where the power was light and prevented them running heavy cars, on last Fourth of July the receipts from three small cars was $669. He thought at times we were getting too much size and weight in cars. Mr. Mitten did not consider trucks. These, he said, were of first importance. He thought a 60-ft. car looked a little too large, and was afraid criticism would develop if the size of the cars were increased. His cars were 56 ft. long. It was his idea that a glass partition should be placed between the smoker and the passenger compartments. He had learned from experience that this would result in better behavior and less rowdyism in the smoker. He did not think it was a good idea to let passengers have a view ahead. They could then see everything that was done, and this had a tendency to develop objections to the methods of operating the cars. He liked the idea of running cars in trains rather than to haul trailers, because he had found that the regular schedule could not be maintained when trailers were added. There was, however, a certain class of rush traffic where it was not important that the schedule be maintained. He referred particularly to that occasioned by the State Fair at Indianapolis, saying that the people had been educated by the steam roads to be behind time on such occasions and did not seriously object. In summing up his ideas, he said he would have the best trucks, plenty of power, make provision for the baggage, put the heater in front with the motorman, and would have the smoking compartment in the forward portion of the car.

Mr. Mitten brought out a new idea in favor of permitting the passengers a clear view in front. He says that many people became ill on electric cars because of the rapidly passing poles so near to the windows. He related an incident where he had found an old lady in the passenger compartment sick. He took her into the front part of the car, giving her a seat where she could look out on the track ahead, and she recovered rapidly. One objection he had to Mr. Henry's idea of placing the heater with the motorman was that this tended to create a coating of frost on the inside of the cab windows, which was very objectionable.

Mr. White defended his idea of pulling trailers by saying that when cars were pulled in trains, the increased current consumption tended to pull down the voltage in starting, and this, of course, cut down the speed. He had found that he could operate with trailers on the same schedule as with double trains.

G. H. Kelsey, superintendent of power of the Indiana Union Traction Company, thought that Mr. Stebbins' idea of placing the baggage under the floor of the car might be worked out. He thought the heater should be placed in the baggage compartment, saying that the ashes were not as objectionable as when the heater was placed in the passenger compartment. As against placing it in the motorman's cab, he said the motorman had enough to attend to and his attention should not be distracted by the care of the heater. He urged that an open view to the front be given to passengers, saying that he had noticed that the passengers in the smoking compartment of the new cars of the Indiana Union Traction Company were always looking ahead. He said that the idea of operating longer and heavier bodies and not increasing materially the dead weight of the car was erroneous; the weight of the trucks should be increased proportionately. He liked the idea of operating single end cars. This permitted the floor of the front vestibule to be built on the same level as the car floor, making it possible to continue the car body sills through to the bumper on the front end. The rear vestibule, he thought, should drop to permit passengers being loaded quicker.

M. H. Evans, master mechanic of the Indianapolis city lines, favored running cars in one direction only. He thought the expense of putting in extra Ys and loops at terminals was counterbalanced by the decreased cost of maintenance of single end equipment. He thought the bottom framing of interurban cars should be constructed stronger and stiffer than at present. The sills should be run continuously from front to rear buffer. He saw no reason why interurban cars should be constructed with entrance doors on both sides. He favored putting such doors on the right side of the car only. He thought it necessary that by some concerted action standards for interurban equipment be developed. Already there were standard brake-shoes, brake-heads, bearings and journal boxes, but the list could be extended to advantage. He expressed himself in favor of a four-motor equipment for interurban cars, adding that it had been demonstrated that such equipment was maintained at the least cost.

Mr. Evans' remarks concluded the discussion of Mr. Mitten's paper. President Henry then called upon Edward C. Spring, president of the Ohio Association, to address the assembly.

Mr. Spring's talk dealt largely with the idea of combining the Indiana and Ohio associations and providing a permanent secretary for the allied organization. He said that at a meeting of the executive committee of the Ohio Association he had been asked to talk with President Henry, of the Indiana Association. President Henry had suggested that he express his ideas directly to the assembly.

At the present time, Mr. Spring stated, the interest in the Ohio Association had risen to a high pitch, and it must be maintained, not only for the good of the association, but also for the benefit of the public. To accomplish the most good it would be necessary to have a permanent secretary. He realized the allied interests between the interurban people of Ohio and Indiana and the lack of information the public had of interurban lines beyond their own locality. In Dayton, he said, the public knew nothing about the connections that could be made with Indiana, and did not realize that there were three different interurban routes into their neighboring State. On his trip over he had asked repeatedly of station agents concerning connections with other lines, and invariably found that they could not tell him anything. One important feature of the proposed allied organization would be to make the public acquainted with what the interurban lines were doing. A plan had been suggested that each of the roads pay $50 per year in $5 per month installments for the maintenance of a permanent office and secretary. He thought it would be the cheapest advertisement that the roads could obtain. The organization could put out a guide dealing with the connecting interurban roads and place them on sale, and the revenue obtained would in a short time go quite a distance toward paying the expenses of a permanent office. He said the New England Street Railway

Club had been organized on this basis and that after two years it became self-supporting, paying the secretary $1,500 a year and bearing other office expenses. If Indiana would ally interests, an office of immense power in two States could be established. The objection to the present arrangement was that all the officers of the association were men busy with other affairs, and that the interests of the association often suffered through the fact that the officers could not give proper attenion to details because of other business.

At the conclusion of Mr. Spring's talk, F. D. Carpenter, general manager of the Western Ohio Railway Company, stated that he had been very much interested in the work of the Ohio Association, which originated in a meeting of the officers of several roads held to arrange for the exchange of mileage. If it had never done anything else than to put in operation the interchangeable mileage system, this alone would have been a sufficient recompense for the work done. He emphasized the fact that the work had grown to such an extent that a permanent secretary was necessary, and he felt that all of the roads could well afford to bear the expense of $50 or less per year to maintain one. He said a permanent secretary could take charge of the interchangeable mileage bureau, of advertising features, and arrange for meeting places and make permanent record of meetings. He closed by saying he was perfectly willing to drop the word "Ohio" from the name of the association if the associations of the two States could perfect a joint organization.

C. C. Reynolds moved that a committee of five be appointed to confer with a like committee from the Ohio Association on the question of a permanent organization. After the motion had been carried, the chair, at the suggestion of members, appointed the following to serve on the committee: Charles L. Henry, president and general manager of the Indianapolis & Cincinnati Traction Company; C. C. Reynolds, general manager of the Indianapolis & Northwestern Traction Company; C. D. Emmons, general manager of the Fort Wayne & Wabash Valley Traction Company; A. W. Brady, president of the Indiana Union Traction Company, and W. G. Irwin, vice-president and general manager of the Indianapolis, Columbus & Southern Traction Company.

G. H. Kelsey, chairman of the question box bureau, was then called upon to read the questions submitted. Only two had been sent in. The first was as follows: Is a conductor on an electric line liable for embezzlement if he finds a ticket in a car or on a street and gives it away to a passenger? The second, in substance, was as follows: What is the largest amount constituting legal tender in the payment of a fare? Is a conductor justified, when offered $20 for a 20-cent fare and having no change, in accepting the money and giving the passenger an order on a company for $19.80. The first of these questions was submitted to Arthur W. Brady for answer, and the second to General Attorney J. A. Van Osdol, of the Indiana Union Traction Company.

Before the adjournment of the meeting Mr. Henry announced that the arrangements for luncheon had been canceled the previous day, word having been received from the Ohio Association that its members had found it impossible to be present, and when a second notice was received to the effect that they would attend, it was too late to provide for luncheon.

The question as to whether the use and sale of a 1000-mile book by the steam roads at $20, and the sale of mileage books by the interurban roads at reduced rates is a discrimination in railroad fares within the inhibition of the Indiana law is a matter that may come before the Indiana Railroad Commission. It is pointed out that the Railroad Commission law expressly prohibits discriminations as regards rates, and it is quite probable the commission will be asked to take the matter up for consideration.

EXHAUST STEAM DIRECT-CURRENT TURBINE IN PHILADELPHIA

The Philadelphia Rapid Transit Company has just installed at its power station at Thirteenth and Mt. Vernon Streets an 800-kw Curtis low-pressure turbine, which takes steam from the engine exhaust. This station is equipped with four Wetherill-Corliss engines of 1500 nominal hp and one Wetherill-Corliss engine of 2200 nominal hp, and as it is practically midway between the Schuylkill and Delaware Rivers, has always been run without condensers. An Alberger condenser and cooling tower with 8000 sq. ft. have recently been erected, however, for the use of the low-pressure turbine. The cooling towers are 22 ft. in diameter and 41 ft. high, and the rotary pumps for circulating the water in these towers are directly connected to a 120-hp inter-pole electric motor, supplied by the Electro Dynamic Company, of Bayonne, N. J. The average vacuum attained in the condenser since starting a few days ago is 28 ins., although a vacuum of 29½ ins. has been secured.

The 1500-hp engines are each direct connected to a 1500-kw generator, which develops an average of about 2000 amps. at 575 volts. The turbine takes steam from the exhaust main at a pressure of, say, 1 lb. above the atmosphere, and is provided with four wheels, each with a single row of buckets. Exhaust steam from one engine when operated at 2500 hp or 2000 amps. is sufficient to secure an output from the turbine of 1300 amps. at 575 volts, with no increase in the back pressure on the engines. As about 150 amps. are required to operate the auxiliaries, the gain from the use of the turbine is from 1000 amps. to 1200 amps., or approximately 66⅔ per cent of the output of the original generating unit, instead of the 25 per cent usually expected from the introduction of a condenser.

The generator portion of the turbo-unit is also interesting, as it is a direct-current machine, but details are not now available, except that it has six poles and runs at from 1100 r. p. m. to 1200 r. p. m. The voltage is remarkably steady, in spite of the fact that no governor is used on the turbine.

The turbine was put in service Dec. 15, and tests are now being conducted to determine its steam consumption. When the turbine is receiving steam at atmospheric pressure without moisture and there is 2-in. absolute back pressure in the condenser, the guarantees provide that the steam consumption shall not exceed 36 lbs. per kw-hour at full load and 40 lbs. at half load. At 4-in. absolute back pressure, these figures are respectively 45 lbs. and 50 lbs. Recent tests on this machine made at Schenectady have shown that these amounts were met with a very large margin, indicating that low-pressure turbines can be used to great advantage where a comparatively large amount of exhaust steam is available. The Philadelphia Rapid Transit Company has already ordered from the General Electric Company a duplicate of the turbine installed, and from the data secured from these machines considerable light will be thrown on the advantage of low-pressure turbines.

By months, the earnings of the Twin City Rapid Transit Company in both gross and net, compared with 1904, show results as follows:

	Gross	Increase	Net	Increase
January	$351,120	$19,708	$175,806	$13,395
February	321,451	8,093	151,170	*2,436
March	361,732	18,430	188,966	10,071
April	355,213	17,811	184,405	7,806
May	389,425	35,779	216,921	24,047
June	392,529	22,388	214,676	18,173
July	435,105	49,326	248,052	41,962
August	422,051	32,854	246,512	35,912
September	454,062	70,118	278,030	70,103
October	420,981	52,824	228,043	30,224

* Decrease.

THE RELATION OF RAILWAY SUB-STATION DESIGN TO ITS OPERATION*

BY SYDNEY W. ASHE

This paper is limited to a consideration of sub-stations in which high-tension alternating current is received and converted into low-tension direct current. In the operation of a modern railway converter sub-station, reliability of service is of paramount importance, being more important than considerations of first cost, of depreciation and of maintenance; and in turn the reliability of service is affected to a marked degree by the length of time required to manipulate the various combinations of sub-station apparatus. The following factors will be noticed in this connection:

1. The best method of starting converters;
2. The protection of converters;
3. The use of oil switches when synchronizing;
4. The regulation of load;
5. The best arrangement of switch gear;
6. The operation of reverse current relays;
7. The adjustment of load between the sub-stations which feed the same circuit;
8. The noiseless operation of synchronous converters.

1. The Best Method of Starting Converters.—In considering the various methods for starting converters, it should be noted that an essential characteristic of every method is ability to start and synchronize a converter in the shortest time without affecting the system generally. The first rule that a sub-station operator must learn is to be ready at all times to carry upon the converters whatever load may come upon the sub-station, this load being limited only by the maximum carrying capacity of the feeder oil switches. Occasionally, as a result of congestion of traffic, excessive overloads come upon a station. In this case another converter must be started immediately, synchronized, and placed on the bus-bar. This calls for a convenient arrangement of switch gear, a rapid, reliable method for starting and synchronizing converters, and a quick and steady operator.

Three methods are usually employed for starting converters, namely:

A. From the direct-current side.

B. By means of a small direct-connected induction motor.

C. From the alternating-current side.

Method A.—The converter is started as an ordinary shunt motor, receiving its current either from a shunt-wound generator or from the direct-current bus-bar. A double-throw switch is usually provided so that the converter may receive current from either source. Ordinarily, when started by current from a shunt-wound generator, about 2 minutes are required to start, synchronize and connect a 1500-kw converter to the bus-bar. In emergency cases the machine is started by current from the direct-current bus-bar, and only a minute and a half are required to place it in service. The advantages of method "A" are the rapidity of starting and the smallness of first cost, since it requires but one starting set for all the converters, and the slight expense of maintenance.

The disadvantages of the method consist in a small factor of reliability and the possibility of a heavy surging of current during the process of synchronizing. The latter disadvantage, however, may be obviated by the use of a simple modification of the switch gear, devised by H. G. Stott. This device is now used in connection with the Interborough Rapid Transit Company's equipments. It consists in closing a local storage battery through the circuit breaker of the starting bus-bar a fraction of a second before the converter oil switch closes. The converter then runs practically free from the direct-current side, and self-excited at the instant the oil switch closes. The oil-switch motor and the tripping coil of the circuit breaker are in multiple with the battery when the control switch on the bench board has been closed. The oil switch requires only 0.4 second for complete connection, whereas the circuit breaker operates almost instantly.

When the converter is rotating slightly under or above its synchronous speed, and the pointer of the synchronism indicator is moving slowly round the dial, if the local storage-battery switch be closed just as the pointer is approaching zero, it is possible to connect the converter through the transformer to the alternating-current bus-bar without the operator being conscious of the fact excepting from the noise made when the oil switch closes.

Method B.—With this method, by means of a small induction motor mounted upon the main shaft of the converter, the converter is brought up to synchronous speed. The starting motor has fewer poles than the converter, and therefore a higher normal speed. A variation in speed may be obtained by placing a slight load upon the converter through the medium of a resistance shunted across the brushes, the converter being self-excited. Varying the resistance in series with the converter field coils will also cause a slight variation of load upon the induction motor.

The main advantage of this method is the increased factor of reliability, since each converter has its individual starting motor. For mechanically starting the converter armature it is common practice to install a motor somewhat smaller than the motor used for driving the exciter generator in method "A." As a result, a converter does not accelerate so quickly with this method as when started from the direct-current bus-bar. One of the disadvantages of this method is the fact that owing to the torque of the induction motor varying with the square of the impressed voltage, a very small drop of voltage will keep the motor from starting at all. For instance, if only 80 per cent voltage were received, as is sometimes the case after a bad shut-down at the power house, or on the system, due to a variety of causes, it is highly improbable that the converter will start. Another bad feature is, in case of a burn-out on a starting motor, the converter is crippled. Other disadvantages are the greater first cost and increased cost of maintenance.

Method C.—In this method two sets of taps on the low-tension side of the step-down transformers are commonly used. These taps are connected to a two-way switch, the middle terminals of which are connected to the converter slip rings. To prevent an excessive starting current, reactance is inserted between the converter slip rings and the low-tension windings of the transformer.

The converter is started as an induction motor by throwing the two-way switch so that the low-potential taps are connected. When the current has fallen sufficiently low—the converted speed increasing—the two-way switch is thrown in the opposite direction, connecting the converter directly to the normal voltage taps.

It is usual with this method to start converters of 300 kw or less, from starting taps giving one-half normal voltage. Converters varying from 300 kw to 1500 kw are started by voltages of one-third and two-thirds the normal voltage. On the one-third voltage taps, with 25-cycle converters, the current at starting is generally a little less than at full load.

Owing to the large ratio of the field turns to those of the armature, high electromotive forces are liable to be induced in the field windings when making use of this method of starting. It is common practice to provide a field switch which disconnects the windings at several points.

With this method no time is lost in adjusting the speed, as the converter builds up into synchronism, but an objection to this method is the large current drawn at starting. This, however, is generally at a power factor that yields a correspond-

* A paper presented at a meeting of the American Institute of Electrical Engineers, New York, Dec. 15, 1905.

ingly increased starting torque and brings the converter up to synchronous speed in a shorter space of time. Another important advantage is the large factor of safety due to the entire absence of starting sets and starting motors. The additional field switches consume, however, additional time for their manipulation.

The time ordinarily required to put converters in service when using this method is approximately as follows:

300 kw	45 seconds
1000 kw	75 seconds
1500 kw	120 seconds

It is possible to start these converters more quickly. The following times have been recorded, though they do not represent the minimum:

300 kw	16 seconds
1000 kw	40 seconds
1500 kw	65 seconds

This includes the time necessary to close the high-tension alternating-current switch of the converter transformer, the time of starting by means of air-brake lever switches, and the time included in closing the field switches, the direct-current circuit breakers and the line switch.

The chief disadvantages of the method are the high potential generated in the field windings at starting, the large starting current which may affect the regulation of the system and the necessity for a change in design. The two former disadvantages are minimized by the arrangements previously mentioned. The latter disadvantage, however, necessitates the elimination of the circular dampers embracing the entire pole piece. A converter constructed in this manner will "hunt" on the slightest provocation and ultimately trip itself out of the circuit. For instance, a short-circuit on some other part of the system, throwing a lagging current on the line, or some slight trouble in the governor of one of the engines supplying it, or anything which may happen to vary the angular velocity of the prime mover, is sufficient to start hunting in a synchronous converter. The starting current is approximately four times that used with methods "A" or "B" for the same capacity machine.

It should be noted when considering the time necessary to start converters that this time depends to a great extent upon the personal peculiarities of the operator. Moreover, the interval of starting for all methods, has been so far reduced as to be adequate to the demands of railway operation. When an excessively steady overload comes upon a station, the operator may easily trip a few of the section breakers while an additional machine is accelerating. The cars on the rail sections fed by this sub-station will receive slight power from adjoining rail sections, as the I^2R drop will be excessive. The cars will consequently slow down. When the power has been off the circuit for about 20 seconds and the speed of the converter is approaching synchronism, the circuit breakers formerly opened may be closed, and the other section breakers and switches opened. In this way trains may be kept moving during the time required to start, synchronize, and place on the bus-bars this additional machine. Passengers in the cars will hardly be conscious of what has occurred.

The Protection of Converters.—In the design and installation of circuit breakers, the inductance of the system is usually relied on to prevent an excessive rise of current during the interval of time elapsing between a short-circuit and the opening of the circuit breaker. This, however, is not sufficient protection; for an excessive short-circuit in the system, say during light load when only one machine is operating, will often cause a flash, accompanied by a shrill sound, around the commutator of the converter. At first one might think that a reactance coil of low ohmic resistance could be placed in series with the breaker to minimize this effect; but a coil of constant reactance, resistance or self-inductance could not entirely meet the conditions, owing to the variability of the time-constant of the circuit. For instance, the self-inductance and resistance would vary with the distance from the sub-station in which the short-circuit occurred. Proper conditions, however, might be approximated and a coil designed which would partially protect the converter.

Where sub-stations are equipped with storage batteries which float on the system, there is a tendency for the storage batteries to bear the brunt of the load, in case of short-circuit, permitting the converter circuit breaker to open, followed shortly by the opening of the battery circuit breaker. This, however, does not always prevent the converter from flashing over, owing to the fact that the velocity of chemical action at the electrodes of the battery and the limitations of the velocity of migration of the ions of the electrolyte are insufficient to prevent this action. Theoretically, the converter bus-bar voltage would drop, the battery carrying the peak of the load. As a matter of fact, the battery does not always perform this function.

The Use of Oil Switches When Synchronizing.—Much has been written of the superiority of oil switches over air switches for opening and closing alternating-current circuits. This superiority is due to several causes, namely, the smothering action upon the arc by the oil, the rupturing of the circuit at the zero point of the current wave, the absence of leakage between contact points, and the small dimensions of the switch. Electrically-operated oil switches, however, have a few disadvantages which, while not vital, are worth mentioning. It is not the intention of the writer in mentioning these disadvantages to criticise the use of oil switches over air switches, as the former are far superior to the latter for heavy traction work.

With an oil switch, the time required to close the circuit varies with the voltage of the local storage batteries. When this voltage falls below a certain point, the switch fails to operate. Such switches are guaranteed to operate over a considerable range of voltage, something like 125 volts to 70 volts, but several instances have been brought to the attention of the writer in which switches have not operated when the voltage has fallen below 95 volts. This characteristic is extremely objectionable, for it obliges the operator to resynchronize, inasmuch as the general sub-station rule requires the starting over again of all auxiliary apparatus when an oil switch fails to operate. Another objectionable feature is that sometimes oil switches fail to lock when closed by the switch motor, opening again and closing subsequently when the converter is perhaps as much as 60 degs. out of synchronism. This performance is characterized by operators as "looping the loop." One can readily imagine what happens when a converter that is considerably out of synchronism is closed upon the circuit, making what is termed "a bad shot." This may do considerable damage. These troubles, however, are not of frequent occurrence and an operator who is familiar with the "individuality" of each switch soon learns to test it frequently, as well as to keep his storage batteries well charged, and thus to minimize these disagreeable characteristics.

The Regulation of Load.—Railway operation does not call for as close a voltage regulation as is requisite for electric lighting circuits. Economic operation, however, demands that converters be run on as constant a load as possible. The general use of storage batteries for load regulating in railway work seems to have been retarded owing to their objectionable features; for instance, their acid fumes, the necessity for special wiring, and their heavy depreciation. In addition, their enormous first cost has placed them actually out of competition with synchronous converters and generating apparatus. The usefulness of storage batteries in railway work is being more and more appreciated, as evidenced by their recent applications. An interesting development in connection with storage bat-

teries is a carbon regulator put to use during the last year. It consists of a variable carbon resistance which is used in connection with pilot cells and an exciter, to vary the excitation of the field coils of a booster.

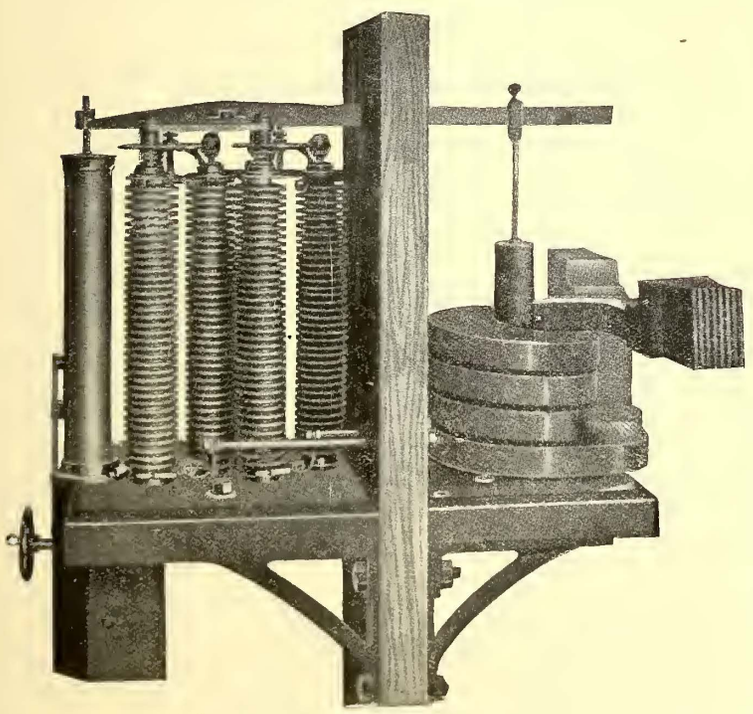
Referring to the diagram, *H* is a solenoid carrying the total generator load, which acts on a soft iron plunger suspended from the lever *A-B* of the carbon regulator. At the other end of the lever is a spring *S*, whose tension is adjustable. *K* and *L* are piles of carbon discs on the opposite sides of the fulcrum *C* of the lever. The resistance of these piles is altered by slight variation in mechanical pressure, produced by slight fluctuations of current in the coil *H*. The details of the electrical connections are self-explanatory. The battery booster is represented by *D*, *F* being its field coils. *E* is a small exciter, whose field coils, *M*, are connected to the carbon regulator as shown.

As the lever arm is raised or lowered, the resistance increases in one arm and decreases in the other, causing wide variations in voltage across the exciter field coils, the direction and intensity of the current in the coils varying accordingly. The action is somewhat analogous to that of Wheatstone's bridge.

With the polarity of the booster changing and its field excitation varying in intensity, it is possible automatically to charge the main battery or to raise the battery voltage so as to carry part of the load of the bus-bar. By limiting the motion of the lever arm it is possible to limit the load which the battery will carry under extreme conditions. With this system close regulation of the load on the converter is obtained.

The Best Arrangement of Switch Gear.—The most suitable arrangement of switch gear is obviously that which best facilitates the manipulation of sub-station apparatus with a minimum outlay.

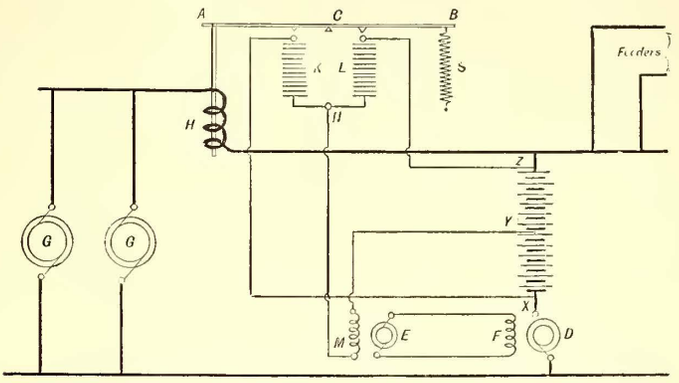
There are two distinct arrangements of switch gear, their adoption depending upon the capacity of the sub-station. With



REGULATOR FOR USE IN CONNECTION WITH STORAGE BATTERIES

one arrangement, which is especially applicable to small sub-stations, all of the switch gear is located upon the main floor with the converters and with the transformers. The other method, which is usually employed in stations of large capacity, consists in locating all the manually-operated switches, except the negative switches, in a switchboard gallery.

It is worth noting that in the first case, where all the switching apparatus is located on the same floor with the transforming apparatus, the station attendance is minimized, for the operator may also perform part of the duties of station foreman, and the converter tender may also perform the duties of janitor, thus dispensing with two men. But this system is not wholly advantageous. In the first place, it is difficult to keep the switch gear clean, and in case of trouble the operator is too near the converters to act with unconcern. On the other hand,



ELECTRICAL CONNECTIONS FOR STORAGE BATTERY REGULATOR

this system reduces the expense of wiring to a minimum, allows excellent ventilation and results in a very compact station.

Where a switchboard gallery is employed, the operator is able at a glance to scan the whole station, a great advantage in case of trouble. He is relieved of the fear of personal injury; he is less hampered and more comfortable, and can better perform his duties. But the expense of wiring is greater and the ventilation inferior.

It is becoming the standard practice to construct the switchboard in three distinct sections, namely, a controller board from which the oil switches are operated; a set of machine panels, and a set of distributing panels. The positive direct-current bus-bar forms a connecting link between the machine panels and the distributing panels. This system is sometimes modified in small stations.

Various arrangements of circuit breakers are employed; in some cases they are mounted directly upon the switchboard panels; in others distinct and separate compartments are used. The latter is preferable if the expense be justified, for it disconcerts an operator to see the flash of an opening circuit breaker.

It has become quite common to separate the negative switches from the positive switches, the reasons for which are obvious.

A feature worth mentioning is the arrangement of a circuit of lamps on the switchboard and their feeding from the local battery circuit, so that in cases of failure of power at the power house there may be sufficient illumination in the evenings for the operator to manipulate the board. Upon the same circuit a complete set of signal lamps should be installed to indicate whether switches and circuit breakers are open or closed.

The Operation of Continuous Reverse-Current Relays.—Much criticism has been directed against continuous reverse-current relays, owing to their sensitiveness, the amount of adjustment they require, and their inability to perform their service at all times. While these criticisms are partly warranted, the fact remains that such relays are better than no protection at all.

An operator is supposed to try the relay controlling the machine circuit breaker each time a converter is disconnected from the bus-bar. The field rheostat of the converter is cut in entirely, the converter dropping its load. The positive bus-bar voltage being slightly higher than the machine voltage, the reverse-current relay is energized, closing the local battery

circuit through the tripping coil of the circuit breaker which should open instantly.

Sometimes when a converter is being placed on the bus-bar its voltage is slightly lower than that of the bus-bar, and consequently it "backs out," the circuit breaker being tripped by the action of the reverse-current relay. This feature is disagreeable, but it tends to make the operator more careful.

If reverse-current relays were not sensitive they would be practically worthless. Hence the features which appear to make the instrument objectionable are necessary elements of its successful application.

The Adjustment of Load Between Sub-Stations That Feed the Same Circuit.—Where all sub-stations are equipped with converters of the same capacity, it is desirable to have a definite rule governing the adjustment of power factor of converters, in order that the rail load may automatically distribute itself to the proper sub-stations. Such a rule requires the adjustment of the power factor of all converters so as to be unity at full load; but it fails where applied broadly, owing to the practical impossibility of finding any two converters of the same capacity, although manufactured by the same company, with identical characteristics and equal brush contact resistances. This rule is usually observed, however, with discretion by sub-station operators, and its observance yields good results. But if the rule be adhered to rigidly, the results are not altogether satisfactory.

For instance, assume two converters operating in multiple between a common alternating-current bus-bar and a common direct-current bus-bar. Assume also that the field resistances of the converters are adjusted for unity power factor at full load. When the load upon both machines is greater than the combined full load capacity of each machine, one converter may draw more than half the load. Also when the total load is less than the combined normal load of both machines, the other converter may absorb the greater proportion of the load. This condition is aggravated by the resistance of the converter field coils changing with the temperature, and also by the maintenance of the converter direct-current brushes.

When an individual converter in a sub-station is disconnected from the direct-current bus-bar it does not follow that the original station load will distribute itself over the remaining converters operating in multiple. Moreover, when an additional machine is connected to the circuit, the sub-station will draw more of the load from the adjoining sub-stations. The energy in this way surges back and forth with each operation. It is obvious, therefore, that it is practically impossible to frame a rule of this character which may be adhered to rigidly. If storage batteries are employed as a method of regulation, keeping the individual load upon the converters practically constant, this rule would apply more generally, but where the energy fluctuation upon the converters varies from quarter load to 50 per cent overload, and sometimes 100 per cent overload, it is obvious that the previous rule will not apply. The same reasoning holds good in the case of a sub-station equipped with machines of different capacities.

Noiseless Operation of Converters.—The operation of converters is usually accompanied by a shrill and disagreeable sound. It is not caused by the commutator, by the slip rings, or by air passing through the crevices of the armature as is usually supposed, but is purely an electromagnetic phenomenon. It is probably the result of vibrations set up in the armature core teeth by the varying electromagnetic conditions of the circuit.

That this tone is caused by magnetic action may be illustrated by the following simple experiment performed by the writer. A converter was driven by a separate belt-connected shunt motor, and the speed was adjusted to 1800 r. p. m. The converter was a four-pole machine, so that this corresponded to a frequency of 60 cycles. The converter field coils were unexcited and the machine operated practically without noise. Upon exciting the field coils this shrill tone became audible, and then increased in intensity until upon overexcitation it became very loud. This would seem to indicate that the phenomenon is purely magnetic, and that it might be obviated or at least modified by proper design. The desirability of such modification must be evident in the case of sub-stations located in residential sections.

SOME CONSIDERATIONS DETERMINING THE LOCATION OF ELECTRIC RAILWAY SUB-STATIONS*

BY C. W. RICKER

No attempt will be made in this paper to define the conditions under which indirect distribution, through the medium of transformer sub-stations, is more economical than direct distribution from one or more generating stations containing prime movers. It is assumed that because of the size of the railways to be considered, and the local conditions determining the cost of generating power, the indirect method of distribution has been selected as offering the best economy in commercial operation, and an attempt will be made to outline a general method for determining the number and location of sub-stations.

In many cases, perhaps the majority of cases, a general solution of this problem is quite impossible. Most of the large electric railway systems now in existence are the result of development not foreseen by their original projectors, and there is little reason to believe that future systems will be very widely different in this respect, but probably they will continue to grow by extensions and consolidations, depending upon the distribution and development of local centers of industry and population.

For convenience of discussion, electric railways large enough to require indirect distribution may be classified as follows:

1. Large simple networks, serving a single community.
2. Long single lines or groups of such lines, connecting separate communities or different parts of a very large one.
3. Complex networks, with connecting lines, serving a city and its suburbs.
4. Several networks, with long connecting lines, serving separated communities.

Railways of the last-named class are usually consolidations of the local systems of neighboring cities or towns, and interurban lines which frequently furnish power for lighting and general uses in the towns served. There are usually well-marked centers of load which together with local business conditions, determine the position and equipment of sub-stations.

Railways of class 3, those serving a large city and its suburbs, are also most often the result of the consolidation of separate lines and networks, and while the large central network belongs in class 1, the outlying districts present a difficult problem to the engineer, for he must anticipate the direction, character and sequence of growth so as to provide against it. This requires an intimate knowledge of local conditions, both industrial and social, and in addition he has need to be something of a prophet to foresee the changes which the building of new lines and the starting up of new works may produce. The problem is a local and particular one, and must depend mainly upon individual judgment for its solution.

Classes 1 and 2 can be treated more generally. Take first the case in which a large network, or long line or group of lines, is contained wholly within a large city, so that a fairly uniform schedule can be operated over the whole, and the mean load upon each mile of road is approximately uniform

* A paper presented at a meeting of the American Institute of Electrical Engineers, New York, Dec. 15, 1905.

throughout the system, at any given time. It is required to adjust the cost of losses in the primary distribution, the secondary distribution, including the track and the sub-stations, the fixed charges upon each of these three divisions and the cost of sub-station attendance, so that their sum shall be a minimum, with due regard to the conditions of regulation and continuity of service.

As the density of the load in such a system is very great, the unit of sub-station equipment may be made large enough, so that at the time of least load, one unit per sub-station may be operated at or near its best efficiency. Hence the sub-station losses per kw-hour may be considered constant.

The aggregate capacity of the sub-stations will equal the capacity of the generating station, plus the sub-station reserve capacity, if any is necessary, which will not exceed one unit per sub-station. The greater the distance between sub-stations, the larger the sub-station unit will be; hence the cost of sub-station apparatus will increase as the number of sub-stations increases, until the largest practicable unit is reached. The same is true of sub-station land and buildings.

The cost of sub-station attendance will depend only upon the number of sub-stations, as the same number of attendants is required in a small as in a large sub-station, unless the cost of land makes it necessary to double deck the sub-stations, which will cause a sharp rise in the cost of attendance when the number of units becomes greater than can be placed on one floor.

When direct-current motors are used, the secondary voltage is fixed by conditions of standard practice. The secondary conductors may be proportioned by Kelvin's law, subject to the limiting condition that the lowest potential shall be enough to allow the required acceleration. As the number of sub-stations increases, the cost of the conductors will decrease rapidly. The energy losses in the conductors may be constant or decreasing. The primary distribution in this case must be by underground cables. The primary voltage will be determined by the relative cost of copper and insulation, and should be as high as is consistent with safety. Hence the losses per mean kilowatt in the primary distribution may be considered constant. The total weight of primary conductors will be practically independent of the number of sub-stations, depending upon the total energy and the mean distance of distribution, and may be determined by Kelvin's law.

To obtain the greatest reliability of service, each sub-station should be fed directly from the generating station by at least three cables, and in the case of a wide difference in the number of sub-stations considered, the total cost of cables and conduits would be somewhat greater with the larger number of sub-stations, as more and smaller cables would be required. Otherwise the cost of the high-tension distribution, and the losses in it, may be considered constant.

Neglecting those quantities which are constant, the fixed charges on sub-station land, buildings and apparatus, and the cost of sub-station attendance increase as the number of sub-stations increases; the fixed charges on the secondary distributions decrease and the losses in the secondary distribution decrease or remain constant.

The various losses and charges upon which the solution of the problem depends may then be considered as constants or variables, dependent directly upon the number of sub-stations and inversely upon the distance between sub-stations. These quantities may be reduced to a common base of annual kw-hours, and curves representing them may be drawn with respect to the number of sub-stations as one co-ordinate, and a summational curve may be drawn which, if the premises are rightly chosen, will indicate the number of sub-stations at which the sum of the various charges is a minimum.

In a far greater number of railways the load is not uniform throughout the system. This is true especially of the long interurban railways using a comparatively small number of heavy train units. The load at any given time is concentrated upon parts of the system, or travels from end to end of the long lines. In such a system, the aggregate capacity of the sub-station apparatus in operation at any given time is greater than that of the generators; hence the load factor of the sub-stations is unfavorable, and in most cases the power factor of the system is low.

In a solution by the method outlined in this paper, several new curves must be drawn in addition to those named. The first showing the all-day losses in the sub-station apparatus, which will increase with the number of sub-stations. The second showing the losses in the primary transmission lines, which will also increase with the number of sub-stations, due to the greater length of lines and to the lower power factor. The third showing the fixed charges on the primary transmission lines.

The last two curves are relatively much less important. It is possible by compounding or automatic adjustment of fields, to keep the power factor of the synchronous converters very near unity, making the transmission losses more nearly constant and independent of the number of sub-stations. In such systems it is not usual, and seldom practicable, to use separate feeders from the generating station to each sub-station; and the primary distribution is usually by overhead lines, generally supported on poles which are used for other conductors as well. But with all the sub-stations along a single line of railway, or a group of such lines connected to one transmission line, the additional cost of extending the same for a greater number of sub-stations will usually be but a small part of the whole expense. So, for at least a preliminary consideration of the problem, the last two curves may be omitted and the same quantities used as are considered in the solution for a road having a uniform distribution of load, with the addition of one containing the all-day losses of the sub-station apparatus.

In systems consisting of long lines with infrequent train service, the cost of attendance and all-day losses in converter sub-stations often become so great that the regulation in secondary conductors economically proportioned for standard direct-current voltage will not permit the operation of the required schedule. The usual remedy is to set the sub-stations nearer together, though at the cost of operating economy.

If other conditions still make the use of standard direct-current equipment desirable, it would seem that better economy could be obtained by lengthening the sub-station sections and using boosters, just as has been found profitable in the supply of such lines of less length from direct-current generating stations. The fixed charges on and losses in the boosters should then be included in the curves of sub-station apparatus.

In the discussion of the method of treating the problem of sub-station location herein suggested, the usual type of converter sub-station, with direct-current, secondary distribution, has been kept in mind, but the method is no less applicable to a complete alternating-current system with static sub-stations, in which case the curves of sub-station losses, attendance and fixed charges all become flatter, while the higher trolley voltage available permits a wider spacing of sub-stations without exceeding the limiting conditions of regulation, all of which indicate a better efficiency of sub-station apparatus and secondary distribution, in roads of low and non-uniform load density.

Following the reading of the two papers on sub-stations, the discussion was opened by H. A. Lardner, who called attention to the fact that in rotary converter sub-stations of the average interurban railway the sub-stations are entirely shut down every night, and unless storage batteries are included in the equipment of these sub-stations, no direct current is available for starting the converters in the morning. Therefore, it becomes necessary to include one other method of starting con-

verters. The method of starting the converters from the alternating-current side has many advantages; among them are great simplicity and the omission of special apparatus. The introduction of taps running from the middle points of the transformers is a very slight modification, and the double-throw switch required is also a small matter. Furthermore, the division of the field coils is not seriously objectionable. Where the size of rotaries is 500 kw and under it is desirable to use the alternating-current, self-starting method for placing the first converter in operation in the morning, when no direct current is available, and to use the direct-current method for the addition of other units at any time during the period of operation.

W. I. Slichter remarked that in addition to the method involving the application of an induction motor in starting rotary converters, there is another method of indirect starting by the use of a single-phase commutator motor. The alternating e. m. f. of a rotary converter is approximately the voltage which is suited for a single-phase commutator motor, and by putting a reactance in series with such a motor an easy means can be obtained for regulating the voltage and the speed. By this method it would be easy to secure the proper speed for throwing the converter into synchronism.

H. G. Stott thought the importance of the line drop had not been properly emphasized. When a synchronous converter is operated with a line drop of 12 per cent, there is difficulty in holding it in synchronism, and its operation generally will be unsatisfactory. This fact is of moment when a converter is started from the alternating-current side. If the line is fairly well loaded and there is a drop approximating 10 per cent if a converter of relatively large capacity be started, there may be such a drop as to start the other converters hunting, and to cause a flashing at the brushes. This fact also has a strong bearing on Mr. Ricker's paper. That is to say, the limiting conditions in the location of sub-stations is set by the line drop, and it must be borne in mind that a maximum of not more than 15 per cent drop can be allowed.

Professor R. B. Owens, of McGill University, called attention to the fact that the main consideration in connection with the location of electric railway sub-stations was omitted from Mr. Ricker's paper, namely, the voltage. Without going into the question of whether or not direct-current generators can be successfully designed of large size, for voltages of 1000 or 1500 or 2000, it is believed that the makers stand ready to furnish rotary converters of 1000 volts, may be more, and also at least bi-polar motors that will operate successfully at such voltages. If this is true it affects the whole question of sub-station location most materially, and materially interferes with the field which some people suppose the alternating-current motor system occupies. The gist of the whole matter depends upon the value to which the direct voltage can be increased. The solution lies in the design of direct-current machinery, in large units, at high voltage, to operate successfully under conditions met in traction work.

William McClellan thought the method proposed by Mr. Ricker would apply very well where trains move over the road without any particular points of congestion; but in any practical case it is necessary to consider the location of each sub-station in connection with the existing conditions.

Dr. C. P. Steinmetz stated his belief that for a long time to come, if not for ever, the largest number of railway sub-stations will remain converter sub-stations. It is proper, therefore, that much attention should be devoted to the rotary converter. The railway converter sub-stations can be divided into two typical classes: the sub-station in a large high-power distribution system and the sub-station in an interurban system. In the former class, the loss between generating station and sub-station and the drop of voltage between sub-stations is very small. The sub-stations contain a large number of large units, which run practically always at steady full load. The individual momentary variations of load are not perceptible in the sub-station to any great extent, and the daily changes of load are taken care of by varying the number of converters. In such sub-stations the possible variation of voltage due to line drop is insignificant. Automatic control of voltage for variations of load on the converter is not necessary, since the converters are maintained at fairly steady voltage. Therefore, automatic voltage controlling devices, as compound field coils and reactive coils, are not necessary, but the shunt-wound converter is suitable, and therefore it is undesirable to have in such sub-stations series field coils on the converters and reactive coils, since they are an unnecessary source of a possible danger, the danger of racing in case of the direct-current system feeding back into the converter sub-station, which danger, due to the small resistance between sub-stations, is greater than in the interurban sub-station, which is the second class of sub-station. In the interurban systems moderate-sized sub-stations with two or three units of converters of, say, 500 kw or less, are fed from long-distance, high-potential transmission lines with considerable drop of voltage in the transmission lines and very considerable resistance between the sub-stations. In these sub-stations systems the variation of load would be impracticably large for any ordinary methods of voltage control to be used. Therefore, these sub-stations utilize powerful series field coils and reactive coils. That is what has been called phase control. In the operation of a converter sub-station the most important matter is the starting of the converter. In the early days the first systems were started from the alternating-current side by throwing full voltage on the converter or synchronous motor and letting it get up to synchronism. The starting from the alternating side gives the severest jolt on the system, especially when started at full voltage. The converter is also started either by a special motor or from the direct-current side, and then synchronized. The methods of starting can, therefore, be divided into two large classes: those methods which require synchronizing devices and those which do not require these devices. There may be some difference in the time required to start; it may take a little longer time to synchronize, but in either case the minimum time is sufficiently short, so that either method would be suitable. The method of starting, which requires synchronizing devices, is the least severe on the system. A converter may be put into the system without any trace of disturbance. This method was introduced to a large extent to avoid shock on the system, but recently the tendency has been strongly away from it, and at least in interurban systems, it may almost be said that the methods of starting which require these devices have failed. They have failed because under just those conditions where the utmost rapidity of starting is essential, where there is trouble in the system or heavy overloads, where the direct voltage cannot be held up, and begins to sag down to nothing, and where in the alternating-current system the voltage goes up and down, the machines cannot be synchronized safely. These are the main reasons for reintroducing the alternating-current, self-starting method. It is true that a specially skilled operator might be able to get the converter in operation in this manner without throwing out the whole sub-station, by closing the switches not at equality of frequency, but when the two frequencies approached each other, while they are yet coming together, because it is impossible to synchronize them while they are together. The speeds cross each other at such rapidity that they are immediately again apart, and there is the danger of improperly estimating the time and thus of short-circuiting the system and throwing out the other converters just when they are most needed. In general, the proper moment for closing the switches is not when the machines are in step and in synchronism, but just a moment before they are in synchronism. That means that a direct-current starting is of exceptional usefulness in interurban systems. In the large metropolitan sub-stations the difficulty is largely reduced, be-

cause the voltage is steady on the alternating side as well as on the direct-current side. At the same time in these systems, if a machine is thrown in when out of synchronism the result is much more disastrous, because there is almost no resistance between the generating station and the sub-station or between the sub-stations, and all the momentum of the whole system feeds back into the converter, thus reversing the converter at full velocity. Even with the most skilled operator, that may occasionally happen. Assuming the efficiency of the operator as very high, that his liability to error is only one-hundredth of 1 per cent, that he will make a mistake only once in 10,000 times, if one considers a city like New York, where more than 100 converters of 1000 kw or more have to be thrown into the system daily, it will be seen that one in ten thousand means three times a year some big converter is thrown in wrong, and tears down the whole station, with the usual disastrous results. This fact gives the preference to starting from the alternating side by means of low voltage. A compromise of the direct-current and the alternating-current methods of starting has been developed to reduce the jolt on the system. The start is made from the direct-current side, and the machine is brought up almost to synchronism. The direct-current side is disconnected and the alternating-current switch is closed. The converter drops in step almost instantly, and there is hardly an appreciable jolt on the whole system. This method is not quite as simple as the one used when starting from the alternating side from rest, but it is sufficiently simple for a large system, where the risk is considerable.

In discussing the hunting of converters, Dr. Steinmetz stated that there are several modifications of the anti-hunting devices. One of the most effective is a squirrel-cage induction motor. That is the most effective anti-hunting device, and it is largely used in synchronous motors intended for very severe conditions, as for operating heavy fluctuating loads at the end of a long transmission line with heavy resistance losses in the line. It is obvious that such a squirrel-cage induction motor is of a great advantage in starting the converters. Two other devices are short-circuits around the field pole and short-circuits between the field poles, each depending for its operation on the shunting of the magnetic flux. When hunting, the magnetic flux vibrates across the field pole. The short-circuit current around the field pole is due to the change in the magnetic flux. The short-circuits between the field poles obviously cannot interfere with starting, but they act as self-starting motors, giving a quarter phase winding to the normal pole, and produce the effect of a quarter-phase motor. The other arrangement of short-circuiting around the field poles is used to a considerable extent in synchronous motors which are built that way, and they give no trouble, because there are many of them in use with synchronous motors. There seems to be no good reasons why they should not be very satisfactory in connection with rotary converters.

The storage battery is a very useful and desirable element in a railway system. The only and main objection to a storage battery which has practically killed its introduction in most railway systems, especially in interurban systems, is that the cost of the storage battery as a rule is so great that an interurban railway cannot pay for it, or cannot be sure to earn sufficient money to pay the interest on the investment in the battery.

General Passenger Agent Dittenhaver, of the Toledo & Indiana Railway, has a novel method of advertising shows and special attractions that appear in towns along his line. He sends a special car with a band to the various towns along the line, and after a band concert to draw a crowd, a "barker" announces the special features of the show to be held in the neighboring town. The plan has worked with great success in several instances of late.

THE ELECTRIFICATION OF THE PENNSYLVANIA RAILROAD BETWEEN CAMDEN AND ATLANTIC CITY

Up to the present time the principal advance in the electrification of steam roads has taken place at the terminal stations or upon branch roads, so that the recent decision of the Pennsylvania Railroad (announced in the STREET RAILWAY JOURNAL of Dec. 16) to equip electrically a portion of its system between Camden and Atlantic City, N. J., is of the greatest interest. The developments which have taken place at New York under the direction of the New York Central and New York, New Haven & Hartford Railroad companies have focussed the attention of the engineering world on this branch of railroad engineering, and this further advance of electric traction, coming as it does when this phase of railroading is fresh in the minds of all engineers, marks another milestone passed in the substitution of electricity for steam for heavy railway service.

That portion of the Pennsylvania Railroad to be electrified comprises some 64 miles of steam road lying between Camden and Atlantic City, N. J., being a portion of the West Jersey & Seashore branch of the Pennsylvania system. It is proposed to utilize the Cape May line of this system from Camden as far as Newfield, this line being double-tracked with 100-lb. rails, and to build an additional track from Newfield to Atlantic City, making the lines double track throughout.

Over this roadbed an express service will be established. The initial installation will provide for a three-car train every 15 minutes between Camden and Atlantic City, making the 64 miles in 80 minutes without stops. The maximum speed of the cars will be between 55 m.p.h. and 60 m.p.h.

In addition to this through service to Atlantic City, a half-hourly schedule is planned, consisting of two-car trains between Camden and Millville, 40 miles, and 10-minute service of single cars between Camden and Woodbury, 8½ miles. Full service will call for fifty-eight cars in operation, each equipped with two 200-hp direct-current GE 69 motors. These motors will be similar to those now being manufactured by the General Electric Company for the equipments of the New York terminal of the New York Central & Hudson River Railroad. The motors will be controlled by the Sprague-General Electric multiple-unit system. Current will be furnished to the cars by the third-rail system, except on the sections between Camden and Woodbury, and Newfield and Millville, where the cars will obtain the necessary current by an overhead trolley. The speed on these sections is less than on the main line.

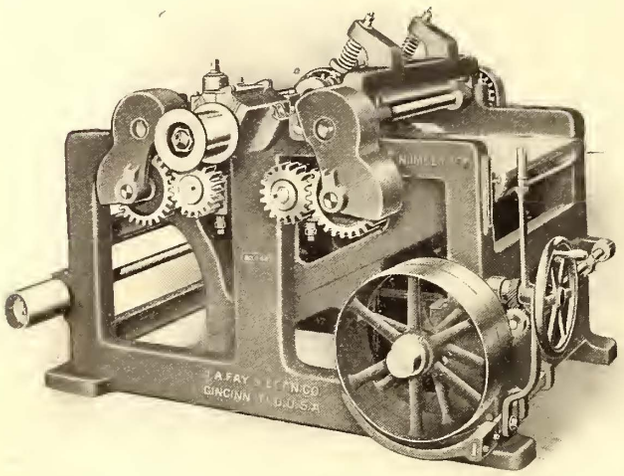
The power house will be located at Camden. Power for the operation of the cars will be furnished by three 2000-kw General Electric Curtis turbo-generators of the three-phase alternating-current type, having a frequency of 25 cycles. From this power house transmission lines will be run to six sub-stations between Camden and Atlantic City, and a seventh sub-station at Millville to supply that section of the road lying between Millville and Newfield.

The transmitting potential will be 33,000 volts. At the sub-stations a total capacity of 11,000 kw in rotary converters will be provided, delivering direct current to the third rail at 650 volts. The individual units will be of the standard General Electric type, and will have a capacity of 750 kw. They will be started from the alternating-current end by means of taps on the step-down transformers. The contract calls for the completion of this road by July 1, 1906, in order to take care of the heavy summer traffic. The total amount of money involved is about $3,000,000.

The Illinois Transportation & Tunnel Company, which controls the Chicago freight subway, has published a pamphlet showing that the amount of finished tunnel on Dec. 1 was 208,220 ft. as against 103,620 ft. on Nov. 1, 1904.

AN IMPROVED CABINET PLANER

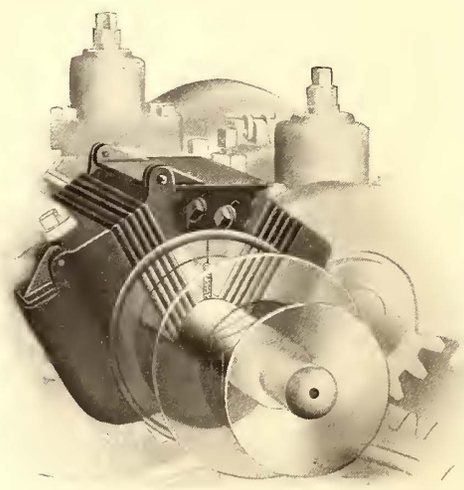
In one of the accompanying views is shown a new cabinet planer from the shops of the J. A. Fay & Egan Company, of Cincinnati, Ohio, especially designed for use in work wherever a fine, smooth surface is required. The heavy table is supported on a pair of inclines which run in gibbed ways on the



NEW CABINET PLANER

base of the machine, and are operated at the feeding-in end by a hand wheel and two parallel screws on ball bearings; at all times the points of support are directly underneath the feed rolls and the cutter head.

The feed mechanism consists of four 5-in. rolls, all driven downward by a system of gears said to be used only on Fay & Egan machines. All gears are keyed to babbitted shafts; the use of studs, with their consequent evils, is entirely avoided.



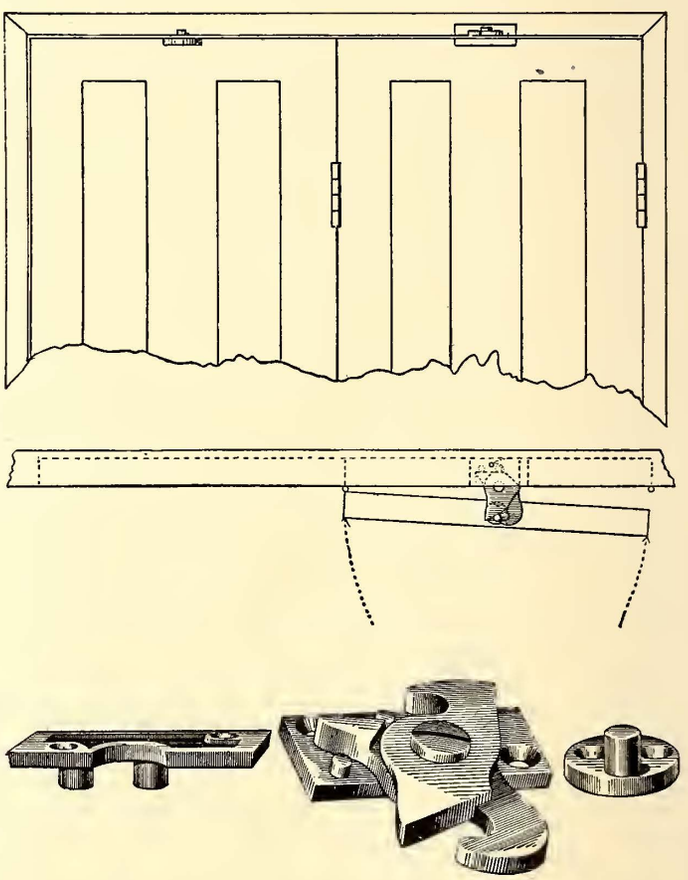
SECTIONAL CLAMP BEARING FOR CABINET PLANER

The infeeding roll is controlled by spring pressure, and may be either solid or sectional. The sectional feed roll is unique in its interior construction. Each section is 1½ ins. thick and drives independently, as if it were a separate roll. This feature is found an invaluable one when it is desired to plane at the same time a number of narrow strips of varying thickness.

The cylinder is tool steel of small cross section—two features essential to fine planing; the cutter head and journals are forged from the same piece. The sectional clamp bearings for the cylinder journals do away with the trouble of rebabbitting. The thin plates which form the cap bearings rest diagonally upon the upper surface of the journals and are clamped in place by bolts, shown in illustration. These plates take up their own wear, and any looseness of the journals may be taken up each day if desired. On either side of the cylinder are the pressure bars, set close to the knives and rising concentric with them. On the lower edge of the front bar is a spring extending from end to end, which rests upon the stock instead of the bar proper, and which is strong enough in itself to press all ordinary crooks out of a board and hold it firmly on the table.

AUTOMATIC LOCK FOR FOLDING VESTIBULE DOORS

In the accompanying illustration are shown the details and application of an automatic lock for folding vestibule doors which is made by the Frank Ridlon Company, of Boston, Mass. It has been found to be of great value in preventing glass breakage and the swinging of vestibule doors. The first half of a vestibule door can be opened while the second half remains



CONSTRUCTION DETAILS AND APPLICATION OF AUTOMATIC LOCK FOR FOLDING VESTIBULE DOORS

closed. This latter cannot be opened until the first half is folded back against the catch, which unlocks the second half and locks the two doors together automatically, upon which both can be swung back together and hooked. When this operation is reversed, the two halves remain locked together until, in closing, the second half strikes the catch; this releases the first half, the second half being locked also in its normal closed position. The first half is then free to be closed and locked.

Thus far this year up to Nov. 1 the interurban cars of the Detroit United Railway, together with the Rapid Railway System, have brought into the city 220,656 cans of milk. In four years they have contributed 803,237 cans to Detroit. That is 8,032,370 gallons, or 32,129,480 quarts.

WHEEL PRACTICE IN NEW BEDFORD, MASS.

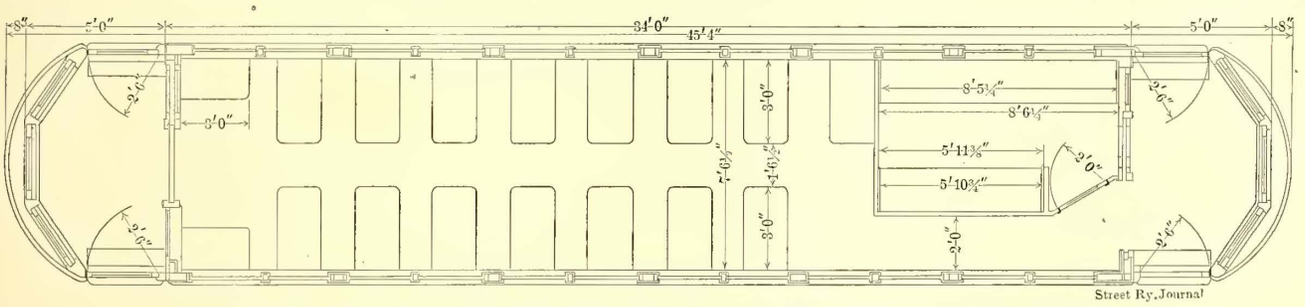
A couple of years ago the Union Street Railway Company, of New Bedford, Mass., which had been using chilled cast-iron wheels for all of its cars, began experimenting with a number of different makes of steel-tired and fused-steel wheels. Up to the present time thirty cars have been equipped for the interurban cars, each car carrying eight wheels of the same manufacture to obtain a fair average life for each type of wheel. Despite the company's precaution in using the same wheels for a given car, one pair of wheels was found to require re-turning after running only 16,000 miles, while the six other wheels were still in first-class condition. At the same time it should be noted that a pair of steel-tired wheels of other manufacture has covered over 54,000 miles without requiring re-turning. In view of the comparatively short time that the company has been trying steel-tired and fused-steel wheels, E. E. Potter, the general superintendent of the Union Street Railway Company, does not think it proper to make any statement relative to the comparative economy of these wheels and the ordinary chilled iron type. Where steel-tired wheels are used, the cost of re-turning them naturally is a very important factor, and until the New Bedford company installs the necessary wheel lathe it cannot present conclusive data. The company's experience, however, appears to have brought out the peculiar phenomenon that after the first turning the steel-tired wheel seems to wear out at a greater rate than before.

INTERURBAN CARS FOR YOUNGSTOWN AND VICINITY

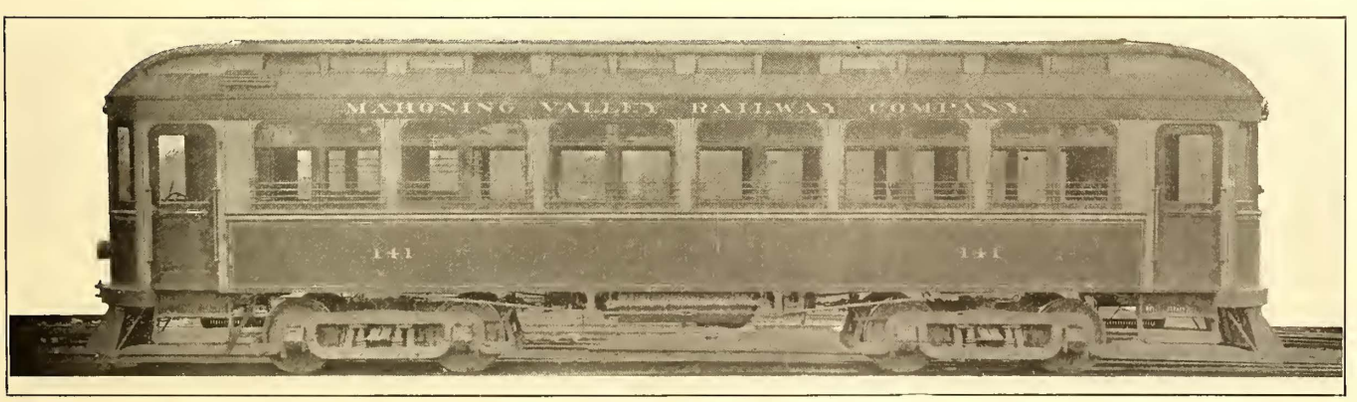
The Pennsylvania & Mahoning Valley Railway, of Youngstown, has just received from the Niles Car & Manufacturing Company several very fine cars designed for the through limited service between Leavittsburg, Warren, Niles, Girard, Youngstown and New Castle. The local conditions were somewhat difficult to meet and the car was designed by the railway people in an effort to supply suitable service for the mill men in their working clothes and at the same time provide a compartment suitable for ladies. It was necessary to operate as a double-end car, with passenger entrance at each corner, and at the same time it was thought desirable to keep the smoking compartment entirely separate from the passenger compartment and not compel ladies to pass through the smoker when entering the car at this end. The plan drawing shows the seating and the arrangement of the passenger and smoking compartment, also the dimensions. The car is 45 ft. 4 ins. over the buffers, and extreme width is 8 ft. 6 ins. The bottom frame is composed of 6-in. I-beams in the center sills. The side sills are double, with heavy steel plates between all sills, extending the length of the car body only, both platforms being depressed about 6 ins. below the car floor.

INTERIOR OF PENNSYLVANIA & MAHONING CAR

The panels are smooth, without raised work, and outlined in neat inlay of colored woods. The interior finish is of solid mahogany throughout, and the ceiling of semi-Empire style, decorated in green and gold. The lamps are arranged in arches between the ceiling panels. Plate glass is used throughout except in the ventilator sash. Owing to the fact that many passengers are mill men riding in their working clothes, it was deemed advisable to upholster all seats in white woven rattan, but high roll backs with corner grip handles and of the reversible type are employed.



PLAN OF INTERURBAN CAR FOR THE MAHONING VALLEY RAILWAY COMPANY



ONE OF THE PENNSYLVANIA & MAHONING VALLEY RAILWAY COMPANY'S NEW CARS COMPLETELY EQUIPPED FOR OPERATION

STANDARD DIMENSIONS AND SEATING PLANS OF BRILL CONVERTIBLE CARS

In the Nov. 18 issue of the Street Railway Journal was shown a series of diagrams giving the standard dimensions and showing the seating plans of several sizes of the Brill semi-convertible type of car. It was stated in the accompanying article that the large use of this car had resulted in the standardization of the dimensions for certain forms of service. This is also true of the convertible car of the same manufacture, and diagrams with dimensions of single and double-truck cars of what are usually considered to be the most suitable length for city service are shown herewith. This type of convertible car was introduced in 1898, and is now used in half the States in this country and in seven foreign countries. Over 100 convertible cars are being built on order by the J. G. Brill Company and its allied companies at the present time.

The recent improvement in the system of sliding the sashes and panels into roof pockets, known as the "grooveless-post system," has been described in these pages in connection with articles relating to cars of this type built for various railway companies, and has also become widely known to railway operators through a car of the type which was exhibited at the recent street railway convention at Philadelphia, and through advertising, etc. It will be noticed that there is a difference of 2 ins. in the width over the posts of the cars shown in the diagrams, and that the aisle width is the same in both. It is usually preferred to reduce the seat length rather than the width of the aisle. The levers of these seats, which support the backs, and by which the backs are moved from one side to the other, are arranged so as not to prevent the bodies of seated passengers from projecting over the ends of the cushions. The seating and aisle space will be found quite equal to that of a standard closed car. The distance between the side posts, 2 ft. 7 ins., has proved adequate for the requirements in every respect. In the longer car, shown in Fig. 2, it is not unusual to have panels between the double corner posts and the first side posts solidly built in, and with this arrangement longitudinal seats accommodating three persons each are used at the corners. The large clear space at the doors, which is obtained by the use of the longitudinal corner seats, is a useful feature in many places. Another modification of this longer car, which

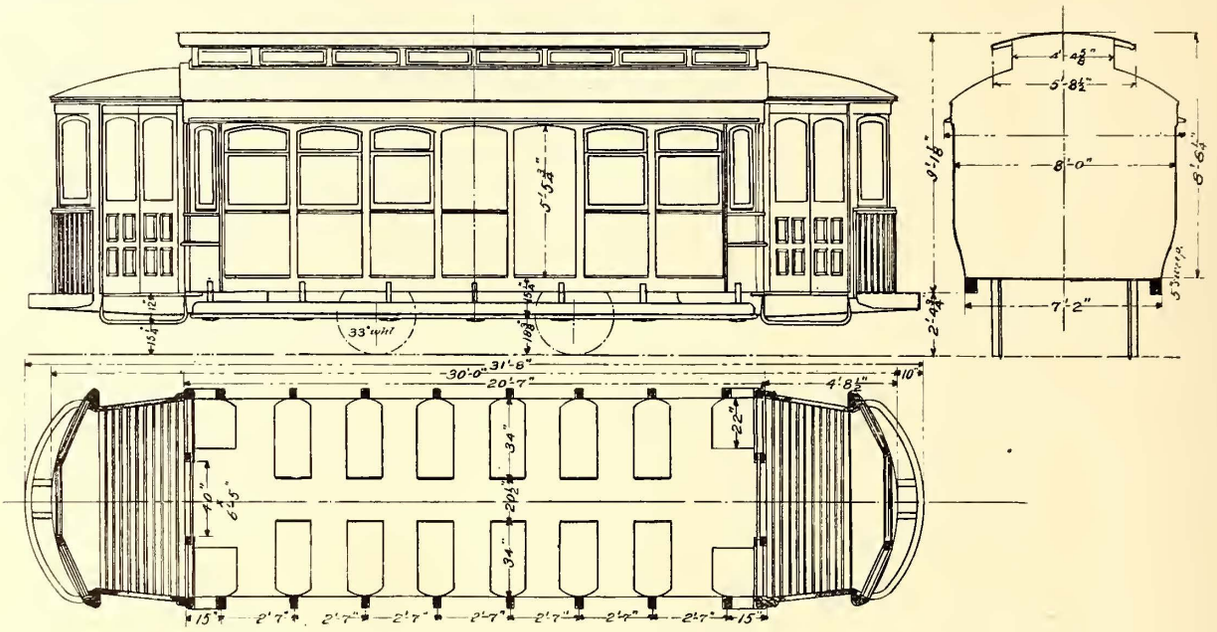


FIG. 1.—PLAN, SIDE ELEVATION AND END ELEVATION OF STANDARD SINGLE-TRUCK CONVERTIBLE CAR

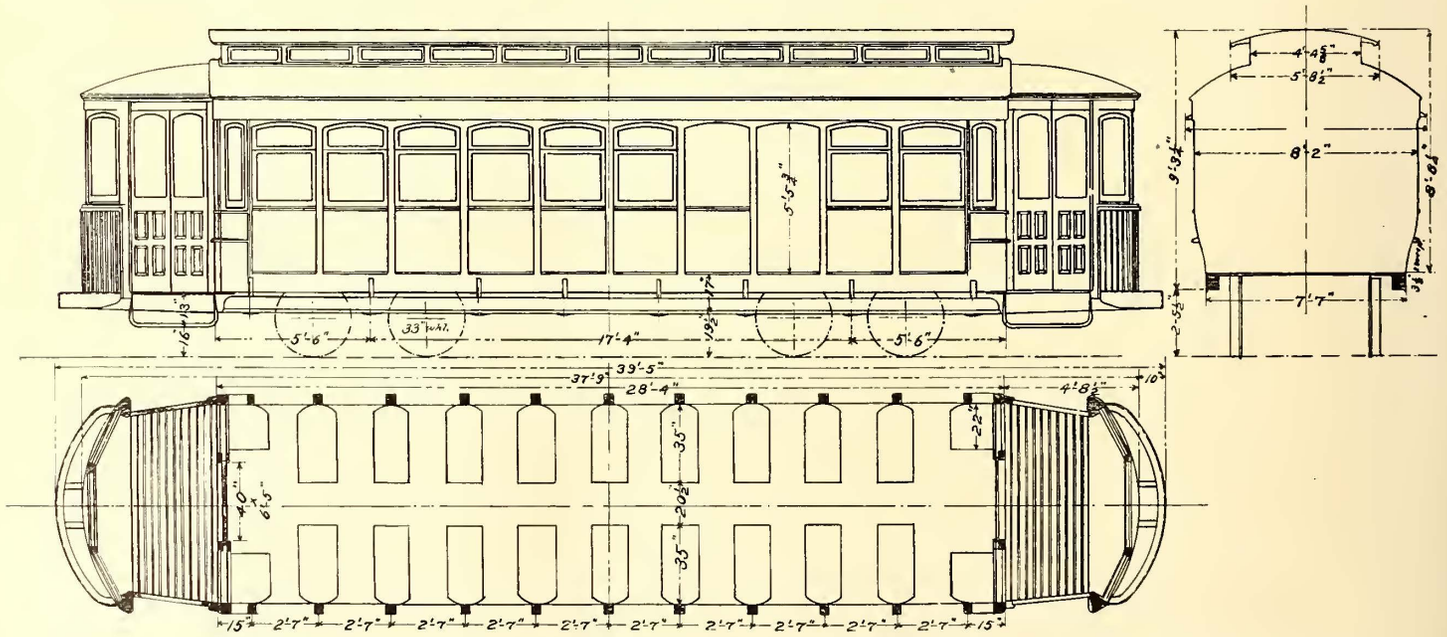


FIG. 2.—PLAN, SIDE ELEVATION AND END ELEVATION OF STANDARD DOUBLE-TRUCK CONVERTIBLE CAR

is considered wise in a number of respects, is the inclusion of the "Narragansett" type of sill step. This arrangement, as is well known, provides an upper step on the lower, outward extending flange of a Z-bar, which forms the sill, and which keeps this step within the line of the posts. It brings the running board down to the same level as the platform step and makes it easier and safer for the passengers to enter and leave the car at the side entrance. Attention is directed to the fact that the clear space between the ventilators of the monitor deck is not materially reduced by the provision of pockets in the side roofs for the sashes and panels, and also that the sweep of posts is not interfered with. The flexible metal panels are capable of assuming whatever curvature is necessary.

While the majority of orders received by the builder for cars of this type have the dimensions and seating plans shown, the adaptability of the type to suit special conditions will be evident to any experienced operator. The filler seats for the aisles have been successfully used by different companies, including the Ocean Electric Company, of Long Island, N. Y., and the Manila (P. I.) Electric Railways. A partition at the center is used in cars built for the Colorado Springs & Suburban Railway, so that passengers might have half of the car opened and the other half closed if they so desired. The Schuylkill Traction Company recently was supplied with cars having a smoking compartment at one end with longitudinal seats, and the panels were arranged to be made operative at any time the company should wish to use transverse seats in this compartment. A number of companies whose lines are laid out so that the cars run in one direction, with the entrances at one side only, have ordered cars with this convertible system for the entrance side.

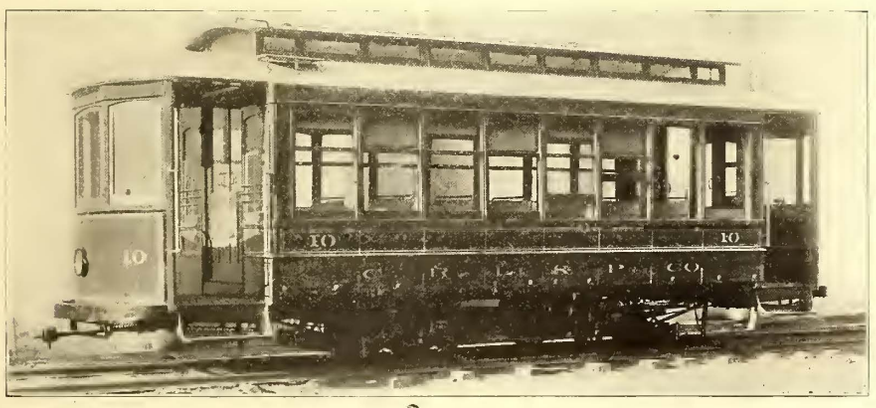
GROOVELESS-POST, SEMI-CONVERTIBLE CARS FOR WILMINGTON, N. C.

In an article in the STREET RAILWAY JOURNAL of Dec. 9, describing a number of Brill semi-convertible cars recently furnished to the Asheville (N. C.) Electric Company system, it was stated that Asheville was one of the first cities to install an electric railway system. The success of the undertaking was widely felt throughout the Southeastern States and led to the electric equipment of a number of lines in other cities in North Carolina within a short period. The electric line at Asheville was first opened in January, 1889, and on May 1 following, electric cars commenced operation in Wilmington.

The J. G. Brill Company has recently shipped three cars of its grooveless-post, semi-convertible cars to the Consolidated Railway, Light & Power Company, of Wilmington, which are the first of this style of car to be used in that city. The railway company has 17 miles of trackage and twenty-four cars. It connects Wilmington, Wrightsville and Wrightsville Beach, and reaches two popular amusement parks.

The cars are 4 ins. wider than is usual in the single-truck type and measure 8 ft. 4 ins. over the posts at the belt. This permits the seats to be 36 ins. long and the aisles 24 ins. wide. The seats are of the builder's manufacture, and have wooden hand rails extending across the top of the backs. The seating capacity of the car is thirty-two. The illustration shows two of the windows at the rear of the car, raised up into the roof pockets, and two held at different heights. The arm rests, which may be seen on the window sills, are necessary on account of the lowness of the sills. To keep the platforms free of water in rainy weather, they are covered with transversely placed boards having spaces between through which the water runs off at either side. The mild winters of Wilmington do not require that the platforms be entirely enclosed, therefore doors are omitted from the platform entrances.

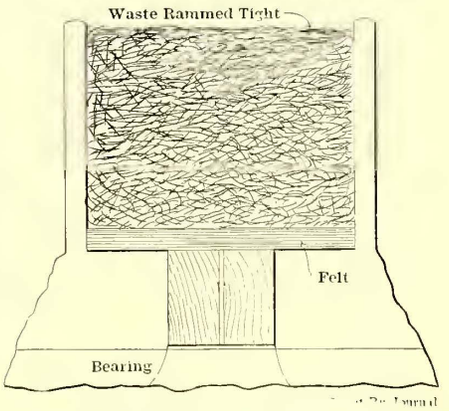
The general dimensions are as follows: Length over the end panels, 20 ft. 8 ins.; over the vestibules, 30 ft. 1 in., and over the bumpers, 31 ft. 9 ins.; height from the under side of the side sills over the monitor roof, 8 ft. 11¼ ins.; width over the sills, 8 ft. ½ in., and over the posts at the belt, 8 ft. 4 ins.; distance between the centers of the posts, 2 ft. 5 ins.; thickness of the corner posts, 3⅝ ins., and the side posts, 2¾ ins. The side sills are 3⅜ ins. x 5 ins., with 12-in. x ⅜-in. sill plates inside. The end sills are 3½ ins. x 5¾ ins.; the wheel pieces, 4 ins. x 4½ ins., and the crossings, 3½ ins. x 4¾ ins. The height from the floor to the top of the window sill, 25 ins., and from the sill to the center of the arch over the window, 2 ft. 6⅜ ins.; from the platform step to the platform, 13 ins., and from the platform to the car floor, 6⅜ ins. The angle-iron bumpers, radial draw-bars, platform and signal bells, seats, steps and other specialties are of the builder's manufacture.



SINGLE-TRUCK, DOUBLE-VESTIBULE, SEMI-CONVERTIBLE CAR FOR THE CONSOLIDATED RAILWAY, LIGHT & POWER COMPANY OF WILMINGTON, N. C.

USE OF OIL IN GREASE BOXES AT KANSAS CITY

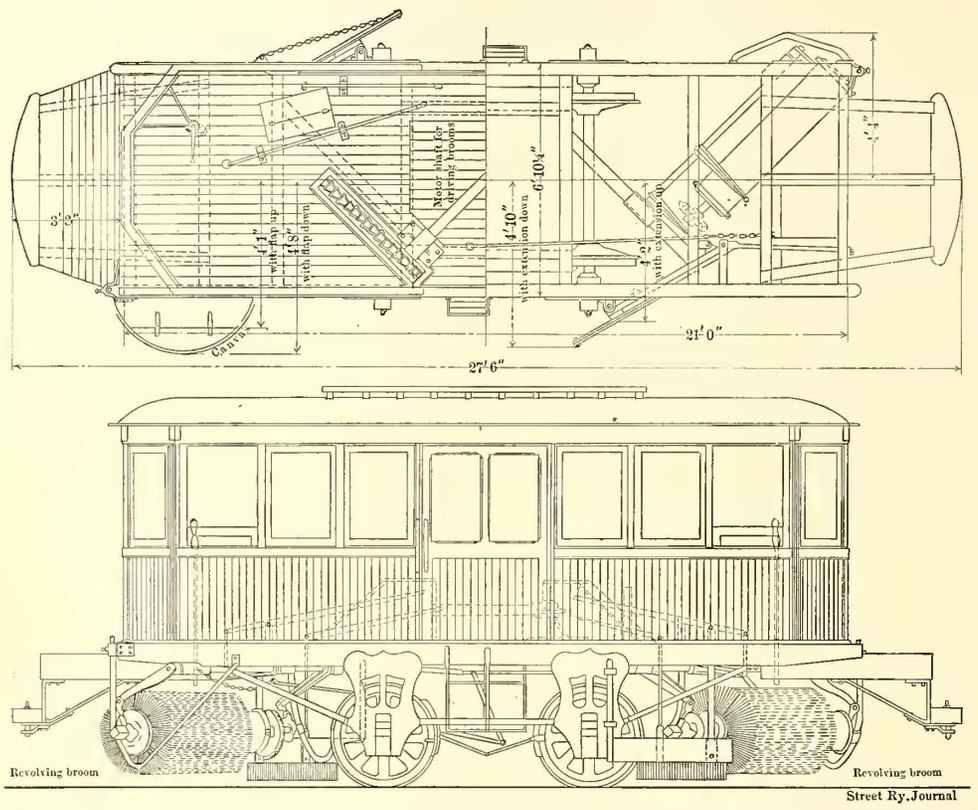
The accompanying sketch shows a cross section of a plan which is being adopted on the cars of the Kansas City Railway & Light Company, which were designed for grease lubrication with grease boxes, and which are being changed for oil lubrication. The scheme is very simple, but in the opinion of G. J. Smith, master mechanic, who has tried a great many different plans to accomplish this end, it is the most satisfactory yet tried. No special oil box is used. The oil is put directly into the regular grease box of the motor. Into the hole in the bottom of the grease box a wooden plug is driven. In this plug is a ⅛-in. hole. On top of the plug is put a layer of felt. The box is then nearly filled with waste. The rule is to put two tablespoonfuls of oil into the boxes every day. The waste is rammed into the box as tightly as possible and brought up to such a height that it is difficult to get more than two tablespoonfuls of oil into a box at once without running it over and making the fact evident upon a casual inspection of the motor.



CROSS SECTION OF GREASE BOX ADAPTED FOR OIL

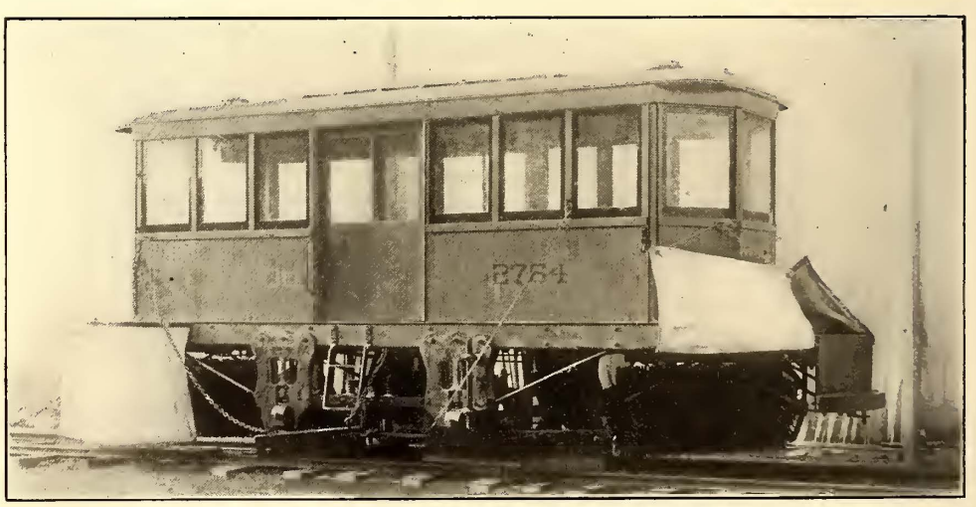
NEW SNOW-REMOVING EQUIPMENT FOR THE PHILADELPHIA RAPID TRANSIT COMPANY

Like other street railways in its vicinity, the Philadelphia Rapid Transit Company had its hands full last winter in the endeavor to cope with the conditions produced by the unusual number of snow storms. The company has a large number of sweepers, and two years ago obtained fifty snow plows of a powerful type from the J. G. Brill Company; but the trackage, which is 544 miles, the longest of any electric railway system in the world, with many miles of track through narrow streets, made the situation extremely difficult. The company has had fifty-seven of its old type of sweeper equipped with the Brill standard broom, such as are shown under the car in the accompanying engraving. The installation of these brooms has recently been made and the sweepers put in A1 condition for the winter's work. The company has also delivered to the Philadelphia Rapid Transit Company within the last week or two, seven of its standard sweepers. The builder claims that the short brooms, which are used with this sweeper, have several advantages over brooms which extend the full width of the track. It is stated that the long or double brooms pile the snow up in front, where they must come in contact with it again; also that short brooms work and wear more evenly and are easier to handle, and are capable of independent adjustment, so that they can be made to conform to the curvature of the pavement between the rails.



FLOOR PLAN AND SIDE ELEVATION OF PHILADELPHIA SNOW SWEEPER, SHOWING THE LOCATION OF THE SNOW-FIGHTING APPARATUS, BRACING AND OTHER DETAILS

The brush board and wing, which are shown in their lowered positions, also the leveler near the side step, keep the track on their side of the car sufficiently free of snow, and the revolving broom at the rear takes up what is left and leaves a clear pavement. The diagrams show the convenient location of the handles for raising and lowering the brooms and brush boards. A shaft at the center of the car, with sprocket wheels at either end, is revolved by a 25-hp motor. The sprocket chains are of the builder's manufacture, and the link are composed of drop-forgings. Gear trucks carry the sweepers and have a 40-hp motor to each axle. The dimensions are as follows: Length over the cab, 21 ft.; length over the bumpers, 27 ft. 6 ins.; width over the sills, 6 ft. 10¼ ins.; height over the trolley board, 11 ft. 6 ins.; height to the sills, 3 ft. 6 ins.; length of the brush board, 3 ft. 2 ins., and length of the wings, 2 ft. The weight without motors is 13,800 lbs.



ONE OF THE NEW PHILADELPHIA SNOW SWEEPERS READY FOR SERVICE

A NOVEL SITUATION IN STREET RAILWAY TAXATION

An interesting question has arisen in connection with the payment of an excise tax to the town of Charlton by the Worcester & Southbridge Street Railway Company. The State law provides for the payment by street railway companies of an excise tax based on the gross earnings for the year, collectable in the various cities and towns through which it operates, in proportion to the number of miles of track in those towns. The town taxed the company for the number of miles operated in the streets, assessing the amount on total earnings on the entire line. The Selectmen are now trying to find out whether they should not figure their proportion from the number of miles operated through streets of the various towns, which would make their share greater than of the total number of miles operated.

The Mexican Electric Tramways, Ltd., has adopted steel-tired and steel wheels as standard instead of the chilled-iron wheel. The company purchases most of its wheels in the United States, although a few have come from England. The rail used permits the employment of a 1¼-in. flange and a 2-in. tread. This tread will later be increased to 3 ins. in width.

FINANCIAL INTELLIGENCE

WALL STREET, Dec. 21, 1905.

The Money Market

Somewhat easier conditions prevailed in the local money market during the past week. The return movement of funds from the interior in progress at the close of last week, has continued upon a fairly large scale, and has materially strengthened the position of the New York City banks. Instead of a deficit of $1,246,529 reported by the clearing house banks on Dec. 2, the same institutions last week reported a surplus reserve of nearly $4,000,000. In addition to this the banks have gained a substantial amount of cash in their operations with the sub-treasury, and with a continuance of the inflow of money from out of town, which now seems assured, the local banks will be in a good position to meet the January 1 interest and dividend payments, which promise to break all previous records. About the only unfavorable development during the week was the failure of three Chicago banks. This necessitated the transfer of substantial amounts of cash to that city, which otherwise would have remained here, but apart from this the embarrassment of the institutions referred to had no important bearing upon the local situation. Sterling exchange has ruled decidedly strong, the heavy demand for remittances in connection with the end of the year settlements abroad resulting in a sharp advance in demand bills to near the gold export point. Shipments of the yellow metal, however, were averted by a rather liberal supply of bankers' bills. The bank statement, published a week ago, made a satisfactory exhibit. Loans decreased $11,756,800, due to the operation of interior banks and foreign houses in the local money market. The reserve required was $2,086,800 less than in the previous week, which, together with the increase in cash of $3,120,800, resulted in an increase in the reserves of $5,207,600, thus wiping out the deficit of the preceding week, and establishing a surplus of $3,961,075. In the corresponding week of last year the surplus was $14,546,625, compared with $14,025,500 in 1903, $8,093,600 in 1902, $5,785,325 in 1901, and $9,497,100 in 1900. The European markets have ruled firmer, discounts at all the principal European centers ruling fractionally higher than those prevailing at the close a week ago.

Money on call in the local market has loaned at 12 per cent and 3 per cent, the average for the week being about 8 per cent. Time money has ruled firm. Sixty-day funds were obtainable at 7 per cent, three and four months at 6 per cent, and five and six months at 5½ per cent. Commercial paper has been extremely quiet and unchanged, at 5½ and 5¾ per cent for the best names. At the close the market ruled firm, and, according to leading bankers, there is not likely to be any material easing off in rates until after the January interest and dividends have been disbursed.

The Stock Market

Practically the only thing which served during the past week to check the rising current of values on the Stock Exchange was the unexpected announcement, on Monday last, of the suspension of three Chicago financial institutions. This news gave quite a chill to speculation, and occasioned some sharp declines in prices, but as soon as it became known that the trouble was to be entirely localized, the general market immediately resumed the upward course, and in not a few instances prices before the close of the week were higher than at any previous time of the year. There were other events during the week of a more or less unsettling nature, such, for instance, as the action of the Rock Island directors in reducing the dividend on the preferred stock, preparatory to passing it altogether at the time for the next declaration; the continued close working of the money market, the rise in sterling exchange to practically the gold exporting point, and the publication of the Southern Pacific's annual report, showing plainly that there is very little prospect for a dividend in the company's stock for some time to come. As intimated above, however, these matters failed of any material influence upon the general speculative situation, chiefly for the reason, no doubt, that the professional element, now so conspicuously in control, still maintained a decidedly bullish attitude, in which position they were fortified by some of the principal banking interest of this city. There were comparatively few developments of a character calculated to cause any pronounced upward tendency in values. The reports of railroad earnings received invariably made better exhibits than those issued of late, and continued unprecedented strength marked the copper metal industry, while in all branches of the iron and steel trade orders were again far in advance of the supply. The Russian situation was regarded as somewhat improved, inasmuch as it did not reach the really critical stage, while the action of the Missouri Pacific Railway directors in declaring the usual semi-annual dividend was looked upon in a favorable light, in view of the recent reports of a reduction of this dividend. However, the speculative community was inclined to regard no news as good news, and in consequence of this sentiment prices mounted upward, except for the temporary halt ocasioned by the unpleasant disclosures made concerning the Chicago banks referred to. As in most weeks of late the speculation ran largely to shares of industrial corporations, conspicuous instances of which were Colorado Fuel, Tennessee Coal, National Lead, sugar, the copper stocks, American Smelting & Refining and the United States Steel stocks. Nevertheless, the more stable railway shares, as was the case last week, occupied a position of growing importance in the activity and advance, the most notable cases in point being Union Pacific, St. Paul, New York Central, Reading, Pennsylvania, Great Northern preferred, and Northern Pacific. The Rock Island shares were exceptionally heavy, for reasons already set forth.

In the general setback which the market received on Monday last, the stock of the Brooklyn Rapid Transit Company suffered quite a severe break, but apart from this the tendency of prices for the local traction stocks throughout the week was upward, with the demand somewhat improved over that of the previous week. One of the reasons for this condition of affairs was the decision of the Appellate Court favorable to the present incumbent of the Mayor's chair; but a much more potent one was the continued expanding revenues of all these properties which is enhancing their intrinsic value.

Philadelphia

There was a material falling off in the dealings in the local traction shares during the past week, and although the general movement of values was downward, the net losses were in most instances limited to the fractions. Philadelphia Rapid Transit was again the active feature, upward of 14,000 shares changing hands. At the opening prices advanced ½ to 33 on good buying, but subsequently there was a gradual decline to 31, on renewed agitation of 3-cent fares. At the close the price recovered slightly to 31¼, which represents a net loss for the week of 1¼ points. Another feature of the trading was the purchase of 10,796 shares of Railways General in one block at 6¼, by parties already having a large interest in the property. Later the price rose to 7. In all about 11,500 shares were traded in. Philadelphia Company was less active, about 7500 shares selling at prices ranging from 52⅛ to 51½, the latter showing a gain of ½ point. The preferred stock was practically neglected, a few small lots changing hands at 49⅞ and 50. Union Traction declined a point, about 600 shares selling at 62½ and 62. Philadelphia Traction lost ⅝, to 100¼, on the transfer of 160 shares. Other sales included American Railways at 52⅝ and 52½, United Companies of New Jersey at 271 and 270, Consolidated Traction of New Jersey at 82⅞ and 82½, and Ridge Avenue passenger at 302.

Baltimore

Very little interest was manifest in the traction issues at Baltimore during the week. The demand for them was limited, and in the absence of any marked pressure to sell, the price changes were, as a rule, without significance. United Railway issues were extremely dull, $38,000 of the 4 per cent bonds brought 92½ and 92⅜, and $12,000 of the free incomes sold at 64⅞ and 64½. Trust receipts, representing income bonds deposited, sold at 64 for $8,000. Other transactions were: $2,000 Baltimore Traction 5s at 110¼, $1,000 Knoxville Street Railway 5s at 107, $2,000 Lexington Street Railway 5s at 103¾, $4,000 Norfolk Railway & Light 5s at 95, $3,000 City & Suburban 5s at 112½, and $12,000 Charleston Consolidated Electric at 95½ and 96.

Other Traction Securities

The Chicago market was dull and featureless, North Chicago sold at 83 for twenty-five shares, and 300 Chicago Union Traction brought 11¾ and 12. The elevated issues were irregular. South Side opened at 97, and ran off to 95, but later recovered a point. Metropolitan Elevated common changed hands at 27½ and 28,

while the preferred declined from 70¾ to 70. Northwestern sold at 24½ for a small lot. . The feature of the Boston market was a loss of 3 points in Massachusetts Electric preferred, from 61 to 58, on the exchange of about 600 shares. The common also was weak, 250 shares bringing 15. Boston Elevated ruled strong, the price rising from 153 to 154½, and closing at 154. Boston & Worcester common brought 28, while the preferred brought 73 and 75½. Boston & Suburban preferred changed hands at 63. West End common sold at 98 and 98½, and the preferred stock at 113½ and 114. In the New York curb market, Interborough Rapid Transit developed considerable activity and strength, upwards of 27,000 shares being traded in at from 210 to 224, and back to 218. New Orleans Railway issues also displayed decided strength, 1800 shares of the common selling at from 38 to 38¾, while several hundred shares of the prefered brought 85 and 86.

Little activity in Cincinnati. Cincinnati, Newport & Covington once more lead in the trading, about 900 shares selling with an advance from 48¼ to 49¼. The preferred advanced from 96½ to 97¼. Cincinnati Street Railway sold at 146¾ to 147. Toledo Railways & Light sold at 32¾.

Northern Ohio Traction & Light continues its upward move in Cleveland on reports of dividends and the sale of a large block of the securities in Montreal. Nearly 3000 shares sold with an advance from 32 to 34 (buyer 60 days.) Aurora, Elgin & Chicago common and preferred moved up on indications that the merger with Elgin, Aurora & Southern is soon to be carried out. The common advanced from 32 to 36½ and the preferred from 92 to 99½; this stock is not yet paying any dividends, yet it sold for more than the 5 per cent bonds—98¼. Elgin, Aurora & Southern advanced from 45 to 49¼. Lake Shore Electric issues continue active, the common advancing from 16 to 17 and the old preferred from 68 to 68½. Western Ohio receipts joined in the upward movement from 18⅞ to 19. Cleveland Electric Railway came in for considerable activity on intimation that the dividend might be increased to 5 per cent, and it sold up from 82½ to 83½. Inquiries for large blocks of Cleveland Electric stock and the recent visit of Randall Morgan and W. Kesley Schoepf, who made a personal inspection of the Cleveland Electric properties, add strength to the reports that the so-called Widener-Elkins syndicate is again seeking to buy or lease the Cleveland city properties. This syndicate made a bid for the property four years ago at the time of the Everett-Moore embarrassment. It is believed that the syndicate will not attempt to enter the Cleveland field unless the franchise controversy can be cleared up on a satisfactory basis. Mayor Johnson has held several meetings with the Philadelphia people, but the officials of the road state that they have not been approached on the subject of sale or lease.

Security Quotations

The following table shows the present bid quotations for the leading traction stocks, and the active bonds, as compared with last week:

	Dec. 13	Dec. 20
American Railways	52½	52
Boston Elevated	153	154
Brooklyn Rapid Transit	86	88
Chicago City	200	198
Chicago Union Traction (common)	11¾	12⅛
Chicago Union Traction (preferred)	—	—
Cleveland Electric	83	80
Consolidated Traction of New Jersey	81	81
Consolidated Traction of New Jersey 5s	107½	107½
Detroit United	94¼	94¼
Interborough Rapid Transit	*210	218
International Traction (common)	35½	36¾
International Traction (preferred) 4s	75½	75½
Manhattan Railway	163	163
Massachusetts Electric Cos. (common)	15	14
Massachusetts Electric Cos. (preferred)	60	58
Metropolitan Elevated, Chicago (common)	27½	27
Metropolitan Elevated, Chicago (preferred)	70	68
Metropolitan Street	118⅜	120⅞
Metropolitan Securities	73½	75⅝
New Orleans Railways (common), W. I.	38	37½
New Orleans Railways (preferred), W. I.	84½	85
New Orleans Railways, 4½s	91	90½
North American	100	99
North Jersey Street Railway	25½	25
Philadelphia Company (common)	51⅞	51¾
Philadelphia Rapid Transit	32½	31
Philadelphia Traction	100¾	100¼
Public Service Corporation 5 per cent notes	95	95½
Public Service Corporation certificates	66	66
South Side Elevated (Chicago)	97	97
Third Avenue	121	124
Twin City, Minneapolis (common)	114¾	116½
Union Traction (Philadelphia)	62	62
West End (common)	98	98
West End (preferred)	113½	113½

* Ex-dividend. W. I., when issued.

Iron and Steel

The "Iron Age" confirms the report that the United States Steel Corporation has on its books orders aggregating 7,300,000 tons. No one fact could better serve to show the condition of the steel works and rolling mills of the country, since it is well known that the other large companies are similarly committed for their full capacity for a long period to come. The scarcity of steel is indicated by the fact that the Ohio works of the Carnegie Company will be taken off from rails and put on sheet and tin plate bars in January. It was hoped that the wire trade would slacken this month so that steel could be diverted, but the pressure on the wire mills is too great. The structural trade is working under tremendous pressure, the open winter facilitating outdoor operations. A very heavy tonnage is coming up for bridges for railroads. There is a heavy export business in progress. The cast-iron pipe industry continues to flourish.

NEW YORK CENTRAL HOLDING COMPANY INCREASES CAPITAL

A certificate of increase of capital stock of the Mohawk Valley Company, which was incorporated last February, has been filed with the Secretary of State, raising the capital from $100,000 to $10,000,000. The report is persistently circulated that Horace E. Andrews, president of the Syracuse Rapid Transit Railway Company, the Utica & Mohawk Valley Company, controller of the Cleveland railways and of the Vanderbilt-Andrews syndicate, which recently acquired the electric railway and lighting plants of Rochester, will leave Cleveland interests and devote himself to the management of the electric railway projects of the New York Central, William K. Vanderbilt, Jr., to continue in charge of the financial end of the projects. It is credited among street railway men that the increase of the Mohawk Valley Company means a decided movement toward the accomplishment of the trans-State electric railway by the Andrews-Vanderbilt syndicate, which controls practically all the important electric railway systems between Buffalo and Albany, including the Rochester, Syracuse, Utica and Schenectady systems.

AURORA, ELGIN & CHICAGO AND ELGIN, AURORA & SOUTHERN TO CONSOLIDATE

Plans for consolidating the Aurora, Elgin & Chicago Railway Company and the Elgin, Aurora & Southern Railway Company are being worked out by the Mandelbaum-Wolff interests, of Cleveland, which control both of these properties. It is stated that a new company, with a capital stock of $6,000,000, divided equally between preferred and common stock, will be formed. Aurora, Elgin & Chicago preferred stockholders are to receive $1,800,000 of the new preferred stock, and the Elgin, Aurora & Southern stockholders will receive $1,200,000 of the new preferred. The common stockholders of the Aurora, Elgin & Chicago will receive 100 per cent in the new common stock. The bond issue will probably be $5,000,000, equal to the combined issues on the two properties, and a second mortgage issue will be authorized to take care of floating debt and provide for needed improvements. The net earnings of the two properties this year will be about $495,000. Fixed charges on bonds, preferred stock and taxes will amount to about $447,500, leaving about $47,500, or about 1¾ per cent for common stock. The mileage of the Aurora, Elgin & Chicago consists of 56 miles, not including the terminals in Chicago, but including 21 miles of double track, total mileage, therefore, of 82 miles. The Elgin, Aurora & Southern has 69 miles of single track. The former is a third-rail system, while the latter is equipped with the overhead trolley system. Meetings of the stockholders to decide on the consolidation will be held about Feb. 1, and the merger will undoubtedly become effective soon thereafter.

OPENING OF WEST SHORE ELECTRIFIED SECTION BETWEEN FRANKFORT AND HERKIMER

The electrified section of the West Shore Railroad between Frankfort and Herkimer, N. Y., was officially opened on Dec. 14, when a party of 100, including visiting railroad men, officials of Utica, Little Falls, Frankfort, Ilion, Mohawk and Herkimer, and representatives of the daily and technical press, made a trip of inspection over the route as the guests of C. Loomis Allen, general manager of the Utica & Mohawk Valley Railway Company. The electrified section was described in the last issue of the STREET RAILWAY JOURNAL. The installation is one of the few examples in this country of a stretch of track used jointly for steam and overhead trolley operation. The section from Frankfort to Herkimer is 3.17 miles long, and will be used jointly by steam trains of the West Shore Railroad and electric cars of the Utica & Mohawk Valley Railway. It forms a very important "cut-off" in the through route of the latter company between Rome and Little Falls, thereby reducing the time by from 10 to 40 minutes between Utica and points east on the Utica & Mohawk Valley route.

For the official opening three of the large interurban cars were provided for the party, and a quick trip was made from Utica to Little Falls and return. The cars left the station in Utica at 2:49, reached Herkimer at 3:22, and arrived in Little Falls at 3:36, the actual running time being 47 minutes. At Little Falls a short stop was made while the guests enjoyed the hospitality of General Manager Allen. Returning, the cars left Little Falls at 4:04, arriving in Utica at 4:52, a brief stop having been made at the West Shore station in Ilion. The regular schedule over the cut-off went into effect Dec. 15.

As stated in the last issue the overhead line on the cut-off is built with catenary suspension, supported on bracket side-pole construction. The Ohio Brass Company furnished the brackets and insulation for the catenary, and the Westinghouse Company supplied the suspensions.

HUGH J. McGOWAN RESIGNS FROM INDIANAPOLIS TRACTION & TERMINAL COMPANY TO BECOME HEAD OF MERGER COMPANY—R. I. TODD, OF PROVIDENCE, HIS SUCCESSOR

Hugh J. McGowan has announced that on Jan. 1 he will retire from the management of the Indianapolis Traction & Terminal Company, in order to devote his attention to perfecting the merger of nine Indiana and six Ohio interurban companies, plans for which have been making for some time. Mr. McGowan will, however, retain his position of president of the company, in which capacity he will be at all times in touch with the affairs of the company without the close application to details that the duties of manager forced upon him. Mr. McGowan announced his successor as R. I. Todd, of Providence, general manager of the Rhode Island Company.

Mr. McGowan's career is familiar in all its details to most of the readers of the STREET RAILWAY JOURNAL, through an extended character sketch of him which appeared in the issue of April 20, 1901. Briefly, it is this: Born at Liberty, Clay County, Mo., Jan. 25, 1857, of Irish parents. Migrated when 18 to Kansas City, where he secured a position in the Wabash Railroad Company's yards. Later he accepted service as a stable boy with the Corrigan brothers, who owned a mule line in Kansas City. This marked his entrance into street railroading. Then came his appointment to the position of conductor. Later he accepted private service with the president of one of the local banks. This position he was forced to relinquish and return to the farm, because he fell sick. On his return to Kansas City, Mr. McGowan pursued a course in a local business college in Kansas City, and later became a car accountant with the Missouri Pacific Railroad. Then followed a connection with the police force of Kansas City, which carried him from the berth of patrolman to acting captain of police. Then he entered politics, and was elected to the position of marshal for the county. In his next connection, that of representative in Kansas City of the Barber Asphalt Company, Mr. McGowan first made the acquaintance of the financial and business interests with which he is at present connected. His territory with this company was finally extended until it covered all the Central West. In 1895 Mr. McGowan straightened out the gas fight in Kansas City for the United Gas Improvement Company. He secured a new franchise for thirty years, with gas at $1.00 a thousand, and brought about the consolidation of the Kansas City and the Missouri Gas Companies. In 1899, Mr. McGowan assumed the management of the affairs of the old Indianapolis Street Railway Company, and harmonized the interests of the State, the city and the company. His achievements in this instance were the securing of a franchise which does not expire until 1934 and the consolidation of the different lines operating in the city.

Mr. McGowan's connection with the new company will be as president of the Indiana companies. For the Ohio companies W. Kesley Schoepf, of Cincinnati, will act in a similar capacity.

The career of Robert I. Todd, who is to succeed Mr. McGowan as manager of the Indianapolis company, is the direct antithesis of that of Mr. McGowan. Mr. Todd has been in charge of the properties in Providence, Pawtucket, Central Falls and other places which are in control of the Rhode Island Company for several years, and has made an enviable record as regards efficient management. Mr. Todd is a native of New Jersey, having been born at Lakewood, Nov. 29, 1869. In 1893 he was graduated from John Hopkins. Soon thereafter began his connection with the street railway industry, his first position being as assistant superintendent of the Eckington & Soldiers Home Railway and the Belt Railway, of Washington. These companies were subsequently consolidated as the City & Suburban Railway Company, and Mr. Todd was made general superintendent and electrical engineer. In the spring of 1899 Mr. Todd resigned from this position, to take charge of the experimental work of the Compressed Air Company in New York. The following year he became mechanical engineer of the Consolidated Traction Company, of Pittsburg, and a year later he became general manager of the Cincinnati Traction Company. Subsequently he was made second vice-president of the company. In the summer of 1902 he became connected with the home office of the United Gas Improvement Company, in Philadelphia, and later was appointed as manager of this company's properties at Providence, combined as the Rhode Island Company.

Other announcements just made in connection with the new merger are to the effect that E. D. Peck will become first vice-president of the Indianapolis Traction & Terminal Company; that Chas. Murdock will become first vice-president of the Indiana systems, and that C. C. Reynolds will be general manager of the Indiana systems. Mr. Peck is at present general manager of the Indiana Company. He has been associated with Mr. McGowan since the latter came to Indianapolis from Kansas City. He had charge of the erection of the new traction and terminal building and the construction of the tracks forming the belt inside the city. Mr. Murdock is one of the directors of the Indianapolis & Northwestern line, and is interested in the Indianapolis Traction & Terminal Company. Mr. Reynolds is at present general manager of the Indianapolis & Northwestern lines.

COURT DECISION IN CLEVELAND THREE-CENT FARE FIGHT

Two important court decisions were handed down recently in the long-drawn controversy in Cleveland over the building of 3-cent fare lines. The Supreme Court of Ohio handed down a final decision in favor of the so-called 3-cent fare company in a suit brought by a property owner, enjoining the company from operating on Dennison Avenue, on the ground that the franchise had been illegally granted. Heretofore the chief battle between competing applicants for a franchise has been to secure "consents" of property owners and induce the withdrawal of "consents" given by a rival company. The question has been fiercely contested as to the particular stage of the game when the withdrawal of a consent can no longer be legally made. This question was settled by the Supreme Court. Under a recent State law the city is obliged to grant the franchise to the party making the lowest bid, providing it has the required number of consents. The court in this decision holds that the required "consent" is for a street railway without regard to the corporation obtaining it, and that if the "consents" of rival companies added together make the required majority, the city must grant the franchise to the lowest bidder. The decision settles a long series of legal fights over the securing of "consents," and the Forest City Railway Company may now operate over the 2 miles of track which have been buried in the mud of Dennison Avenue for the past three years.

The Cleveland Electric Railway scored a point in the Central Avenue case. Some time ago the company's grant on this street was declared to have expired, and a grant was made to the Forest City Company. The Circuit Court has now affirmed the decision of a lower court, which decided that the franchise of the Forest City Company is not valid, because it was granted under a law providing for a renewal of a franchise. The court held that a renewal of a grant must be to a company already operating the line. The injunction prohibiting the Forest City Company from using the line remains in effect. The city may now readvertise for bids on this street.

FIRE DESTROYS MT. LOWE PROPERTY

The Pacific Electric Railway Company on Saturday, Dec. 9, suffered a severe loss by mountain fire on its famous Mt. Lowe line. Every building on Echo Mountain excepting the astronomical observatory was destroyed, including the power house that served the incline railway, the Casino and the company's hotel. The Mt. Lowe extension and the famous searchlight were also consumed. The power house and all the valuable machinery it contained are a total loss. The loss is estimated at about $200,000. The fire started in Rubio Canyon, and quickly swept the mountain side all but clean. Because of the difficulty encountered in the construction of buildings above the incline, where every stick of timber must be raised by laborious effort, the expense of rebuilding will be far greater than if the work were to be done in the valley.

CHICAGO TRACTION MATTERS

At the meeting of the Chicago City Council, held Dec. 20, a communication, signed by President T. E. Mitten, of the Chicago City Railway Company, was received, to the effect that Mr. Mitten's company would not accept the franchise ordinance now under consideration if material changes were made in it. The communication was as follows:

In view of the fact that the pending ordinance in regard to the street railways of the Chicago City Railway Company requires that the company should assent to it and become bound by its provisions as a contract, it is perhaps due to your honorable body that the company, as one of the parties to such proposed contract, make known its position in advance of action upon the same in the Council.

The company, for the purpose of determining what it was possible for it to do under the conditions imposed by the proposed ordinance, secured the services of the well-known street railway experts, Ford, Bacon & Davis, of New York, who have now completed a most thorough and comprehensive investigation of the property, and the conclusion arrived at, resulting from such investigation, has been that the company could not, under any circumstances, make greater concessions or assume greater obligations than those now required by the terms of the pending ordinance.

I beg leave, therefore, on behalf of the company, to say that the company could not accept the ordinance if the terms and conditions imposed upon the company are made more onerous or burdensome than those contained in the ordinance as it now stands. Respectfully yours,

T. E. MITTEN, President.

Judge Grosscup, as receiver for the Union Traction Company, has appointed John Maynard Harlan as one of the counsel for the Union Traction Company, to represent the people of Chicago in the pending discussions over franchise ordinances. Judge Grosscup states that in addition to the interests of the traction companies and those of the bondholders, the receivership also represents the interests of the public, and to take care of these Mr. Harlan was appointed.

ERIE TO BUILD AN ELECTRIC LINE

Following closely the announcement last week that the Pennsylvania had let a contract for equipping with electricity one of its Philadelphia-Atlantic City lines, came a statement from the Erie Railroad of plans which it has developed for building an electric railway from Binghamton, N. Y., to Corning, a distance of 76 miles. The new line will parallel the present line of the Erie between these two points, and is intended to care for local passenger traffic. The surveys for the line are to be made immediately, and the contracts for the construction work will be let probably in January.

The Erie management, in building this line from Binghamton to Corning, is forestalling the construction of lines between those points by outside interests. By being the first to occupy this particular territory with electric lines, the Erie believes that it will prevent the competition from such lines with which the other roads mentioned have been obliged to contend. The cost of the electric line, it is understood, will be provided out of the proceeds of the recently authorized $12,000,000 issue of convertible bonds.

The Erie's new line from Binghamton to Corning will be built along the present right of way, making a third standard track adjoining the two tracks which the Erie now has in operation between these points. The line will be so constructed that it will be available for the operation of the company's regular trains should occasion arise for such use of the new tracks. If the traffic on the new line warrants it, a fourth track, also equipped electrically, may be added.

The line, starting from Binghamton, will run through the towns of Union, Owego, Southboro, Waverly, Chemung, Elmira and Horse Heads, ending at Corning, where the northern line of the Erie diverges from the main line. There will be considerable local passenger traffic along the new line, and it is hoped to relieve the Erie's main tracks of its burden, leaving them to be used for through trains and freight. It is probable that trains will be run on the electric line at intervals of an hour, or perhaps even closer together.

No decision has yet been reached by the Erie officials in regard to the electrification of its suburban lines running out of Jersey City. It is the ultimate intention of the management to electrify these lines, but how soon and in just what manner has not been determined.

It is altogether possible that the further electrification of the Erie's lines will be undertaken at various points before the work is begun on the road's lines in New Jersey.

ELECTRICITY ON THE CUMBERLAND VALLEY RAILROAD

If the conversion of the Dillsburg & Mechanicsburg branch of the Cumberland Valley Railroad Company into a combined steam and electric line should prove a success—and of this Superintendent G. H. Bartle, of the Valley Traction Company, who is directing the work, has not the slightest doubt—the company will next proceed with the transformation of the Waynesburg branch into an electric line. This line is 13 miles long, whereas the Dillsburg & Mechanicsburg is but 9 miles. The work of bonding the latter line is completed, and a passenger coach of the Cumberland Valley Railroad has been remodeled and fitted for trolley service at the railroad company's shops in Chambersburg. The Dillsburg & Mechanicsburg line has been resurveyed for the planting of the poles, some of which are in position. These poles are cemented into the ground at a depth of 5 ft. or more. They are placed 8 ft. from the rail, and have an arm 6 ft. long. Wire is strung at a distance of 1 ft. from the end of the arm. The stand for the trolley pole is placed on the side instead of the center of the car, and a 0000-wire is used instead of the usual 00-wire. It is the company's purpose to continue the use of steam as a motive power for the freight traffic on the Dillsburg & Mechanicsburg as well as on the Waynesboro branch.

All the wire has arrived for the sub-power stations, to be erected at Trindle Springs and Carlisle, and when these are completed the present small plant at Carlisle will be abandoned. The substations will be equipped with 300-kw generators, transformers and switchboards. The company will then have about four times the power now needed, and expects to cut down the schedule of through cars between Harrisburg and Carlisle from 2 to 1½ hours.

The two 44-ft. semi-convertible cars recently received from the J. G. Brill works have given so much satisfaction that the company has placed an order for four more of the same type, to be delivered by April 1, 1906. These cars are the largest and most modern of any now in use in inland Pennsylvania. They are 32 ft. long inside, with a 6-ft. platform at each end, and are equipped with two Brill 27-G. 1. trucks, with 4½-in. axles, 33-in. wheels, with 2½-in. tread and ⅞-in. flange; have the Lehigh Car Wheel Works wheels, four 101-B Westinghouse motors, having a capacity of 40 hp each; 28-B controllers, automatic circuit breakers, No. 6 trolleys, Westinghouse air-brakes, Crouse, Hinds & Company Imperial arc headlights, Adams & Westlake Company markers (showing red, white and green lights), Heywood Bros. & Wakefield Company 36-in. rattan seats, with revolving foot rest; leaving a 25-in. space for aisle, with longitudinal seats at either end. The cars are lighted by three series of eight incandescent lights each, arranged along the sides of the roaf, have electric push buttons, twelve Consolidated electric car heaters under the seats, bow-window sills with arm rest.

One special feature of these cars is that the windows are pushed up into the sides of the car instead of dropped during warm weather. There are no fender gates, but doors, so arranged that the upper portion can be removed in the summer time. The signal and fare register cords are suspended through the center of the car, allowing the conductor to use them without reaching over the heads of passengers. International fare registers are used. The cars also have rolling waterproof blinds, and the roof extends out over the platforms and sides, all the plates for sills and roof being of steel. The body of the car is made of oak and the inside finish is poplar. The cars are painted in Tuscan red with cream yellow trimmings. The use of the markers on these cars (are at each end) has reduced the percentage of accidents to a marked degree, and greatly facilitates the placing of blame upon an employee in case of accident.

It is confidently believed that inside of a few years the Valley Traction Company will extend its system as far as Chambersburg, thus relieving the Cumberland Valley Railroad Company (owner of the system) of much local passenger business that now hampers the increasing freight business of the line. The acquirement of another electric railway in the territory now occupied by the Valley Traction Company is also expected before long.

GOULD IN SOUTHERN CALIFORNIA INTERURBAN

The Pasadena, Verdugo & San Fernando Railroad Company has been incorporated in Los Angeles with a nominal capitalization of $25,000. According to reports, the company eventually is to be heavily financed by Gould interests, and is to build a line to parallel the Huntington electric railways to Pasadena, and to secure for Gould a possible gateway to the Pacific Coast. The directors of the new company are M. A. King, Gilbert S. Wright, C. J. Fox, R. H. Brown, Martin C. Marsh, Dr. H. B. Wing, Fred. L. Sexton, W. S. Brent and E. S. Jones. Since the organization of this company, Mr. Huntington has ordered proceedings rushed on his Eagle Rock line to cut out the rival road and preserve his right of way, which was recently presented to him by the citizens of that district. Several carloads of steel have been piled up near the city limits, and officials of the company declare that work will start within two weeks. Meanwhile, the Salt Lake road has announced that it will start work shortly on an extension of its line north through the San Fernando Valley.

CLEVELAND-CHICAGO CONNECTION

Clevelanders have let contracts for an electric railway to connect Cleveland and Chicago. The road they are building is the Chicago, Lake Shore & South Bend Railway, and it is one of the essential links in a chain of Cleveland-controlled roads reaching from Cleveland to Chicago. Edwin Hanna and J. B. Hanna are interested.

Out of Cleveland the Lake Shore Electric will be used through to Toledo, or to Fremont, where connection will be made with the extension of the Western Ohio, which will carry the line to Lima. From there a road is projected through to Fort Wayne, Ind., which is to be completed this coming year. There is yet a gap covering part of Allen County, Whitley County and a part of Kosciusko County. The Hanna lines take up the thread there. The present extension of the Hanna lines is to extend from Warsaw through Marshall, Laporte and Porter Counties to a connection with the Hanna road already in operation, which extends from Indiana Harbor to South Chicago. At the latter point connection will be made with the Illinois Central at Kensington Street. Another possible connection for the new road is the Lake Shore Electric through to Toledo and the Toledo & Chicago line to Warsaw, and the Hanna lines on to the west. This line is already projected for an extension into the Chicago territory. During the past few months stories have been abroad that the connecting link between the Hanna lines at Warsaw and the line into Fort Wayne is to be built, but these have not reached the stage of definite announcement. Plans are expected before the opening of spring. It is announced that the Hanna lines will begin construction in the spring. The completion of the new line will also make direct connection between the Western Ohio and the Cincinnati, Dayton & Toledo, which will give a traction line from Cincinnati to Chicago. More than half of the traction lines are already in operation. The Hanna line and the Fort Wayne line from Lima will be completed before the close of 1906. It is now believed that the through cars will be running from Cleveland to Chicago before the end of 1907. The delay will be in the construction of the links between Fort Wayne and Warsaw.

NEW BRIDGE TERMINAL PLANS

Detailed plans for the underground terminal at the Manhattan end of the Williamsburg Bridge, New York, have been presented to the Municipal Art Commission. They involve many changes in the bridge proper, and very material changes in Delancey Street. The plans, as drawn, provide that the cars from the Manhattan lines shall continue to run on the surface. Only the Brooklyn trolleys and elevated cars will have a terminal underground.

It will be necessary to reconstruct the elevated roadway to the bridge for a considerable distance. The structure holding the elevated tracks will be lowered so that they can be brought under what is now the roadway of the promenade. This roadway, which now slopes gently to grade at the end of the bridge, will be raised so that it will practically become a second story. It will be laid out as a plaza, surrounded by an ornamental rail.

The approach to this plaza will be up a stairway of ornamental design, which will occupy the space where the Brooklyn trolleys now have a terminal. The treatment of this terminal wall will be highly artistic.

On Delancey Street there will appear two long stations between Norfolk and Suffolk Streets. These will be the entrances to the underground terminal. The Manhattan surface cars will be run close to the curbs of these stations, thus taking them from the side of the street where they are now.

There will be eight trolley loops underground for the Brooklyn cars and separate stairways will lead to each loop. The elevated trains will run in to the side of the trolley tracks, and ample provision for switching facilities is made in order that there will be no delay in that particular. Just as soon as the Art Commission has approved the plans the bridge department will invite bids.

NEW LINE BETWEEN LOWELL AND BOSTON

Promoters of the project for an air-line electric railway between Lowell and Boston are beginning to show some activity before the local authorities in the cities and towns through which they propose to run their line. A short time ago they had a hearing in the town of Burlington on the question of a 4-mile location there; and last week they took up almost 2 hours of time before the Aldermen of the city of Somerville urging their claims to a location. It developed at this last hearing that they propose to run their line from the Sullivan Square terminal of the Boston Elevated Railway as far as the limits of Somerville, on an overhead structure. They make the plea for this method of construction on the ground that Somerville is thickly built up, and that only on an elevated road could high speed be attained. Prof. William L. Hooper and Secretary Henry G. Chase, of Tufts College, were present at the hearing, and spoke in favor of the project. The line as projected would run close beside the hill on which Tufts College is located. The form of roadbed proposed for the elevated structure is 6 ins. of crushed stone instead of wooden sleepers, and the claim was made that this would enable the company to operate trains with practically no noise. The Somerville board took the matter under advisement, after giving an opportunity for remonstrance and not hearing any.

Charles F. Remington, the promoter of this line, has been interested in times past in other similar projects in the Southeastern part of the State. Lowell men understood to have become interested in it are Paul Butler, Congressman Butler Ames, George M. Harrigan and George Fifield; with Major Thomas Talbot, of Billerica, and Oakes Ames, of Easton. The Remington plan is a double-track railway from Somerville through Arlington, Lexington, Woburn, Burlington, Bedford, Billerica and Lowell, with not a single grade crossing, with no grades of more than 2½ per cent, and no curves of more than 2½ degrees, with a small fireproof concrete station at every cross-road, and a Lowell terminus at Tower's Corners, in Williams Street. The plan is to run 15-minute trains of three cars, multiple-unit system, and to cover the distance between terminals in 43 minutes. The line as projected is said to be more than a mile shorter than the straightest route by the Boston & Maine Railroad.

BROOKLYN EMPLOYEES ENTERTAINED

Another of the special winter entertainment features of the Brooklyn Rapid Transit Employees' Association was given at the main club house at East New York on Thursday evening, Dec. 14. There was a concert by the regular association band, composed of employees of the company, a series of moving pictures and a series of illustrated songs. The practice of the association in making entertainments of this kind free to employees and their families was followed in this instance, and the appreciation of the men was evidenced strongly by the goodly number in attendance. Upward of a thousand persons are estimated to have been present at the entertainment.

Five numbers, all programme music, were first given by the band, after which followed the illustrated songs and the moving pictures. All of these were up to the standard of excellence set by the association on previous occasions of this kind. Bandmaster Mygrant was several times compelled to repeat numbers, so persistent was the audience in its applause. The moving pictures and the songs were equally as well received.

During the entertainment the association announced that it had arranged to give, some time in January, an entertainment for a week similar to that given last year at the club house. At that time an excellent vaudeville programme was arranged, made up of the best talent showing in the city, and there was given a run of a week, which afforded every employee and his family an opportunity to attend. On the occasion of the theatrical last year the company provided free transportation to and from the club house.

What, with its regular educational work, its bowling tournaments, its band concerts, its special entertainments and other features, there always is something doing along social lines for the employees. Best of all, these things are carried out with the end in view of making them equally available to every employee, no matter what may be his hours of service.

THE DES MOINES FRANCHISE CONTROVERSY

The first stage in the hearing of the quo warranto proceedings brought by the Des Moines Civic League and the County Attorney against the Des Moines City Railway and the Interurban Railway, attacking the franchise rights of the two companies, was completed recently, and the decision of the judges was a mixed victory for both the Civic League and the companies. The judges heard arguments on the demurrer of the companies, the attorneys for which contending that the Civic League had no authority to bring the suit and that the whole proceedings should be thrown out of court, on the ground that the companies had not been served with notice. The attorneys for the Civic League contended they had authority to bring the proceedings by virtue of the waival of the County Attorney, and that notice was not required in quo warranto proceedings under the laws of Iowa. The feature of this hearing was the appearance of Jefferson S. Polk, president of the Des Moines City Railway Company, in court as an attorney for the two companies. His argument was considered the best of the series, although he had not appeared as an attorney in any case for forty years. The judges rendered their decision on the demurrer Dec. 9. The following is a synopsis of their findings:

"The court has jurisdiction to determine on motion whether the relators (the Civic League) shall be permitted to maintain action. That the privileges exercised by the two railway companies are franchise privileges as distinguished from mere easements. That quo warranto is the proper remedy to test the rights of the defendant companies to such franchise privileges. That the wrong sought to be redressed is a public wrong, as distinguished from a private injury, and that the Civic League have no interest therein other or different from the public, and that, therefore, the action must be maintained in the name of the State of Iowa, on relation of the County Attorney, and not by private relators."

The court also states that the County Attorney may secure legal assistance in pushing the quo warranto proceedings, so while the Civic League is ruled out of court, the attorneys for the League will probably be retained by the County Attorney. The hearing on the quo warranto proceedings proper will probably be held during the January term of court. Under agreement between all parties there will be no appeal from the above decision.

The movement to secure an agreement between the Des Moines City Railway Company and citizens of Des Moines has been progressing quite rapidly during the past ten days. A meeting, attended by the officials of the two companies, the officers of the Commercial Club, the members of the City Council and other prominent citizens, was held several days ago, and a sub-committee of fourteen was appointed to draw up an agreement in the shape of a franchise, which would be acceptable to all parties, and have this ratified by a mass-meeting of the citizens, and then voted on at a special election. If it carries, this franchise is to take the place of all others held by the two companies during the term of twenty-five years, even if the courts should finally hold that the Turner franchise is a perpetual franchise. The committee has now been at work several days, and the following are the main provisions of the contract, or franchise, which have been agreed upon by the officials of the company and the members of the committee:

1. The contract, or franchise, is to be in force for a period of twenty-five years.

2. That the Des Moines City Railway Company pay to the city of Des Moines, for the use of the streets and in lieu of all other taxes and assessments, a percentage of its gross earnings, as follows: Six per cent annually for a period of five years, 7 per cent annually during the next five years, 8 per cent annually during the next five years, 9 per cent annually during the next five years, and 10 per cent annually during the last five years, which sum, so paid, shall be devoted as follows:

A. A portion in lieu of general taxes, which shall be apportioned to the State, county and school districts, and the general fund of the city in the proportion provided in the general law for the distribution of direct taxes collected.

B. A second portion to pay for paving between the rails of said railway company on streets ordered paved by the city, and the surplus of said fund to be devoted to repair of paving outside of the rails of said street railway company on streets traversed thereby.

C. The third portion to be applied to a sinking fund to be invested at interest and applied by the city to the purchase of the property and all rights of the Des Moines City Railway Company, such purchase to be effected at the option of the city at such time and as may be agreed upon, and at a price to be fixed by a disinterested board of three appraisers, to be appointed by the judge of the United States District Court of the district in which Des Moines is situated, such purchase to be approved by the electors of the city at a special election, called for that purpose. In the event of such purchase, the city is to operate same under leases to an operating company, at a rental thereof of a percentage of the gross receipts or a fixed sum in cash. Such leases to be for limited terms.

3. That during the period of the agreement the Des Moines City Railway Company shall grant to all interurban railway companies equal rights and privileges in the matter of connections, interchange of business and entrance of their cars into the city of Des Moines over their tracks.

4. That the present custom of selling tickets at the price of six for 25 cents and a free transfer of passengers from line to line be preserved without restriction, unless the company, after paying the percentage of gross earnings above provided for, does not have sufficient money left from the net earnings to pay the interest on its bonds, in which case the company can charge a fixed fare of 5 cents. (This concession was incorporated at the request of N. W. Harris, of Chicago, who has floated all the bonds of the street railway company, and who came to Des Moines to take part in the drafting of the contract or franchise.)

5. That the Des Moines Street Railway Company shall furnish to the executive of the city an adequate amount of tickets for transportation over its lines, such transportation to be distributed among the various employees of the city, for use while in the discharge of their duties, and that all free transportation in excess thereof be prohibited.

It is the general opinion of all interested that a contract or franchise with the foregoing provisions incorporated therein will be ratified and adopted by the people. The object of clause 5 and sub-clause *b* under clause 2, is to remove all causes for the street railway company from taking such an active part in city politics. The company has always considered that it had to take a hand in order to protect its interests. The adoption of this contract, which grants the company an extension of twenty-five years, provides for the city to pay for the paving between the rails and compels the company to give free transportation to the city officials, will remove all reasons for the company interfering in city politics. The officials of the company have agreed to all the provisions set out above, and they will offer no opposition to the adoption of this contract or franchise. What they want is a tangible settlement of present difficulties, so they can assure the bondholders and others interested that the property of the company is safe. The quo warranto proceedings will be pushed to a conclusion, and the company will try to prove that the Turner franchise is a perpetual one. If the company loses the case, they have the new franchise to fall back on; if they win they have a property with a greatly enhanced valuation on account of the perpetual franchise, and they will thus secure more money for it when sold to the city. It is estimated that the 6 per cent of gross earnings will amount to from $36,000 to $40,000 annually, that the general taxes of the company will amount to $15,000, and the special paving assessments from $10,000 to $12,000 annually, so there will be left from $10,000 to $15,000 annually to be turned into the sinking fund, which will at the end of twenty-five years be used to purchase the rights of the company for the city. The amount turned into this fund will increase each year aside from the increase every five years due to the graduated percentage provision.

TRACTION RIGHTS DENIED IN ILLINOIS

Judge Thompson, in the Superior Court, sitting in Chicago, has handed down a decision concerning rights of street railway companies to condemn land, which, if sustained by the Supreme Court, will seriously affect the plans of the different interurban companies now operating and being formed in Illinois. Judge Thompson denied the petition of the Chicago & Southern Traction Company to condemn private property along its proposed right of way between Chicago and Kankakee. The attorneys for the traction company maintained their right to condemn private property along the right of way under the right of eminent domain given to railroads under the general railway act. The company was incorporated under the general railway act to construct and operate a street railway between Chicago and Kankakee, and had asked the Superior Court to condemn several pieces of property which it was said was necessary for the construction of the street railway. In refusing the petition Judge Thompson took the position that the incorporation of the traction company under the general railway act to conduct a street railway, when there is a specific act of the Legislature for the incorporation of the latter class of railways, was wrong, and the company could not ask for the privileges of a regular railroad while enjoying the immunities of a street railroad. The court further held that the Chicago & Southern Traction Company could not exercise the right of eminent domain in the present case without presenting the proper cause for the condemnation of the lands.

QUESTIONS ON SUBJECTS TO BE DISCUSSED AT THE MILAN CONVENTION

The International Street & Interurban Railway Association (Union Internationale de Tramways et de Chemins de Fer d'Intérêt Local) has issued from its headquarters in Brussels a list of questions for five of the topics to be discussed at the Milan Convention next September. To all of these questions the members of the association are expected to reply. The other questions will follow later:

II.—MECHANICAL BRAKES

Reporters: M. Petit, engineer and division superintendent of the Société Nationale des Chemins de fer vicinaux, of Belgium, and M. Scholtes, general manager of the Tramways of Nuremberg-Furth. Note—By mechanical brakes only electric, magnetic and air brakes are to be considered. The replies are to cover only those systems of brakes in permanent use. In the case of electro-magnetic brakes, specify if the brake is used only as an emergency brake. Where exact replies are impossible, give approximate data, and state the basis for the approximation.

1. For how many years has your system been equipped with electric traction?
2. What is the length in kilometers of route?
3. What is the gage?
4. What is the maximum grade, its length, the total length of the grades between 3 per cent and 5 per cent, the length of the grades over 5 per cent?
5. Number of motor-car kilometers and trail-car kilometers run during the last fiscal year.
6. What is the minimum headway and for what length of line is this minimum headway in use?
7. Give total number of motor cars, number of single and double-truck cars, number and type of motors, weight of cars empty, number of cars equipped with electric brakes, number of brake points on controller and their resistance in ohms, number of cars equipped with short-circuiting brake, disc brake and solenoid brake, number of cars equipped with air brakes, air-brake system, whether a hand-brake is also used, and whether the air compressor is motor or axle driven?
8. Give total number of trail cars, number equipped with single and double trucks, weight empty, number equipped with disc electric brakes, solenoid brakes and air brakes. Indicate in each case the number of axles braked.
9. Were the brakes installed when the cars were purchased or later? Reply both for motor and trail cars.
10. Was the braking system selected by yourself or required by the authorities?
11. Have you made any comparative tests of braking systems? If so, give results, specifying rate of acceleration, weight of cars, state of atmosphere, whether rails dry, slippery or wet, number of trail cars, test on level and on grade.
12. Are sand-boxes used? State system and whether they sand both rails or only one.
13. If air brakes are used, what is the consumption of energy required to compress the air? Note—As the data on this subject vary greatly, it would be very desirable for all systems using air brakes to observe the following points: (a) Previous tests have shown that where grease lubrication is used the results are not sufficiently satisfactory; all tests should therefore be made with oil lubrication on all bearings. (b) The wattmeters should be connected in series. (c) The different tests should be made on the same car; the air compressor should be then disconnected and hand-brake and electric brake tried. (d) The different tests should be conducted under the same conditions, moreover, all outside conditions, such as atmosphere, rails, etc., should be the same.
14. What is the annual expense of maintenance of the braking system per car year for motor and trail cars? Also per car kilometer, motor and trail cars?
15. What is the first cost of braking equipment for a single and double-truck trail car?
16. Has electric braking increased the repair charge to the motors? Has it had any effect on the commutators? Have you noticed any other extra wear on motors, gears or other parts?
17. Have you had any trouble with air brakes from freezing, non-operation of the compressor, etc.? Have the tires shown any additional wear? Does the braking system require more frequent overhauling than other braking systems?
18. Which braking system do you recommend from the standpoint of safety and from that of maintenance?
19. Have you had any collisions between motor cars? If using more than one kind of brake, with which system have the most accidents occurred?
20. Which braking system do you consider most desirable for trail cars? Do you lay much stress on uniformity of equipment?
21. What has been the average consumption of energy during the last two years per car kilometer, estimating one motor-car kilometer equal to two trail-car kilometers, also per ton-kilometer, exclusive of load?
22. What is the maximum speed (a) on suburban lines? (b) on lines of medium traffic? (c) on lines of heaviest traffic?

III.—DESIGN OF CARS, ESPECIALLY AS REGARDS SIZE

Reporter: M. Geron, manager of the Cologne Tramways Company (in liquidation), Brussels.

1. What are the main dimensions of your cars as required by your franchise or by municipal enactment, especially as regards over-all width
2. Are these requirements the same for all kinds of cars, viz.: closed and open, motors and trailers, etc.? Accompany your reply with a copy of the ordinance-franchise clause.
3. What reasons are given for these requirements, especially in regard to over-all width?
4. Do you consider these requirements proper at present? Give reasons for your reply.
5. What are actually the over-all heights and widths of your different kinds of cars? Submit a cross-section showing the over-all profile, including all projections, also plan showing position of seats, form of the seat back and width of aisle.
6. What dimensions would you desire to adopt for height and width? What arrangement of seats do you prefer, longitudinal or cross? What form of back, width of seat and width of aisle? Give your reasons for your reply.
7. Do you consider a wide car accelerates the ingress and egress of passengers?
8. What is the gage of your track? What is the width between track centers on straight track and curves?

IV.—MAXIMUM SPEED FOR INTERURBAN LINES ON THEIR OWN RIGHT OF WAY OR ON THE HIGHWAY

Reporter: M. Krasa, general manager of the Bukowina Railway Company, of Czernowitz, Austria.

1. Is your interurban line operated by steam or electricity?
2. Is your traffic passenger, freight, or both?
3. What is your average speed between two consecutive stations? (a) On your own right of way? (b) On country highways? (c) On highways with medium congestion? (d) On more congested highways
4. What is your average speed between termini on the four classes of routes mentioned?
5. What is the rate of braking?
6. What is the braking distance?
7. How is the braking equipment of your trains affected by any statutes, especially as regards peculiarity of profile, speed, etc., on the four different classes of routes mentioned?
8. What is the maximum speed on these four classes of roads?
9. Is the speed governed in any respect by a statute? If so, by what authorities? Submit copy of the law.
10. What maximum speed do you think could be attained by your trains without danger? Give your reasons for your reply.
11. What maximum speed do you think could be attained economically if your trains were equipped with efficient braking apparatus on your own right of way? On country highways? On highways with medium congestion? On more congested highways

V.—TRACK CONSTRUCTION.

Reporter: C. de Burlet, general manager of the Société Nationale des Chemins de fer Vicinaux, of Belgium.

1. What size of ties do you use?
2. Why did you adopt this size?
3. Are you satisfied with this size?
4. What experience have you had with Falk or Goldschmidt or any other type of welded joint?
5. Do you use opposite or broken joints?
6. What has been your experience with opposite and broken joints?
7. Do you use lock nuts on your angle-plate bolts, and do you think it desirable to use them?

X.—ADVANTAGES AND DISADVANTAGES OF SECTIONALIZING THE DISTRIBUTION SYSTEM

Reporters: M. Fiazzoli, manager of the lighting and tramwaay company of Palermo, and Mr. Rasch, professor of the Polytechnic School at Aix-la-Chapelle.

1. Do you sectionalize your distribution system into several zones? Submit a diagram to scale showing position of the feed-in points and section insulators.
2. If you use sections, are they insulated from each other, or are they connected by fuses or circuit breakers?
3. If no sections are used, how do you locate a fault or short circuit?
4. Why did you adopt the system which you employ?
5. If sectionalized, do you obtain an economical use of all of your copper?
6. What is the maximum drop in voltage, and what the current density in your underground feeders?
7. What are the advantages and disadvantages of the two systems of distribution mentioned in the case of two tramway systems in the same city supplied with current from the same power station?

LOS ANGELES PACIFIC TO STANDARDIZE ROAD

The Los Angeles Pacific Railway Company, according to authentic reports, is making active preparations to standardize its entire system in and out of Los Angeles, comprising several hundred miles of narrow-gage track. While the officials of the company do not care to discuss their plans in detail, it is known that the company proposes to float a bond issue of from $10,000,000 to $15,000,000, part of the proceeds of which will be used for this purpose. Other noteworthy improvements involving the expenditure of vast sums of money are also contemplated. With one portion of the bond sale the company will extend and perfect its various tributary lines and local systems in San Monica and Ocean Park, and will probably construct more lines to Venice and other resorts. The scope of plans is very extensive, and many localities at present handicapped by lack of complete traffic facilities will be developed

CONSOLIDATED RUSHING WORK ON NEW LINE

The Consolidated Railway Company is pushing the work on the system which will unite Melrose, Rockville, Vernon and all intermediate points with Hartford by a trolley system which will reduce the time from the City Hall, Hartford, to Rockville to an hour. The cars will run over the tracks of the Hartford Street Railway Company, from the City Hall to a point in East Hartford just opposite the eastern end of the East Hartford freight yard, and from there over the steam tracks of the Highland division of the Consolidated Railroad to Vernon. From the Vernon station the cars will run on the steam tracks of the Rockville division to Rockville, thence on to Melrose.

The scheme will provide a double-track trolley service all the way to Vernon with the exception of a short stretch over the temporary bridge across the Connecticut River and another short stretch over in East Hartford. It will permit the operation of a service as frequent as the traffic demands.

The Consolidated Railway Company was anxious to furnish a high-speed service over the Rockville line, so that without increasing the speed west of the Connecticut River the entire distance from the City Hall to Rockville could be made in 40 minutes, but there are two factors which, at present, render it impossible to get the running time below an hour.

The first of these, as given out by the Consolidated Railway Company, is, that in order to run with the same margin of safety, the flanges of the wheels of the trolley cars must be increased in depth, according as the speed is increased. The old agreement with the city of Hartford, which President Mellen has directed shall be observed, requires the road to use the Hartford grooved rail, in which the available space for the wheel flange is limited. This fact precludes the use of cars with deep flanges on the wheels and consequently prevents the cars being run at as high speed as would be necessary to make the run to Rockville in 40 minutes.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED DEC. 12, 1905

806,761. Railway Crossing; Charles A. Alden, Steelton, Pa. App. filed May 20, 1905. Relates to a hard-metal wear-plate for street railway crossings which may be readily removed and renewed.

806,767. Ice-Removing Track Cleaner; Francis M. Bancroft, Lowell, Mass. App. filed March 22, 1905. A cutter bar provided with removable teeth is arranged diagonally in front of the car.

806,809. Semi-Convertible Car; William H. Heulings, Jr., Philadelphia, Pa. App. filed May 27, 1903. Sash pockets are formed in the side walls of the car and between the stanchions, which extend within the side sills and adjacent to the lower edges, so that the car windows may be made of maximum length, and when the car is in its open condition these sashes will be entirely inclosed and protected in the sash pockets.

806,867. Trolley Contact; Ira J. Bradshaw, Waukegan, Ill. App. filed Sept. 21, 1905. Relates to means for making electrical connection with annunciators for trolley cars designed to be located in waiting rooms for passengers, and comprises a rocking frame pivoted above the trolley and having a ball therein, which rolls from end to end when the frame is moved by the impact of the trolley wheel, thereby making the suitable connections.

807,009. Safety Apparatus for Railways; Samuel L. Adelson, New York, N. Y. App. filed June 29, 1905. At the end of each block section is placed a post having a pair of contact springs. The train has lateral arms, adapted to contact therewith, and ring a local alarm to indicate the condition of the block.

807,029. System of Electric Railways; Joseph H. Hoadley, New York, N. Y. App. filed Sept. 16, 1904. The air inlet of a gas engine is connected to the trolley pole so that when the pole is lowered the gas engine may be started to operate a separate generator.

807,053. Switch Signal; John C. Wigman, Greenbay, Wis. App. filed April 6, 1905. When the switch is opened the movement of the switchpoint closes an alarm circuit to thereby indicate the condition of the switch.

807,063. Switch-Operating Mechanism; George J. Curran, Plymouth, Pa. App. filed Oct. 14, 1905. Involves devices wherein a four-pointed star-wheel is engaged, and turned a half-revolution by a bifurcated shifting bar depending from the car platform, and adapted to be operated therefrom, a disc or eccentric being mounted on the shaft carrying the star-wheel and connected with the point-rail or switch point by a lever or system of levers.

807,089. Electrically-Driven Suspended Railway; Rudolf Pfaffenbach, Leipsic, and Herman Muller, Leipsic-Gohlis, Germany. App. filed Jan. 13, 1904. An automatically-engaging and disengaging cable system for assisting cars up a steep incline.

807,152. Car Fender; Eli Campanari, New York, N. Y. App. filed Aug. 11, 1905. Comprises a main frame, a foldable fender mounted thereon, an arm having swinging connection with the main frame, a toggle-link connection between the arm and the fender frame, a lug on the upper member of the toggle-link and a hook on the main frame for engaging with the lug.

807,171. Switch-Operating Device; Willson E. Hubbard, Dennis, Tex. App. filed April 19, 1905. A long lever extending parallel and between the track rails is attached to the switch point at one end, pivotally mounted in the roadbed, and adapted to be engaged at its other end by a cam on the car.

807,199. Magnet-Controlled Third-Rail System; Henry J. Palmer, Philadelphia, Pa. App. filed Oct. 3, 1904. An underground conduit system in which the iron cable is inclosed in a conductor rail. When the car passes the iron cable is magnetically drawn up so as to make contact with a sectional rail over which the car is passing.

807,217. Rail-Bond; William G. Stuart, Newburyport, Mass. App. filed July 14, 1904. A laminated rail-bond having its ends bent rearwardly and formed into loops and rails provided with counter-bores in which the loops are seated.

807,287. Signaling and Train-Controlling System for Railways; Frank E. Kinsman, Plainfield, N. J. App. filed April 18, 1905. A pair of contact-rails are placed along the usual track rails so as to complete a train-stop circuit on the locomotive, including a pneumatically-operated brake and power release. The rail sections are in circuit with devices controlled by the usual semaphore signals, and serve to enforce the warning displayed by the signals.

807,386. Signaling and Train-Controlling System for Railways; Frank E. Kinsman, Plainfield, N. J. App. filed July 24, 1905. A train-stop system is placed in circuit with the usual semaphore signals, and a continuously-moving recording tape is made to receive a record of the movements of the signals.

PERSONAL MENTION

MR. FREDERICK UHLMANN, formerly president of the Brooklyn Elevated Railroad, is dead.

MR. J. C. ROTHERY, division superintendent of the International Railway Company at Niagara Falls, N. Y., has resigned.

MR. FRANK W. FRAUVE has resigned as president of the Indianapolis & Eastern Traction Company, which has passed into the hands of the new consolidated company.

MR. N. C. DRAPER has been chosen general manager of the Eastern Wisconsin Railway & Light Company, of Fond du Lac, Wis., to fill the vacancy caused by the resignation of Mr. T. F. Grover, who moved to Chicago recently.

MR. P. E. FANSLER, of J. G. White & Company, was elected president of the Purdue Alumni Association of the City of New York, which was organized on Monday, Dec. 18, by about forty alumni of Purdue University living in and about New York. Mr. L. M. Grant, of the C. W. Hunt Company, was elected secretary-treasurer of the association. The association will meet on the second Wednesday of each month. The list of charter members numbers about 100.

MR. A. I. CULVER, second vice-president of the Delaware & Hudson Railroad, has been elected vice-president and a director of the United Traction Company, of Albany, N. Y., recently acquired by Delaware & Hudson interests, to succeed Mr. Francis N. Mann, Jr., resigned. It is expected that at the meeting of the board of directors of the United Company on Jan. 13, the formal entrance of Delaware & Hudson Company interests will be signalled by the election of other representatives of that company to the directorate of the United Company and to important executive positions.

MR. S. R. DUNBAR, passenger agent of the Indiana Union Traction Company, has resigned from the company, and will become associated with E. K. Dunbar & Company, of Boston, Mass., dealers in investment securities. Mr. Dunbar entered the service of the traction company about three years ago, when he went from the East to become purchasing agent of the road. Upon his arrival, in order to become perfectly familiar with his future work, he assumed the duties of storekeeper for a period of six months. On May 1 last, when Mr. H. A. Nichols became general manager of the Indiana Union Traction Company, Mr. Dunbar was appointed passenger agent. Previous to his coming to Indiana, Mr. Dunbar was associated with Mr. A. E. Appleyard for a period of more than four years, acting in the capacity of financial agent.

CORRESPONDENCE ON DIRECT VS. SINGLE-PHASE ALTERNATING CURRENT FOR THE NEW YORK CENTRAL TERMINAL

The following correspondence has recently passed between W. H. Newman, president of the New York Central Railroad, and George Westinghouse, president of the Westinghouse Electric & Manufacturing Company. It was given out for publication as this issue was on the press, but is of such interest that the forms were opened to present it to the readers of this paper:

Oct. 27, 1905.

W. H. Newman, Esq., President,
New York Central & Hudson River Railroad Company,
Grand Central Station, New York:

Dear Sir.—There can be no more important questions before you and your officers than those involved in the present electrification plans for your New York terminal and adjacent suburban lines. When your company, under public pressure and legislative enactment, undertook the change in your terminal facilities involving the use of electric power for your cars and trains, there had been no such development of the single-phase system now actively under discussion as could warrant its adoption, and therefore the selection of the continuous-current system by your commission of engineers was an obvious outcome of the situation as it then existed, notwithstanding there had been enough progress made with alternating-current single-phase traction to warrant frequent references in my conferences with you and your officials to the possibility of that system being perfected in time for a change in your plans.

The business relations existing between your company and those I represent, and the consideration you and your officials have always given my personal views on the subject of the electrification of your railway, seem to demand the prompt fulfilment of my recent promise to set out to you in a letter the reasons why, because of the possible much greater use of electricity upon many of your lines of railway, your company could and should now change your plans providing for the use of the continuous-current, third-rail equipment, to those employing the alternating-current single-phase overhead system.

These are some of the controlling facts as they have been developed:

1. Motors can be as successfully and economically operated by single-phase alternating currents as by continuous current, with the advantage in favor of the use of the alternating current, in that the great variations in speed requirements of a railway can be more easily and economically met thereby than by continuous current.

2. Single-phase electric locomotives larger than you require have already been constructed and operated by current from overhead lines.

3. Electro-pneumatic multiple-unit control has been perfected whereby trains fitted with alternating-current motors can be better operated than those propelled by continuous current.

4. Both locomotive and car equipments with multiple-unit control have been evolved, whereby either the alternating or direct-current systems of distribution can be used.

5. If there is any desire for the use of the storage-battery system, such batteries can, with rotary transformers, be as well utilized in connections with the single-phase system as with the direct-current system.

COMPARATIVE COST

Bearing upon these great questions are the comparative costs of the line equipment of the two systems.

As an example, the comparative cost of line and sub-station installation for alternating-current single-phase and direct current to meet the conditions of traffic now existing on the section of the New York, New Haven & Hartford Railway from Woodlawn to Stamford, based on the following:

(a) Single-phase alternating current, high-tension transmission, transformer, sub-stations, 6000-volt overhead line supported by catenary construction from bridges spanning four tracks.

(b) Direct current employing high-tension alternating-current transmission, rotary converter sub-stations and third rail at 600 volts.

COMPARATIVE COST PER MILE OF FOUR-TRACK LINE

	Single-Phase Alternating System	Direct-Current System
Sub-stations	$1,714	$16,150
Contact line	12,436	18,872
Transmission line	1,815	2,181
Track bonding	308	308
	$16,273	$37,511

Difference per mile in favor of a. c., single-phase, $21,238.

COMPARATIVE COST PER MILE OF DOUBLE-TRACK LINE

	Single-Phase Alternating System	Direct-Current System
Sub-stations	$1,542	$13,840
Contact line	6,750	9,436
Transmission line	1,815	2,181
Track bonding	154	154
	$10,261	$25,611

Difference per mile in favor of a. c., single-phase, $15,350.

These figures mean, assuming that your company may in the near future electrify its main lines from New York to Buffalo, that the extra cost of the line equipment with the continuous-current system for 450 miles of four-track road of the New York Central main line would amount to $9,000,000, and for the double-track of the West Shore road, $6,750,000. From these figures you can easily compute what the additional cost would be upon the entire mileage of the New York Central's other lines east of Buffalo and those west of that point.

This great difference in the first cost of the continuous-current system, with the almost absolute certainty that traffic depending upon the third rail will be subject to many interruptions during your severe winter months, coupled with the constant danger from live third rails upon the surface, would seem to make most fortunate the advent at this moment of the complete system of overhead single-phase apparatus, before any great quantity of car and locomotive apparatus has been constructed on your order, or the line and overhead construction has been begun under your extensive plans.

Stated briefly, your situation seems to be this: Your power house and its equipment now under construction is suitable, without substantial change, as are also your sub-station rotaries and storage batteries, for the operation of single-phase equipment. Orders have been placed for 35 electric locomotives, costing, say, $900,000, and 180 electric car equipments with multiple-unit control, involving an additional $775,000. Neither the locomotives nor the cars and equipments will be needed before September of next year, according to your present desires, but most probably not before April in the year following, because of the inevitable delays in the carrying out of so important a work as you now have in hand.

Had the order for the locomotives and equipment been placed with the Westinghouse Electric & Manufacturing Company, that company would have been very glad to have taken up with you a change in programme on a reasonable business basis, and I assume that your contract relations with the General Electric Company are of such a character that you can also ask them to discuss the change in the character of equipment or arrange with them for a specific sum to cover the amount they have already expended, with such profit as they are likely to make from the completion of the work. Such sum ought to be an unimportant item as compared with the costs which may result from the completion of the work along the lines of your present plans. We are aware that the General Electric Company have admitted their inability to produce locomotives of the character which the Westinghouse Company has contracted to supply the New York & New Haven Railway, but such admission on their part does not really affect the question of the Westinghouse Company's ability to produce such apparatus in the necessary quantity and in the time required.

You know of the diametrically opposed views and interests of

the Westinghouse and General companies and of the strife between them. You also know of my full recognition that the works of the former company being upon your line at Schenectady, it is natural that your company should give the General Electric Company at least a preference in the placing of contracts for electrical machinery.

The greatest difficulty in arriving at a conclusion is likely to be due to the commercial rivalry between the two electric companies, but there seems to be no good reason why your company should be a victim of such commercial strife. I feel confident that my recommendation that you now take steps to effect the change from your present plans will be found to be based upon the best of reasons, and that that recommendation will in all probability prevail if the matter is most carefully investigated, as I am sure it will be.

I am sending Mr. Wilgus a letter with some technical correspondence, of which I have pleasure in enclosing you herewith a copy, with a hope that you may find time to read the same.

Inasmuch as many of your directors know only the one side of this important situation, am I asking too much of you to have my letter placed before them? I ask this because of my very great desire to have my suggestion that your company now make a change fully understood and appreciated by your associates.

Believe me, Very truly yours,

Geo. Westinghouse.

The letter inclosed by Mr. Westinghouse follows:

Oct. 27, 1905.

Mr. E. M. Herr, First Vice-President:
Westinghouse Electric & Manufacturing Company,
Pittsburg, Pa.

I have noted H. H. Westinghouse's letter addressed to you, in which he gave the result of a conversation with Mr. Wilgus, of the New York Central, in which Mr. Wilgus brought forth certain reasons, which, in his opinion, militated against the use of single-phase apparatus in the New York Central terminal.

It would appear, from the statements advanced by Mr. Wilgus, that he had drawn his conclusions on incomplete or unreliable information, as we have not yet given out sufficient data to anyone except our customer that would enable comparisons of this nature to be drawn which would be of any value.

While the comments in Mr. Westinghouse's letter are under certain more or less definite heads, for the purpose of clearer discussion, I will set forth my views under somewhat more general headings:

LOCOMOTIVES

As to Production.—It has been assumed in the communication referred to that owing to the apparent novelty of the design of the New Haven locomotives, insufficient time is available to produce a successful single-phase locomotive in order that it may be ready for the date set for the proposed operation by electricity of the New York Central terminals. Our opinion on this matter is that this single-phase locomotive operated as a direct-current equipment comes much nearer to standard, well-accepted direct-current practice than the locomotive adopted by the New York Central for its service.

The type of mechanical construction, using swivel trucks, is very similar to that universally used on heavy electric traction cars, while the method of control, involving series parallel operation of the motors, is common practice everywhere.

The type of motor used is not a radical departure from direct-current practice except in minor features of construction. The motors are extremely well protected from dirt and moisture, and they possess certain features which make them superior to any large direct-current motors yet built by any concern, more especially as regards entire freedom from "flashing," "bucking," and difficulties of commutation, not to speak of the great advance which has been made in the application of forced ventilation.

If the Westinghouse Company had been asked to build passenger coaches fitted with four motors of the capacity used on this locomotive, these motors to be operated with the usual electro-pneumatic series parallel-control system, there would have been no hesitancy in undertaking the contract, and it would not have been considered necessary to have made a long test on a trial equipment. The problem would have been considered as merely a further development of the type of equipments now operated on the Pennsylvania, New York & Long Island Railroad.

On the other hand, the long time taken by the New York Central Railroad for testing and experimenting was but a natural precaution, in view of the many radical departures from standard practice which were incorporated in their locomotive. For instance, the type of motor used on the New York Central locomotive is entirely open, and exposed to dirt and weather conditions. This construction is a radical and questionable departure from what experience in railway work has taught us in good practice, and it would have been folly to have attempted to put such machines in operation without very long and extended tests. Aside from the mechanical features of this equipment, the motors electrically and magnetically are such as had never been tried out by the experience gained by long service.

The result of all previous experience in electric traction has apparently been abandoned in the New York Central type, and I consider that that locomotive is an infinitely greater experiment than any that the Westinghouse Company could be considered as offering in the New Haven type.

In the course of our consideration of this problem, nothing has developed which leads us to have any doubt as to our entire ability to meet the requirements of delivery with an entirely successful locomotive.

As to Operation.—It is interesting to note that these locomotives have been pretty generally referred to as "single-phase" or "alternating." We, among ourselves, have used these terms, and perhaps are responsible for the nomenclature. In reality, however, the equipment of these locomotives is simply a high-class direct-current arrangement adapted for operation on alternating current as well.

The motors are not primarily designed for alternating current and adapted for operation on direct current, but knowing the problem which we had to meet, they were in reality designed for the very highest class of direct-current service, and they will operate successfully on alternating current. In accomplishing this result, the fundamental features which make for a good direct-current railway motor have not been slighted, but on the contrary they have been amplified in order that the motors may work successfully on alternating current. We may take it as a fundamental condition in this class of work that in order that a motor work successfully on alternating current it must be an extremely good direct-current motor.

Method of Control.—It has apparently been assumed, although the example of many of our single-phase roads is to the contrary, that a multiple-unit system of control is not possible or feasible with the types of equipment which we are building for the New Haven road. This is, of course, an error, but it is probably brought about by the fact that only the electric system of multiple-unit control has been kept in mind, whereas the system which we use is the electro-pneumatic. It has further been assumed that with any system of control duplicate apparatus is necessary for d. c.-a. c. operation, which, of course, is another misconception, as the type of control which we are building for the new locomotives, and which is also in use on other of our installations, involves the employment of the same controller for both alternating-current and direct-current service.

This assumption has also called forth criticisms of the complications and difficulties in passing from direct current to alternating current, or the reverse, and much stress has been laid upon the awkwardness of having to employ two systems of control. As a matter of fact, roads now using this system pass from one current to the other at speeds as high as 50 m. p. h. without the slightest delay or any indication to the passengers that such a change has been effected. The whole mechanism to accomplish this is of the utmost simplicity and reliability.

It should be borne in mind that when multiple-unit control is referred to, we do not mean that form which depends for its operation upon the use of the line current, but upon the form used successfully and exclusively by our company, namely, the electro-pneumatic system, which depends for its operation upon the use of compressed air.

The type first mentioned, that is, the straight electric control, is obviously but ill-suited to use on a. c.-d. c. systems without additional prohibitive complications.

If the New Haven road should decide that it wishes to operate its suburban or any other service by multiple-unit trains, there is no reason why we cannot furnish entirely suitable equipments for d. c.-a. c. operation.

POWER CONSUMPTION

Locomotives.—In Mr. Westinghouse's letter it is stated that the single-phase locomotive, when used on d. c. and running at low speed, requires double the amount of energy compared with a locomotive designed for direct current only. This statement, when read by itself and without any other consideration of the conditions, is apt to lead to very erroneous conclusions. The statement is true only when the d. c.-a. c. locomotive which we have sold to the New Haven road is compared to the case of a d. c. locomotive equipped with four d. c. motors, where all four can be thrown in series on the low speeds. Where the ordinary series-parallel control is used, such as on the Interborough system and the New York & Long Island road, and which also is proposed for the New York Central multiple-unit cars, there will be no essential difference in

current consumption between the d. c.-a. c. and the straight d. c., provided the equipments are designed for the same normal car speeed.

In criticising the apparent disadvantage in economy of the d. c.-a. c. locomotive at low speeds, it would be only fair at the same time to show its superiority on higher speeds, which, I will point out later, more than offsets this apparent disadvantage in power under which it operates at the very low speeds.

It is true that the d. c.-a. c. locomotive, equipped with four motors, will, at certain very low speeds, consume what appears to be a large percentage excess of current over the straight d. c. locomotive equipped with four motors, but it should be remembered that this condition of lowest speed also means the point of least power consumption. This being kept in mind, it can readily be seen that a large percentage increase of current actually means only a small increase in power requirements.

At higher speeds the conditions, when comparing the two types of locomotives, is exactly reversed, the locomotives which we are building being of greater economy at the various higher speeds than those with which they have been compared to their disadvantage.

At one-fourth speed the total power consumption of the d. c.-a. c., or the straight d. c. locomotive, is in no sense a controlling feature. It is the power required to accelerate the locomotive up to its full speed that is of importance, and also the power consumption when running at high speeds.

The New Haven service up to Woodlawn may be considered as consisting of three sections: First, a short section where the speed may possibly be 6 m. p. h.; a second section where the speed may possibly be 26 m. p. h., and a third section, where the speed may possibly be 45 m. p. h. The total power consumption of a train on the first section, whether with d. c.-a. c. or straight d. c. equipments, will be small, due to the shortness of this section of the tracks, and to the fact that the input of the motor at these lower speeds is a minimum.

On the second section the d. c.-a. c. will be very nearly at a par.

On the third section, where a high-speed service is required, the d. c.-a. c. locomotive, as designed for the New Haven road, will present considerable economies over the straight d. c. as adopted by the New York Central.

It should be remembered that the higher economy gained with the utilization of larger amounts of power will offset a very large per cent loss in economy at the low speed when very small amounts of power are required.

The results of a comparison of a typical run on the New Haven service, showing in the first case the d. c.-a. c. locomotive which we propose to furnish, and in the second case, a straight d. c. four-motor locomotive adapted to handle the same train service, are shown in the table below.

NEW HAVEN LOCOMOTIVE

Speed M.P.H.	Time, Seconds	Kw.	Distance, Feet
0 to 6	13	654	59
6	58	150	570
6 to 21.5	36	654	....
21.5 to 25	12	654-420	1715
25	52	240	3632
25	Momentary	720	3632
25 to 45	240	720-324	17470
45	88	303	....
45 to 25	14	0	23749
25	25	240	24649
25	Momentary	720	....
25 to 32	28	720-486	....
32 to 25	5	0	25906
25	23	240	26761
25	Momentary	720	26761
22 to 46.6	404	720-312	....
46.6 to 0	262	0	62357

30 Watt-hours per ton mile

FOUR-MOTOR D. C. LOCOMOTIVE EQUIVALENT TO NEW HAVEN

Speed M.P.H.	Time, Seconds	Kw.	Distance, Feet
0 to 6	13	327	59
6	58	75	570
6 to 9.5 / 9.5 to 21.5	29	654	....
21.5 to 25	12	654-420	1517
25	52	240	3632
25	Momentary	420	3632
25 to 36	209	420-210	....
36	182	210	....
36 to 25	8	0	23749
25	25	240	24649
25	Momentary	420	24649
25 to 29	28	420-304	....
29 to 25	4	0	25906
25	23	240	26761
25 to 44.8	45	1392	....
44.8 to 61.4	183	1392-570	....
61.4 to 0	382	0	62357

30.1 Watt-hours per ton mile

From which it appears that the actual energy per ton mile required by the d. c.-a. c. locomotive is almost identical with that required by a straight d. c. locomotive under the same conditions of service.

Effect on Power House and Sub-stations.—If reference is made to the foregoing table, which shows the relative power requirements of the two types of locomotives at various speeds, it will be seen that as regards the fluctuation in the power supplied the d. c.-a. c. will represent an easier condition than the straight d. c. locomotive, as the load will be very uniform. While the minimum load will be greater than the straight d. c., the maximum or peaks will represent less power. Such a condition is in reality more ideal and much easier on the power house or sub-station than one where the same total power represents greater maximum and minimum values. The ideal condition as regards efficiency at generating and sub-stations would be a constant power or a constant load, and we come nearer to this condition with our d. c.-a. c. locomotive than is obtained by the New York Central type, on the basis of the same total power consumption in each ease.

In conclusion, I believe that the statements made herein are a sufficient refutation of the views set forth in Mr. Westinghouse's letter. The New Haven road, however, in adopting apparatus adapted for single-phase operation, are looking further than the limitations imposed by the terminal requirements. The engineers of the New Haven road recognize that the extension of electric operation was absolutely prohibited, both for physical reasons and reasons of economy, if direct current were adhered to.

The necessities of economical high-speed railway service require that power shall be drawn by the system in proportion to the work it has to do. The trains must at times run at full speed, at intermediate speed, and in emergencies at extremely high speeds, to make up for loss of time. The single-phase a. c. locomotive or equipments are the only feasible type which draw power in exact proportion to the work to be done. Direct-current equipments have but two or three points of maximum economy. They have no ability to go beyond a certain maximum speed, which is a frequent requirement of railway service. At all other speeds, except these few economical points, power is wasted in regulating the speed. The single-phase a. c. equipments utilize power at all speeds at maximum economy. I believe that this feature alone is sufficient justification, aside from the many other advantages of the system, for its adoption by the New Haven Railroad.

B. G. LAMME,
Chief Engineer Westinghouse Electric & Manufacturing Company.

As bearing on this general subject, Mr. Westinghouse also contributes the following letter to the current issue of the "Railroad Gazette":

THE SINGLE-PHASE ALTERNATING AND THE DIRECT-CURRENT SYSTEM

111 Broadway, New York, Dec. 19, 1905.

To the Editor of the "Railroad Gazette":

The railroad officials of the country are so deeply concerned in all that relates to the electrification of their lines that I deem it important now to take notice of an article which appeared in your issue of Oct. 20, as well as of the article in the STREET RAILWAY JOURNAL of Oct. 21, written by Frank J. Sprague, one of the important engineers upon the Electrical Commission of the New York Central, which thereby precipitated a far-reaching controversy as to the relative advantages and disadvantages of the two systems of electric traction, namely, the alternating single-phase, which can be operated with overhead conductors, and the direct-current system, which, for railroad purposes, requires a third rail.

In dealing with this subject, it is well to recall that when the alternating-current system was first introduced into this country by the Westinghouse Company in 1886, the advocates of the direct-current system, feeling that their particular business and their efforts to secure a monopoly of the electric light and power industry of the country might, as they really have, become abortive, left no stone unturned to accomplish the suppression of this new and comprehensive electric system. Legislatures in several States were invoked to pass laws to prohibit any use whatever of the alternating electric system, and the present method of killing criminals in New York State was the direct outcome of the organized efforts of the business rivals of the Westinghouse Company, who were also enemies of the public, to use that company's make of alternating-current generators for this base purpose in the hope that their legislative efforts referred to might be crowned with success.

The triumphant success of the alternating-current system, without which none of our great railroads could have had the benefit of electric traction, needs no words of mine to emphasize it; but there are arrayed to-day against the alternating-current single-phase system of electric traction many of the same men and the same interests, actuated by the same commercial spirit and using the same methods and tactics as were employed by them in the days referred to when they began their "peculiar" opposition to the alternating electric system.

Public discussion and the facts already demonstrated will bring discomfiture to that organization which has made a long and losing fight to acquire a monopoly of the electric light and power business of the country, and will insure the acceptance in this country of the single-phase system as the only solution of the electric traction problem on main railroads, as has already been the general result of a most intelligent consideration of the subject in Europe.

In 1886 it was said by some influential people that I was making a mistake in attaching so much importance to the efforts being made at that time to discredit the alternating system. The beneficial results which have followed my efforts in that and other cases, in the true interests of users of electric apparatus, impel me to believe that I would be remiss at this moment to accede to like suggestions which have been recently made to me.

Mr. Sprague, while disclaiming that he was speaking officially for the New York Central Company, seems to have left no doubt in the minds of a large number of people that his views were those of the members of the New York Central Electrical Commission. In his haste to create for his clients a strong public opinion calculated to induce the officials of the New York & New Haven Railroad to give up their plan to use the single-phase alternating system and to take exactly the same kind of apparatus as the New York Central had already contracted for, namely, the third-rail direct-current system, and in pleading the great need for uniformity, Mr. Sprague forgot to inform the public, probably as he would have done had he had more time, that he is receiving a very large retainer under a contract of years duration, whereby, though he may become consulting engineer for a railroad, yet he cannot do so if, in the opinion of the officials of the General Electric Company, such work or obligation may be in conflict with the interests of that company; and having a particular personal interest in his own form of control, which is suitable for direct currents only, he equally overlooked the fact that the electro-pneumatic multiple-unit control made by the Westinghouse Company had been fully perfected for the operation of locomotives and multiple-unit trains when operated by the alternating single-phase or the direct current.

Your article above referred to also tended to mislead its readers upon most important railroad questions, because it seems to have been written with a knowledge of only one side of a situation, and thus under an impression that the action of the New York, New Haven & Hartford road might prove not helpful, as it will, but rather disadvantageous to electric traction in general.

Believing that a great effort had been inaugurated to fasten upon the railroads the direct-current third-rail system as a standard, through a specious appeal in this particular case for uniformity, and knowing that nothing more harmful could happen to railroad interests than to extend that system, I wrote a letter, after a conference on the subject, to President Newman, of the New York Central, and inclosed therein a letter from Mr. B. F. Lamme, chief engineer of the Westinghouse Electric & Manufacturing Company, in criticism of observations made respecting the action of the New York, New Haven & Hartford Railroad. Copies of these letters are inclosed herewith for your perusal and publication.

An intelligent public discussion of these important questions cannot fail to be of the utmost benefit, and in saying this I have in mind the rather harsh criticisms made of my letter published in the "Railroad Gazette" of Jan. 17, 1902, written in a spirit of friendliness and helpfulness to the New York Central officials, who were, in my opinion, being misjudged with reference to the accident which had shortly before occurred in the New York Central tunnel. The result of that discussion has, as all know, been the development of the steel car, so that there are now a number of firms ready to supply non-combustible cars, which are superior to the old form; in fact, the Interborough, the Pennsylvania, and the New York Central have all ordered steel cars in large numbers, and no one would now think of doing otherwise.

In conclusion, I wish to say that the single-phase alternating-current system not only equals the direct-current system in every particular, as fully set out in Mr. Lamme's letter, but in several respects has advantages of supreme importance, two of which I will particularly refer to.

No problem is of higher importance than that relating to the avoidance of the destruction by electrolytic action of all underground metallic work, such as employed in the great improvements of the New York Central, the Interborough and other underground work yet to be undertaken, and the water and gas pipes of New York. These works have been created, not to last a decade, but are intended to, and should, endure for ages. It has been shown fully and completely that the direct current is working all of the time in the destruction of some of the metallic structures, especially water and gas pipes, adjacent to electric conductors, which metallic structures invariably act as conductors for some of the current escaping from the uninsulated rails forming part of the electric circuit in railroad operations.

In illustration of this electrolytic action of continuous currents, I enclose a photograph with memorandum of explanation showing the electrolytic action due to the leakage of electric current from a street railway line in East Pittsburg. I do not pretend that the rapidity of action in his case is likely to occur, except under extraordinary conditions. However, had the alternating current been used, there would have been no electrolytic effect whatever. This electrolytic difficulty is a well-known one. It cannot be hid or covered up and must be surmounted, because the sum involved in this phase of the electric problem is so great as to justify every possible effort to avoid its rapid depreciation or loss.

In the matter of the regulation of the speed of trains upon standard railroads, the single-phase system will have it all its own way, because with the continuous current no speed can be attained greatly in excess of the predetermined one. In railroad practice it often happens that speeds of 70 m. p. h. and 80 m. p. h. are necessary to make up for time lost. If the direct-current motors are constructed for this speed, then at the ordinary speeds of 40 miles or 50 miles there would have to be introduced a dead resistance in the motor circuits to reduce the voltage, which condition can be maintained only for a short time, and is in effect not unlike applying a brake to hold the speed down. The only other way to maintain an average low speed would be to put the current on and off, an intolerable and uncomfortable practice one frequently observes when a motorman is obliged to move a street car at a slow speed. In the single-phase system, the auto-converters used in connection with the locomotive and car equipments provide for continuous running at any desired speed in a manner equivalent to the placing of the throttle and reverse lever in appropriate positions.

My references to Mr. Sprague and his article and his interests are reluctantly made, and are not to do him an injustice but to prevent an injustice being done to vast interests by the forgetfulness referred to. Geo. Westinghouse.

The electrolytic action referred to in the preceding communication of Mr. Westinghouse occurred in one of the natural gas wells on the property of the Westinghouse Electric & Manufacturing Company in East Pittsburg. The action was found to be due to electrolysis, caused by stray currents from the street railway system. This gas well was in operation for several years with 2-in. tubing, consisting of bare steel pipe with no preservative or other protection. The well suddenly gave out, and upon pulling the tubing it was found that for 30 ft. or 40 ft. above the rubber packing (located about 1800 ft. down for preventing access of water to the gas-bearing strata). the pipe was greatly reduced in thickness, more or less uniformly, but broken entirely through in several places, thus causing the well to be "drowned out." As the well goes through salt-water strata and there is some sulphur in the surface waters, this was believed to be the cause. As a supposed remedy, new tubing was installed, protected by a japanned coating inside and outside, known as "Loricated" tubing. Photographs of this tubing, taken after thirty days' use, show numerous pit holes. The action was immediately diagnosed as electrolytic entirely, and was, of course, aggravated because a very slight defect in the coating concentrated electrolytic action at these spots, thus causing an aggravation instead of a remedy. To cure the trouble, careful observations were made as to the source of current, and a slight flow of current was found at all times with very heavy flows during the busy hours of the street car line. After installing the new tubing, several insulating joints were inserted in the casing in the hope that these will prove a remedy.