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During 1906 the Street Railway Journal printed and circulated 426,950 copies, an average of 8210 copies per week. Of this issue 8200 copies are printed.

The Quarterly Meeting of the New York State Association

A considerable portion of this issue is devoted to papers read at the quarterly meeting at Buffalo on Jan. 11 of the Street Railway Association of the State of New York, and to an abstract of the discussion. The meeting was one of the most valuable which has ever been held at which the subject of track construction for street railway lines has been discussed, and amply justifies the policy of the State Association in holding quarterly meetings.

The program contained six topics, viz., track construction, rail sections, rail joints, derailing devices, rail bonds and overhead lines. On the first subject three papers were presented by the track engineers of Rochester, Buffalo and Syracuse, the three largest city properties in the western part of the State. Mr. Matthews, who represented Rochester property, advocated as the most durable construction on streets of heavy traffic, wooden ties spaced 2 ft. to 2½-ft. centers and carried on a 6-in. concrete base. This construction can be slightly cheapened by employing concrete beams under the rails instead of using an entire concrete bed, and this plan is entirely satisfactory where the street traffic is not heavy and where the subgrade is good. The most substantial Buffalo construction, as described by Mr. Jackson, differs from that in Syracuse in the use of steel ties instead of wooden. The concrete is carried the entire width of the roadway and 6 ins. under the ties; beam construction has also been used, but is not now considered so desirable. The paper by Mr. Roundey, of Syracuse, did not take up the subject of subconstruction, but was devoted principally to the advocacy of tie rods instead of brace plates. The latter are difficult to spike in the first place, and as the tie gets old the efficiency of its holding power decreases, allowing the rail to tip outward. The greater ease of paving when brace plates are used instead of tie rods was formerly considered an important advantage of the brace plate, but as this point was not mentioned by Mr. Roundey it has evidently been found by him to be of no great practical importance. There were no papers advocating ballasted track, but a representative of one of the companies using this construction to a large extent was present in the person of Mr. Stanley, of the Public Service Corporation of New Jersey. While not claiming that it was perfect, Mr. Stanley discussed this construction at considerable length, and is evidently still to be convinced that the more rigid construction on concrete is desirable from every standpoint.

The subject of rail sections was taken up in an interesting paper by Mr. Reel, of Kingston, who strongly advocated the use of standard T-rail. Owing to the large number of engravings accompanying this paper, its publication is deferred until next week. Most of those present agreed with Mr. Reel that T-rail could be used satisfactorily on streets of light traffic, but there was some dissent to his claim for it in streets with considerable vehicular traffic, in spite of the instances cited by him of satisfaction given in Denver, Minneapolis, Milwaukee and other cities. There seems to be no doubt that where teams follow the track they will wear ruts in the paving close to the rail unless the railway company provides a more durable street surface in the form of a steel girder. We believe, however, that in the cities where the T-rail is widely used, the teams do not hug the track as in those where grooved or girder rail is employed; hence the vehicular wear is distributed over the entire street and there is no tendency to form ruts along the side of the rail. It is not a necessary duty of the street railway company to provide a runway for heavy drays, however convenient to the teams such a track may be, nor is it desirable from the standpoint of safety for vehicles to be attracted to the portion of the street containing the track rather than to other parts of the highway. They may have to use a part of the track in narrow streets, but need not be encouraged to do so, and in wide streets, especially if the tracks are near the side of the street and T-rails are used, we believe that the tendency of the vehicles is to keep away from the tracks. One feature of Mr. Reel's paper was the presentation of testimony in favor of T-rails from city engineers in the cities in which that form of rail is employed. These letters spoke most favorably of this form of construction.

Rail joints were treated in papers on thermit welding, by Mr. French, of Utica, and electric welding, by Mr. Wilson, of Rochester, and very valuable information was brought out in the discussion. Mr. Clark, particularly, gave an interesting account of a form of joint originated by him for Cleveland conditions, and giving very good satisfaction in that city. The advantage of eliminating the necessity of a bond by welding rail was one of the points dwelt upon in the discussion.

Derailing devices was the subject of a topical debate, in which it proved to be the consensus of opinion that sending the conductor forward to flag the crossing could not be avoided. Whether it was desirable to have him throw a switch after reaching the railroad crossing was another question, provided his presence there could be insured in any other way. It also seemed desirable to locate derailing switches not too near nor too far from the crossing, as in the former case the car might run through the switch on to the crossing, while in the latter case there is chance for danger to originate after the car had passed the switch; 40 ft. to 70 ft., the regulation distances in Ohio, seemed to meet general approval, as approximating the proper maximum and minimum.

The subject of bonds was discussed in an interesting paper by H. L. Mack, of the International Railway Company, of Buffalo. This company has used nearly all types of bonds, and it is significant that Mr. Mack believed that the best bond is the one "in which the greatest care is exercised in its application." In other words, a good bond can be rendered practically worthless by carelessness, and a bond poor in principle can be made effective by the proper installation. Mr. Mack of course has his preferences, and they are discussed carefully in his paper.

The session concluded with a discussion on overhead lines, in which Mr. Bagg, of Gloversville, pointed out the advantages of span wire construction, and Mr. Eveleth described the latest form of catenary suspension. While catenary construction was originally designed for alternating-current roads, it is equally well adapted to any high-speed line and is being used to a considerable extent on direct-current railways. In fact, for high-speed work it is practically essential to good service.

The Design of Rapid Transit Cars

In Mr. Fox's paper, which is concluded in this issue, we present a rather exhaustive study of a very important and difficult problem. The fact is that modern conditions have made so great a change in the requirements imposed on cars that old precedents are of little value save as guides as to things to be avoided. The typical American center-aisle car as used on ordinary steam railroads is most convenient and has made headway even in foreign practice. It was never designed, however, with a view of providing facilities for exceedingly rapid ingress and egress. A long central aisle effectively prevents this, but in ordinary railway service there is no resulting delay, since the handling of baggage and express matter rather than the movement of passengers is the thing which chiefly determines the length of the stops. It is only within comparatively few years that the suburban passenger train carrying no baggage car has become common, and has brought with it an acute necessity for easier movement of the live load. In a similar fashion the street car of the earlier days gave sufficiently good exits and entrances by the end door. One of the ancient 16-ft. bodies could be quickly enough cleared of all the passengers it could hold, particularly when schedule speeds were low and people were not in so desperate a hurry as now. The coming of long double-truck cars made a disastrous difference in the conditions, but there have been no corresponding advances in design, and street cars have either followed the earlier practice or have been made cramped and uncomfortable copies of ordinary railway carriages.

When necessity for rapid transit forced itself into prominence the perfectly natural step was from the ordinary railway car to the longitudinal seats of the tramcar. The result was the compromise found in the early cars on the New York elevated roads, with cross seats in the middle and longitudinal seats with wide aisles at the ends of the car. This car has given fairly good satisfaction under New York working conditions, but has the obvious objections of poor circulation and the rather contracted doors. The whole story is that one cannot drive through end doors the horde of passengers that is crowded into a rapid transit car under modern conditions. The end doors worked well enough so long as the car was not used much above its seating capacity, but beyond that they failed.

Now the most essential thing in considering any improved design is the expressed or implied purpose with respect to seating the passengers. The car which provides the minimum of seats is likely to have the clearest space in which to move a crowd and probably the best chance of getting a car which could be rapidly emptied and filled would be one with merely such longitudinal seats as would be permitted by end doors and one or two wide side doors. On the other hand the introduction of many seats means a lower carrying capacity, because in the same area more people can be carried seated than standing. The proper policy to pursue must depend then upon local conditions. If the distances are long and the track clear the tendency will be to provide the majority of passengers with seats. When, however, the congestion is great and the distances short it becomes simply a question of the best method of taking care of the maximum number of passengers. The car which in this country is carrying the largest crowds with the quickest station stops is one with a wide side and end doors and longitudinal seats between the doors; in other words, the present Brooklyn Bridge car, to which Mr. Fox apparently fails to give the due amount of credit. While it is a fact that the great crowding of the Brooklyn Bridge terminal is deplorable, it is very questionable if any improvement could be made in loading and unloading trains at that terminal so far as speed is concerned. Whether one side door is more desirable than two or more narrow ones is a question. In either case, to reduce the station stops to a minimum, a guard would be required at each door, since a crowd of struggling passengers cannot safely be left to itself. In this connection we doubt whether the policy of bisecting the center door by a post on the theory that it would direct the streams of passengers is expedient, as we fear that injuries would be caused by its use. Of course the possibility of using side doors depends upon the conditions at curved platforms. Sill extensions to the cars themselves would usually not clear other points in a narrow subway, while sliding platforms at the station, although used to some extent, do have an element of danger unless they are withdrawn at exactly the right moment. Nevertheless, the tendency in rapid transit rolling stock is undeniably in favor of the side-door car. The question then, where the conditions admit of their operation, narrows down to the use of a single or a multiple side-door car.

The Illinois Central type is the most conspicuous example of the latter, and experience in Chicago has shown that it can be loaded and unloaded with astonishing rapidity. The accident liability with the Illinois Central type, according to the evidence, is extremely low, but we cannot help feeling that under subway or elevated conditions the situation might be changed. That is, in the latter service the question is not one of simply taking from a station the passengers who are waiting there to board the car, but the situation is complicated by the stream of passengers who are constantly arriving on the platform and who will insist upon boarding a car so long as a closing door can be stopped with the foot or an umbrella and then pried open. Mr. Fox considers this point at length in his discussion of multi-door cars, and refers to the open surface car and to the open cars on the Manhattan Elevated, somewhat unfortunate precedents, as neither of these is conspicuous for its freedom from accidents. We do not mean by this that a multi-door car is necessarily dangerous, but only when there is a stream of passengers and the doors are closed by a single guard at the end of the car. The liability could be reduced by providing platform guards during the rush hours. Two guards for each car would probably be sufficient to close the doors by hand, as in European conditions, leaving the doors to be opened by the guards on the trains. The train guards could also close the side doors during the light hours, thus dispensing with the platform guards at those times.

Mr. Fox's suggested modification of the Illinois Central car is very ingenious, consisting as it does of seats and doors arranged as in a Continental railway carriage, combined with the open saloon and center aisle of the American car. A car so constructed excels in seating capacity, and if not filled with standing passengers is very accessible in all its parts. Its construction is so novel that it is difficult to analyze the possibilities of its use, but our fear would be that when crowded with a standing load it would be difficult to escape from, owing to the very narrow passages required to gain the seating capacity. The combination of feet, umbrellas, bags, and bundles that have to be dodged in our present cars would be very much in the way in the narrow side exits of the proposed car and might easily cause delay, not to say extreme annoyance, to both seated and standing passengers. As a whole the type strikes us as better adapted to express service under a no-seat-no-fare rule than to the exigencies of congested local traffic. In other words, we are brought back to our original question, i. e., can enough cars be run so as to give all or most of the passengers seats, or must a considerable number of the passengers stand? For the latter service a multi-door car with a single row of vis-a-vis longitudinal seats in the center seems to us more practical. Openings could be left in the center row of benches, as passageways. Such a car would at least place the fixed seats where they interfere least with the flexible movement of the crowd, while the multi-doors would enable one-half of the side of the car to be thrown open at station stops.

There are many possibilities in cross-seat construction that have not yet been touched, and we are glad to see them come up for keen discussion, but the task of designing cars practicable for rush hours is a very difficult one. It is even an open question whether there can be any great shortening of stops at stations without considerable additional discomfort and, for that matter, danger. Possibly it may in the long run be necessary to use island platforms uniformly receiving passengers on one side of the car and discharging them on the other simultaneously, at the more important stations, and limiting the access of crowds to the working platforms beside. Station design is at least as important as car design in alleviating congestion, and the one must to a considerable extent depend on the other. Mr. Fox's plans will repay a good deal of study, and must be considered in connection with platform construction and the general means of checking congestion in the approach to the cars. The certainty that new subways will soon be constructed renders the subject an important one. The fact that a new type of car cannot be exchanged with those on the present subway is not an insuperable objection. If of demonstrated value in loading and unloading, it is possible that the capitalized saving through reduction of station stops and present car weights may be sufficient to warrant the substitution of a side-door car to replace the present subway type.

SUGGESTIONS ON RAPID TRANSIT WITH PARTICULAR REFERENCE TO ROLLING STOCK—III

BY JOHN P. FOX

In the last issue of this paper the writer described a proposed type of car with eleven doors on each side, mentioned its advantages for rapid transit service and discussed the objections often urged against side-door cars.

The body of the car is carried by a steel underframe, consisting of 9-in. channels for side and end sills, and 9-in. I-beams for center sills. In order that the car sides may project as much as possible over curved platforms, with a minimum thickness of the flooring, the posts are carried on an 8-in. angle riveted to the side sills. This allows the car floor to be nearer the platform level than if a projecting floor framing were placed on the underframe as is common in Europe. The door posts are 3-in. channels, and the intermediate posts, if needed, are 3-in. tees. The plate is a 5-in. x 3-in. angle. The roof might be the same as with the present subway cars, of composite board carried by fireproof wood and angle carlines. Finish of steel, aluminum and transite, without fireproof wood, if it can be avoided.

AISLES

The writer still prefers one center aisle to the two side aisles of the Illinois Central, but is open to conviction on the matter. The loss of seats with two aisles would appear too great with the New York subway, and one thing affecting the opinion of the passengers is the absence of any corner seats so much sought for. Mr. Dawson prefers the single side aisle of the German cars, but this does not seem so convenient, where the doors on both sides are used, as the center aisle. As to the width of aisle, Types 7000 and 8000 have only a 16-in. aisle. With all passengers seated, an aisle may obviously be narrower than with many standing. All the width the writer personally requires is 10 ins. at the seat level and 20 ins. at the top of the seat backs. The aisle in a Berlin Stadtbahn car measured only 13½ ins. at the seat and 18 ins. above. On the upper deck of one English double-deck car, where great economy of space is necessary, the aisle measured 12¼ ins. at the seat, and 16⅛ ins. between seat backs. If it is necessary to defend a 16-in. aisle in a 120-seat car, one must ask what clear width of aisle is left in a present subway car with 120 passengers in it?

BUFFERS AND UNDERFRAME

The buffers, fastened to the end sills, as shown in Figs. 17 and 18 in the last issue, are represented as corrugated buffer blocks, like the cast-steel ones on the Metropolitan District cars in London. The corrugations are to reduce the chance of telescoping in an accident. The heavy steel underframe of a side-door car should give much greater safety in case of collision than the construction of the steel subway cars, provided the underframes can be kept in line, for the weak point of the subway cars is that the side girder has to stop at the end doors, leaving only 5-in. and 6-in. beams at the car ends, instead of the 9-in. beams of the side-door cars. It is a question how far to design a car to meet accidents, and when English car construction was criticised after the Salisbury accident as being too light, though the construction there must have been greatly intensified by the fact that the brakes were never set, one heard the defense made that English railways were so safe that there was no need to make cars collision proof. It may be that more money should first be spent strengthening other weak points of a railway.

CONTACT SHOES, CONTINUOUS WALKS AND TRACK CONSTRUCTION

The fire in the New York subway on June 1, 1906, emphasized again the danger of a third rail in case of derailment, and the need of an overhead conductor, at least for new subways. While the clearance between car roof and subway beams was considered too small at first for any overhead conductor, European precedents seem to modify this opinion, the writer having found a minimum clearance in use as small as 1½ ins., and conductor rails only 2 ins. thick and 4½ ins. from tie to surface. The writer has found it possible to design a heavy conductor, properly insulated, whose under surface would be only 1½ ins. below the subway beams. A continuous board of some fireproof insulating material would be suspended below the latter and the insulators placed between the beams where the hollows of the concrete arches are 6 ins. deep. The writer has no preference for any type of contact shoe, merely indicating a kind so long used in parts of the Orleans tunnel in Paris. The shoe should have some device for pulling it down, of course, so as to stop any short circuit that might occur.

Fig. 19 illustrates contact shoes, conductors and other possible subway improvements, not wholly matters of cars, but which may be of interest. A great need in every subway is a safe means to get passengers quickly out of the trains in case of fire or smoke or any serious delay. By shifting the track in the present subway one side as shown, it would be possible to construct continuous walks alongside the trains, at least 3 ft. wide if side-door cars are used. The 4 ins. indicated between the car roofs and subway braces need not be so little, especially with a segmental car roof, but is used as the minimum space allowed in tunnels in steam railroad practice with speeds of 36 m. p. h. or even over. One railroad has reported a minimum clearance at this point of only 1 in., but found that cars would naturally sometimes scrape in passing. Of the types of track construction shown in Fig. 19, that farthest to the left is an attempt to carry out the suggestion of the "Engineering News," with stringers on steel ties, asphalt about the rails somewhat as used with German surface tracks, and ledges in the concrete serving in place of guard rails. The right-hand express track, under car 6000, tries to adapt the Philadelphia plan of screwing the rails down to wooden blocks, bolted here to Z-bars and a 15-in. channel, which is the best the writer could do with the present shallow space in the concrete. The right-hand local track has the rails fastened to 8-in. angles which serve as guard rails where there is no wear. These ties rest on Z-bars and steel ties and the rails are surrounded with asphalt or any other desirable composition. Car 8000 is shown as at a station platform just as now exist on the New York subway, and shows how the much wider car would require no alterations at stations. If a walk were desired with this type of car, it could only be about 24 ins. wide between sides and subway posts. If the clearances shown between cars and posts seem small, it may be remembered that in the Budapest subway the space between cars and sidewalls and also posts is only 7⅞ ins., with a 31½-in. space for employees between passing trains. If continuous walks were used, employees would take refuge under them.

CURVED PLATFORMS

Fig. 20 illustrates the minimum radii of curved platforms with which car type 6000 can be used. The running board projects 11½ ins. beyond the underframe, and its top is 4¼ ins. above the platform, which then is the step up into the car. This allows a 2-in. space between the under side of the 8-in. angle and the platform, but this clearance of course can be increased if a higher step is not objectionable. On the Mersey Railway a similar clearance at one place as small as 1 in. gave no trouble, but was not thought desirable. As to platform curvature, allowing a horizontal space of 2 ins. between running board and platform edge, a minimum radius of about 300 ft. is possible. Allowing the extreme of a 6-in. gap, the minimum radius of a concave platform is 228 ft. With a 6-in. gap and a convex platform, it is possible, by having the guard stand in one of the end doors, the other being left closed, to use nine doors with a radius of 151 ft. City Hall station would then be the only place not provided for by the car itself, on account of its 150-ft. radius curve with a concave platform. But the wider gap at this one station could easily be filled in by the use of extension platform bridges, as found at the South Ferry elevated station and so common in the Boston subway.

DOORS

The doors as illustrated are thick enough to have a sliding window and a sliding shade in a metal frame. It seems doubtful if any of the windows ought to open at all, however, except the guard's, and those in the doors especially for safety's sake. As to the operation of the doors, the mechanism has to be very compact, and so ball-bearing hangers would be used, which on one heavy door the writer tested, about 3 ft. wide, required only 8 ounces pressure to start. With any such easy movement, it seems well to avoid operation by air and use hand levers, if these can be installed, or some other hand mechanism like the Illinois Central. The failure of the center doors in London and the difficulties with pneumatic operation in Boston make one a little shy of air. Of course the Boston mechanism was of an early type, and it took time to avoid leaks; but even now one will find air escaping, pump governors struck, and occasionally an air pressure too low to release the brakes. The writer has heard of two roads where the air for operating doors has at times exceeded the air used in braking, and in one case only about 30 per cent of the air compressed reached the brake cylinders. The additional wear on ordinary compressor equipments must be considerable. With a side-door car, however, there need only be two cylinders to a car, instead of the six or eight with center-door types, and the leakage should be reduced to a minimum. For convenience, air operation would probably be best in the side-door types illustrated, except Type 5000, Fig. 16, where there is ample room for hand levers. A difficulty with the independence of the doors of a center-door car is how to lock the doors securely when shut, so as to insure safety if the air mechanism fails. The first pneumatic-end doors in Boston had latches opened by foot pedals, as shown in the STREET RAILWAY JOURNAL for Aug. 6, 1904. But when the center doors also were equipped with pneumatic apparatus, the operation of a separate latch and valve for every door was too much, and now the doors are held closed by air only. But it is not altogether satisfactory to have to start a train with a door in the center merely kept closed by its own friction. There should at least be some way to lock such a door closed if the mechanism has failed, and a signal system would be an added safeguard if it rang bells on the cars when any door opened while the train was in motion. On the Illinois Central cars the doors are held firmly closed by a ratchet and pawl, which can be operated by foot pedals at each end and the center of the car.

As to the edge of the door, the pneumatic cushion in Boston has also been somewhat disappointing, though the

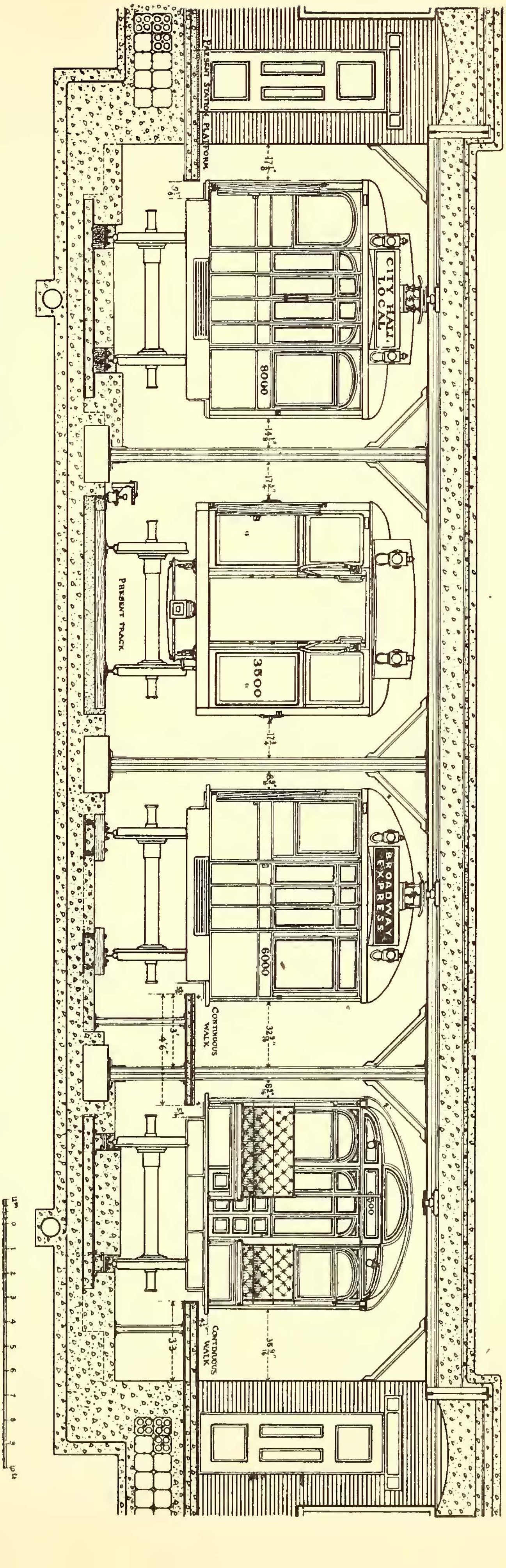


FIG. 19.—CROSS-SECTION OF NEW YORK SUBWAY, SHOWING PRESENT AND POSSIBLE TYPES OF CARS AND TRACK CONSTRUCTION

trouble is perhaps more with the adjustment of the space between door and jamb. In the first cars with pneumatic doors in Boston it seemed impossible for any one to be held between the door and the frame, as the rubber allowed anything to be pulled out. But when all the cars came to have the doors altered, some of the latter closed too far and as a result one woman was nearly dragged off into the street. When a tight door closes with a bang at the end, it takes great care by a guard not to have any accidents. People in Boston were at first afraid of the mysterious self-closing doors, but now they often try to push in through the last crack.* It would seem as though a number of side doors, attached to one operating rod as in the Illinois Central cars, with a separate adjustment for each door, would allow a more definite space to be maintained for safety when closed. Then, in leaving a station, it would seem well for the guard not to close the doors tight till, while looking out the window and along the platform, he is sure no one is caught in any door. Then he can close the doors tight. Emergency brake cords should be run along each side of the car just over the doors, both inside and out, so that even a person caught may instantly stop the train.

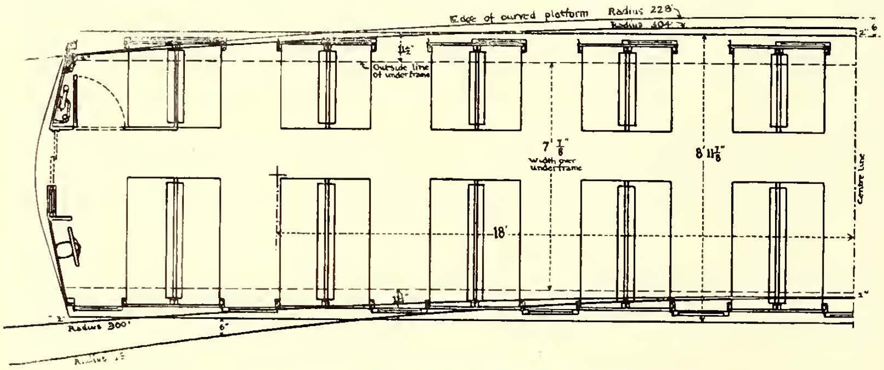


FIG. 20.—TYPE 6000 AT CURVED STATION PLATFORMS

CIRCULATION

One interesting experiment with the Boston cars has been the attempt to train the passengers to circulate always in the same direction, viz: out through the center door and in through the end doors. The guards at every stop request passengers to leave by the center door, and signs both inside the car and at the stations give the same directions. At first the people were somewhat confused by the fact that the center doors were not always opened except at terminals, but after pneumatic operation of all doors at all times was inaugurated there was less confusion. But people little by little forgot their training, and began to go out at the end and in at the center even before those inside were out. This breaking up of the regular circulation was probably started by the congestion in the rush hours, when it was impossible sometimes to get in or out the proper door. Then people began to use the nearest door more and more at all hours, in spite of the requests of guards, and now the rule is not much heeded. It is not surprising that people try to get in and out the quickest way, although a regular circulation might in the end be more satisfactory. Apparently the only rule that can be strictly enforced is that passengers must be allowed to get out first. Even that is not always possible in Boston. The writer wonders whether the continuation of a regulation to leave at the center and enter at the end doors may not hinder now more than it helps, for the reason that it tends to increase friction between passengers. Passengers who follow directions naturally resent the obstruction of those who disregard rules, and as a result tempers often suffer besides the length of stops. It would seem well to accept the inevitable, and tell passengers to leave by the nearest door, concentrating attention on keeping passengers out till all are off a car, as New York passengers had to learn in the subway.

One trouble with a wide door is that it tempts persons to push in before inside passengers get out, and this is a frequent and annoying occurrence with the Boston center doors, in spite of efforts to stop such causes of blocking and friction. With the narrow doors of side-door cars, passengers would have to wait their turn, just as in the New York subway now, with the added advantage of being able to see easily and quickly when all inside were out, as the passengers from a side-door car would generally come straight from their seats, making it necessary for one about to enter a door to look at a space only about 8 ft. deep; whereas now one needs to see half the interior of a car, while standing passengers often cause twice the amount of obstruction to view possible with a 100 or 120-seat side-door car.

FLOOR

The use of smooth floor surface seems desirable in place of wearing strips for purposes of cleanness. Some European railways use linoleum, but that would not last long with heavy traffic. Two or more roads are trying lito-silo, a non-conducting, fireproof composition, which is not slippery, and is being used in the new Great Northern & City cars as described in the STREET RAILWAY JOURNAL for Jan. 6, 1906. The composition is laid on a smooth floor of steel plate, which is strengthened with transverse flanged troughs whose flanges keep the composition intact. One advantage of a smooth floor is that people are not so likely to spit on it, because any dirt shows more.

LIGHTING

The STREET RAILWAY JOURNAL has pointed out so well the need of better car lighting, and the greater effectiveness of softened lights, that there is little to say on the subject except in suggesting a new method to be criticised. The clumsy shades shown in Fig. 17 are supposed to be of either very dark translucent glass, or even metal, so as to cut off all sight of the lamp filaments from wherever one is seated. The present subway cars have lights enough, but some persons find the bare filaments very disagreeable, especially as they are multiplied by reflections from windows and polished surfaces two or three times over. While the use of frosted, holophane, or prism globes would greatly improve things, it would seem worth while to make a trial with solid shades, throwing light downward, and possibly allowing some opening for lighting advertisements, but the best shade would seem to be the common cone-shaped one, with mirrors inside, used with such effect in store windows. They allow a very wide angle of lighting without showing any bright surface, and if placed just over the heads of seated passengers should make newspaper reading easy without eye-strain. The extinguishing of car lights in the last subway fires in Boston and New York, while no panic fortunately resulted, shows the need of some kind of emergency lights as sometimes found in Europe. The Berlin cars have candle lamps,

* The increase of this bad habit is perhaps partly due to the leniency of the guards in trying to prevent accidents, because people take advantage of the ease of reversing the movement of a pneumatic door.

which need no attention, and the candles are locked in. A better plan would be to use a small storage battery with some of the lamps, though the most satisfactory thing would be to have the lighting circuits independent of the power except when the former gave out, just as with the subway stations, using another conductor and sliding contact as in the Glasgow District Subway.

NOISE

Continuous walks as shown in Fig. 19 would tend to shut in some of the noise from the trucks and track, just as station platforms do now. The shutting of all windows and vestibuling of the cars, as referred to later, would cause a further reduction. Wood-centered wheels, so universal on English steam cars and used on all of the cars of the Central London except those carrying motors, might help still more. These wheels have teak centers with steel tires, and makers have been ready to guarantee them as safe for driving wheels on motor trucks, but they have not yet been so used to the writer's knowledge. Much of the quiet of some foreign subway trains is due to the removal of all motors and apparatus to the ends of the trains, as on the Central London and some other London tubes, where no passengers sit over the motors. The cars are light, and do not even

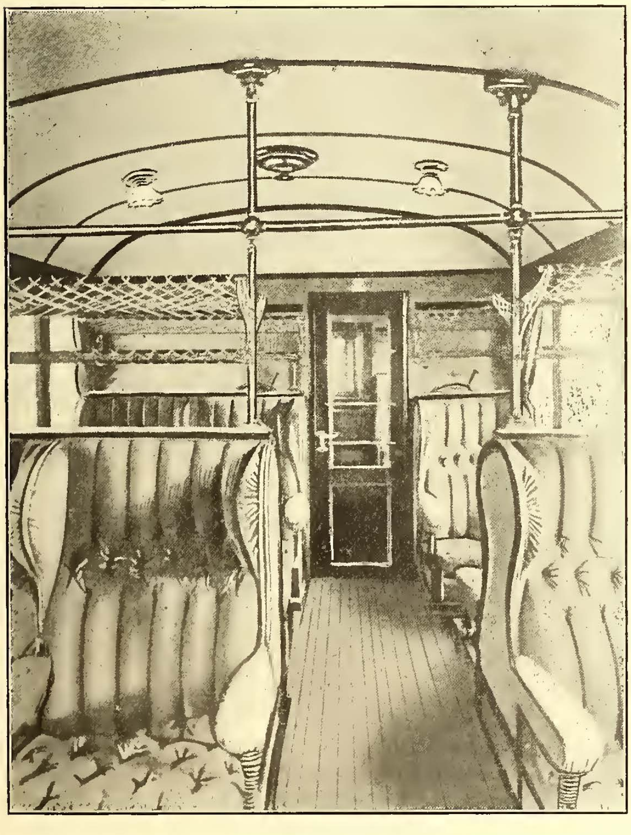


FIG. 22.—INTERIOR OF SECOND-CLASS VESTIBULED CAR, GOTTHARD RAILWAY, SWITZERLAND

carry air compressors. The concentration of apparatus in roomy, fireproof cabs at the ends of trains has more advantages than reducing noise, in the greater safety, less chance of causing panics, as from short circuits, economy of first cost, and opportunity for better inspection and maintenance than where so much apparatus is under the cars. The frequency of failures with present American subway and elevated cars would seem to suggest a more careful consideration of the European practice in this respect. Is not the splitting up of trains overdone in this country? It has been found too expensive on some European roads, the providing of empty seats at slack hours being much cheaper than attempting to keep down the seats at all hours. The London & South Western Railway has an excellent practice with its eight-car electric-lighted suburban trains. Each train is made up of two groups of four cars, the latter permanently coupled for economy. At slack hours four cars are run; at the rush hours, eight cars. There is never any need to send one car to the shops, for each train goes through the shops at such frequent regular intervals as to make inter-

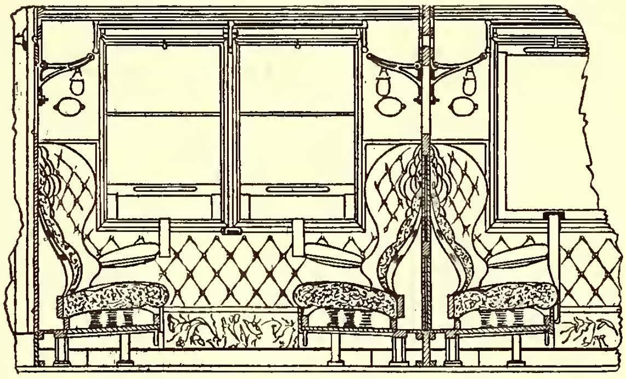


FIG. 21.—SEATS IN FIRST-CLASS VESTIBULED CAR, WESTERN RAILWAY OF FRANCE

mediate repairs unnecessary. It would be interesting if some American road would find the exact cost of splitting up trains at the slack hours, and see if the saving of the very short trains is enough to make up for the tendency to discourage traffic from overcrowding. An English steam road that runs the same trains all day long at twenty-minute intervals, with electric-road fares, and without cinders or dust, will get more passengers than many American electric roads.

POSTS

It is curious that the prevalence of grab posts in some of the Continental cars has not been followed in this country, where there is so much more need of them, and they are so much safer, more convenient and lasting than straps. They should be placed at least on the top of every fixed seat back, and probably at the corner of every seat next to the aisle. Grab handles should, of course, be located on each side of the doors, especially to keep passengers' hands out of the way. In some European rapid transit cars there are baggage racks over the cross seats, as illustrated in Figs. 21 and 22. As our subways grow warmer, some practical joker may demand not only the hat hooks supplied on the Central London, but coat hooks, ice-water tanks, and refrigerating coils underneath the seats.

SEATS

In a side-door car the seats must obviously face each other, but it is to be hoped the public will see the advantages of the arrangement already common in many rapid transit cars, the Illinois Central, and sleeping cars. The ordinary American cross seat has points of superiority in its always facing forward, and its foot rests, but it is out of the question for congested service with short stops. Vis-a-vis seats must be carefully designed both to make them popular and successful. As to the spacing, 60 ins. is the ordinary minimum in Europe where there are side doors, or 54 ins. where there are no doors, as on the latest Berlin surface cars. The minimum spacing the writer has measured is 52 ins. on a Liverpool elevated car. In this country even closer spacing can be found on cars in Escanaba, Mich., where it is 50 1-3 ins. Rattan cannot be used for this type of seat without great waste of room, as seen in the 70-in. spacing in the present subway cars, which even then allows a space between knees of only about 11½ ins. at the most, which is the same that one would get with the 56½-in. spacing in Figs. 17 and 18. The reason for this surprising result is simply that the thickness of the rattan seats through the backs is 13½ ins. greater at the critical point just above the cushion than with the compact type illustrated. The writer would use a spring back, but raise it so as to fit the small of a person's back. The longitudinal upholstered seats in the Boston surface cars have an excellent profile, and merely need the addition of springs in the back and springs under the cushion, as shown in the sections. The best models for seat or chair construction are the steam railroad seats of England and France, where a cushion is usually placed on a spring frame as illustrated in Figs. 17, 18 and 21. There may be more work to take care of this combination than the cushion alone or the nearly bare springs which make American seats so uncomfortable with any length of ride; but the immense gain in comfort might pay simply as a matter of policy. As to seat material, now that vacuum cleaning is being used on railway cars, it is to be hoped that rattan will be employed as sparingly as possible. Where an impervious covering is needed, let it be some imitation leather that can be shaped to a person's body and not make one sit on a hump and lean against a hump. When the writer first began to study seats in Europe, several years ago, he was a strong advocate of plain wood; but a few months' travel on luxurious cushions (see Fig. 22) played havoc with one's Spartan theories. Our seat manufacturers have long tried to change the human anatomy in the interests of economy with their convex seats, but while one may admire their heroic warfare against nature, it seems time to admit defeat and to apply some science to the most unscientific thing about a modern car. Let the cushion be soft, and a hard-riding car can be forgiven.

The seat backs in Figs. 17 and 18 are 42 ins. high above the floor. Higher backs would have the disadvantage of making it harder to see empty seats, and for the guard to watch the doors, but would have the advantages of reducing draughts on passengers' necks, of confining the odors of persons who do not wash often to a more limited space, of reducing noise somewhat, and of assisting in the downward ventilation discussed later. The tendency in European side-door cars is towards lowering the partitions between seats, except perhaps in Germany, where, in the Berlin Stadtbahn cars, the partitions between compartments all extend up to the roof, though with door openings along the side aisle. The swinging doors there are closed by the passengers or a platform man.

SIGNALS

Where automatic electric signals are used, and the starting signal is not given till every door is closed and contacts made, the side-door type has a great advantage over center-door cars in needing only two contacts to a car, in connection with the single operating rod on each side. With a five-car train at a local station only five contacts would have to be made, where with a center-door train there would have to be thirteen. At a terminal the numbers would be 10 against 26. The greater the number of contacts the greater the chance of failure, and so it is not surprising to find frequent failures with these automatic signals, especially at terminals, where more doors are opened. Such failures will delay a train as much as twenty seconds at a single station after all the doors are shut. When the guards at last find that the signals will not work on a train, they then give hand signals promptly and reduce the delay.

The question has been raised whether an automatic starting signal should not give warning if any door begins to open on the road. While this might be needed with doors held closed only by air pressure, it would not be so necessary with the Illinois Central cars, where a strong and positive locking device is in use. If a train is to be started before all the doors are tightly closed, instead of an automatic signal system the guards might operate the door mechanism with one hand and close a signal circuit with the other at the safe moment, only it might be necessary for preventing the guards from giving the signal carelessly and too early, to allow the circuit to be closed only when the doors were shut to a safe amount.

The use of automatic signals sounding only at the head of a train has one disadvantage, in giving the passengers no warning as to just when a train will begin to move. If the start is likely to be jerky, it seems safer to continue to have a bell sounded on each car, as this will cause people instinctively to brace themselves or to take hold of a strap or something firm.

SIGNS

A much neglected factor in the matter of reducing the time of stops is the question of signs. The excuse sometimes given for their absence is the time taken to change them at the end of a run, although enough time may be lost in passengers having to ask the guards where a train goes to change the signs a dozen times over. The real trouble is plainly that it is too much like work to get the signs up and see that they are properly used. This is illustrated by one road which for years had no illuminated signs on its open cars, and at night, where the streets were not bright, it was necessary for persons to hold up car after car and ask the motorman where he was going. The loss of time, current and brake-shoe metal was apparently never considered. An electric road is no place for affectation in the matter of signs, and the neglect of this point is inexcusable.

As to subway or elevated trains, passengers cannot be expected always to understand markers, and an illuminated destination sign at the front of a train is a necessity and not a luxury. The large sign on the cars in Figs. 17 and 19 may be smiled at, but it is no larger than those on the Berlin elevated or subway or surface cars even, or the new Metropolitan trains in London, and the Lancashire & Yorkshire trains out of Liverpool. Even the express trains on the latter road, which make no stop for over 17 miles, have the same illuminated signs, giving the destination and the word "Express" as well. Even more important than end signs is the need of signs on the side of a train. While train indicators may be satisfactory if as brilliantly lighted as in the Berlin subway, every train should have signs along the sides so that one is always in sight, as on the Mersey Railways and so many European surface cars. And there should be destination and route signs inside a car also, for those who are strangers or got on a train in a hurry. The latter again are not luxuries, but simply common-sense devices whose importance is realized in Europe.

While the English signs are the brightest in use, the sign system of the Grosse Berliner Company is the model one in the world, and needs application on subway and elevated trains as well as all surface cars. On both front and rear is a large destination sign, Fig. 23, large route number, and the route color (now being given up as unnecessary), all illuminated. On each side, running the whole length of the car, is a black-and-white sign with letters that can be read and are not simply ornamental, giving every street in order through which the car passes, with the destinations, and the route number repeated at each end. In the front and rear windows of each side of the car are placards printed on both sides so as to be read from both outside and inside the car, repeating all that is on the other signs, and giving in addition everything else a passenger could want to know, such as the correct time for leaving on every trip, the time to reach intermediate points on the road, rates of fare, and even the time to make the trip in both rush hours and slack hours, week days and Sundays, the location of the office, etc. Nothing is concealed from the passengers as in some of our cities, and the city authorities have been obliged to limit the number of cars in some places instead of to demand more.

The desirability of station annunciators is another question. An interesting offer was recently made to one American company to experiment with loud-speaking telephone transmitters for use in cars to announce stations and in stations to announce trains. The difficulties of hearing in noisy subways and on exposed elevated stations, and in seeing and reading signs and indicators, make the need of such experiments desirable. In a train or station one person's voice could be distributed everywhere, and the transmitters would sound like a megaphone. The next best thing would be for the guards to use megaphones, or, as one railway official desired, phonographs might announce the stations.

TRUCKS

Two improvements in subway trucks may be needed, though not illustrated in the article. One is a device worked out in Germany some time ago, which would catch any derailed truck and hold it within a few inches of the rails and keep the wheels off the tires. The other is a wheel guard to try and reduce running over employees, suicides and other persons on the track. In the Philadelphia subway there appears to be sufficient depth of space between the rails for a train to pass over a fallen person, as has actually happened at the Brooklyn Bridge, without hurting a man. The Central London Railway has a very deep space of this kind. The safest track would evidently be one with considerable space below the rail head, or with the floor as high as the rail, as again in the Philadelphia subway. For the first condition, a guard in front of each wheel, as found in Europe, might at least save a fallen person from being run over. For the second construction, the Liverpool plow guard, as illustrated in the JOURNAL for August 15, 1903, would evidently make it impossible to run over a fallen person, judging by the five years' perfect record of this wheel guard on the Liverpool surface cars. With a more permanent track construction than the present one, and the resulting reduction of track repairs, there would be less need of these safeguards, except perhaps at stations.

VENTILATION

The most radical departure in the side-door cars submitted is probably in the matter of ventilation, and it takes some courage to advocate such different methods from those at present employed. But any one who has ridden in the subway on one of the hottest days, and had dirty neighbors in the next seat, knows how bad conditions can be. The very breeze that sweeps through the cars after the suffocating heat of a station stop simply brings more smell. While trains are in motion in summer the heat is more endurable, but the noise demands the closing of the windows, and in winter, when windows are closed, the air gets close, especially during stops. As the subway gets hotter and hotter in the future, like those in this country and some in Europe, fans in the cars will simply be a necessity if only to stir the air up. In the Budapest subway, fans were installed which started up automatically whenever a car stopped. On the Mersey Railway powerful exhaust fans are installed in combination cars, to work all the time, and the lead of this model public service corporation seems well worth following. Any system of ventilation which depends on the movement of a car may be satisfactory under steam railroad or interurban railway conditions, with long runs without stops; but for the small, congested spaces of city cars, with long stops

FIG. 23.—BERLIN SIGNS, GROSSE BERLINER STRASSENBAHN

and not infrequent blockades, it seems impossible to keep the air up to the standards demanded by health and the encouragement of traffic without the use of ventilating fans, except when cars can be in the open air with all windows wide open. Managers hesitate to add the complications of fans, but the public will demand and require them some time. The first American company that introduces scientific ventilation may get a very substantial return from a pleased public, and the expense might well be charged to advertising.

As to the best method of ventilating cars, an important discovery was made not long ago by Dr. G. W. Fitz, a well-known authority on hygiene, who has made careful investigations of car ventilation. He found that the tendency of a person's breath is downward, and that by circulating air in a car down, much less fresh air is needed than with an upward movement, because the downward air that reaches the nose or mouth is all fresh, while air moving upward is contaminated by air expelled by each person. Downward circulation is often considered too drafty, but in the case of a car, passengers always have their hats on. Downward circulation would obviously be the most effective in dealing with odors from passengers, as the odors would be carried directly down to the floor away from other people's noses. Upward ventilation presents the most difficulties with a side-door car, as air ducts must be carried along under the floors, and air brought down from the roof to avoid dust. Heaters are of course easily placed under the seats.

The question has been raised whether it is safe to carry 120 passengers in so small a space as the ordinary car, even if they are seated, on account of the danger of spreading disease from the close contact of persons, the increased risk in case of panic, etc. Perhaps the answer to this is that the orderly seating of all passengers in clean cars, the maintenance of a uniform breathing level, the downward direction of all vitiated air, and the keeping down of floor dust, would sufficiently satisfy the chief requirements of health, though it might be better in the future to plan to provide each passenger with more seat space. If people were more careful about keeping clean, and not coughing in others' faces, there would be less need of improvement in car sanitation; but there is no doubt that where part of the passengers are standing and others are seated the former will be apt to cough in the faces of the latter. On the other hand, the side-door car affords the widest separation between people's faces, the abundance of seats would seem to make possible a uniform breathing level, and downward ventilation would seem to be the most effective remedy for the remaining difficulties.

The system of ventilation suggested for the new types of subway cars illustrated is probably evident from the use of as a short circuit of fresh air immediately out of the top of the car might result.

The transoms seen in Fig. 17 over each window were put in so that each passenger could have the pleasure of opening or shutting something near him, according to his taste, but it would be best to keep even the transoms closed. Transoms are a common means of ventilation in European subway cars, but for American congestion at least they are not adequate. The mechanism is apt to wear and the transoms to get stuck, so that with slow speeds and shorter stops little air enters the car. This is a more serious matter where cars

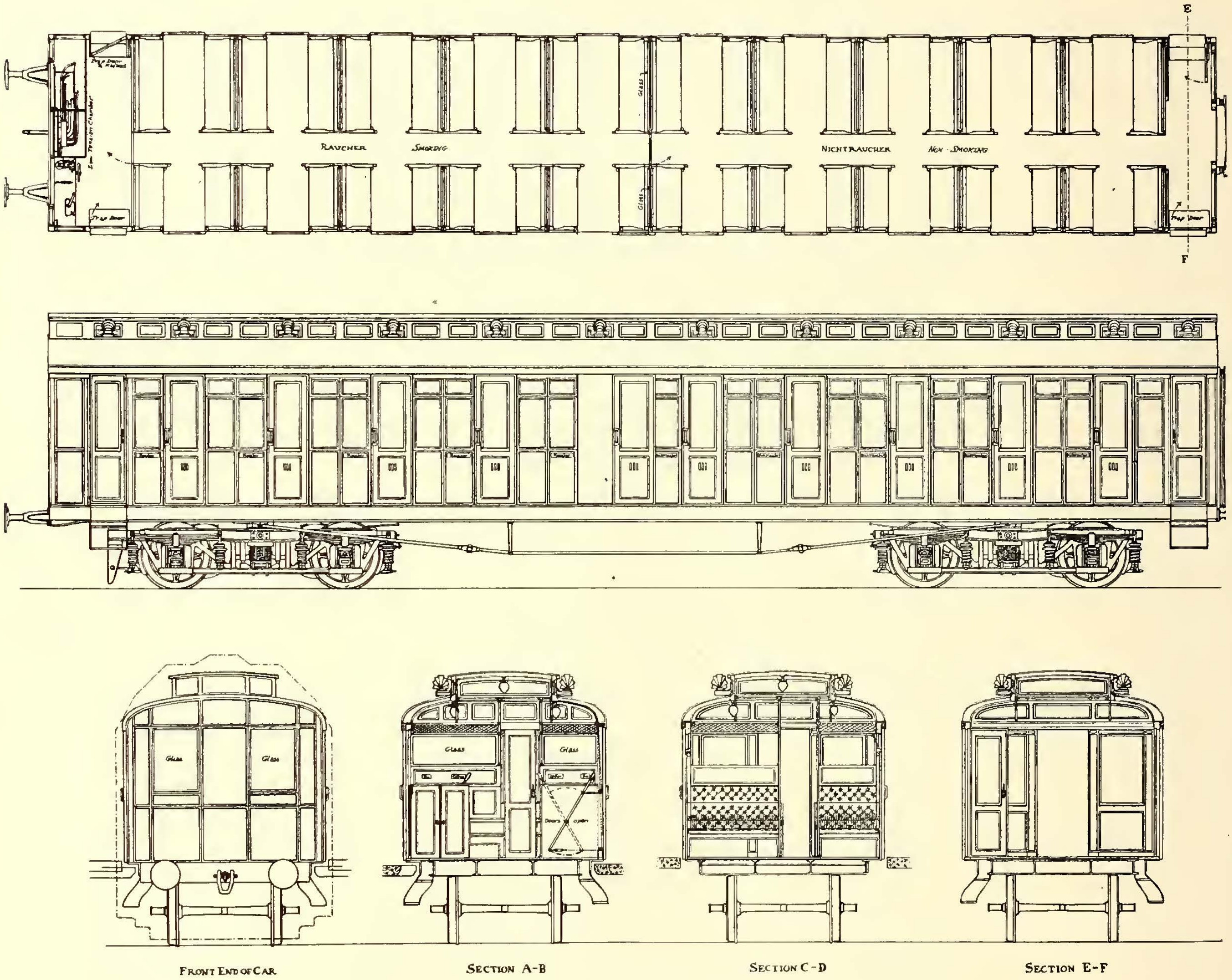


FIG. 24.—STUDY FOR A EUROPEAN SIDE-DOOR CAR

elliptical roofs. The interior ceilings are kept much as now, except for the absence of deck sashes in the clerestory. At each end of the car would be a motor-driven centrifugal fan, taking in air probably through the transom over the brake wheel, and blowing it through one of the ducts in the car roof, down through openings over each seat as shown in the longitudinal sections, the exhaust air passing out through gratings in the floor in front of each door or under the seats. Such a plenum system would seem the best if it proved successful. In winter the air would be warmed by electric heaters at the fan or along the ducts as needed. It has been found to take much less current to heat a car in winter when air is blown through the heaters than with no circulation at all. A thorough test of electric car ventilation is urgently needed. With the suggested plenum system it would be obviously undesirable to have any windows open, are vestibuled than where platforms are open and there is more opportunity for ventilation in other ways. Smoking cars, when used at the end of the train, also give trouble all the time in one respect, for the smoke cannot be kept out of the car ahead. Although the end doors of cars are kept closed in winter, the smoke surges forward whenever a train stops, through the small window through which the guard calls the stations, into the preceding car. In summer the latter car is even more smoky, because the end doors are open.

Another troublesome feature in American railway practice is the ventilation of the first car in summer. In order to get enough air the front door is usually kept open in pleasant weather, which gives an agreeable breeze at low speeds, but at a high speed it is sometimes difficult to keep one's hat on, and reading of newspapers is very difficult. The children like it, but it is rather disagreeable for men and women, especially the latter. The blowing about of the dust from the car floor is very objectionable, and the Boston cars, perhaps even more than the New York, show the need of fan ventilation with moderate and well-regulated currents.

VESTIBULES

While no vestibules are shown on any of the cars, they appear to be very desirable on subway cars for several reasons: (1) To keep air from entering or leaving the car except at the desired points, so that no drafts may interfere know enough to transfer to other cars before reaching their desired station; otherwise the plan is hardly practical.

The need of vestibuling the cars of a train is strikingly illustrated in Boston, where the sharpness and frequency of the curves have led the company to allow no passing between cars whatever, even at stations, the end doors being narrow and used only by the guards. This is a return to a custom which is being given up in Europe, and is probably one of the causes of the long stops in Boston, as it renders impossible the distribution of passengers from the crowded to the less crowded cars. The station arrangements in

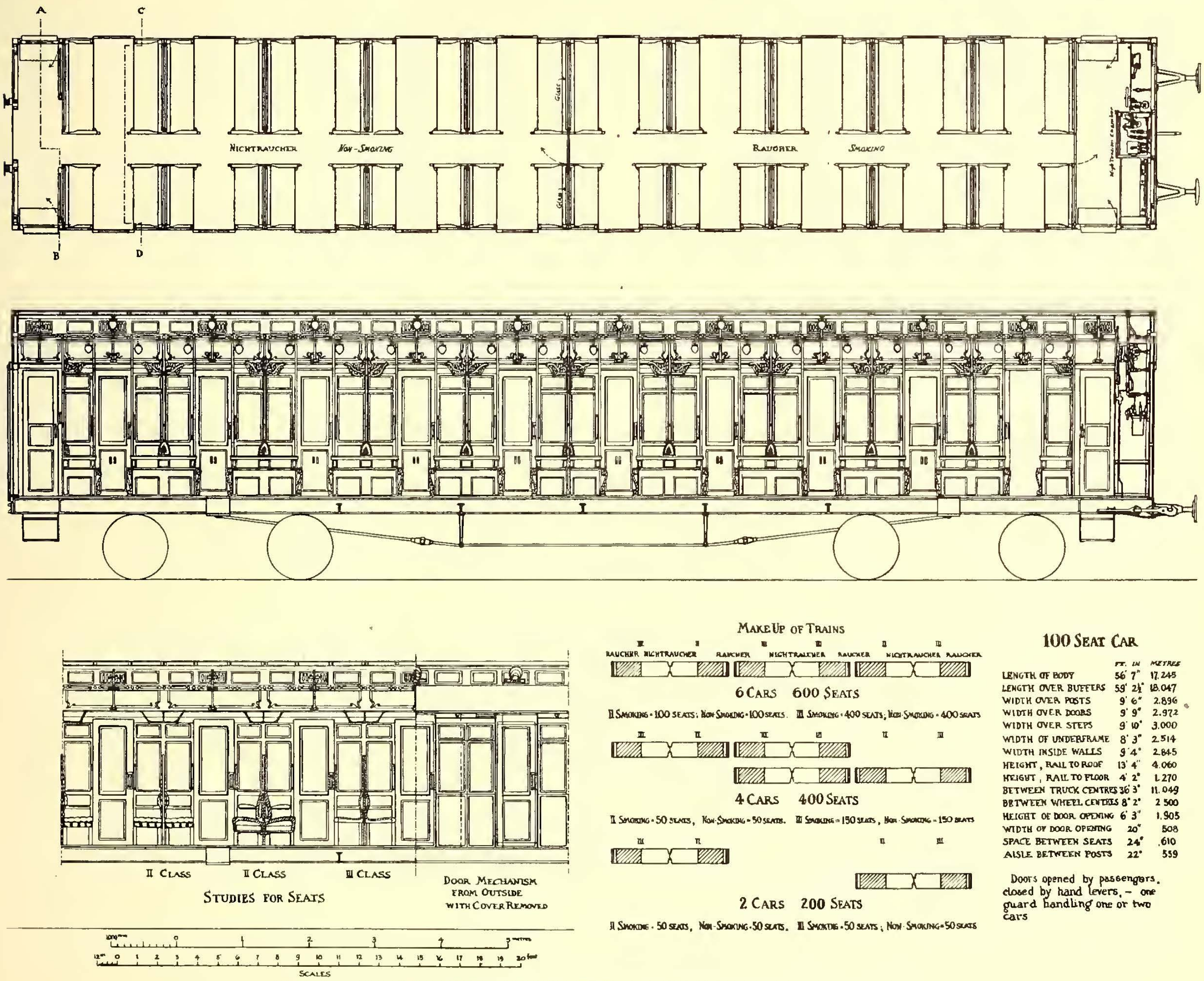


FIG. 24.—(CONTINUED)—STUDY FOR A EUROPEAN SIDE-DOOR CAR

with systematic ventilation, and (2) to make it as easy as possible for passengers to distribute themselves through a train and avoid any congestion in any part of a train While the present subway cars have wide doors opening between them, probably passengers would distribute themselves better if passing between cars was not accompanied by strong drafts and dust and there were no space down which one could slip. It has been suggested in New York that the capacity of trains might be increased by increasing the length of the train beyond that allowed by the length of the platforms. This would answer if passengers who rode in the end cars would understand that they would have to transfer to other cars before arriving at the station at which they wished to alight. Possibly these end cars could be used for parlor cars, for which an extra fare would be charged, and thus attract more intelligent users who would

Boston tend to bunch passengers in one part of the train, in the rear cars when going north and in the front cars going south, so that there are often seats in one car when another is crowded. The length of stop, of course, is determined by the most crowded car. Vestibuling does not prevent the concentration of passengers getting on, but helps with those getting off. It is not so necessary with a side-door car and plenty of seats, as with the Liverpool overhead cars and English suburban trains, for with plenty of seats there is less blocking of the doors. But even with the fifteen-car trains of the Great Eastern Railway at the rush hours there is trouble from the lack of aisles and vestibules, for passengers naturally crowd into the center cars of such long trains.

SUGGESTED TRAIN FOR TWO CLASSES, WITH SMOKING AND NON-SMOKING COMPARTMENTS

Fig. 24 represents an attempt to adapt the Illinois Central type of car to European conditions. The problem chosen by the writer for solution was to design a unit adapted for single-phase operation, to handle at the rush hour a very heavy traffic, consisting of passengers of two classes, and of smokers and non-smokers, the lower class seats to predominate if possible. A maximum economy in employees was desirable.

When one tries to combine features from different countries, the result may not satisfy anyone, but the indulgence of critics is asked, as the task was rather difficult. The conditions selected were those of trains to be made up of two-car units, vestibuled and with aisles, so that a person could board a train at any point and find his desired class and seat later except that the second-class seats were only in the end units. The passing through one class to get to another might not be desirable, but is necessary if the shortest possible stops are wanted.

The two cars in each unit are permanently coupled and vestibuled. The doors are sliding ones outside of the car body, to be opened by each passenger, as on the Illinois Central and after the present custom in Europe, to be closed simultaneously by the guard with one operating rod. As in previous types, the guard would stand at the end of each car at an open window, so as to watch easily both the inside and outside of the car in closing the doors. If economy in trainmen were more important than economy in length of stops, one guard could close the doors on two adjacent cars. This would allow two men to handle two cars, three men four cars, and four men six cars with 600 seats. The economy of this feature may be seen by the fact that to furnish 600 seats with the present New York subway cars would take twelve cars and twelve men instead of four.

The reasons for using sliding instead of swinging doors have already been given. The doors would be hung on ball-bearing hangers to reduce friction, and all would be closed by moving one operating rod. The force needed to close such doors would be so slight, only a few pounds probably, that a hand mechanism is used, as on the Illinois Central, and not air. European roads would hardly care to use as much air as American roads, as greater economy of operation is desired. As European passengers are already used to opening their own doors with handles, the latter are employed instead of the ingenious hand holes of the Illinois Central cars. Similar sliding doors and handles are provided on the Berlin Elevated and Underground Railway.

The operating rod of the door is connected by chains to a vertical lever, seen on each side of the guard's vestibules. The doors are unlocked by pushing the top of the lever away from the car sides, and closed by pulling the lever in the opposite direction. The lever can be further locked in the closed position. Each door would have a spring connection with the operating rod, so as to allow enough opening when closed to release any clothing caught. The cars, of course, should have emergency brake cords run along over the doors both inside and out.

The windows in the doors can be lowered, but not the others, as is already the custom in Europe. Passengers can open the lower transoms by hand and the upper ventilators by the handles over each door. Heating apparatus, if needed, would be placed under the seats, and the heat could be turned on or off by the passengers, as now. Fan ventilation seemed a little too radical to suggest in this case.

Several types of seats are shown, wooden for the lower class, and upholstered for the higher. The seat backs are made very high, but low enough for the guard to see passengers inside the doors. Baggage racks and abundant posts and handles are provided. As persons pass between the seats, brackets will keep them off the feet of those seated.

The car construction is the same as in previous examples, and so needs no description. Adjacent units are not connected by vestibules, but this might be done by placing the high and low-tension chambers at the right, and swinging the end doors of the cars when open for passage so as to shut off more or less from the passengers the motorman's apparatus. While the ordinary vestibule for side buffer cars might be used, it would be obviously better at the end of a train to use a more compact vestibule. If baggage were to be carried on this train, the motorman's cab might be made larger and the motorman handle the baggage during the stops.

To allow passengers or employees to board the cars where there are no platforms or only low ones, steps are provided at the car ends, covered by trap doors, after the American wide vestibule practice. The doors over these steps, however, can be opened at high station platforms without opening the trap doors, which might be taken advantage of in cold or stormy weather at unprotected stations, making unnecessary the opening of the side doors. Trap doors can, of course, be lifted from outside the car as well as inside.

HORSE CAR LINES TO BE ELECTRIFIED IN NEW YORK

Mr. Oren Root, Jr., vice-president and general manager of the New York City Railway Company, announced last week that the directors of the company have authorized the president to make contracts, order materials and do everything necessary to expedite the change-over of the present horse-car lines to electricity. The order of lines to be changed over has not yet been entirely settled, but the company has notified the State Railroad Commission that one of the first lines will be that on First Avenue. Construction will be commenced as soon as the frost is out of the ground and will be completed at the earliest possible date. Another line which will probably be electrified soon is the Twenty-Eighth and Twenty-Ninth Street line. President Vreeland, referring to this decision, said:

There has been a very grave misunderstanding on the part of the traveling public, caused by the horse cars being operated of late years in Manhattan. The problem from an operating standpoint has been one of the most difficult to solve.

We all know of the vast public and private improvements which are being made in and around New York, creating new centers for the distribution of passengers. New bridges are being constructed across the East River, and new tunnels are under way. Up to a few months ago it was not definitely known what arrangements the city and private corporations would make at the new terminals in New York to accommodate the traveling public. It would have been futile to plan for accommodating passengers arriving over the Blackwell's Island Bridge without knowing where the city was to put the terminal.

As a matter of fact, however, passenger traffic business in and to New York will undergo a complete change of conditions within the next few years, and the New York City Railway Company by putting into effect the plans adopted to-day will be in a position to give the traveling public greatly increased facilities.

The Indiana, Columbus & Eastern Traction Company inaugurated on Jan. 7 a new limited service between Zanesville and Columbus, Ohio. The distance of 64 miles is made in two hours. Of this time it takes the car about 45 minutes to run through the 8 miles of streets in the terminal cities and larger towns, so that the remaining 58 miles out in the country are covered in 1¼ hours. So far only one car has been put on this service. It starts at Zanesville in the morning and makes two round trips.

PAPERS READ AT THE BUFFALO MEETING OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK

TRACK CONSTRUCTION IN PAVED STREETS

BY I. E. MATTHEWS,
Engineer Maintenance of Way, Rochester Railway Company

An absolutely "permanent way" is a dream which will never be realized, but is the ideal condition toward which we aim. The increasing weight of rolling stock has been met by altering the sections of the rail from the flat-strap to the girder and gradually increasing the weight and depth of the rail; thus affecting the depth of foundations and increasing the cost.

Joints are one of the greatest sources of trouble to the maintenance of way engineer. Owing to the difficulty of removing the paving, many slight defects in joints are neglected until it is absolutely necessary to make repairs, and then the cost is much greater than it would have been if repairs had been made at the first indication of trouble. This condition of affairs leads to a considerable amount of rough track, not quite bad enough to warrant ripping up the pavement, and yet by no means a track in first-class condition. It is therefore imperative that the joints be as substantial and durable as the rail itself. In order to eliminate joints, it is now customary to use rails 60 ft. in length, and if the idea be indefinitely extended we obtain a continuous rail. This is accomplished to some extent by the electric or cast welding of the rail ends; but as this is the subject of another paper I will not consider this matter further at this time. The question of joints, tie plates and bonds have also been made subjects for special papers, so I will omit them too.

Smooth track to true gage is an essential feature to electric roads. Wooden ties spaced 24 ins. to 30 ins. center to center, and laid in or on concrete foundations probably give the best support to track. It has generally been advocated that the rail should have an elastic support, such as the wooden tie affords, but more recent practice would seem to indicate that the metal tie thoroughly embedded in concrete would be an improvement on the older method. In keeping the track to gage the braced tie-plate is preferable to the tie-rod.

Passing from the above general remarks, we may consider some of the variations in construction. Obviously the selection of the proper track construction for any given street will depend, as indeed does the pavement itself, on the class of traffic which will use it. For a street of heavy traffic, one would expect to use stone blocks for paving material with a correspondingly heavy track construction. Where traffic is light, brick or asphalt might be selected as paving and a lighter track construction would be used. In either case a concrete foundation at least 6 ins. in thickness under the ties is recommended. This is costly, but necessary to good permanent track construction. Where the foundation is quite solid and has never been disturbed by gas or water-pipe trenches, sewers or other excavations—a condition rarely, if ever, found in our modern cities—this concrete foundation might be replaced by broken stone or gravel with fairly good results.

Under the concrete foundations and about 1 ft. outside of the outside rails there should be laid a 3-in. farm tile drain in coarse gravel with joints covered with gunny cloth, to be laid parallel with and the full length of the track, connecting with surface sewers or manholes. It should be at least 2½ ft. below the grade of the finished pavement and covered with coarse gravel for a width of 6 ins. and up to the bottom of the concrete foundation under the pavement. The sub-grade should be crowned so as to render the drain more effective.

The type of construction best adapted to streets of heavy traffic is the 9-in. full-grooved rail, well tied with Georgia pine ties, spaced 24 ins. to 30 ins., center to center, and laid on a 6-in. concrete base. The concrete should be mixed—Portland cement one part, sand three parts, and broken stone which will pass through a 2-in. diameter ring, six parts. This concrete should be laid at the same time as that for the foundation of the adjoining pavement and should be carefully tamped under the ties and rails. A fine concrete or grout of one part Portland cement to two parts sand should be poured around and under the rail, in order to give a firm and uniform bearing to the rail. The space between the flange and head of the rail should be filled with a Portland cement mortar in the proportion of one to three. The stone blocks, resting on 6 ins. of concrete and with joints thoroughly grouted, complete this construction. It is the type used by the Rochester Railway Company on streets of heavy traffic, the paving blocks being of Medina sandstone. The cost of the construction has averaged $5.80 per lineal foot of track. Using the same track construction, but with brick paving, the cost has been $5 per lineal foot of track.

In recently rebuilding the University Avenue line of the Rochester Railway Company, we adopted a concrete beam construction under the rails. The beam is 12 ins. in depth below the base of the rail and is 18 ins. wide under the outside rails, and 14 ins. wide under the center rails. Wooden ties are spaced 5 ft. center to center, the beam being carried to a depth of 8 ins. under the ties. Ninety-four-pound 9-in. girder rails, held to gage by brace tie plates at each tie, rest solidly on the continuous concrete beams. The pavement between the tracks and 2 ft. outside is of Medina block, the paving in the street beyond being asphalt. This construction costs $5.06 per lineal foot of track. University Avenue is an outside street and would not be classified as one with heavy traffic; however, by using the concrete beam we were able to obtain a stone block pavement at about the same cost as the brick pavement with solid concrete foundations. One point should be emphasized—to render the continuous concrete beam construction satisfactory, the concrete foundations of the track and pavement should be thoroughly bonded together. If the subgrade has been disturbed and there is any possibility of future settlement taking place, I should hesitate using the concrete beams.

I am of the opinion that a material reduction in the cost without lowering the standard of construction from that given above can be effected by the use of the high T-rail in paved streets.

The municipal authorities to a large extent seem to be opposed to the growing use of T-rail in paved streets, but there are now upon the market paving brick of such shape that the paving around the rail gives practically the same effect as the groove in the girder rail, and in many Western cities this type has become the standard. It is claimed that the groove or flangeway so formed is superior to the grooved girder rail. In streets of heavy vehicle traffic the cost of maintenance of the paving might become excessive with T-rail, but on all other streets I am of the opinion that the T-rail would be preferable to the grooved rail, both because it is cheaper in first cost and because it gives the bearing of the wheel squarely over the center of the base. The base being wide, there is no tendency to overturn, and the flangeway formed by the special paving blocks gives a groove which is as self-cleaning as that of the grooved rail. Another consideration which should receive attention is the increasing number of interurban cars which are entering our cities with their greater depth of wheel flanges. Very little wear can take place on the ordinary grooved or girder rail before the cars are running on the wheel flanges. With the T-rail, however, the amount of wear that can take place before the track is entirely worn out is independent of the car wheel flanges.

The STREET RAILWAY JOURNAL of June 3, 1905, discussed, editorially, the persistency with which city engineers in certain municipalities cling to the idea that the grooved rail is the only suitable rail for paved streets, and then advanced the idea that the grooved rail was dangerous to interurban cars, citing some examples from Cleveland, where serious derailments had occurred, due to the grooves in the rails not being deep enough to admit the flanges of the interurban wheels.

Wherever T-rail in paved streets has been given a fair trial it has been notably successful. I believe the honor of the first use of T-rail in paved streets belongs to Denver, Col. They use a 72-lb., 6-in. Shanghai T-rail laid on wooden ties only 21 ins. between centers, tamped with gravel. Extreme care is taken, however, to have the ground thoroughly settled before placing the ballast. Other cities in which T-rail construction in paved streets has been adopted to a large extent are Indianapolis, Milwaukee, Minneapolis and St. Paul. The two latter cities are notable because it was there that T-rail was first used in streets paved with asphalt, where girder rail had been the rule before. The rail used is an 8-in. Shanghai T, weighing 79 lbs. to the yard. A concrete beam supports each rail and is 22 ins. to 24 ins. wide and 12 ins. deep under the rail. Around and above the base of the rail are placed 3 ins. of natural cement, if the paving is of brick, and less if the paving is of granite.

The most notable instance of recent adoption of T-rail construction in the East was in Boston some two years ago, when they installed about 2½ miles, following closely the practice of Minneapolis. As the writer has not built any T-rail track in paved streets, he is not in position to present any figures as to actual costs. John A. Beeler, of Denver, who, I believe, designed the first Shanghai rails, made some estimates of track construction which are given in "Herrick's Electric Railway Hand-Book," in which he states that stone block paving on concrete base with 70-lb. T-rail, track on wooden ties 21 ins. between centerrs and ballasted with gravel, cost $4.43 per lineal foot of track. Using the same track construction and paving, but with a 6-in. concrete foundation, the cost is stated at $4.90 per lineal foot of track. This is 90 cents per foot of track less than the cost of the same type with girder rails in the city of Rochester. The difference between track on gravel ballast and concrete base as shown above is only 47 cents per lineal foot of track. This additional 10 per cent of cost would insure a more serviceable and durable construction and in the end give the best satisfaction.

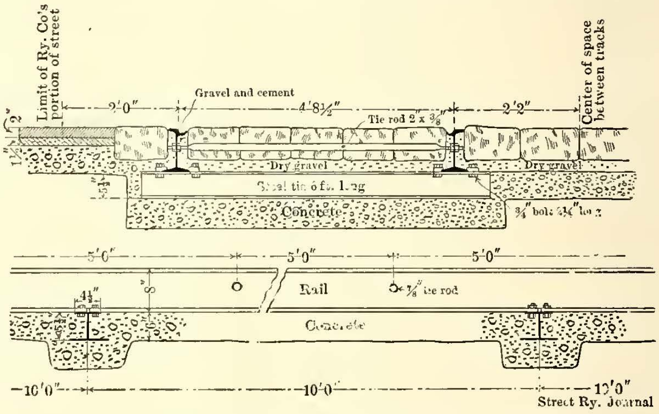
In conclusion, I would suggest the high T-rail with wooden ties on a concrete base, or steel ties on the concrete stringers as the ideal track construction in paved streets; excepting, however, in streets of heavy traffic where the grooved girder rail would be superior on account of the better protection afforded to the pavement adjacent to the rail.

CONCRETE STRINGER, CONCRETE STRINGER WITH TIES, AND STEEL TIES

BY F. D. JACKSON,
Engineer of Way, International Railway Company, Buffalo

A complete description of the Buffalo track system was contained in two very able articles by Mr. Wilson appearing in the "Street Railway Review" for March and August, 1903. An article on the same subject was also published in the STREET RAILWAY JOURNAL for Oct. 31, 1903.* The present paper will treat, not of all the styles of construction used in Buffalo, but of two distinct types, viz: concrete stringers with and without ties, and solid concrete in the track.

Realizing, as we do, the necessity for providing substantial substructure in electric railway roadbeds to take care



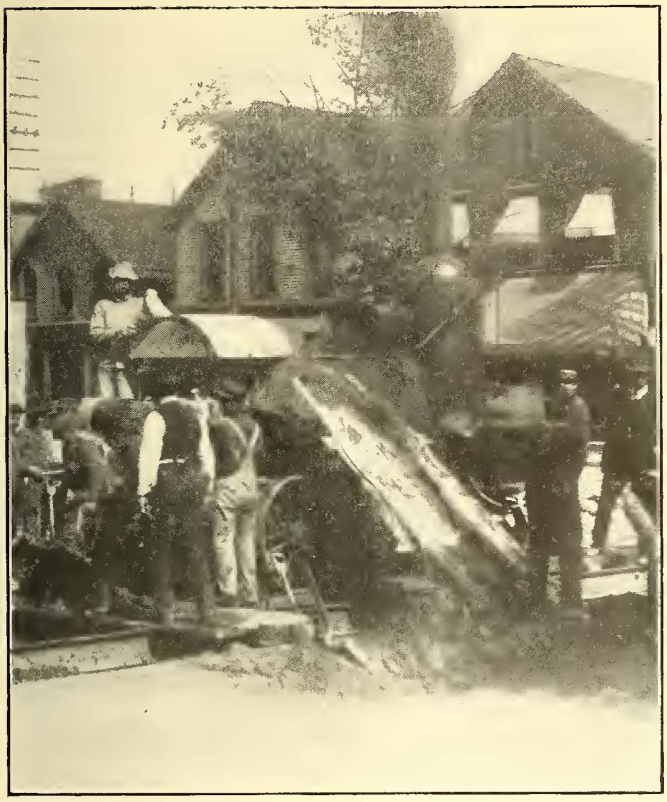
GROSS SECTION OF CONCRETE AND STEEL TIE TRACK WORK ON FILLMORE AVENUE, BUFFALO, N. Y.

of the increasing weights of cars, which at present are 30 tons, the tendency to-day is in the direction of providing a foundation for the rails which shall be as nearly rigid as possible. Many engineers question the advisability of so rigid a construction, claiming undue wear to the rails, on account of the inelasticity of the roadbed. Measurements made of rails on a line operating a one-half minute service do not bear out this statement. We find the head of the rail has worn ⅛ in. in about four and one-half years, which would give a life for the rail under this very frequent service of more than sixteen years, before the ¾-in. flanges would commence to touch the bottom of the groove. There is also a very important thing to consider, namely, that the life of the pavement adjoining the rails is prolonged, and its cost of maintenance is cut down very considerably. On the other hand, elasticity in the roadbed favors the life of the rail. The desirability of either form of construction must therefore eventually be determined by comparing the cost of renewing rails more frequently, the pavements remaining

*See also STREET RAILWAY JOURNAL, July 21, 1906.

in good condition, and of paving more often and securing a longer life of the rails.

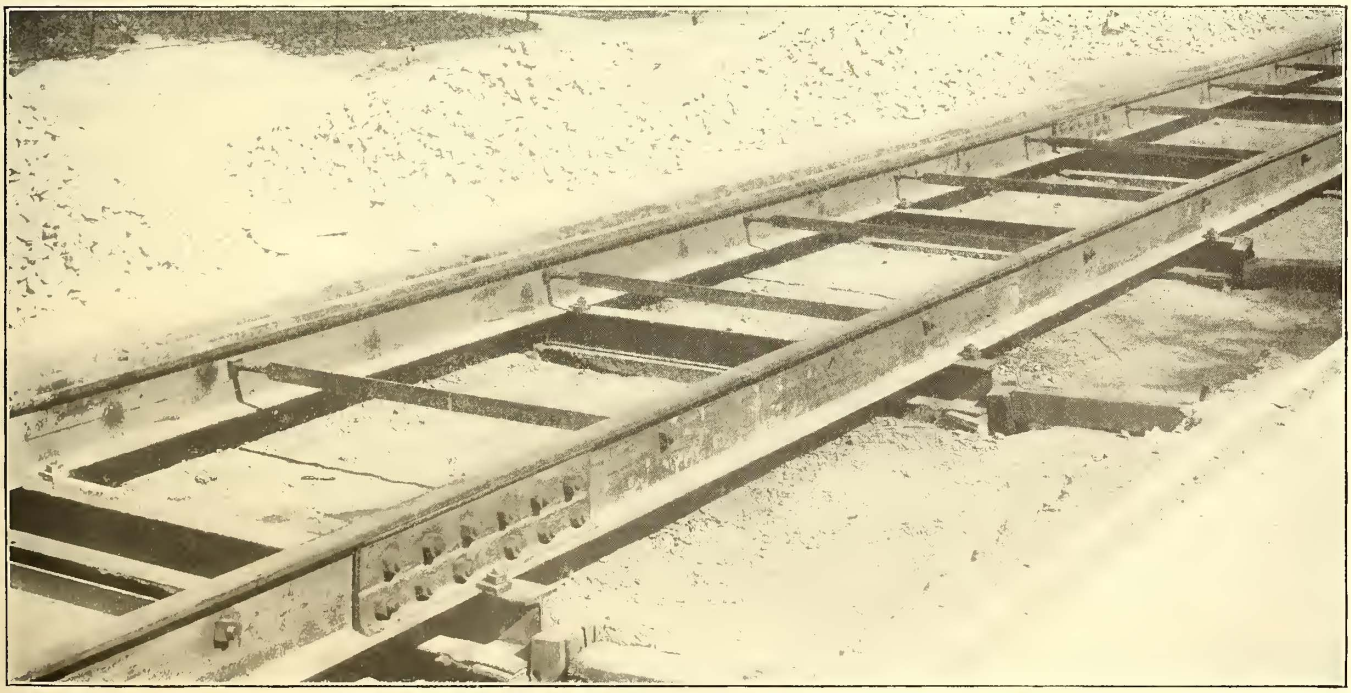
Buffalo has carried the concrete stringer idea further than most roads, by laying a solid bed of concrete the entire


PORTABLE CONCRETE MIXER AT WORK ON FILLMORE AVENUE, BUFFALO, N. Y.

crete beam 12 ins. wide by 8 ins. deep under each rail. This beam is not bonded to the concrete which forms the paving foundation, so that in fact there is no concrete except under each rail. The solid concrete construction with stone paving has been adopted as our best style of work, and the following data will show to what extent it has been used:

Of the 194 miles of city tracks, 62 miles are of the concrete beam construction and 87 miles of the solid concrete construction. The remaining 45 miles is old-style work and is mostly on lightly traveled lines where sand, gravel or stone is used for ballast.

Two streets have concrete beam construction without ties, viz: Clinton Street, Bailey Avenue to city line, 5300 ft. double track, and Jefferson Street, Dexter to Main, 2998 ft. double track. In each case the rail is 9 ins., No. 94-204, with standard twelve-bolt joint, with tie rods at 8-ft. and 5-ft. centers, and toothing and asphalt. These two pieces of track were built in 1897 and to-day are in fair condition. On Clinton Street 16-ft. single-truck cars are run on ten-minute headway, and no repairs have been made to the track. On Jefferson Street double-truck cars are run on five-minute headway. Repairs on portions of this track have been made. One reason why this style of track has held so well is that after the rails were well surfaced and lined, concrete was tamped well up against the base of the rail. The remaining 59 miles of track of the concrete beam type employ ties. Two sections of rail were used: 9-in. and 6¼-in. girder and two kinds of ties; steel channels, 7 ins. x 5 ft. 9 ins., and yellow pine ties 5 ins. x 7 ins. x 7 ft., at 10-ft. centers. With the steel channels no tie-rods were used. With wooden ties, tie rods at 10-ft. centers and brace tie-plates were employed, most of the track being built in 1899. With this style of construction the rail gets out of surface and line, affecting both pavement and rolling stock.

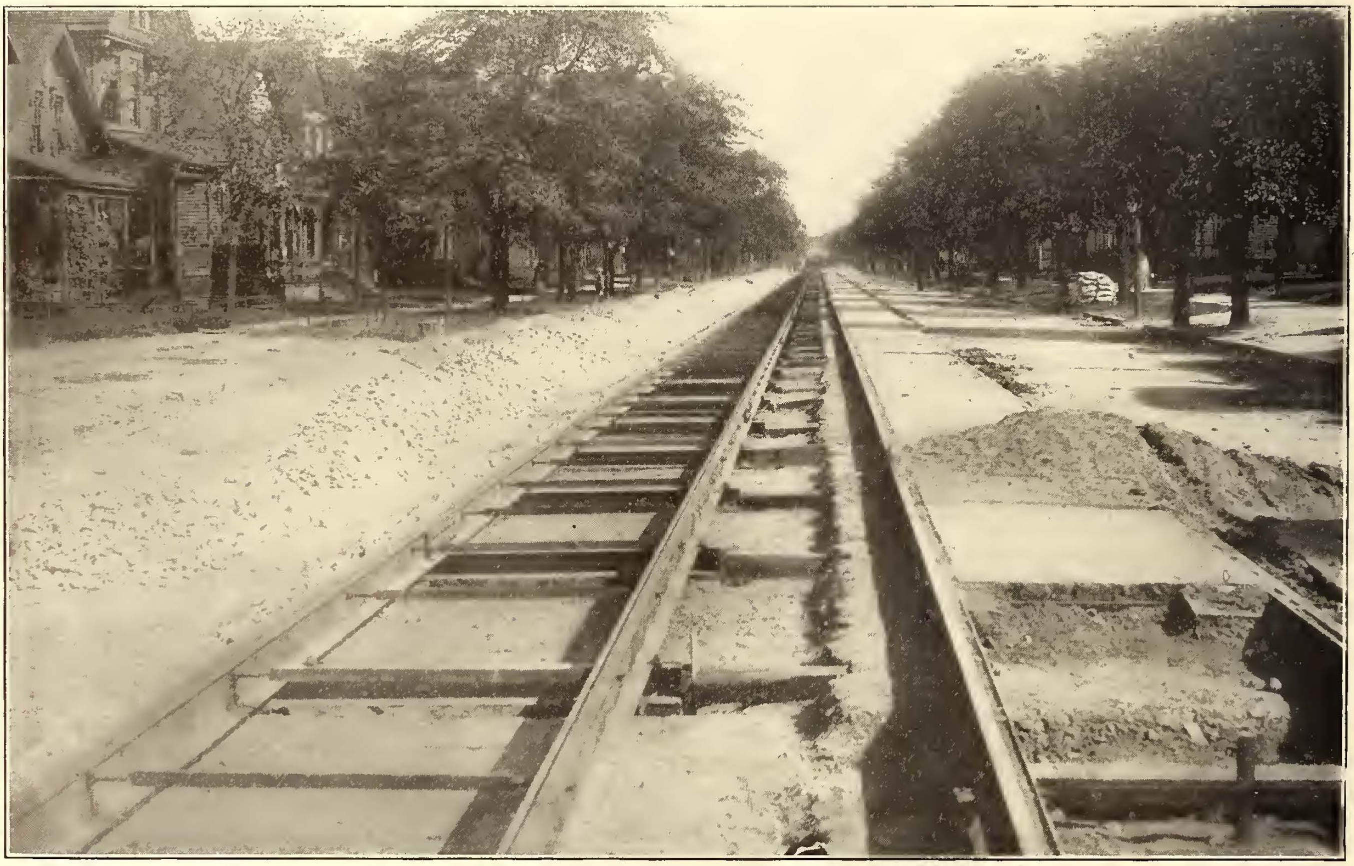

VIEW SHOWING STEEL TIES AND THE TIE-RODS IN PLACE ON FILLMORE AVENUE, BUFFALO, N. Y., BEFORE CONCRETE WAS LAID

width of the roadbed, 6 ins. deep and 6 ins. under the ties, instead of having a concrete beam under each rail. This style of construction is used with tracks laid in block paving. On the other hand, in streets paved with asphalt we have gone to the other extreme, and have placed a con-

In the 87 miles of solid concrete construction there are several notable features. Nearly all this track is 9-in. girder, mostly welded, but some with the standard twelve-bolt joints. Only 2.2 miles of this type of track are laid with 6¼ in. rail. Most of the welding was done in 1899 and 1900.

Yellow pine 5-in. x 7-in. x 7-ft. ties are used at 5-ft. and 10-ft. centers; tie-rods are employed at 10-ft. centers, and in a few cases brace tie-plates at 6-ft. centers. Various kinds of paving are used, including common stone and a little brick, but most of the paving is No. 1 block stone. Some of this track was laid in 1893, but most of it about 1900.

The construction which we consider most up to date is solid concrete, with Carnegie steel ties, and tie-rods at 5-ft. centers. Five miles of double track of this style of construction were put in this past year on Fillmore Avenue and 1.1 miles of double track on Sycamore Street. A trench 18 ft. wide was dug to 15 ins. below the surface of the street. The 9-in. rail was laid and bolted with four bolts and clips to Carnegie steel ties spaced 10-ft. centers. These ties are of I-beam section, top flange, 4½ ins.; bottom flange, 8 ins.; depth, 5½ ins.; 6 ft. long and weigh 19.7 lbs. per foot. The track was then surfaced and lined by blocking up under the ends of the ties, and ⅞-in. tie rods spaced at 5-ft. centers were put in. A 6-in. trench was dug under each tie. Concrete, proportioned one part of Lehigh Portland cement, three parts of clean, sharp sand and five parts of 2½-in. stone, was then put in by a Foote continuous concrete mixer. This mixer in operation is shown in one of the accompanying illustrations. One pair of wheels ran on the asphalt outside the track and the other pair of wheels on 5-ft. planks properly blocked up so that no weight was brought upon the track. The concrete was shoveled into the trench to a depth of 6 ins., was well tamped under the rail, and was then thoroughly pounded after being leveled to the top of the ties. Three ties were kept tamped ahead of the mixer to insure thorough work at the ties. Four hundred feet of single track were concreted per day of ten hours, this work includes the space within the rails, 2 ft. on the outside and 2 ft. in the devil strip. By the use of the continuous concrete mixer a uniform mix was secured for the entire job with a saving of about 10 per cent of cement. The pavers followed behind the concrete gang, using 3 ins. of coarse gravel for a cushion and on that the No. 1 Medina block stone was placed. Full stone paving was employed between the rails and in the devil strip, and toothing was laid along the outside of the track to receive the asphalt, which was placed up against it. The stone paving was then pounded and slushed with a grout composed of a mixture of one part Portland cement to two parts of sand, which completely filled up the voids between the stones, making a perfect bond. This style of construction costs about $5 a running foot of single track, as against $4.50 where wooden ties and tie-rods at 10-ft. centers are used. Part of this increase in cost is due, not only to the extra cost of steel tie over wood and to an extra tie-rod, but also to the higher price of labor and material.



VIEW SHOWING COMPLETED AND UNCOMPLETED PORTIONS OF TRACK ON FILLMORE AVENUE, BUFFALO, N. Y.

Where it is necessary to keep cars moving over a stretch where track is being reconstructed, portable cross-overs are used and cars are kept off the new work for at least seventy-two hours to allow the cement to set. Special care should be taken to see that concrete is thoroughly tamped under and around the ties and under the rails, following this up by thorough pounding.

The fact that we have considerable track with concrete beam under each rail, laid since 1897, and more of the solid concrete style laid at a later date, gives opportunity to make a just comparison between the two styles of construction. That we have so much of the solid concrete construction indicates which style of work we prefer.

In Lockport, on Main Street, we have 4217 ft. of single track laid with 100-lb. A. S. C. E. rail on solid concrete in a brick-paved street, with a special brick along groove side of rail. Over this track three sections of wheels run, namely, wheels with 2-in. tread, ⅝-in. flange; 2½-in. tread, ¾-in. flange and M. C. B. wheels. Over this track 100,000-lb. gondola cars are run. This track was constructed in 1903, and to date is standing up perfectly.

TIE PLATES, BRACED TIE PLATES AND TIE RODS

BY E. P. ROUNDEY,
Engineer Maintenance of Way, Syracuse Rapid Transit Company

Our attention was first called to the inefficiency of braced tie plates as a means of holding girder rails to gage when the cars on several of the lines in Syracuse began to leave the tracks; and in every case we found the track in the neighborhood of the place of derailment to be from ½ in. to 1 in. wide gage. The track construction on these lines is as follows: 9-in. half-groove rail, Lorain section 90 - 317; oak ties 6 ins. x 8 ins. x 8 ins.; 6 ins. of coarse gravel ballast; and malleable iron brace plates every 6 ft. The concrete for the paving, which is both brick and asphalt, extends from the bottom of the tie to about 4 ins. above it. The track has been down about ten years.

The derailments became so numerous a short time after putting some new heavy cars on the lines that we decided to place tie rods in all of our tracks having the half-groove rail and brace plates. When the track was opened for the tie rods, we found the ties in fair condition, but many of the brace plates were bent backwards and others twisted away from the head of the rail, being practically of no use for holding the rails to gage. The track had been gradually widening out under the small cars, and when the large heavy cars were run it only took a short time to widen the gage until the track was unsafe.

Tie rods have been placed in most of this track now and we have had no more trouble with derailments. The great objection to brace plates, judging from our experience, is due to their being spiked to wooden ties. They are dependent for their efficiency on the holding power of the spike, and as the ties get old the continual tipping of the side bearing rail loosens the spikes and allows the brace plates to twist and become loose; they also cut into the ties as the ties decay, thus allowing the rail to tip outward. A great deal of care should be taken when putting on brace plates, as the spikers will often twist them when spiking and get a poor bearing under the head of the rail; crooked or uneven ties will also make trouble in getting a good job.

We have some steel brace plates, on a piece of track which has been down for about three years, and have had no trouble as yet, but the cars are small and ten minutes apart. When this track is to be paved we will place the tie rods 6 ft. apart, in addition to the present brace plates. The use of brace plates would be advisable in laying track in an unpaved street, which would be paved in a few years, as a strong steel brace should hold the track when the ties are in good condition, and when the street is paved, put in the tie rods.

The objection to tie rods in an unpaved street is that as the filling between the rails settles the rods are exposed to wagon traffic and become bent or broken. The theoretical objections to the brace plates, as compared with the tie rods, are as follows: The brace plate depends for its efficiency on the condition of the tie, and braces each rail independently; if the braces on one side fail, the gage will widen; with the tie rod, if the rails get out of line they will move together and maintain the gage. On ordinary girder rail track a ½-in. or so wide gage will not cause derailment of cars, but with the half-groove type, especially Lorain section 90 - 317, ½-in. wide gage usually means trouble.

The lip on this rail is thin and narrow, and flattens down under wagon traffic, often breaking off in places. When a car comes to a place where the track is ½ in. or more wide gage, the flanges of the wheels on one side get inside of the lip of the rail, and when the track comes to gage again the opposite wheels are forced over the head of the rail, causing derailment of the car.

With this type of rail, which necessitates tight gage for safety, tie rods are the best fastening. If a strong steel brace were used in connection with a steel tie, it should make an efficient device for holding the rails to gage.

There is not much to be said in favor of the use of ordinary tie plates on rail in a paved street, as the concrete between the ties will support the rail and keep it from cutting into the tie any appreciable amount. However, the concrete in the older tracks in Syracuse does not seem to be of any use for holding the rails to gage.

ELECTRICALLY WELDED JOINTS

BY P. NEY WILSON,
Roadmaster, Rochester Railway Company

I shall not go into the subject of the details of electric welding so far as the equipment is concerned. This matter has been covered, I understand, very thoroughly in past meetings of this organization. Joints are unquestionably the most important detail in the permanent way department. It is my opinion that no mechanical joint is equal to a good weld. Viewed from the financial standpoint, or from the standpoint of the purely practical track foreman, the weld is the thing. We know that we can make a good roadbed if sufficient funds are available. Unless the joints are welded, we cannot by any means be positive that we can hold our joints.

As I have been connected with the Rochester Railway only about one week, I am not familiar with the performance of the electric welded joints in that city. I shall therefore read a detailed statement of cost of welding 3087 joints in Camden, N. J., which is the South Jersey Division of the Public Service Corporation.* You will note that the credit for the sale of old fish-plates and copper bonds represents rather a large figure. I admit that I was somewhat surprised at this figure myself, but it is based upon actual cash received from a local scrap dealer in making sale of the old material. I might add that the sale of the bonds figured very materially in making this figure so high. We used a bond devised by ourselves, which cost in material alone $1.25 per joint. As the material was almost entirely composed of copper we naturally had a very good return in the way of a credit.

We paid little or no attention to expansion and contraction, as I am strongly of the opinion that in improved paving there is little change in the temperature of the earth and correspondingly there is very slight expansion and contraction. In the total of 3087 joints we had 32 breaks in one year, or about 1 per cent. On Broadway and on Kaighns' Avenue we had a total of 779 welded joints, and

* See also Street Railway Journal for Jan. 6, 1906.

none broken. These two streets were paved with asphalt on concrete. The entire number of broken joints occurred on Haddonfield Pike and Moorestown Pike, where the track was laid on sand and paved roughly with rubble-stone. The condition of the paving was such that in the winter months the snow and ice had an opportunity to get in around the rail. I regard this condition as the cause of the broken joints, as the same section of rail was welded in each instance.

The bonding of joints is so closely identified with the joint itself that one should be considered with the other. This feature is very important, as the question of installing a rail bond is, to my mind, simply a choice of evils. With the weld we know we must have a perfect bond. From the general manager's standpoint I think the matter should be approached in this way: In the case of old track with more or less battered joints, prices should be obtained upon a step-joint for raising the receiving rail sufficiently to surface the lowest spot in the dish with the abutting rail. To this figure should be added the cost of the bonds (loose and battered joints are usually accompanied with bad bonding); then add labor cost and incidental material and reach a total. This total should be compared with the cost of welding.

In the work at Camden I found that the cost of electric welding was less than the estimated cost of placing step joints. I found by making tests of electrical welding joints that the conductivity was equal to or greater than the solid rail section, using the Conant tee-pole bond testing machine.

I have heard the opinion expressed by several managers that they would not weld new track, but that welding was all right in the case of battered joints. Personally, this appears to me as a discrimination without a difference.

SUMMARY OF COSTS OF ELECTRICALLY WELDING 3087 JOINTS IN CAMDEN, N. J.

Cost of labor	$7,031.24			
Cost of material	581.00			
		$7,612.33		
Credit from sale of old fish-plates and bonds *		2,816.59		
			$4,795.74	
Cost of welding 3037 joints, at $5.25 each			16,206.75	
Cost of replacing asphalt, 899.6 yds., at $2.53, and 117 yds., at $2.51			2,569.65	
Total cost of operation				$23,572.14
First cost per joint:				
Labor				2.277
Material				.188
Labor and material				2.465
Cost per joint, labor and material, after credit is deducted				1.553
Final cost per joint, all labor, material, welding and asphalt charges				7.635
Cost per mile, under similar conditions, 30-ft. lengths				2,627.52
Cost per mile, under similar conditions, 60-ft. lengths				1,343.76

*Scrap value of the iron, $15.60 per gross ton, copper at 15¼ cents per pound; actual price received from the scrap dealer.

COST PER JOINT, PAVING AND RAIL SECTIONS ON ABOVE STREETS

Haddonfield Pike, 7-in. girder (P. S. Co., section No. 238, and Cambria No. 824), rubble stone on sand, all 60-ft. lengths; 989 joints	$6.684
Moorestown Pike, 9-in. girder and 7-in. girder (P. S. Co., sections 238 and 200), rubble stone on sand, all 60-ft. lengths; total, 1128 joints	6.704
Broadway, 7-in. girder (P. S. Co., section No. 238), asphalt between rails and part of shoulder, Belgium block along rail, on 6-in. concrete; Kaighn Avenue, 7-in. girder (P. S. Co., section No. 238), bricks between rails and shoulder, on 6-in. concrete, all 30-ft. lengths; total, 779 joints	10.438
State Street and River Road, 7-in. girder (Cambria, section 334), rubble stone on sand; 115 joints with 30-ft. lengths, 76 joints with 60-ft. lengths; total, 191 joints	6.632
Total, 3087 joints	7.635

	Haddonfield Pike	Moorestown Pike.	Broadway and Kaighn Ave.	State St. and River Road.
Number of joints	989	1,128	779	191
Cost of labor	$2177.55	$2528.19	$1944.94	$380.56
Cost of material	140.85	142.85	239.78	57.61
Total cost	$2318.40	$2671.04	$2184.72	$438.17
Credit from sale of old fish plates and bonds	900.00	1030.19	712.146	174.26
Net cost	$1418.40	$1640.85	$1472.574	$263.91
First cost per joint, labor	$2.201	$2.241	$2.496	$1.993
First cost per joint, material	.142	.127	.307	.201
First cost per joint, labor and material	2.343	2.369	2.803	2.294
Cost per joint after credit is deducted	1.434	1.454	1.89	1.382
Cost per joint for welding	5.25	5.25	5.25	5.25
Final cost per joint, all labor, material and welding	6.684	6.704	*a*10.438	6.632
Total cost of operation	6610.65	7562.85	8138.17	1266.66
Cost per mile, 30-ft. lengths	2352.76	2359.80	3674.17	2334.46
Cost per mile, 60-ft. lengths	1176.38	1179.90	1837.08	1167.23

a This figure includes cost of replacing 1016.6 square yards of asphalt, $2.569.65 or $3.298 per joint.

I learn from Mr. Kleinschmidt that the Lorain Steel Company has recently successfully applied the process to T-rail track on interurban lines, having welded a stretch of about 6 miles from Providence, R. I., to River Point. In this track expansion joints are used every 1000 ft. The same company has also welded the third rail on some 2 miles of elevated track in Brooklyn. Another interesting piece of welding was the new T-rail tracks on the Brooklyn Bridge. As this rail is laid directly on the plank, it is evident that the electric weld was the only form of welded joint that could be used. There are, I believe, five expansion joints on each rail, and no reports have been reported to date.

In August, 1905, 1770 joints were welded in Rochester. The cost of welding was $5 per joint. The total cost, including welding and replacing pavement, etc., was $11.25 per joint. Up to Jan. 29, 1906, there had been 114 breaks, or about 6½ per cent.

On Monroe Avenue, Rochester, out of a total of 303 joints there were 48 breaks, or 15 per cent. This was a Trilby rail, and I believe Mr. Matthews attributes these failures to the type of rail, especially on account of the weak web. The fact that 415 joints were welded on Park Avenue and Mt. Hope Avenue and Main Street, and none broken, seems to prove the above statement.

I would like to conclude by asking a question: The cost of placing a step joint with bonds on old and battered joints is about one dollar more than welding. The cost of placing an improved mechanical joint is about the same as a weld. Why don't the general managers weld?

RAIL BONDS

BY H. L. MACK,
Superintendent of Lines, International Railway Company, Buffalo

The object of rail bonding is to join the ends of rails so as to afford an unbroken circuit through them for the return current. The carrying capacity of the bonds can be determined in the same manner as that of the feed wires. If the tracks or rails of one line carry return current from two or more lines, the carrying capacity of the bonds can be determined by that of the feeder for the two or more intersecting lines. If the flow of current is greater than the carrying capacity of the rails a supplementary return cable or cables should be used and should be provided with frequent connections to the rails. Supplementary wires can also be used with good results where trolley tracks cross steam railroad tracks at grade, but are of no value around curves or special work, except where the uniform bond cannot be applied. Grounding the rails to water or gas pipes is of no value for increasing the capacity of the return circuit and damaging results often occur through such practice.

The question is often asked, What is the best bond? The best bond is that in which the greatest care is exercised in its application, as the workman can make the bond an effective connection, or so much junk. Too much care cannot be taken in such application, which should not be made until the hole in the rail is perfectly bright and free from rust, dirt or moisture. The terminal on the bond should also be bright and free from moisture before being put in. Bonds should not be applied in damp or wet weather, as moisture will start corrosion and greatly reduce their efficiency. In drilling rails for bonds the best results may be obtained by drilling dry, and in no case should any oil be used on the drill, as oil forms a coating at point of contact and greatly increases the resistance of the bond. Where holes for bonds are drilled in the rails at the mills they should be drilled 1-32 in. smaller than the diameter of the terminal of the bond, as the rail often becomes rusty before it is used, and if the holes should be drilled large enough at the mills they would be too large after reaming out. The hole should be reamed out to exactly the diameter of the terminal. No type of bond should be installed by unskilled labor if good results are expected. One man should have charge and be responsible for the installation of all bonds and keep as near as possible a complete record.

The International Railway Company has used nearly all types of bonds which it was thought would give good results. After long experience and a careful study of different types, we have adopted as a standard the compressed terminal bond which we have used for several years with very good results. During the summer of 1906 we had the entire system gone over with the Albert B. Herrick Autographic Test Car to determine the condition of the bonds. The test proved very valuable, as well as interesting. In the city of Buffalo there are about 106 miles of electrically-welded track; the test showed this track to be a uniform conductor for the entire length, as when the rail ends are welded together the resistance at the joints is no greater than at any other place in the rail.

The type of compressed terminal bond which we use is a No. 0000 10-in. x 12-in. flexible with 7/8-in. terminal. Two of these bonds are put under the splice bars at each rail joint, and if they are carefully installed I believe they are most reliable and after four or five years' service will show less resistance than any other type of bond which is on the market. At the present time we have this type of bond installed on some of the track which was laid in 1897 and 1898, and the tests taken in the summer of 1906 showed the resistance of the joint to be less than 4 ft. of adjacent rail. I think this record very good in view of the fact that the importance of a bond or a complete return circuit was not considered as serious at that time as at the present.

In 1900 we laid about 12 miles of track and bonded it with 10-in. x 12-in. No. 0000 Crown pin figure 8 bond, with 3/4-in. terminal. Two bonds put in at each joint under splice bars. A recent test made did not show these bonds to be as efficient as the compressed terminal bond. As the compressed terminal bond had been installed nine years, and the Crown pin bond but five years, this would show a marked difference in the efficiency, but in justice to the Crown pin bond, I may state that there was not the care exercised in applying these bonds that there should have been to give the best results, as the work was rushed and not enough time was taken to permit careful installation. The bond has some advantages over any other type of bond when rebonding is necessary and trains or cars are run at frequent intervals and at high speed, and when it is not desirable to interfere with the service. Its application is very simple, as it is only necessary to drive in a pin; the drilling and bonding can be done without placing any obstacle on the rail, such as a screw compressor, to cause fear of derailment. This advantage applies principally to high-speed interurban lines or to steam roads undergoing electrification.

I believe that we were one of the earliest users of the soldered bond, which we started to use in 1893. After a number of tests, both electrically and mechanically, we thought we had solved the bonding problem. We not only used these bonds on all new track and track relaid, but we went in very extensively to rebonding. In about three years we had occasion to change some special work where these bonds were used, and to our surprise we found some of them practically of no use at all, as the tinning between the bond terminal and the rail had very nearly all disappeared and rust had taken its place. It is needless to state that we discontinued for the time the use of soldered bonds. The bond which we used was made in our shops; the terminal was about 2½ ins. in diameter, carefully planed off; the rail was also carefully cleaned off with a special tool made for the purpose; the bond terminal and rail were both tinned before installing the bond, so it is quite evident that our experience with soldered bonds has not been very satisfactory. About one year ago we had installed by one of the leading makers of soldered bonds about 500, and I have just recently made a test of a number of these bonds and am pleased to state the test was very satisfactory. I do not believe enough is known of soldered bonds to determine their exact location in the scale. I would like to see a soldered bond not only stand as a competitor to other types of bonds but to rank first in the list, as I believe it is the most practical in application and has the highest electrical test when first applied. What remains to be determined is the life of the bond.

CATENARY LINE CONSTRUCTION

BY C. E. EVELETH

The primary cause for the change from bracket and span construction, as ordinarily used for direct current, to catenary construction was the difficulty in obtaining suitable insulation in the old types of construction. With the trolley wire supported by a messenger wire, which in turn can be directly supported on porcelain insulators, there is no difficulty in obtaining sufficient insulation for almost any voltage. This type of construction resulted in a more flexible trolley wire and one which a wheel follows with much less jumping. By additional points of support the deflections of the trolley between supports could be decreased as much as desired. Another advantage of this system is that when used with trolley wheel collectors there is little chance of the overhead work being pulled down by the wheel catching on the supporting wires when it comes off the trolley wire. It is only at curves that there is anything which could give trouble from this source, as the tangents are entirely clear even at anchors.

It has been found feasible to increase the distance between poles up to what is now considered a standard distance of 150 ft. on tangents with shorter distances on curves. The poles are set about 6 ft. to 6 ft. 6 ins. in the ground. With bracket construction they are given an outward rake at the top of about 1 ft. Guys are needed only on curves or where the ground has poor holding qualities, since with bracket supported trolleys the strains tending to bend or displace are only from one-fifth to one-tenth as great as those existing with span construction. The question of doping the poles with tar or protecting them at the ground surface with cement and asphalt is largely a matter of individual taste.

A new element is introduced in the requirements for a bracket with the catenary construction. When the trolley is installed the maintenance will depend largely upon the exact balance of forces on the messenger wire, which means that the deflection for the individual spans should be the same. It is desirable then to have a certain amount of rigidity in the horizontal direction so that the initial dip of the messenger wire may be adjusted to the desired amount. To obtain this stiffness an angle-iron bracket has been designed, consisting of 2-in. x 2½-in. x ¼-in. angles fastened together with suitable spacing blocks at the end over the track and at a point 18 ins. nearer the pole. Through this latter block is passed the stay bolt supporting the bracket from the pole top. The angle brackets are shipped unbent, as they are flexible enough to spring out sufficiently to take the pole.

For double-track work longer angle-irons are used, riveted together with suitable spacing blocks at each end. These may be sprung open and slid down over the top of the pole. Where this is impossible, due to wires or other conditions, one end of the bracket is usually bolted. The distance mentioned between the spacing blocks on the bracket is provided to allow an adjustment of the insular position to accommodate alignment of the trolley and provide means to obtain staggering when the bow or pantograph collector is used.

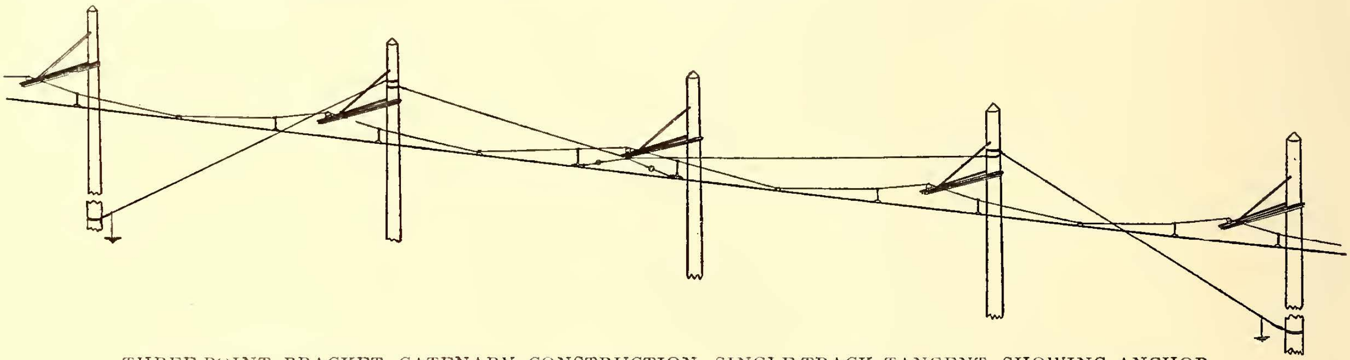
A short iron pin designed with special base and having a bolt passing up between the two angle-irons is used to support a standard type of pole line insulator, which is preferably made in two pieces cemented together. The insulators are cemented to the pins. Cementing is preferred to threading, as it gives the porcelain a more rigid backing and so aids materially in preventing breakage from missiles. It will be seen that any friction due to movement of the messenger wire on the insulators will create a force tending to twist the insulator around the bracket. This is prevented by the pin stud passing between the two angle-irons.

If rigid economy requires a lower cost bracket than the angle-iron, one made of tee-iron would be the next choice, as this possesses a shape to which the insulator pin may be readily attached without danger of twisting around the arm, though this latter bracket is undesirable from the construction standpoint, as it has no stiffness in the horizontal plane.

For single-track work it is well to raise the outer end of the bracket 2 ins. or 3 ins. so that when loaded with a messenger wire and trolley the pole deflection will make the bracket level.

When the poles and brackets have been put in position and the insulators installed the line is ready for the messenger wire, which for trolley wire up to No. 000 capacity usually consists of a 5-16-in. second grade or high strength seven-strand, double galvanized steel cable having an ultimate strength of about 8100 lbs., or a ⅜-in. Siemens-Martin seven-strand, double galvanized steel cable, having an ultimate strength of about 6800 lbs. The grade first mentioned requires the use of mechanical clamps at the splices, while the softer steel can be made up into the usual cable joint. One or two miles of this messenger wire are usually run out and pulled up to give the required uniform deflection before loading with the trolley wire and fittings. For a 150-ft. span at about 50 to 75 degs. F. the initial deflection of the wire should be about 16 ins. With the messenger wire in place the trolley is run out, pulled tight and clipped in at the center points of the spans. This will change the span deflection at the center from 16 ins. to 24 ins. The deflection will be about 28 ins. when the rest of the hangers have been installed with three or more points of suspension. It is well to anchor the trolley while clipped in at the center points only so that any change in the relative position of trolley and messenger wire will not necessitate adjusting the additional suspensions. Both the trolley and messenger wires should be anchored at each end of every curve. The messenger wire deflection given above seems to be about the most satisfactory for 150-ft. spans, as less deflection will cause much more variation in height of the trolley wire due to temperature changes and make the system rigid, while more deflection makes the whole system too flexible in the horizontal plane.

For years the spacing between trolley supports has been in the neighborhood of 100 ft. Many roads are now running satisfactorily with wheel trolleys with this spacing up to speeds of 60 m. p. h. It is probable, therefore, that the direct-current trolley wheel collectors and three-point suspension, bringing the distance between points down to 50 ft., will be entirely satisfactory for any reasonable speed. With sliding contacts of either the bow or pantograph type, having much more inertia than the wheel collectors, a closer spacing of supports is doubtless of advantage, as this makes the difference in level between the supports and center points of spans sufficiently less to enable the heavier collecting device to follow the wire and also lessens the blow at each support. There is nothing to decide just the number of points to give the best results, but it appears that the



THREE-POINT BRACKET CATENARY CONSTRUCTION, SINGLE-TRACK TANGENT, SHOWING ANCHOR stiffness of a No. 0000 trolley is such that the system seems to pass the point of maximum flexibility when the supports are about 15 ft. or 16 ft. apart. If they are closer than this a contact passing under a support not only raises that support but the two adjacent ones, while at this spacing the trolley wire will bend and lift only the support under which the collector is passing. If more than three points of suspension are used the weight of trolley carried by the center point is not very great, and an initial twist in the trolley conductor is liable to cant the center point ear sufficiently to cause it to hit on the moving collector. It is, therefore, desirable to allow a greater distance between the lowest point of the messenger wire and the trolley, so that the weight of the latter will be sufficient to prevent an initial twist canting the center point hangers.

Inertia tests on the pantograph collectors indicate that with a properly installed trolley supported every 20 ft. or 25 ft. there is sufficient activity of the collector to follow up the deflections in the trolley wire, even supposing that these deflections were not actually reduced by the pressure of the collector on the wire at intermediate points between suspensions.

A number of styles of connection have been developed to support the trolley wire from the messenger, but the one which we are recommending most strongly at the present time consists of a sister hook of malleable iron grasping the messenger wire having a flat strip of steel 1/8 in. x 5/8 in. connecting this sister hook with the clamping ear. This ear has been made up in a variety of forms, and the selection of the type is largely a matter of personal choice, as a number of mathematical and screw clamp ears have been developed for this purpose.

With the pantograph collectors a clearance of about 6 ins. vertically 3 ft. away from the trolley wire is required for clearance on curves where the outer rail is elevated, throwing the collector contact surface at an angle with the horizontal. Since the pull-offs must be on the outside of the curves where the clearance space is necessary, a bridle arrangement has been adopted, which consists of 1/4-in. seven-strand cable attached to a special clamping ear with eye on the trolley wire and a special sister hook with an eye on the messenger cable. A rod forms a rigid connection between the sister hook and ear. The strain insulator is inserted in the apex of the triangle formed by this bridle. With curves of large radius, a device known as the "steady brace" is used to push off the trolley wire at a point directly below the bracket. This push-off brace consists of a screw clamp car, to which is attached a gooseneck piece of 5/8-in. threaded steel rod, which in turn is attached to the end of a wooden stick about 2 ins. in diameter. The other end of this stick is fitted into a socket carried, in the case of high-voltage work, by a special porcelain insulator, which is so pivoted at the pole as to allow the motion in a horizontal plane that is required by movements of the trolley wire. In double-track work the principle of the bridle pull-off is used just as the double-curve hanger for direct-current work.

It is well to anchor the trolley about four times to the mile. The anchor is attached to the trolley about 25 ft. either side of the pole anchor bracket, which in turn is anchored to adjacent poles. The change from the center point of span, where the anchor cable would be nearly parallel to the trolley wire, to this location nearer to the bracket is necessitated by the danger of a loose anchor cable catching in a sliding contact. With this type of anchor and a wheel collector the angle between the anchor guy and the trolley is so small that it is not possible to catch a wheel between them.

All of the catenary material is installed suitably either for wheel or bow collectors, with the exception of the frogs, which must be special for each condition.

The strain insulator required for this high-voltage work has been one of the most difficult problems to solve, but a solution has been very well worked out in a special type of insulator made of porcelain, weighing 3½ lbs., and capable of withstanding 10,000 lbs. pull, or, in other words, more pull than any cable used in this sort of construction.

CORRESPONDENCE

THE BOW TROLLEY IN GERMANY

Schenectady, N. Y., Jan. 7, 1907.

Editors STREET RAILWAY JOURNAL:

The article on "The Electric Railways of Germany at the Close of 1906," in your issue of Jan. 5, 1907, contains some statements about bow collectors which may give American readers an erroneous impression. The author says that several companies have changed from the wheel to the bow, but none from the bow to the wheel. In most cases this change-over was not based on engineering, but more or less on commercial reasons, such as the merging of railways, part of which were being operated with the bow collector and part were equipped with trolley wheels. The bow collector has the advantage that it runs smoothly on curves of small radius, such as are frequently met with in old European cities, but has the disadvantage that its current-carrying capacity is limited to practically 50 amps. for free running, and 150 amps. when starting.[1]

Where large current-carrying capacity is required, however, the bow collector is at a disadvantage. This is proved by the fact that the Grosse Berliner Strassenbahn, after taking over the railway connecting Berlin with Charlottenburg, was able to run its motor cars over this line with one wheel trolley, which was substituted for the two bow collectors which were formerly necessary.[2] This change contradicts the statement that none of the German companies has changed over from the bow to the wheel. Of course it is a well-known fact to the trade, if not to the general public, that the use of the bow, which was originally brought out by Siemens & Halske, is now free to everybody. The wider employment of the wheel trolley is due, therefore, not to any patent situation, but to its demonstrated greater advantages for heavy electric street railway service. In cases which warrant its use, as on high-tension single-phase roads, the bow trolley is employed by the Allgemeine Electricitäts Gesellschaft.

Another statement to which I would like to take exception is that relative to the car lightning arresters. The facts are that most of the European electric railways are built according to the Thomson-Houston system, and are not equipped with the horn type car lightning arrester, but with the well-known magnetic blow-out lightning arrester, as manufactured in this country by the General Electric Company.

EUGEN EICHEL.

[1] See letter of Mr. Cremer, engineer of the Siemens-Schuckert Works. Elek. Bahnen u. Betriebe, May 4, 1906, page 244.

[2] See letter of Mr. Dietel, engineer of the Allgemeine Elektr. Gesell., Elektr. B. u., Betr., July 14, 1906, page 384.

PROCEEDINGS OF THE BUFFALO MEETING OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK

The fourth quarterly meeting of the Street Railway Association of the State of New York was held on Friday, Jan. 11, at the Iroquois Hotel, Buffalo, N. Y. The subjects covered were track construction (including bonding and welding), derailing devices and overhead work. There were about seventy-five in attendance, and the live discussions on the topics presented showed how much interest the quarterly meeting idea has created among the street railway men of New York and contiguous territory.

MORNING SESSION

The morning session opened at 10:15 a. m. with President Shannahan in the chair. Mr. Shannahan announced the paper on "Track Construction in Paved Streets," by I. E. Matthews, engineer, maintenance of way, Rochester Railway Company, which will be found on page 99 of this issue.

Following Mr. Matthews' paper the president introduced F. D. Jackson, superintendent of track, International Railway Company, who read the paper on "Concrete Stringers and Concrete Stringers with Ties and Steel Ties," published on page 100.

E. P. Roundey, superintendent of track, Syracuse Rapid Transit Company, then read the paper on "Tie Plates, Braced Tie Plates and Tie Rods," published on page 103.

When these three papers noted had been read, the president announced that the discussion was open.

Mr. Bagg asked whether the estimate given by Mr. Matthews included the cost of paving. Mr. Matthews said it did.

A delegate inquired of Messrs. Matthews and Jackson as to the relative noiselessness of concrete and the old construction with broken stone and regular paving, as compared with concrete and steel ties. He wanted information on this point because the relative noiselessness of different kinds of construction was an important argument with property owners. Mr. Matthews thought there would be some rumbling with the more rigid track construction, but that was naturally to be expected in large cities, where there is always noise from vehicular traffic.

Mr. Roundey asked Mr. Matthews what his object was in using a full-grooved rail in paved streets. Mr. Matthews replied that the city authorities would not permit a regular girder rail, and besides he thought that a full-grooved rail made a better looking pavement. On Mr. Roundey's query whether such a rail would not fill up with dirt, Mr. Matthews said that certain grooves would, but a section which is now being made with a wider groove than usual seems to be very satisfactory. They had some semi-grooved rail in use on the city lines, the Lorain section, 94-313 being the one he had in mind.

Mr. Clark asked Mr. Matthews whether interurban cars entering Rochester experienced any trouble in passing over the girder rail. Mr. Matthews replied that the interurban cars did not have a very deep flange and so had no trouble.

Mr. Clark said that in Cleveland, where the Trilby rail is used, they had a great deal of complaint from the Lake Shore Electric Railway on account of broken wheel flanges —the inside of the flange rubbing against the inside of the Trilby rail flange. This had a tendency to press the wheels outward. The Lake Shore officials wanted his company to grind the rails to suit. He thought that they concluded to widen their gage a trifle. They have had no trouble ever since. The Lake Shore Electric Company uses the standard 1-in. flange.

Mr. Griffin said that the cars of the Rochester & Eastern Rapid Railway in entering Rochester over the tracks of the Rochester Railway had trouble with some Trilby rail which was made for ¾-in. flange. It was necessary to move out the wheels more than ⅛ in. and re-gage all their own track to overcome the difficulty.

Mr. Brown remarked that lack of care in gaging track caused a great trouble, while Mr. Roundey added that cars were frequently found to be of different gages.

Returning to the subject of roadbed construction, Mr. Jackson stated that more noise would be expected from a solid concrete base because it was more rigid, but that it depends upon conditions. On a wet day, when the rail is perfectly clean, the noise is no more than on other construction, but on a dry day when sand and concrete get on the rail there will be more noise because there is less "give" to the structure.

Mr. Wilson, of Toronto, asked if any members had had experience in using sand or coarse gravel instead of broken stone, to make a concrete mixture.

Mr. Clark said that he had built a bridge at Utica with gravel concrete. Mr. Brown remarked that he had put in a large quantity of gravel concrete in Canandaigua, and that it had made an even better concrete than broken stone.

Later, Mr. Clark explained his method of making gravel concrete mixtures by stating that he mixed a small quantity at a time. Good gravel concrete was possible, but there must be no guesswork about the gravel.

Mr. French mentioned a concrete with clay gravel laid by him on Wolf Street, Syracuse, in 1894. A paving contractor who had to dig cross-trenches through it told him it was the toughest he had ever struck. In reply to an inquiry from Mr. Brown, Mr. French said that the clay-gravel concrete seemed to be very dense.

Mr. Penoyer said that his company used crushed stone measured in a box and a proportion of 1-2-6.

Mr. Bragg said that as he understood Mr. Jackson's paper, his new construction consists of a 6-in. sheet of concrete underneath the whole track, that the Carnegie ties are 10 ft. apart and the rails are held with tie-rods. It seemed to him that steel ties placed 10 ft. apart did not have a very important part to play in the track construction after the concrete has set. He wanted to know whether the ordinary yellow pine tie would not have answered as well as steel ties after the concrete had set. Assuming that the steel ties were removed, would not the track stand up as well?

Mr. Jackson replied that it might stand the service almost as well. The steel ties serve to fix the gage during construction and afterward. If the concrete should break a wooden tie would not have the holding power of a steel tie. With the latter there is better holding power against the wet and also underneath the top flange.

Mr. Bagg asked if there would not be some sag.

Mr. Jackson replied that the concrete also extends under the steel tie for 6 ins., so that the steel tie itself is embedded in 12 ins. of concrete. Wooden ties last eight to 12 years;

his company figures that the steel ties should last fifteen years. It seemed to him poor economy to use a wooden tie on construction of such character. He believed they could take out the pavement, remove the rail and place the new rail on the steel ties without interfering with the sub-structure.

Mr. Clark said he was using steel ties every 5 ft. and a 10-in. beam under the rail with tie-rods every 6 ft.

In reply to a question by Mr. French relative to taking up rails on this construction, Mr. Jackson answered that his company had just started to use this construction but he saw no reason why there should be any trouble.

Mr. French said in answer to Mr. Bagg's question that his company had used a few Carnegie steel ties. However, instead of stopping the concrete at the bottom of the rail they brought it up 2 ins. above the base of the rail. In that way they get the whole steel structure in the concrete so there is less liability of moving of the rail. Careful tamping of the concrete under the rail is necessary.

Mr. Roundey said that in Syracuse concrete 4 ins. above the ties would not hold the track to gage. This may be due to the concrete which was put in ten years ago and which may have been a natural cement He did not think that concrete was of much use in holding the track to gage.

Mr. French said it was not his idea to use the concrete for that purpose. He would not lay track without tie-rods.

Mr. Wilson, of Buffalo, took up some of the criticisms made on the new track construction as to the spacing of the ties and rods, etc. The fact was that when his company took up the question last year they found no steel tie designed for electric railway work. They were therefore forced to use steam railroad sections. This year, at his suggestion, the Carnegie Steel Company had rolled a new tie for electric railway use. It was somewhat lighter and cost them $1.40 instead of $1.81. As to concrete, he thought either gravel or broken stone would do, provided the mixture was carefully made and a good cement used. Natural cement is not good for track work. A good Portland cement should be employed even if it is costly.

Mr. Clark asked Mr. Wilson why he adopted a twelve-hole angle-plate. Mr. Wilson replied that he had not yet adopted any standard joint. He was much interested in finding a standard joint. He had used an electrically-welded joint for some years and had gotten tired of replacing broken joints. They could only be replaced in their former condition by the use of the original extensive welding outfit or the thermit weld, which is still experimental.

Mr. Stanley asked if any one knew of failure through the use of concrete in track construction. He knew of a city where a great deal of concrete had been used in track work and every mile laid, whether with wooden or metal ties, had to be rebuilt. That track construction provided for 6 ins. beneath the ties and later for 13 ins. There could be no criticism about the methods used in the construction, as the best material was employed with brace plates or tie-rods on 9-in. and 7-in. rails. The track was in streets with light traffic and single track, and also in streets carrying heavy interurban cars. That experience determined him when deciding upon track reconstruction in New Jersey. They were using broken stone entirely with no concrete whatever beneath the ties, but only between the ties for the support of the pavements. A 2-in. stone is used. This is rolled by a roller and laid to a depth of 6 ins. The ties are laid and tamped and cars are run before the paving is laid. The depth of concrete laid between the ties depends upon the pavement used. The inter-spaces between the paving blocks are filled with cement grout. He was rather surprised to hear so much about the general use of concrete without a single instance of failure, yet here was a large system where it had proved a failure.

In response to a question as to the evidence of failure, Mr. Stanley said it appeared in the rail breaking through the concrete. The metal ties buckled. All sorts of methods were used to overcome this trouble, but they were unsuccessful.

Mr. Peck inquired as to the character of the soil, and Mr. Stanley said it was similar to Cleveland and Buffalo with plenty of sand.

Answering Mr. Brown's question regarding sub-drainage, Mr. Stanley said that tile was laid either through the center or outside of rails.

Mr. Clark said that perhaps Mr. Stanley was referring to the buckling of ties on Michigan Avenue, Detroit. He was there in 1903. He picked up a piece of concrete, struck it on the rail and it went to pieces, so he concluded that it was natural cement concrete which the city demanded. Mr. Stanley said it was true of that street but not of others.

Mr. Clark expressed the opinion that a Carnegie steel tie would not have buckled.

Mr. Stanley further pointed out that where concrete was used the track was idle for seven and in some instances fourteen days..

Mr. French said he believed it must have been poor concrete if it would not stand up as well as loose broken stone, because the concrete is stone with some cement in it, whereas what he is using now is simply loose stone.

Mr. Brown asked Mr. Stanley if he would use coarse broken stone or a rather fine stone for foundation if he did not use concrete. Mr. Stanley replied he would use 1½-in. stone.

Mr. Matthews mentioned an interesting experience which he had had several years ago with concrete construction. A water pipe broke and washed out a large hole 3 ft. in depth beneath the concrete, yet cars were operated over the track for some time before the hole was discovered. Mr Clark said he had had the same experience in Cleveland, where they operated for some time over a hole 6 ft. to 8 ft. wide caused by a broken water pipe.

Mr. Fairchild stated that in Kansas City where much concrete work was done they had some trouble, but overcame it by increasing to 18 ins. the depth of concrete under the rail.

Mr. Jackson asked Mr. Stanley whether he thought broken stone would stand up against the rail as well as concrete which keeps out moisture and prevents the settling of the pavement. In reply Mr. Stanley said that in his territory the teaming was probably as heavy as anywhere else in the United States, still their track had been down for nearly three years and there was not the slightest break in the pavement.

F. A. Heindle, of J. G. White & Company, said he had had some experience with the English type of construction, in which the rails are laid on concrete stringers 9 ins. to 12 ins. deep and 18 ins. wide. They found that in any type of concrete construction if there is a bad foundation and an excess of water or moisture of any kind, the rails eventually will begin to go up and down. This increases until the concrete immediately under the base of the rail is worked up into powder. Of course, American traffic is considerably heavier than that in England, but even there they find that proper concrete construction can be put in only at great cost and care in installation.

At this point the discussion on the first three papers closed. President Shannahan then informed the members that the Central Railway Club extended them a cordial invitation to attend the annual banquet to be held that evening at 7 p. m. in the Iroquois Hotel. Several members signified their intention to be present.

The president then introduced C. Gordon Reel, vice-president and general manager of the Kingston Consolidated Railroad Company, who read a paper on "Standard Rail Sections for Paved Streets." Mr. Reel prefaced his paper by stating that his company proposed laying standard T-rail in the streets of Kingston, and during the last year he had been collecting data to prove his case. He said that when he originally proposed T-rail construction he thought he had a good case, but in looking into it further he felt sure that there could be no successful opposition. He found that T-rail is exclusively used in some of the largest and most progressive cities in the country. This paper will appear in the STREET RAILWAY JOURNAL for Jan. 26.

In connection with his paper Mr. Reel explained from drawings several styles of T-rail construction. The scoria block construction in Montreal he thought was about right. Mr. Reel also read letters received from several city engineers.

Mr. Wilson, of Buffalo, who was now in the chair, opened the discussion on Mr. Reel's paper, which he said was most interesting and admirable. He had taken up the subject with more courage than any one else. To start the discussion he would offer his criticism of this style of construction. As far as the accommodation of the cars was concerned, it was all right; but the fatal point in T-rail construction seemed to him to be the paving. He had occasion about two years ago to examine some track work on Archer Avenue, Chicago. One track was laid with Trilby section and the other with T-rail. He believed that when he examined the track it was about one and one-half years old. The portion which has been built with T-rail had the paving stone worn down next the gage line of the rail. It was not worn evenly, but in ruts, and in his opinion that pavement would have to be reconstructed very shortly This was his objection to the T-rail construction, especially in cities that have a large amount of team travel, heavy drays, etc. In Buffalo they had an illustration of that kind of traffic on North Main Street above Cold Springs. Paving stone which was the best (Medina sandstone) in the vicinity was worn down to the lip of the rail. It did not wear down any further because the lip caught it. On another avenue where they did not lay a new rail, the paving stone next the gage line is all worn out because the lip was not heavy enough to protect it. The lip is also worn down. He thought that was the idea large cities had in mind in designing such large girder sections like the 140-lb. rail in Philadelphia, the lips being made heavier and heavier to take care of team traffic. The new section for Chicago is practically the same as for Philadelphia except that it is 129 lbs. In conclusion, it seemed to him that the greatest objection to T-rail in large cities or congested portions is in the wear of the pavement.

Mr. Danforth said that it seemed to him that the preceding speaker had covered the large city end of the argument in good shape. As he had had occasion to say in previous discussions on this subject, the roads in the Middle West find that the T-rail laid in stone-paved streets is satisfactory except where there is a very heavy traffic. He thought that Mr. Reel was right in saying that T-rail is best for average conditions. Properly laid, it is cheaper for the railway and offers less obstruction to ordinary vehicles; improperly laid, it is worse than any section of girder rail ever laid.

Mr. Bagg said that he might follow up Mr. Danforth by stating that the Fonda, Johnstown & Gloversville Railroad is using T-rail. The pavement is brick, asphalt block and bitulithic, with Medina sandstone on the inside and outside of the rail. The cities traversed have 15,000 to 20,000 inhabitants and the team traffic is not heavy. There is not much wear on the paving inside or outside of the rail. They formerly used a special brick to form a flangeway each side, but the brick broke off and crumbled. This may have been due to poor brick. Lately they have been using a brick placed under the rail and curved over the head on the other side of the rail, thus affording a good flangeway.

Mr. Clark said he had Mr. Wilson's idea on T-rail until he had visited Milwaukee, Minneapolis, St. Paul and other Western cities last March, where T-rail is standard. Milwaukee has a 95-lb. T-rail with 3-in. head. He failed to see any of the difficulties mentioned by Mr. Wilson, and was very much surprised at that fact. In Minneapolis they use a granite block which is chipped to make a groove, and they have no trouble at all with the pavement. In Minneapolis the drays keep out of the car tracks, whereas in Cleveland it is otherwise. Hence he was not so sure that they would not have paving trouble in his city.

Mr. Griffin mentioned a small town (Bellevue, Ohio) where a 70-lb. T-rail was used with concrete sub-grade and brick paving. On examining this track last summer he did not see any ruts. It is true that this town has no heavy teaming, nevertheless, the paving also was light.

Mr. French cited an example in Utica. On Whitesboro Street they have a section laid with 70-lb., 7-in. T-rail and another portion with a 90-lb. Pennsylvania section 201 9-in. girder rail. These have been subjected to the same traffic conditions, that is, the operation of 28-ton interurban and regular double-truck city cars. After operating about four years the girder rail is absolutely worthless, in fact, it should have been taken out long ago, whereas the T-rail is in condition to last four or five years more. This work is paved in with common old-fashioned cobble paving on cinders. Mr. French also said that last year they laid on Genesee Street, Utica, 1800 ft. of double-track 95-lb., 7-in. T-rail with 3-in. head, using the Arthur hump block to form the flangeways. This section was laid with the permission of the city engineer, and his company hopes it will prove a good argument for more T-rail construction in the future.

Mr. Clark related a humorous incident relative to team traffic. It seems that a prominent dump wagon manufacturer wrote to him at Cleveland asking for the exact track gage so that he could build his wagons to suit! Mr. Clark told him to build them 4 ft. 10½ ins. outside to outside of wheels.

In reply to a request from the Chair, Mr. Stanley said that on the system of the Public Service Corporation of New Jersey the Trilby rail was used almost everywhere except in some of the smaller towns, and even there the people were agitating for its installation.

Mr. Wildey remarked that in Peekskill they were using some 7-in. high T-rail, Johnson sections and Trilby sections. They have some steep hills on their lines, and he noted that on the Trilby sections the cars could not be held as well on the grades as where the Johnson and T-rail sections are laid.

Mr. Evans, of J. G. White & Company, said that as he was mainly interested in construction rather than operation he did not have the chance to watch results. From personal observation, however, he preferred a 7-in. T-rail. In some towns they had succeeded in getting it installed but the paving to go against T-rail must be the very best.

Mr. Reel asked Mr. Evans why he preferred a 7-in. light T-rail to a 5½-in. or 6-in. heavy standard T, since the cost is about the same anyway. Mr. Evans thought that he could get the paving in better and cheaper that way, besides securing a better job.

Mr. Brown said he was advocating a 5½-in., 90-lb. T-rail with beveled brick underneath the head of the rail. From his experience with it there seemed to be less wear than with the grooved brick, and one can turn out of it more easily.

Mr. Clark brought up the track situation in Cleveland, where the city cars are run with 2¼-in. tread and interurbans come in with 3-in. tread. He asked: "Don't you think a wide head rail is not the proper thing; and should it not have a sloping back?"

Mr. Wilson, of Buffalo, said that led up to a very interesting question for him. They are considering the advisability of changing their standard rail. Up to this time they have used the Lorain 94-lb. grooved section 94-313. The head is too narrow to take care of their interurban cars, and also on the prospective freight rolling stock they might figure having in the future. He had a new section designed for use in Chicago, weighing 129 lbs. per yard. This has a 3¼-in. head, the last ¾ in. of which is beveled. A new section designed for San Francisco also appealed to him very much, with the one exception that the lip seemed too light for team traffic. It seemed to him that some of the metal could be transferred from the base to strengthen the lip. Mr. Wilson showed sections of various new rails to illustrate his remarks. The question of a standard rail section was a grave one in any event, besides depending upon city ordinances.

Referring again to the T-rail, Mr. Wilson said he might have been misunderstood when he first spoke. His company uses it in Lockport and finds it very satisfactory, but Lockport has no considerable team traffic. The same construction would be entirely out of place in Main Street, Buffalo, and in the principal streets of other cities like Philadelphia, Cleveland, New York, etc. It appeared to him to be mainly a question as to the locality where the rails were to be laid.

Mr. Reel admitted that there was a chance for an argument between standard and high T sections, but when the question between girder and T-rail came up it seemed to him that if the T-rail had been adopted in Denver, Milwaukee, St. Paul, Minneapolis, Montreal, Indianapolis and elsewhere, he did not see why that form of rail when properly paved against would not give as satisfactory results in Buffalo. If a manager should use a girder section willingly, unless he is positive that the T-rail won't answer, it is a question whether he is doing the best thing by his company and the public. Girder joints cannot be held and the streets must be torn up oftener, making the company lose money and inconveniencing the public. The life of T-rail is one of the principal arguments in its favor.

In reply to a question from Mr. Roundey whether T-rail joints would hold better, as it seemed to him steam railroads also had joint troubles, Mr. Reel mentioned the battered-down condition of the girder rail joints on Broadway, New York, and asked where one would see such conditions on the New York Central or other steam railroads. They do not get battered down to the last two or three inches from the ends as girder rails do.

Mr. Danforth concluded the discussion by remarking that he had seen granite in Chicago which showed considerable wear, while there were Buffalo streets in good condition where Medina sandstone had been down for thirty years.

M. J. French then read an abstract of his paper on "Thermit Welding," published in full in the Street Railway Journal of Jan. 12. He was followed by P. N. Wilson, roadmaster of the Rochester Railway Company, who read the paper on "Electrically-Welded Joints," published on page 103.

At the end of his paper Mr. Wilson put the question: "The cost of putting on step joints, figuring labor and material, is more than by welding over the battered joint; the cost of putting in a 9-in. girder improved mechanical joint is the same as welding. Then why does not the general manager weld?"

Mr. Wilson, of Buffalo, said he was one of the managers who did weld. Probably his company had more electrically-welded track than any other in the country. In the first place "it involved a great deal of trouble to weld." One has to guarantee a certain number of joints per day—he thought it was four per hour, so it can be seen how fast it is necessary to work. He added that they had had breakages every year on the track welded in 1899. These breaks always occur in winter, and it is quite an item of cost to cut them out and repair the damage. They cannot be re-welded with the electric weld, for that requires having the complicated and costly welding apparatus on hand, so of late the Buffalo company has been going away from the electric-welded joint. It is an admirable joint after the welding, but the question of repairs made him question its economy.

He had looked into the thermit joint with interest, and believed there was a great deal in its future. The reason was that it required no train of cars to apply it. The electric weld would make a better joint, too, if it could be applied with a "pot and brush" as it were, but machinery which occupies the track is necessary. On some new track work this year he was seriously considering the Nichols joint, which is of the riveted type used almost exclusively in Philadelphia as a standard since 1901. That city now has about 135 miles of track laid with this joint. It is riveted to the web of the rail and the return is obtained by spelter both on the base and the head. The question of the electrical return of this joint, however, was one point about which he was not entirely satisfied. He would ask Mr. Mack a little later about that. Mechanically he thought the Nichols joint was one of the best joints on the market. He expressed himself as very much interested by the description of a joint used in Cleveland. This is a combination of a bolted joint having on the base of the rail a small thermit weld to secure conductivity. This not only makes the contact but also reinforces the rail at the point where it most needs it. He would like further data on this from Mr. Clark.

Mr. Clark began by saying that without throwing bouquets at himself, he thought that in Cleveland they probably had more experience with joints than any other city. They have the old electric weld, the cast weld, the thermit, continuous, Weber, Atlas and others, not excluding, he said laughingly, the Clark joint. During 1905 they placed about 3500 thermit welds, and in 1906 concluded they would not continue its use. They had to contend with a condition in Cleveland not existing in other cities unless they also become "Johnsonized," namely, if a joint breaks they must get a city permit stating the exact time and pay 46 cents an hour to an inspector for watching the company carry out the repairs. If only one joint is broken and it takes five hours to do the work, $2.30 is paid for politics alone. So he concluded the thermit weld was not giving satisfaction. There were other reasons why they had so many breaks. He concluded to try a combination of a common joint and thermit. He ordered their rails drilled 2½-6-6 for a twelve-hole common splice bar. The holes are drilled 1 1-16 ins. The holes on the plate are both round holes. In the common fish plate the holes on one side are slotted and sometimes on both sides. He rigged up a car with two No. 2 Christensen compressors with a bank of tanks and an air reamer to ream the holes to 1⅛ ins. He then employed 1⅛-in. machine bolts and nuts with hexagonal heads to make a driving fit. In laying the rails, first two holes were reamed by hand, the common workmen put in two bolts and screwed them up as tight as possible. Then the compressor car comes along carrying the bolts for the rest of the joint. The other holes are reamed and the bolts are inserted, while following workmen tighten them up. After this work is done the men go on to the next job, five or six jobs often going on at the same time. Then the thermit car comes. The thermit is the regular mixture except that the weld is placed across the base of the rail only. First this weld was made ½ in. at the head of the base and ¾ in. at the center. He experimented quite a little, sawing these joints in two to see how much was welded. He found the center was not welded and concluded that this was due to the cooling of the mixture before it got to the rail. So instead of making the collar ¾ in. thick under the web of the rail, it is ¼ in. thick, which allows the steel to flow continuously from side to side. This welds the base of the rail thoroughly and up into the web, greatly increasing the strength of the joint. He estimated the tensile strength at the base of the rail at 120 tons, and figured that the six bolts on each side of the joint would stand safely a shear of 90 tons, hence he did not believe that the rail would ever break at the joint. He added that a hole was left around the joint, the concreting going right on ahead of the welding. The welder then comes along and the hole is filled with concrete after the weld has been made.

This joint has been used since last summer. Some 3000 are now installed and no breaks have appeared. He had an electrical test made on eighty-five 60-ft. lengths of rail in one straight line on Jennings Avenue, and not one showed a leak. As to the cost of the joint: The pure thermit is $1.75, but a mixture of 7 lbs. thermit with ½ lb. steel is used, as the thermit alone would burn the crucible and some would be lost through spluttering; the joint plates are bought by the ton at $37.55 in Cleveland, and bolts are ¾ cent additional per pound on account of being machine bolts; mold, 2 cents for a box 8 ins. x 4 ins.; cost of reaming, placing bolts and welding brings the total to $4.24 or anyway under $4.50. The price of common labor per diem was given as $1.40, and foreman's services $3. If there is a break in this joint it would show up only with a Conant tester or similar device for testing conductivity. Such electrical breaks are repaired by applying a bond which is brazed on the side of the rail.

Mr. Wilson asked whether riveting Mr. Clark's joint would not improve it. Mr. Clark answered that his early work along these lines was more or less experimental; the coming year he expected to rivet, but it meant that another car would be required for riveting.

Here President Shannahan announced that the discussion would be continued in the afternoon session. He informed the members that President Pierce and General Manager Wilson, of the International Railway Company, had provided a splendid luncheon for the members in the adjoining chamber. Before adjournment, however, he would ask Secretary Swenson, of the American Street and Interurban Railway Association, to address the meeting.

After expressing his pleasure at being able to keep in personal touch with the interesting quarterly meetings of the New York Association since they were started, Mr. Swenson pointed out how much good was being accomplished by these little gatherings where mutual experiences could be exchanged more freely than at the larger conventions. He regretted that conditions made it impossible to have similar meetings in the American Association. Mr. Swenson also mentioned the fact that W. Caryl Ely, the former president of the American Association, had been anxious to greet the delegates in his own city, but an imperative business engagement obliged him to be in East Liverpool, Ohio, instead. The secretary then told something about the present condition of the American Association. The annual notices for dues had been sent out and a large number of members had already responded—which was very encouraging, as every secretary knew. The reports of the Columbus convention would be quite voluminous. Each of the four constituent associations would have one, averaging at least 350 pages, which will make about 1400 pages bound in two volumes. One of these volumes will cover the proceedings of the American and Engineering Associations and the other those of the Accountants and Claim Agents. The two latter are strictly company memberships, whereas the others include the associate members. These volumes will be bound in cloth, instead of paper as hitherto. In conclusion Mr. Swenson pointed out the benefits and low cost of association membership in the American Association, and told the delegates that he would never be too busy to go to a State Association meeting.

THE LUNCHEON

During luncheon the delegates were cordially welcomed by Henry J. Pierce, president of the International Railway Company. His speech had both humorous and serious phases, but while the former served to entertain the diners the latter was of such import as to secure their undivided attention. He spoke of the benefit of getting together as shown by the ever-increasing tendency toward the consolidation of like interests in the form of business combinations or simply as an organization for mutual instruction on technical topics, like the New York State Street Railway Association. Throughout the country there has been an increased cost of living and all materials and labor have advanced in price. Unlike other lines of industry, however, the street railway companies can not increase the selling price of their commodity in proportion to the increased cost of labor and material. To-day some 50 per cent of the street railway companies of the United States are unable to pay dividends. Though it sounded like a paradox, the speaker believed that hard times to the industrial world at large presaged good times for the railway companies, since the amount of riding would not be reduced in the same ratio as the prices of material.

Mr. Pierce deplored the tendency manifested by companies whose franchises are expiring to make offers for renewal on a basis lower than compatible with meeting actual cost of operation and fixed charges and providing for depreciation. He recommended that when a street railway company's franchise expired it should offer for renewal only such terms as would allow it a fair return on the investment. Should a cheap-fare company enter the field—do not oppose it. Sooner or later the newcomer will find it impossible to make both ends meet, and then the old company will be able to pick up the property probably for less than cost. Street railway companies spend millions of dollars toward paving streets and keeping them in repair, and yet have not the right of way.

In conclusion Mr. Pierce pointed out that the duty of the association was to work for the amelioration of the many onerous conditions imposed on street railways by appealing to the State Legislature and the different municipalities. The question of taxes in particular should be definitely settled. He believed that franchise taxes should be levied on gross receipts of the system rather than varying percentages in the different communities served.

After the conclusion of Mr. Pierce's remarks the assembly listened to a short and witty address by Mr. Porter Norton, who has been the attorney of the company for about 25 years.

AFTERNOON SESSION

The afternoon discussion on rail joints was opened by Mr. Stanley, who expressed himself as still doubtful about the proper joint. At present many miles of Trilby rail on the Public Service Corporation's system were used in connection with the continuous joint. A great deal of this property had once been welded with the cast-welded joint, and in almost every instance that joint proved a failure. He had seen many miles of track welded electrically, but after a year or two those who installed the electric welding process were not quite so enthusiastic about it; the same seemed to be true of thermit. In his judgment, at this time he would prefer to use a mechanical joint which he knew would answer the purpose for a reasonable period, and hope that when the renewal period came experience would have demonstrated which of the new methods was the most advantageous. Mr. Clark's joint appealed to him more than any other he had heard about, but he still wanted information very badly.

Mr. Reel said that in their new (T-rail) work at Kingston they were planning to use a thermit joint to come about halfway up to the head of the rail, and will omit the end bolthole with which Mr. French had had trouble. The first hole will be 6 ins. or 8 ins. back from the end of the rail. What he wanted to know was whether the head of the rail would be injured by the excessive heat in proximity to it, and whether there would be any deterioration as time goes on.

Mr. Clark said that he had noted no such deterioration in Cleveland during the two years thermit welding had been installed there. Mr. Reel thought that any trouble of that kind if it existed would have shown itself appreciably in two years.

Mr. Clark said he wanted to take up Mr. Stanley's remarks regarding joints. To be sure such joints as the Weber and Continuous are good mechanically, but the bonding or electrical features should also be considered. He had put in plug and solid terminal bonds, but had been unable to get one which after a year had not become oxidized and started to leak. They are now brazing the bond on the head of the rail. Wherever a leak shows the bond is put on.

Mr. French said in answer to Mr. Reel's question about rail deterioration due to thermit welding, they had found that apparently the wear is no more at the joint than anywhere else. If he remembered correctly, the Thermit Company will guarantee that the weld will not injure the rail in that respect.

Mr. Wilson, of Rochester, said he had noticed no bad effects. In thermit welding he thought the heat was so concentrated that it did not affect the head of the rail at all. As to what Mr. Wilson, of Buffalo, had to say about the Nichols Philadelphia joint, while he had not been connected with the Philadelphia Rapid Transit Company he believed the application of this zinc joint required as much machinery as electric welding,—a riveting machine, a zinc machine, sand blaster, etc. He could not see that any mechanical joint is as good as a welded one, nor why it should be preferred when it was possible to have a continuous rail. Besides, no mechanical joint can be considered without bonding.

A delegate asked Mr. French what he thought of thermit on unpaved streets. Mr. French replied he saw no objection to it provided the rail was kept covered to prevent contraction and expansion with changes of temperature.

Mr. Clark said that when the Cleveland authorities got hot-headed recently they tore up some of his company's track on Fulton Road, breaking it at different points. It happened that this track had been electrically welded. When the company was replacing the track on this street Mayor Johnson came along and told Mr. Clark that he would be unable to weld it, whereupon Mr. Clark averred that it would be ready in two days. The Mayor did not believe this, assuming that the Lorain method would be used, which of course requires getting the necessary special cars "Well," said the Mayor, "even if you do weld you will soon find your tracks over there against the lamp post." The result of the argument was a bet between the two involving a new hat. Mr. Clark welded the tracks with thermit and they lay in the hot sun for three or four weeks, simply banked up with dirt. There was no trouble. His present hat he said was bought by Mayor Johnson.

Mr. Reel asked in the event of welded joints being put in unpaved streets, how much of the welded track it would be safe to open up as one wanted to do the paving. Would the buckling be serious?

Mr. French suggested that a record be kept of the temperature when the rails were laid originally and then do the paving under slightly lower temperature. Not more than 200 ft. ought to be exposed.

Mr. Wilson, of Buffalo, said he did not think there would be any trouble on that score, and Mr. Jackson could tell them how long their exposed sections were. Mr. Jackson remembered that once when they had opened up at least 1000 ft. it was out of line during the day but came back at night all right. In reply to a query from Mr. Reel, he said the track did not lift.

Mr. Brown recalled one case where 400 to 500 ft. had been exposed over night. The weather became very cold and five or six joints were found broken next morning. Mr. Wilson, of Rochester, said that in Philadelphia he had seen some 1200 ft. laid open. The track was covered with wet canvas and the buckling went back. Another delegate said that playing on the rail with a water hose would also remedy the trouble, while Mr. Clark gave an instance where 2800 ft. of crawling T-rail on a bridge was straightened by sprinkling it.

President Shannahan announced that, at the suggestion of Charles R. Barnes, expert of the State Railroad Commission, he would call for a discussion on derailing devices.

Mr. Stanley, on being asked to open up this subject, said that in most instances they used only the ordinary hand derail and interlocked with the steam railroads in some cases. They did not use the interlocking system.

Mr. Wilson, of Buffalo, said that at a few places on their interurban lines they had distance signals operated from a tower. The trouble with derailing apparatus is to keep it thoroughly drained. As a rule there is no means of draining the pipes through which the levers run, so in winter the trainmen disconnect and plug them. Putting the derailing duty up to the conductor was a good thing and an accident preventer. The derail ought to be put back a sufficient distance from the rail. One delegate thought 25 ft. a sufficient distance, while another believed it should be located 100 ft. from the first steam railroad track—back far enough to make it impossible to reach the steam track.

Mr. Clark said that in Ohio the law stated the derailing switch must not be further than 70 ft. or closer than 40 ft. If too far it causes a great deal of trouble. They have been contemplating the trial of a new derailer. With the Porter and similar derails, the conductor must go either to or across the track and pull the derail,—sometimes this puts him in such position that he cannot get a clear view up and down the track. They had a case in Cleveland a few weeks ago where a conductor pulled a derail just as a string of cars, which he did not see, was coming down. A collision was avoided by 2 ft. He referred to the Cheatham electric switch, which he wanted to put in, setting the connections so that whether the car has power on or not it will stop as soon as it comes to this switch. Then make it an order that the conductor must go ahead and stand on the track—not get away over and stand behind a string of cars. In the meantime, the motorman must get off the car and throw the switch back. This scheme was suggested by one of their conductors.

President Shannahan told the members that the State Railroad Commissioners had been anxious to have this matter taken up because of the large number of accidents on grade crossings, and in several instances on crossings which were supposed to be protected by some form of derail. These devices had been put in at Mr. Barnes' suggestion, and it was with great surprise that the Commissioners noted that accidents continued to occur at these very crossings. On investigation it was found that the derails had been frozen tight or for other reasons had been disconnected and were out of use. It really seemed to the Commissioners that they were a source of danger rather than of safety. It appeared to him that Mr. Clark's method would obviate this. Two men must do the work and it puts the conductor at a point where he will be hit by the train if he is not vigilant.

Mr. Stanley asked whether the Cheatham switch got out of order. Mr. Clark said that it had given very little trouble. Mr. Stanley thought it better to have it mechanical rather than electrical, but Mr. Clark said in that event it would be necessary to have a switch-throwing equipment on every car. Keeping the switch in order had given them little bother.

Mr. Wilson, of Rochester, said he did not see what would compel the conductor to get off and stand on the track, but Mr. Clark replied it would not take long to discover such neglect of duty.

President Shannahan asked if it would not be possible to locate the switch so as to have it thrown by the conductor instead of the motorman. Mr. Clark, however, said a duty of that kind would be simply mechanical, whereas his judgment is exercised when he is obliged to get on the steam railroad track to watch for trains. Mr. Harvie thought there should be no objection to placing a lever somewhat in the position of a draw signal between or close to the tracks, so the conductor would know the track was clear.

Mr. Eveleth asked if it would not be possible to use a device that would make the conductor hold the derail until the car was over. Mr. Clark believed that the conductor should be sent ahead of the car, but if he had to stand there and pull some switch it would be hard for him to jump on the car as it shot by—it being the rule on his line to run over crossings as quickly as possible after the safety signal is given. They have thirty-five derailing places. The boxes are kept from freezing by putting in salt.

Mr. Wilson, of Rochester, thought a bad feature was the absence of the conductor from the car, as the motorman could not see passengers entering or leaving the car. Mr. Clark answered that their agreements with the steam railroads in Cleveland expressly state that the conductor must go ahead of the car and signal the motorman in advance. They had practically no accidents due to passengers entering or leaving the cars, as very few do this at crossings, and anyway it is second nature for the motorman to look back when he starts his car.

The president then introduced Mr. H. L. Mack, superintendent of line, International Railway Company, who read the paper on "Rail Bonds," printed on page 104.

In the discussion which followed Mr. Mack's paper, Mr. Clark said that in Cleveland they have used all kinds of bonds—pin, soldered, terminal, compressed, etc. The fact was they were discarding bonds anyway. Their electrical engineer had recommended thermit welding on all lines with heavy return currents. What they are doing and have done during the past year is to coat the bonds with some amalgam (plastic alloy) daubing both sides of the bond to keep the air out. They use the Crown bond. Most of their bonding is really around special work. Before using the plastic alloy they coated the bond with white lead.

Mr. Wilson, of Rochester, asked Mr. Clark what he thought of the comparative value of white lead compared with the amalgam. Mr. Clark said he could speak only from what Mr. Cook (their electrical engineer) had told him, namely, that they test about as well.

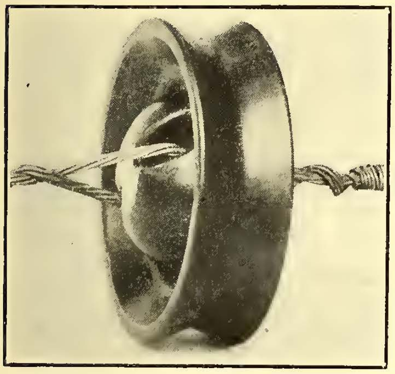
Mr. Brown asked Mr. Matthews what results he had with plastic bonds.

Mr. Matthews said they had occasion in 1903 to go over the track where plastic bonds had been installed nine years. On testing the joints they found no deterioration except of a mechanical nature, such as the loosening of the joint bolts.

Mr. French said he had some sad experiences with soldered bonds, but was not certain that the principle was at fault. In 1905 a small portion of the West Shore (steam) Railroad, between Frankford and Mohawk Junction was electrified and soldered bonds were used on the outside of the rail head on his recommendation. The bond was 500,000 circ. mil capacity and was made up of ribbons running horizontally. The freight traffic on the West Shore was so heavy that the excessive vibration worked the bonds loose because they did not possess sufficient flexibility. Finally they were replaced by 10-in. compression bonds put under the fish plate. If the bond had been constructed with the connecting wires coming from the terminals vertically instead of ribbons laid horizontally, they would have held a great deal better. He had also used the American Steel & Wire Company's twin terminal bond, which appealed to him more than the old compression bond. (This was described in the Nov. 24, 1905, issue of the Street Railway Journal on page 1021.) Mr. French said that this bond showed a conductivity equal to a soldered bond of the same capacity. This he thought superior to pression bond except that it must be placed on the outside of the rail where it may be stolen, but so far they had had no trouble in that respect. He thought that the man who tried to steal this bond would be convinced that he could not enough copper to pay for his trouble.

Mr. Wilson, of Toronto, who is also using twin terminal bonds, said he had avoided their being stolen by coating them with a mixture of oil and lampblack. They had many junk men traveling up and down their 30 miles of tracks, but no bonds have been stolen, though they have lost wire.

Following this discussion the subject of electrolysis was taken up in executive session.



G. E. Eveleth, of the General Electric Company, then read the paper on "Span and Catenary Construction," published on page 105.

Following this paper Mr. Eveleth showed the novel form of strain insulator illustrated herewith, and used in catenary construction. He stated that a great deal of attention had been given to this subject by the General Electric Company, and the form illustrated has so far proven very desirable for 6000 and 11,000 volts. It is of porcelain, weighs 3½ lbs., and is capable of withstanding about 10,000 lbs. pull. Its shape is somewhat similar to that of a trolley wheel. The object of the flaring flanges is to lead rain away from the vertical surfaces. The strain wires pass through holes which loop around each other so that the insulating material between them is under pressure and not under tension.

F. A. Bagg, chief engineer of the Fonda, Johnstown & Gloversville Railroad, who had been scheduled to read a paper on "Center Pole Construction," said that in preparing it he had found it was more of an argument for span construction than for center poles, and as the association was going to have a paper on span construction he thought another paper unnecessary. He would, however, give a few of his reasons for preferring span construction. The most important objection to center-pole construction is the manner of supporting the trolley wire at the bracket arm. It is not as flexible as the rest of the trolley wire and therefore the wheel jumps at the higher speeds and there is always sparking at the ear, which hurts the wire and in time brings on breaks at such points. He objected to seeing poles on the devil strip because it was dangerous,— they should be out of the way. There is a saving in grading and ballast in span construction, as the road can be narrowed by about 2 ft. With center-pole construction the tracks should be placed 15 ft. center to center, and with span construction they can be 11 ft. This difference is quite a consideration in first cost and maintenance. He thought span construction would estimate more per mile than the other, but the saving in grading and ballast will be in favor of span work. Catenary construction, of course, brings up new considerations. He had seen span and center-pole construction used indiscriminately in the same territory and on the lines of the same company, but it would seem that one type should have some advantage over the other. He believed that eventually one of the two methods, probably span construction, would win out and the other become obsolete.

Mr. Mayer asker Mr. Eveleth if he considered 15 ft. the minimum distance between hangers for catenary construction with the trolley wheel. He replied that there was nothing to limit the distance between points—it is simply a case of how many are considered necessary. If they had been running for years with 80 ft. to 100 ft. between points, an assumption of 50 ft. between points would be close enough for wheel collector work. Distance less than 50 ft. could be used for the wheel, but less than 15 ft. would make the systems more rigid without obtaining much more value for the greater cost.

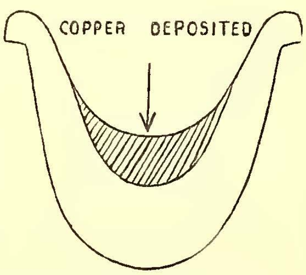
Mr. Reel asked Mr. Eveleth if it would not be practicable and desirable to apply the catenary system to span construction instead of carrying it on long brackets which, as Mr Bagg had pointed out, have their disadvantages.

Mr. Eveleth said there were a number of roads operating that way and the only difference from the usual cross-suspension is the extra weight of the messenger wire. It is also advisable to allow a little more depth between the points of support on cross-suspension and the connections to the messenger wire than in the ordinary construction On one catenary line of this kind no one had ever seen a wheel leave the wire on tangents.

Mr. Pardee wanted to ask one question regarding wire breakage. They were using 0000 wire and had five or six breaks inside the splicing sleeve during the last two months. Every time the wire broke 1-in. inside the sleeve. He was anxious to learn of a permanent corrective for this.

Mr. Clark said they should use a mechanical instead of a soldered sleeve. Another delegate suggested that the trouble was probably due to overheating the wire during the soldering process.

Mr. Griffin, who with Mr. Pardee represented the Rochester & Eastern Rapid Railway, said they were using a home-made trolley wheel with a collecting surface of 2¼ ins., as against the 1¾ ins. of the Kalamazoo wheel. This wheel was put on for a two-car train carrying eight 75-hp motors, and after running about 1725 miles copper from the wire was deposited on the wheel in the way shown in the accompanying cut. Other wheels wore out in the usual way after making from 5000 to 6000 miles, and he could not understand why a deposit should have occurred on this particular wheel. The pressure they try to keep is 35 lbs. at the trolley. The wheel increased 5-16 in. in diameter in 1725 miles. The schedule speed is 24 miles per hour.



SECTION OF WHEEL SHOWN BY MR. GRIFFIN

One delegate who had experienced a similar trouble when operating locomotives said it was due to heavy currents at slow speed; if the speeds were increased the trouble would disappear. Mr. Pardee pointed out, however, that this would not be a remedy in their case, for while the schedule speed was 24 miles an hour, the running speeds were often 50 to 60 miles.

The president then read a telegram from Mr. Barnes expressing his regret at being unable to attend the meeting.

The meeting then adjourned after unanimously adopting a vote of thanks to President Pierce and General Manager Wilson, of the International Railway Company, for the many courtesies extended to the delegates.

COPPER WELDING FOR RAIL BONDING

Copper welding as used in connection with rail bonding is now attracting the attention of electric railway men throughout the country. This process for uniting the bonds to the rails has been worked out by the Electric Railway Improvement Company, of Cleveland, and promises both durability and perfect conductivity.

In applying the process a quantity of copper is first

APPLICATION OF COPPER BEFORE WELDING

brought to a white heat in a crucible placed in a small furnace using hard coal or coke, served with an air blast. The bond is placed on the rail with the strands projecting into a mold made to the shape desired for the head. A portion of the melted copper is poured through a small opening in the mold where the point of contact is desired. The mold extends back along the rail some distance and is hollowed out to form an overflow, so that sufficient of the white-hot copper may be poured in to bring the strands of the bond and the steel up to the welding point. The copper at the same time adheres to the steel and the end of the bond in sufficient quantity to form a solid metal head. The

THE BOND IMMEDIATELY AFTER WELDING

mold is then taken off and the overflow knocked off with a hammer to be used again in the crucible for the next bond. This weld is said to be so perfect that even in breaking off the overflow particles of steel adhere to the copper and portions of the copper remain on the rail.

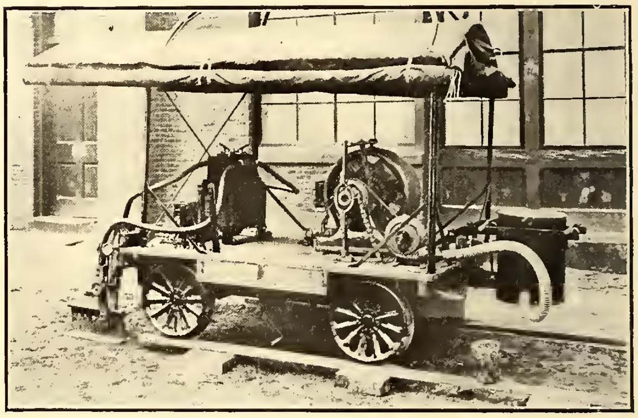
On a road under construction where power is not available, the car for carrying the furnaces and other welding apparatus has a 35-hp marine gasoline engine which is also used for operating the blower furnishing the blast for heating the copper. This engine has a chain draft with a

THE BOND COMPLETED

friction clutch. Where available the power of course can be taken from the trolley.

The portable furnace added to the welding car made by this company (which, together with the original process, was described in the Street Railway Journal for Nov. 24, 1906), is mounted in the rear of the car upon removable arms, so when not needed the entire apparatus may be taken off at will. The air blast is furnished by a small blower mounted on the car and operated by the welding generator through a band and friction clutch. When operating the electric welding machine it often happens that there is special work such as welding large cables. The copper welding outfit is of great advantage in this respect in connection with the electric welding machine. Cables as high as 1,500,000 circ. mil may be welded with this process.

The electric welding machines manufactured by the company are provided with rotary converters and step-down transformers for securing the desired voltage at the rail. The current for the weld is regulated through a switch in the primary of the transformer and the desired heat is obtained by a controller and rheostat in series with the armature. In operation, the bond is clamped to the rail and the



RAIL-WELDING OUTFIT ON LIGHT CAR

current turned on, when sufficient heat is developed to melt the brass cap forming the head of the bond. This makes a perfect union between the steel and the copper. Tearing off the bond ruptures either the steel or the copper and it is therefore never breakable at contact.

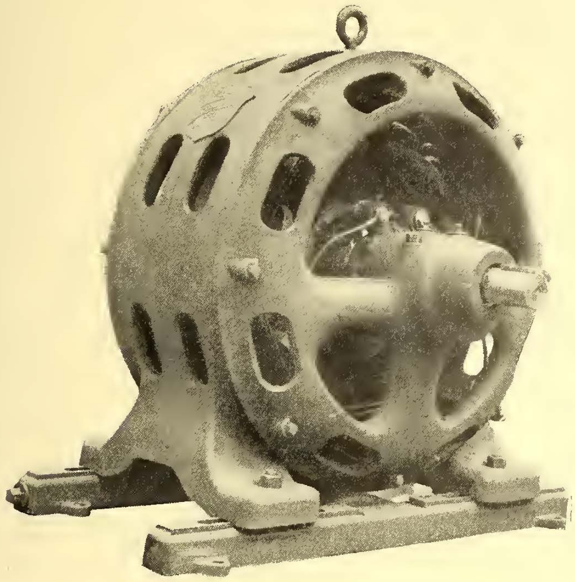
AN ELECTRIC RAILWAY SHOP FOREMEN'S ASSOCIATION FOR GREATER NEW YORK AND VICINITY.

At a meeting held in Newark, N. J., on the evening of Jan. 14, steps were taken by a number of shop foremen connected with the Public Service Corporation of New Jersey to form an association to have meetings from time to time for the discussion of shop questions. It is planned to take in at first the foremen connected with the electric railway companies in New York and vicinity, and later on form branches in more distant cities. At the present time the originators of this idea are perfecting the draft of the constitution and by-laws which will be presented at a meeting to be held Jan. 29, at 8 p. m., in the Wood Building, 122 Market Street, Newark. An invitation to attend this meeting is being sent to all foremen connected with the nearby railway companies, but should any fail to receive it, they are asked to come anyway and get acquainted. This meeting will be devoted to a discussion of the best methods for carrying out the work in a manner most beneficial to all the members. The present idea is to have monthly meetings at which experts from the different manufacturing companies will be invited to give talks on topics connected with the care and maintenance of equipment. Following each lecture there will be an open discussion and smoker.

All correspondence should be addressed to J. R. Case, foreman of South Orange Repair Shop, Public Service Corporation of New Jersey, Newark, N. J.

SELF-CONTAINED BELTED ALTERNATORS

The Allis-Chalmers Company has recently developed a line of small 60-cycle belted alternators known as Type A B. These machines are self-contained and are built for outputs ranging from 50 kw at 1200 r. p. m. to 150 kw at 900 r. p. m., two or three phase. They can also be furnished for single phase in outputs ranging from 37½ kw at



SELF-CONTAINED ALTERNATOR

1200 r. p. m. to 110 kw at 900 r. p. m. As shown by the accompanying illustration, the bearings are supported in end housings bolted to the stator yoke so that the whole machine is self-contained and requires no base. The stator yoke rests on slide rails, to which it is bolted.

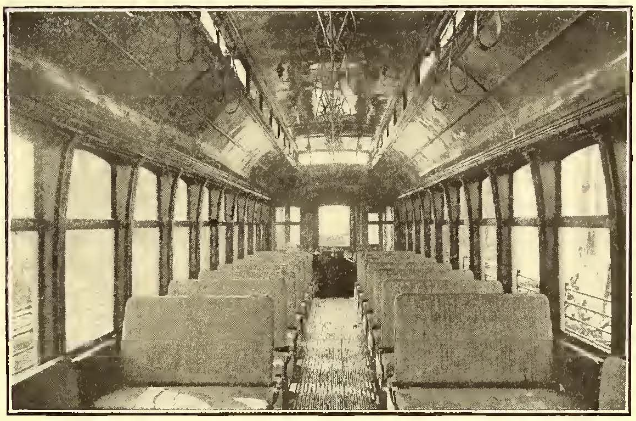
These machines are of the revolving field type, the armature being stationary. The stator punchings are of selected steel carefully annealed. They are supported in a cast-iron yoke provided with numerous openings to allow free circulation of air.

All armature coils are form wound. As the slots are open, the coils can be readily removed, thus giving a decided advantage over machines having closed slots, in which the coils are difficult to replace in case of accident. The projecting stator yoke and end housings completely protect the end of the coils where they project beyond the laminated core.

The field poles are built up of steel laminations riveted between end heads and dovetailed and keyed to a spider or hub. The field coils are wound with square wire, which makes a very compact and durable winding. Exciting current is supplied to the field through cast bronze collector rings mounted on the shaft between the field and the outboard bearing. The bearing housing has three arms, as shown in the illustration, thus leaving the space around the collector rings and brushes easily accessible. Each ring is provided with two brushes. The machine illustrated has the shaft extended to receive a pulley for driving a belted exciter; they can, however, be furnished without extended shaft. The bearings are of the ring oiling, self-aligning type, and are of liberal dimensions; both bearings are of the same size.

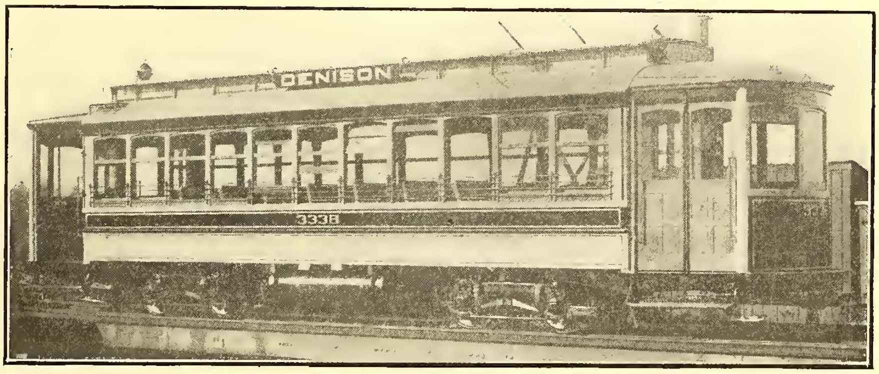
LARGE SHIPMENT OF SEMI-CONVERTIBLE CARS FOR CLEVELAND

The most noteworthy shipment made by the John Stephenson Company last month consisted of twenty cars of the Brill grooveless-post, semi-convertible type for the Forest City Railway Company, Cleveland. These cars present some interesting features in the interiors, notably the register rod, which runs directly down the center line of the roof instead of along the ventilator rail as is usual, thereby obvi-



INTERIOR OF FOREST CITY COMPANY'S CAR

ating the necessity for the conductor to ring up fares over the heads of seated passengers. The arrangement of the lights on either side of the register rod is also noteworthy. Arc lights are placed at each end of the car on the monitor roof. The finish of the interiors is in cherry, the ceilings



EXTERIOR OF FOREST CITY COMPANY'S CAR

are of three-ply birch, and the seats are of the Brill make. Angle-iron bumpers, drawbars, vestibule door controllers, sand boxes and other specialties used on the cars are all of Brill make. The car bodies are mounted on No. 27-G trucks having a wheel base of 4 ft. 6 ins. The weight of the car and trucks with motors is 44,000 lbs. The chief dimensions follow: Length over end panels, 30 ft. 8 ins., and over vestibules, 42 ft. 8 ins.; width over sills, including sheathing, 7 ft. 11½ ins.; size of side sills, 3¾ ins. x 7¾ ins.; end sills, 5¼ ins. x 6⅞ ins.

FINANCIAL INTELLIGENCE

The Money Market

WALL STREET, Jan. 16, 1907.

The past week has witnessed a decided improvement in the monetary situation. The heavy inflow of money from all parts of the country has materially strengthened the position of the New York City banks, and all indications point to a continuation of the movement in this direction for some weeks to come. For the week ending Jan. 12 the net gain in cash by the local institutions amounted to nearly $11,000,000, and since that time the cash holdings have been further increased by nearly $7,000,000, as a result of their operations with the Sub-Treasury. These favorable developments were reflected in a general disposition on the part of the large lenders of money to offer with more freedom, and consequently a further easing off in the rates for practically all classes of accommodations followed. Money on call, which last week commanded 15 per cent, was in abundant supply at rates ranging from 6 to 3 per cent, while funds for all fixed periods were readily obtainable at 6 per cent. The demand for time money, however, was largely for the short maturities, and lenders reported considerable difficulty in placing funds for six months and longer at 6 per cent. Mercantile paper was in better demand, but quotations ruled entirely unchanged at 6 and 6½ per cent for the best names. The sterling exchange market was strong at rates well above the gold import point, and this, together with the easier local monetary conditions, were reflected in a decidedly better feeling at all of the principal European centers, and especially at London, where money and open market discount rates have displayed an easier tendency. It is not expected, however, that the governors of the Bank of England will order a reduction in the official discount rate at this time.

At the close of the week the belief prevailed in banking circles that the present easy conditions will continue for some time. It is not expected that rates for day to day money will go materially below those ruling during the week, but it is probable that further concessions will be made in charges for time accommodations. About the only unfavorable factor of the situation is the heavy borrowings by the railroads and other corporations. The announcement of the issue of new securities by the St. Paul, Northern Pacific, Great Northern and other corporations, was followed this week by the announcement that the Pennsylvania contemplates the issuance of $100,000,000 new stock and a like amount of convertible bonds, while the directors of the Chicago & Northwestern have decided to issue $25,000,000 new stock, being part of the $100,000,000 authorized by the stockholders last autumn. Other new issues of stocks and bonds are likely to be announced from time to time, but the financing of them will probably be deferred until such time as the banks are in a better position to stand the strain. The bank statement published on last Saturday made a decidedly favorable exhibit. Loans decreased $858,800 and net deposits increased $8,344,100. The gain in cash was $10,578,900, but as the reserve required was $2,086,025 more than in the preceding week, the surplus was increased by $8,492,875. The surplus now stands at $8,640,700, as compared with $147,825 in the preceding week, $12,808,650 in the corresponding week of last year, $24,459,275 in 1905, $23,181,750 in 1904, $20,217,125 in 1903, $19,061,450 in 1902, $22,398,050 in 1901, and $16,707,350 in 1900.

The Stock Market

In so far as the volume of business is concerned the past week in the stock market has been one of the least important for some time past. This is in a measure accounted for by the revival of active interest in mining stocks dealt in on the curb market, although the tendency on the part of the big railroad corporations to bring out new issues of securities, as manifested by the announcement that the Pennsylvania Railroad would issue $100,000,000 stock and a like amount of bonds, and that the Chicago & Northwestern will shortly put out $25,000,000 additional stock, served as a pronounced deterrent in the taking on of new ventures by the speculative and investing public.

Such highly important factors as a pronounced restoration in the surplus reserves of the New York City banks, decidedly easier conditions in all branches of the local money market, continued enormous earnings by the railroads and further material advances in prices for copper metal, both here and in London, were almost entirely without influence in a stock market sense, although they unquestionably tended to strengthen belief in an ultimately higher ruling for all classes of securities. However, with such an uncertain element hanging over it as the making of new securities by the large railroad corporations, as well as rumors of further impending issues, it is not surprising that the market failed to respond to the favorable factors alluded to. Wall Street still remembers the effects of the last period of "undigested securities," and while it entertains no fear that it is about to run into any such period again, the mere suggestion of any such possibility is sufficient to retard operations for the bull account.

Another matter which has served to temporarily check bullish ardor is the absence of the customary demand for bonds incident upon the January interest and dividend payments. The high rates for money that have prevailed for several weeks past have been too tempting for those having ready cash at their command, and comparatively speaking the investment yield on railroad bonds is at present small, the money received as interest and dividends found its way into the loan market instead of that for bonds. Now, however, that the tension in the money market has apparently relaxed, and conditions promise permanent ease, this money will in all probability find its natural channel and the bond market benefit accordingly. This, of course, will exert a good effect upon the stock market.

There were very few noteworthy movements in individual stocks during the past week, and aside from those immediately concerned in the new issues of securities and those in the Hill-Harriman group, fluctuations as a rule were in keeping with the restricted volume of trading. Pennsylvania & Northwestern at one time suffered severe declines, but subsequently recovered part of their losses. Chesapeake & Ohio, Canadian Pacific and Erie, which companies were specifically mentioned as also considering the advisability of raising money by new security issues, were likewise heavy at intervals, but generally speaking the undertone of the market was steady, and some stocks even manifested rising tendencies. As a group, industrial stocks ruled firmer than the railways, the natural reflection of existing conditions in practically all branches of industry throughout the country, notably in the iron and steel, copper and rubber trades, where conditions are much more favorable than they have ever been at any time in history.

Philadelphia

The local market for traction shares has been comparatively quiet during the past week, and the general trend of values was toward a lower level. Philadelphia Rapid Transit was again the leader of the group, and the price sustained a sharp decline. Opening at 21, the price ran off to 19¼ on the reported serious illness of a prominent director of the company. About 8000 shares changed hands. Union Traction slumped in sympathy with the decline in Philadelphia Rapid Transit, upwards of 5000 shares selling at prices ranging from 59⅛ to 56. Philadelphia Traction sold as low as 94, and Philadelphia common ran off from 48 to 46¾. Other transactions included American Railways at 51, Railways General at 6½, Philadelphia Company common at 48 and 47, Philadelphia Company preferred at 48, and Frankford & Southwark at 425, and Consolidated Traction of New Jersey at 76½ and 77.

Baltimore

The United Railway issues were again the leading features of the Baltimore market, and although dealings in them did not assume large proportions, prices for these issues held decidedly firm. Of the 4 per cent bonds, $50,000 sold at 90 and 89¾, while $45,000 of the income bonds changed hands at 58¾ and 58½. Small amounts of the new funding 5s sold at 86¾ and 86½. The free stock changed hands at 13¼ and 13½ for upwards of 800 shares, and the certificates representing deposited stock sold at 13¾ and 13½. Other transactions included Macon Railway & Light 5s at 96½ and 96, Norfolk Railway & Light 5s at 98, and Lexington Street Railway 5s at 100¼.

Other Traction Securities

Interest in the Boston market centered largely in Massachusetts Electric issues, both of which were unusually active and strong. The common stock, after selling at 18½ early in the week, advanced to 20⅜, and eased off at the close to 19⅞, fully 3000 shares changing hands. The preferred stock rose from 69 to 71½, and then reacted to 70, about 2000 shares changing hands. Boston & Worcester common was easier, about 10,000 shares selling at from 27¾ to 26½. Boston & Suburban sold at 13½, West End common at 92½ and 92, West End preferred at 107, and Boston Elevated at 151. The traction issues at Chicago were practically neglected. Transactions included Chicago Union Traction preferred at 19¼ and 19⅛, Metropolitan Elevated at 27½ and 27¾, Northwestern Elevated preferred at 64½, and West Chicago at 27.

On the Cleveland Stock Exchange the feature of interest the past week has been the advance of Cleveland Electric of about 12 points since last week. This is due, of course, to the prospects of a settlement of the fight in the city. Traders did not ask so much upon what basis the settlement would be made, but whether it would be made soon. For a time after the decision of the United States Supreme Court it seemed that the stock would reach a very low point, but the reaction began with President Andrews' proposition to make a settlement on a fair basis, and the probability that Mayor Johnson would be willing to treat with him in the same spirit.

Security Quotations

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

	Jan. 9	Jan. 16
American Railways	51	51
Boston Elevated	150	a151
Brooklyn Rapid Transit	81⅞	81
Chicago City	160	160
Chicago Union Traction (common)	5¼	5½
Chicago Union Traction (preferred)	17½	17¼
Cleveland Electric	61⅝	71
Consolidated Traction of New Jersey	*75½	75½
Detroit United	80	80
Interborough-Metropolitan	36½	36¼
Interborough-Metropolitan (preferred)	73¾	73½
International Traction (common)	a63	a62
International Traction (preferred), 4s	82½	82½
Manhattan Railway	143¼	142¾
Massachusetts Electric Cos. (common)	19	19
Massachusetts Electric Cos. (preferred)	68½	69½
Metropolitan Elevated, Chicago (common)	27½	27
Metropolitan Elevated, Chicago (preferred)	69½	70
Metropolitan Street	105	105½
North American	87¾	89
North Jersey Street Railway	40	40
Philadelphia Company (common)	47¾	46¾
Philadelphia Rapid Transit	20⅛	19¼
Philadelphia Traction	95¾	94
Public Service Corporation certificates	67	67
Public Service Corporation 5 per cent notes	96	96
South Side Elevated (Chicago)	89	89
Third Avenue	120	121
Twin City, Minneapolis (common)	107	107½
Union Traction (Philadelphia)	59⅛	55¾

* Ex-dividend. a Asked.

Metals

The "Iron Age" says that the buying movement in pig iron for forward delivery in the Central West has made further progress. It is estimated that during the past week there have been made sales aggregating 100,000 tons in the Chicago district, and other markets like Cleveland and Cincinnati are feeling the movement, the furnaces in the former district having advanced the price to $22. Pittsburg reports that the supply of steel is becoming better so far as the open market is concerned. It is estimated that all of the steel rail mills in the country have on their books orders aggregating 2,500,000 tons in addition to about 250,000 tons carried over from last year.

Copper metal continues firm. Prices for all of the leading grades rule ½c. a pound higher for the week, and the tendency is still upward. Lake is quoted at 24½ and 24¾c., electrolytic at 24¼ and 24½c., and castings at 24 and 24¼c.

EARNINGS OF UNITED RAILROADS OF SAN FRANCISCO FOR YEAR AND STATEMENT FROM PRESIDENT THALMANN

The gross receipts of the United Railroads of San Francisco for 1906 were $5,941,000, a loss of approximately $1,116,000, compared with the year 1905. The gross passenger receipts for December were $556.000.

President Thalmann, of the United Railways Investment Company, which controls the stock of the United Railroads of San Francisco, says: "The officers and directors of the United Railroads are confident that the rebuilding of San Francisco will go forward with continued vigor. They report that the labor situation is steadily improving, and that the company now has no difficulty in obtaining all the labor necessary for the reconstruction of its old cable lines, several of which have been completed, and the entire work of reconstruction will be finished by spring.

"The delivery of the 250 new cars which were ordered by the company has begun, and when they are placed in the service the company should be as well equipped as any street railroad property in America. The new construction has been of the highest order. The officials of the company report a most favorable outlook for this year's business. It is confidently believed that the earnings for 1907 will exceed those of 1905."

AMERICAN RAILWAY INSURANCE COMPANY ORGANIZED

The organization of the American Railway Insurance Company, of Cleveland, Ohio, was completed at a meeting of stockholders, held at the office of Henry H. Staats, Thursday, Jan. 10. The directors of the company are: Horace E. Andrews, of Cleveland; C. L. Allen, of New York; A. E. Akins, of Cleveland; H. L. Clark, of Philadelphia; Alexander Dow, of Detroit; Henry A. Everett, of Cleveland; G. L. Estcrbrook, of Philadelphia; C. G. Goodrich, of Minneapolis; J. C. Hutchins, of Detroit; Walter Kernan, of New York; R. E. Sheldon, of Columbus, and J. H. Price, Samuel Scovil and Henry N. Staats, Cleveland. The board organized by the election of officers as follows: Horace E. Andrews, president; Henry N. Staats, vice-president and general manager; H. J. Davies, secretary and treasurer. Horace E. Andrews, Henry A Everett, H. J. Davies and H. N. Staats, all of Cleveland, and J. C. Hutchins, of Detroit, executive committee. H. L. Clark, of Philadelphia; R. E. Sheldon, of Columbus; C. G. Goodrich, of Minneapolis, and E. W. Moore and J. H. Price, of Cleveland, financial committee.

Electric railways and light companies represented at the meeting are as follows: Twin City Traction Company; Cleveland Electric Railway Company; Rochester Railway Company; Syracuse Rapid Transit Company; Utica & Mohawk Valley Railway Company; Schenectady Railway Company; Rochester & Eastern Rapid Railway Company; Rome City Railway Company; Oneida Railway Company; Northern Ohio Traction & Light Company; Toledo Railways & Light Company; Canton-Akron Railway Company; Detroit United Railway Company; Bangor Railway & Light Company; East St. Louis & Suburban Railway Company; Alton, Granite & St. Louis Railway Company; Grand Rapids Railway Company; St. Joseph Railway, Light, Heat & Power Company, Columbus Railway & Light Company; Lake Shore Electric Railway Company; Cleveland & Southwestern Traction Company; Cleveland, Painesville & Eastern Railway Company; Detroit Edison Company, and Cleveland Electric Illuminating Company.

The company is capitalized at $200,000, and has a surplus of $300,000. It is possible that the capitalization and surplus will be increased to $1,000,000 later on. The company will write on electric railway properties and lighting plants exclusively, and from the start will be able to carry pretty large lines. It will be ready to write business within two months. The Traction Mutual, the Electric Mutual and the Asociated Railway Companies' Insurance Company will also be put into operation later on. The office is in the Citizens' Building.

A TRUCE AT CLEVELAND

A thirty-day truce has been declared in the street railway controversy at Cleveland, and, in the meantime, all injunctions will be inoperative and the Municipal Traction Company will operate its cars over the Cleveland Electric's line from its present western terminus to the Square. This agreement was reached between President Horace E. Andrews, of the Cleveland Electric, and President Dupont, of the Municipal Traction Company, as a result of the decision of the United States Supreme Court on the Central Avenue and Quincy Street lines a few days ago. As a duty to the public, these lines must be kept in operation by some means, and this plan was adopted in order that sufficient time might be given to arrive at some conclusion as to a permanent settlement of the question. Of course, the Cleveland Electric was not expected to give up the lines without an opportunity to secure a renewal of its rights in some way. On the other hand, the new companies were anxious to get possession of the streets on the strength of the franchises that were granted after it was declared by the United States Circuit Court that the Cleveland Electric had no right in these thoroughfares by virtue of the renewal of the old franchise at first granted by the City Council.

Immediately after the news of the decision of the Supreme Court reached Cleveland a public meeting of the City Council was called for Thursday afternoon, when the Cleveland Electric Railway Company was asked to present some plan looking to the termination of its occupancy of the streets on which its franchises had expired. Mayor Johnson presided at the meeting. President Horace E. Andrews read the proposition of his company from the clerk's desk. In substance, it said that when the City Council determines the wisest course to be followed, his company desires an opportunity of presenting a proposition for the continued use of the lines on which the franchises have expired. As some time is necessary in arriving at such conclusions, he suggested that the company be allowed to operate the two lines at cost, pending a final determination of the course to pursue. To this end he proposed to operate the lines at a fare of three cents per passenger, with transfers, as at present, and at the termination of the arrangement, if the cost of carrying passengers proves to be less than three cents each, the amount of surplus is to be determined by H. J. Davies, secretary of the Cleveland Electric, and A. B. Dupont, president of the Municipal Traction Company, with the provision that if they cannot reach an agreement a third person shall be chosen by them. As to the other streets on which franchises may have expired, he suggested that if their use as loops and for terminal purposes were forbidden, the public good would not be subserved. At the same time, he said, if it is the will of the Council, they will be abandoned. Mr. Andrews stated that, although the company is not legally bound to compensate the city for the use of Central Avenue and Quincy Street since the expiration of the franchises in 1905, and that a Supreme Court decision on the subject is to the effect that streets used for street railway purposes is highway use, it wishes to meet the question and pay to the city every cent to which it is entitled, eliminating any question of technical law or legal rights. The company at one time offered to make an agreement to the effect that it would account to the city for all profits above 6 per cent on the property used in these streets, in case the courts decided that it had no rights in the streets, but it was refused by the city. However, Mr. Andrews said that the company is now willing to submit the entire matter to the judgment of H. J. Davies and A. B. Dupont, with the stipulation that the amount fixed by them shall not exceed the amount originally offered by the company for the use of the streets. In case they fail to agree they are to call in some third person to settle the differences.

President A. B. Dupont, of the Municipal Traction Company, presented a proposition in writing looking to the lease of the entire system of the Cleveland Electric Railway Company, on the same basis as the Municipal Company, now holds the property of the Forest City Railway Company. On this it is paying 6 per cent on the stock that the company issued at not less than 90 a share, and redeemable at $1.10, the stock representing only the physical and construction value of the property. The Municipal Traction Company is willing to enter into similar contracts with the Cleveland Electric, the rent to be fixed by a careful determination of the physical value of the property and the present worth of the unexpired franchises, adding to that sum one-ninth thereof, and upon the sum so derived, paying at the rate of 6 per cent per annum. The company instructed Mr. Dupont to suggest that he was willing to meet President Andrews, of the Cleveland Electric, and determine with him the valuations. It was also suggested that a stock reorganization might be effected which would allow the stock of the Cleveland Electric to be redeemable at the same figure placed upon the Forest City. In case such a proposition is accepted, the company expressed its willingness to make such changes in the personnel of the company as would be satisfactory to all concerned.

W. A. Greenlund, secretary of the Low Fare Railway Company, presented a proposition to lease or rent the property of the Cleveland Electric Railway Company on Central Avenue and Quincy Street and operate the line on a fare of three cents, giving transfers to any other road in the city that will give transfers to its lines. The conditions are that the property shall be appraised by a commission of three, one chosen by the Low Fare Company, another by the Cleveland Electric and the third by these two, and that 6 per cent interest be paid upon this valuation in the form of rent, payments to be made monthly in advance. Strict account would be kept of the business and full reports made to the City Council. This arrangement was to be maintained as long as perfectly satisfactory to the city and until some more permanent arrangement could be made for the use of the streets. The property, of course, would be adequately maintained. The company also proposed to purchase the property at the values fixed.

The Mayor suggested that the Council meet the next afternoon in executive session to consider the propositions that had been submitted for a settlement of the trouble. When the time came for the meeting, however, the Mayor said it should be an open session. Members of the Council were surprised when the first order of business was announced as a joint communication from President Andrews, of the Cleveland Electric, and President Dupont, of the Municipal Traction Company, and they were more surprised when that communication proved to be a truce declared for thirty days on conditions satisfactory to all parties concerned. Besides agreeing that all injunctions should be suspended for that period, and that no new legal cases should be begun, the Municipal Traction Company agreed to defer all further work on new lines for that period. This indicates that both sides will make an earnest endeavor to arrive at some plan that will mean a settlement of the long fight here satisfactory to the city and the companies. The fact that Mayor Johnson blocked the incorporation of a three-cent clause in one of the resolutions offered at this meeting also indicates that he is not decidedly averse to a settlement that does not call for that exact figure.

On taking up the discussion of the proposition of the Cleveland Electric, made the day before, an attempt was made to inject a thirty-day limit into it. This was opposed by the Mayor and many of the Councilmen. When the vote was taken there were only four against it. The question was put in the form of a resolution, and the chairman of the committee on street railroads was instructed to prepare proper resolutions to be presented at a regular meeting of the Council embodying what had been done. The proposition of the companies to call a truce having already been accepted by resolution, both Messrs. Andrews and Dupont said that the lines would all be in operation Saturday morning, according to the plans agreed upon, which was done.

That the interests affected are ready to consider the matter, was indicated by the fact that President Andrews asked President Dupont to meet him and begin negotiations at once. It was decided, however, that it would be better to delay the matter until the Council had received a communication from the Cleveland Electric that it was willing to enter into such negotiations. President Andrews left for New York Saturday evening and will not return until Wednesday evening, so that the negotiation will necessarily be postponed until the latter part of the week. Mayor Johnson and President Dupont, of the Municipal Traction Company, conferred on Saturday, and, it is said, considered the working out of the details of the plans upon which a holding company could take over the Cleveland Electric property.

Aside from the security to be offered, one of the hard points to determine will be the valuation of the Cleveland Electric's stock. It is surmised that a holding company should not take the business at a higher valuation than 70, and possibly not that. On the other hand, the owners of the Cleveland Electric stock would probably not be willing to lease on a basis under that figure, and they would probably want more. The stock has gone up about five points within the past few days, and shows an inclination to go still higher. At one time when Mayor Johnson broached the subject of a holding company, he stated that he would be willing to accept a lease on the basis of 85, but of late he has placed a lower valuation on the stock, perhaps because he believes the company is not in as strong a position as it was at that time.

On Wednesday Judge William A. Babcock, of the Common Pleas Court, decided that the franchise of the Low Fare Railway Company on Sumner Avenue is not invalid because it was not published a second time before the ordinance granting it was passed by the Council. This, of course, was only a partial victory, as the Cleveland Electric still had the financial interest contention to interpose; but the following day the attorneys for the Cleveland Electric announced that they would not continue the case, and the restraining order was dissolved. The Forest City Railway Company at once put a force of men to work on the road, and on Friday evening they had used all the material at hand and the tracks had not yet reached East Ninth Street. Just what course the Forest City will pursue now is problematical. It is included in the agreement made with the Cleveland Electric, and cannot consistently continue the construction of the Low Fare Company's road, although the latter is free to do as it chooses, according to Secretary Colver.

The hearing of the financial interest case against the Forest City Railway Company was taken up early last week, and Randolph Clitz, sales agent of the Lorain Steel Company, was put on the stand. He testified to the guarantee that Mayor Johnson gave his company for the rails furnished the Forest City Company. The court, in deference to the wishes of the contending companies, however, suspended the operation of all injunctions, and nothing more will be done with these cases until the expiration of the agreed thirty days. The Cooper injunctions on Superior Street cases were also suspended for that time, and the Forest City cars were in operation regularly over the tracks of the Cleveland Electric Saturday. They go to the Public Square and return. The agreement provides that the low fare companies shall not operate, or attempt to operate, cars east of the Square.

The City Council has accepted the proposition of President Andrews, of the Cleveland Electric Railway Company, regarding the manner of arriving at the amount of compensation for the use of the streets since the franchises expired, and the agreement on a truce between the contending companies has also been approved. In a communication to the City Council, read Monday evening, Jan. 14, the Cleveland Electric indicates its willingness to treat with the city and the other companies on a holding company plan, but states frankly that the officers believe their proposition to give seven tickets for a quarter and universal transfers will be more satisfactory to the people. The letter states in detail the reasons for this belief, and also that, from their experience, the officers think a road cannot be operated on a 3-cent fare. They fear a failure of the plan, although the company will, under the ideas advanced, be protected in case of such a failure.

TRANSIT MATTERS IN NEW YORK

Chas. Buckley Hubbell, Harry W. Alden and Warren Leslie, commissioners appointed by the Appellate Division of the Supreme Court to consider the advisability of four subway routes, presented their report Monday, Jan. 14. They approve three of the routes.

The first route approved is the bridge loop railway. It extends from the Manhattan terminus of the Williamsburg Bridge, through Delancey Street to Center Street, and thence to a "suitable point under the proposed terminal of the Brooklyn Bridge." It has three spurs; the first from Center Street, under Grand and Desbrosses Streets to West Street; the second from Center Street, under Canal Street to the Manhattan terminal of the Manhattan Bridge, now under construction; the third from the southern terminus of the loop under William Street to Beekman Street.

The second route recommended is the Beekman Street Railway. It will connect with the present Subway at the City Hall, and local trains will run from the Subway through it under the East River to a point in its center, where it will join a tunnel now under construction. From there the trains will run under Cranberry and Fulton Streets, Brooklyn, to Joralemon Street.

The Maiden Lane route is the third which has been approved. It is a link in the Fourteenth Street section, which is to pass through Fourteenth Street, come down the west side to Liberty Street, and run east to Maiden Lane. From there it will run to the East River and will meet the proposed tunnel to Brooklyn in the center of that stream.

The commission, however, decides against the William Street route upon the question of the nature of the ground through which it would have to be built. The suggestion is that it begin at Beekman and William Streets, the end of the southerly spur of the Bridge loop, and pass under William Street and Old Slip to the tunnel to Brooklyn, making the same connection with the Brooklyn subways as the Beekman Street and Maiden Lane routes.

The routes were laid down by the Board of Rapid Transit and have passed the Board of Estimate and Apportionment. As the abutting property owners did not consent, the Appellate Division named the commission. If it approves of their findings, it will consent to the construction of the lines. As several schemes for effecting the same object—the relief of transportation conditions—are under consideration by different commissions, the approval of this report by the court will not take from the Board of Rapid Transit Commissioners the ultimate decision as to what subways shall be constructed. The board will still have the power to build all or none of those approved by the court. The next step in the proceedings will be the hearing of a motion to confirm the report before the Appellate Division.

The Interborough Rapid Transit Company completed one of the last links of its Broadway subway line Monday, Jan. 14, and one minute after midnight Tuesday morning the first train was run over the Ship Canal Bridge to the 225th Street station. The opening of the new station is of great importance to residents of Kingsbridge, Marble Hill, and points as far as Yonkers. Up to this time passengers in that locality have had to walk acros the Ship Canal Bridge to 221st Street to get subway trains. The subway, by the opening of the new station, will connect directly with the trolley for Yonkers, which has a terminal at this point. The station is also only about 200 ft. from the Kingsbridge station of the Putnam Railroad.

The plan for a speedy relief of traffic conditions at the Manhattan terminal of the Brooklyn Bridge, for which the Board of Estimate and Apportionment on Friday, Jan. 11, authorized the appropriation of $3,000,000, embraces, among other things, a temporary rearrangement of all the tracks, both elevated and surface, running into the present terminal and the diversion of the traffic to a sub-surface station between Park Row and Center Street.

STREET RAILWAY RESULTS IN CONNECTICUT FOR YEAR ENDED JUNE 30, 1906

The fifty-fourth annual report of the Connecticut Railroad Commissioners to the Governor for the year ended June 30, 1906, has just been made. In the part of the report which deals with street railways the commission refers to what has been done during the year in building lines and extending those already built and says that the growth in the traffic and earnings of the street railways is a "surprising revelation."

Below are given extracts from the street railway part of the report:

The total capital stock of the street railway companies outstanding is $29,107,500, representing 739,931 miles of main tracks owned, computed as single track, including, in some cases, gas and electric lighting properties. This amount is $1,347,488 less than the amount reported one year ago, principally caused by the consolidation of various companies since that time. If the whole amount of stock reported is considered applicable to street railways (which is not the case), and is divided by the miles of main track owned, viz., 739,931, it would show $39,338.13 capital stock issued per mile.

The total bonded debt of the street railway companies is $48,251,592.88, an increase of $11,715,000 over the previous year.

The floating indebtedness of the companies is $823,299.16, a decrease of $233,652.28 since the previous year. The total stock, bonds and floating indebtedness of the companies is $78,182,392.04, an increase of $10,133,859.72 over that of last year.

The cost of construction and equipment reported is $64,394,736.42, including the cost of the street railways and certain gas and electric lighting properties. This amount divided by the number of miles of main track owned, viz., 739,931, giving $87,028.03 as the cost per mile including gas and electric lighting properties.

The gross earnings of the companies for the past year were $6,349,202.31, an increase of $925,585.88, or 17 per cent over the earnings of the previous year. The gross earnings per mile operated were $7,989.36, being $813.55 more per mile than last year, and per mile run $0.2432. The gross earnings per car-hour were reported as $2.319.

The operating expenses for the year were $3,795,694.11, being $416,064.04 more than for the previous year, amounting to $4,776.21 per mile operated and $0.1454 per mile run.

The net earnings for the year were $2,558,602.14, compared with $2,043,986.30 for the previous year, an increase of $514,615.78, or an increase of about 20 per cent, and were $3,213.15 per mile operated, and $0.0978 per mile run.

Dividends amounting to $453,935.54 have been paid upon $16,900,000 of capital stock, while no dividends are reported paid on $12,207,500 capital stock.

The amount of taxes paid to the State by the various companies was $295,892.53.

The number of miles run was 26,096,310; gross earnings per mile, $0.2432; operating expenses, $0.1454, and net earnings, $0.0978. The number of miles run increased 2,107,195 over the previous year, an increase of about 13 per cent, and the gross earnings, operating expenses and net earnings per mile run show a slight increase.

The number of fare passengers carried was 121,322,906, an increase of 18,428,746, or 18 per cent over the number carried last year, compared with 70,536,271, carried by the steam railroads.

The number of employees was 3815, an increase of 208, averaging about 4.8 per mile operated.

CHICAGO TRACTION ORDINANCES RECOMMENDED TO THE CITY COUNCIL

The Chicago traction ordinances have been completed and have been recommended by the Council committee on local transportation to the City Council. The action was in accordance with the vote of the Council a week ago, declaring itself in favor of immediate settlement of the traction question rather than to delay until a referendum vote could be taken in April. This action of the Council evicted a strong protest from Mayor Dunne, who favors a referendum, and as a compromise provisions for a referendum were incorporated in the resolution of the committee recommending the adoption of the ordinances. The resolution as passed read:

Resolved, That the committee recommend the adoption of the pending ordinance as reported by the committee unless a petition signed by the number of bona fide voters required by law requesting the subntission to the electors of the city at the election to be held on April 2, 1907, of the question of the adoption of said ordinances as reported by the committee shall be filed with the Board of Election Commissioners of Cook County not less than sixty days before said election.

And that in the event of the filing of such a petition, the ordinances be passed after their amendment by the addition of a section providing that said ordinances shall not take effect unless a majority of the votes cast upon the question shall be in favor of the adoption of the ordinances.

The committee's action, which was taken after the end of a 14-hour session, is regarded as a definite step towards the settlement of the traction difficulties. If the Council passes the ordinances as is generally expected, and a referendum is not desired by the people, relief from the present inadequate transportation facilities will be in sight.

The traction ordinance for the lines of the present Union Traction Company is left blank. A provision is made in the ordinance for the organization of a holding company to take over the properties of the Union Traction Company. Special Traction Counsel Fisher has announced that a board of five trustees has been selected for the new incorporation to succeed the Union Traction Company. This board, as announced, is made up of Charles Gates Dawes, president of the Central Trust Company of Illinois; A. A. Sprague, of Sprague, Warner & Company; Chauncey Keep, capitalist and one of the executors of the Marshall Field estate; Charles H. Hulburd, president of the Elgin Watch Company; A. C. Bartlett, of Hibbard, Spencer, Bartlett & Company.

MORE BOSTON-PROVIDENCE INTERURBAN PLANS FILED

The Gaston-Shaw-Stone & Webster plans for an interurban electric railway have been filed with the Massachusetts Railroad Commission, with a petition asking the board to certify that public exigency requires the construction of its line. A hearing will shortly be assigned upon the matter. The petitioners are: J. L. Richards, H. H. Newton, F. S. Pratt, Russell Robb and L. E. Snow, directors of the Boston and Providence Interurban Electric Railroad Company.

The estimated cost of construction and equipment of the new line, which will be about 40 miles long, is $4,730,819. Among the items which are included in this total are: Right of way, $473,058; steel rails, 8203 tons, $278,140; track laying and surfacing, $82,498; clearing and grubbing, 270 acres, $18,630; twenty-eight overhead crossings, $253,000; twenty-one underneath crossings, $136,500; changing channel of Neponset River, $12,000; bridging and trestle work in Boston, $55,676; power station and equipment, $774,000; fifty-two 50-ft. passenger and combination cars, $565,000; two freight locomotives and two express cars, $61,000; ten coal and freight cars, $24,000. The route begins in Hyde Park Avenue about 1200 ft. south of Forest Hills Square.

PENSION SYSTEM IN WASHINGTON

The Washington Railway & Electric Company and its allied companies have established a new pension system, which went into effect Jan. 1. Employees who have attained the age of seventy years, those who have worked continuously for twenty years or more in the service of the company, and those who become physically disqualified by reason of injuries received in the line of duty will be benefited by the system. The railway company has appropriated the sum of $5,000 annually to defray the expense incurred in paying these pensions. It is announced that a board will be named whose main duty will be to consider and pass upon all matters pertaining to the pension system. The number of members of this board has been fixed at not less than five and not more than seven, and they will be appointed by the president of the company to serve as long as he deems best.

Any employee in the service of the company who is a member of the Washington Railway Relief Association, or who shall become a member of that association before June 30, 1907, is eligible, it is stated, for a pension allowance, provided he remains a member until his retirement or has been declared ineligible to membership by the officers of the association. The employees benefited are those who are employed by or in connection with any of the railroads operated by the Washington Railway & Electric Company, or its allied lines, and also the Potomac Electric Power Company, so that the service of any such employee shall be considered as continuous from the date upon which he has been employed upon or in connection with such railways or companies. Arrangements have been made whereby the board shall appoint one or more physicians, who will examine the member making application for a pension. The allowances paid the employees after all formalities have been complied with, are as follows:

If service in the company's employment shall have been continuous for thirty-five years or more, 40 per cent per annum, in equal monthly instalments, of the average annual wages for the ten years next previous to the retirement.

If the service has been continuous for thirty and less than thirty-five years, 30 per cent per annum, in equal monthly instalments, of the average annual wages for the ten years next previous to retirement.

If the service has been continuous for twenty-five and less than thirty years, 25 per cent per annum, in equal monthly instalments, of the average annual wages for the ten years next previous to retirement.

If the service has been continuous for twenty and less than twenty-five years, 20 per cent per annum, in equal monthly instalments, of the average annual wages for ten years next previous to retirement.

The same basis of payment to apply to all employees who are retired at the discretion of the pension board.

Pension allowances may be revoked by the board upon conclusive proof that the recipient has been guilty of misconduct, of which the board shall be the sole judge.

PRESIDENTIAL ADDRESS OF B. J. ARNOLD BEFORE WESTERN SOCIETY OF ENGINEERS

The presidential address of Bion J. Arnold at the annual dinner of the Western Society of Engineers, on Jan. 8, was devoted to the subject of heavy electrification. Mr. Arnold gave a brief summary of the electric railway plans of the New York Central & Hudson River Railroad Company; the Pennsylvania Railroad Company's New York terminal; the Long Island Railroad Company; the Hudson Companies; the New York, New Haven & Hartford Railroad; the St. Clair tunnel of the Grand Trunk Railroad; the Erie Railroad; the West Jersey & Seashore branch of the Pennsylvania Railroad; the West Shore Railroad between Utica and Syracuse; the Spokane & Inland Railway; the Simplon Tunnel, and the Southern Pacific Railway, near San Francisco. According to Mr. Arnold, these propositions involved an expenditure of approximately $100,000,000 for electrical equipment and a collateral investment of some $300,000,000 more. He also referred to the proposed electrical equipment of the Cascade division of the Great Northern Railway, for a distance of about 100 miles, and a division of the Southern Pacific Railway through the Sierra Nevada Mountains, both of which are for the purpose of eliminating the difficulties due to tunnel operation.

WORCESTER RAILWAYS & INVESTMENT REPORT FOR YEAR ENDED DEC. 31

The Worcester Railways & Investment Company, which is controlled by the New Haven, has issued its pamphlet report for the year ended Dec. 31, 1906. The company itself is a voluntary association, owning all the stock of the Worcester Consolidated Street Railway Company and other miscellaneous street railway securities. The income account for the year compares as follows:

	1906	1905
Gross receipts	$283,318	$237,282
Balance income acct. previous year..	23,142	149,761
Total	$306,461	$387,043
Expenses	4,692	4,411
Balance	$301,769	$382,632
Dividends	292,284	359,490
Surplus	$9,485	$23,142

In his report to the shareholders, President Bullock says:

"A large amount has been expended the past year in reconstruction and repairs of the various properties owned by this company and all properties are in excellent condition.

"During the year the Marlboro & Westboro Street Railway has been purchased. Two lines are thus established between Worcester and Marlboro, so that cars can be run alternately and give a half-hour service between the two places. One line runs by the way of Shrewsbury and Northboro, the other by the way of North Grafton and Westboro.

"On Dec. 18 the new line, practically an air line, between Worcester and Leominster was opened. It is located for the most part for about 10 miles on private land, which enables the company to reduce the running time between the above mentioned places from 2 hours to about 1 hour, and it takes only 1½ hours to go from Worcester to Fitchburg by this route.

"As it passes through West Boylston, Sterling Junction and Sterling, towns that never have had the advantage of street railway connections, the local traffic is expected to add considerably to the through business, especially in the summer, when a large number of persons go to Sterling Junction.

"The floating debt of the Worcester Consolidated on Sept. 30, 1906, was $1,978,000, an increase of $275,500 over the previous year, the greater part of which increase was expended in connection with the new line to Leominster."

The principal change in the investments of the company are the acquisition of 1585 shares of the capital stock and $80,600 notes of the Marlboro & Westboro Street Railway Company.

OPERATING RESULTS IN MASSACHUSETTS FOR YEAR ENDED SEPT. 30

From the reports of the street railway companies of Massachusetts for the year ended Sept. 30, on file with the Railroad Commissioners, have been compiled figures giving in outline the general results for the year. The record of the ninety-two companies shows a total of 572,128,730 passengers carried. Gross earnings were $33,955,447, an increase of $6,914,156 over the previous year, while net earnings, $8,199,561, showed a decrease of $572,471. Dividends amounting to $2,159,321 were paid by only twenty-nine companies out of a total of ninety-two. On their railways, land, buildings and equipment, the railways place a book value of $133,357,315, of which the cost of railways represents $75,261,295; equipment, $34,927,226, and land and buildings, $23,168,795. The capital stock of all of the ninety-two railways amounted to $72,187,200, an increase over 1905 of $1,860,215. The number of car miles run was 113,205,945. The number of miles of railway operated was 3,307.2 miles. A total of 7318 cars were operated, while aggregate number of employees was 17,134 Only three persons were killed out of an enormous total of 572,128,730 persons who used the trolleys, while 5156 persons were injured. The following table shows the more important operations of the Massachusetts street railways for the years ended Sept. 30, 1906, 1905:

	1906	1905
Gross earnings	$33,955,447	$27,041,291
Net earnings	8,199,561	8,772,032
Dividends	2,819,404	3,174,505
Capital stock	72,187,200	70,326,985
Number passengers carried	572,128,730	532,731,013
Car miles run	113,205,945	109,258,739
Miles operated	3,307.2	2,668.5
Persons employed	17,134	16,479

CONSTRUCTION OF SAN FRANCISCO, VALLEJO & VACA VALLEY RAILWAY BEGUN

Work has been started on the grading of the San Francisco, Vallejo & Vaca Valley Electric Railway from Vallejo, Cal., to Benicia. This road is the one which was promoted by the late Col. L. W. Hartzell. He sold his franchises to Col. Stock, who, in turn, secured the money for the building of the road in France. The company will first build its road from the Maine Street wharf in Vallejo, where it will connect with the steamers of the Monticello Steamship Company running to San Francisco. It will extend along Maine, Alamedá and Pennsylvania Streets and Solano Avenue, in Vallejo, to the county road to Benicia. Along this road a franchise has been secured to the tannery city. Where the road is not straight, private rights of way will be secured by purchase or condemnation proceedings. The route of the road will pass within a half mile of the big oil refinery to be built at Dillon's Point, four miles east of Vallejo, on Carquinez Straits, and a branch road will be run to the oil works. From Benicia north, the road will connect with Suisun, Vacaville, Winters and Dixon, and later with Sacramento. This has been definitely announced. What means will be used to reach Marysville, to connect there with Stock's Marysville & Great Eastern road to Downieville, is not known, but already a conference has been held with the Northern Electric officials for the use of its tracks from Sacramento to Marysville. Vallejo is now connected with Benicia, the second largest town in the county, by a stage line which gives fairly good service, but an electric road will pay big returns from the start, as Vallejo is off of the main line of the Southern Pacific road, and a branch electric line will cause all of the Vallejo traffic to Sacramento, Oregon and eastern points to pass over the electric road to the steam road's main line at Benicia and will benefit that town immensely. The grading work will start at the city limits of Vallejo and extend eastward. No work will be done in town until nearly all of the outside line has been finished. May 1 is the date set for the opening of the road between Vallejo and Benicia.

PUBLICITY THE TOPIC AT MASSACHUSETTS ASSOCIATION DINNER

At the monthly dinner of the Massachusetts Street Railway Association, at Young's Hotel, Boston, on Tuesday, Jan. 8, Thomas F. Anderson, of the Boston Publicity Bureau, was the chief guest. President Francis H. Dewey, of Worcester, presided. There was a large attendance of members. Mr. Anderson spoke informally upon the relations that exist between the transportation companies and the press. He referred to the present policy of railroads and street railway companies in the matter of furnishing to the newspapers information concerning these companies that is of interest to the public. He said that a number of the big railroads of the country have established press or publicity bureaus during the last ten or fifteen years, and some of the important street railway companies have followed the example.

MANY APPLICATIONS FOR CHARTERS IN PENNSYLVANIA

The probability of the present Pennsylvania Legislature exacting legislation favorable to the electric railway companies of the State, including the authority to carry freight and the right of eminent domain, has greatly accelerated the movement toward establishing new lines, as evidenced by the number of applications for charters filed in the office of the Secretary of the Commonwealth. A number of these lines will traverse populated districts now without steam or electric connections. Among the companies recently granted charters are the following:

Big Valley Street Railway Company.—Capital, $162,000; length of line 27 miles, extending from Mill Creek, Huntingdon County, to Lewistown, Airy Dale, Allenville, Belleville and Reedsville. Of this line 11 miles will be in Huntingdon County and 16 miles in Mifflin County. It will be a single-track line. R. W. Jacobs, of Huntingdon, is president, and the other directors are: F. Blair Isenberg, H. E. Steel, George C. Wilson and Wallace Wilson.

Juniata Valley Electric Railway Company.—Capital, $84,000; length of line 14 miles; extending from Third and Washington Streets, Huntingdon, through Ardenheim, Mill Creek, Long Hollow and over certain streets in Mount Union and Huntingdon. The directorate is the same as for the Big Valley Electric Railway.

Caledonia Street Railway Company.—Capital, $200,000; length of line 13 miles, extending from the present eastern terminus of the extension of the Chambersburg & Gettysburg Electric Railway at Graffenburg, thence over the Chambersburg Turnpike and Gettysburg and Petersburg Turnpike through Franklin and Cumberland Townships, Adams County to Gettysburg, to a terminus at Washington and Chambersburg Streets. The charter sets forth that the line is to be operated by either electric power or motors driven by gas, gasoline or oil. The president is H. C. Kennedy, president of the Cumberland Valley Railroad Company, and the other directors are: H. A. Riddle, C. Davidson, Thomas B. Kennedy, Thomas J. Brereton, J. H. Tonge, all of Chambersburg. All these gentlemen are officials connected with the Cumberland Valley Railroad Company, which interests are also in control of the Chambersburg & Gettysburg Electric Railway Company. The new line will give the Cumberland Valley Railroad Company an electric railway entrance into Gettysburg, which was lost to the company when the Philadelphia & Reading Railway Company purchased the Gettysburg & Harrisburg Railway, from Carlisle to Gettysburg, some years ago and made it a part of its system west of the Susquehanna River.

Coraopolis Street Railway Company.—Capital, $24,000; length of line 2 miles; extending from Groveton Station, Allegheny County, to Coraopolis, to the line of the Pittsburg, Neville Island & Coraopolis Railway Company. The line will cross Montour Creek near Coraopolis. The president is J. W. Arras, and the other direetors are: C. B. Ferguson, W. J. Dithrich, M. A. Ross and W. J. Tredway, all of Coraopolis.

Jefferson & Wilson Street Railway Company.—Capital, $8,000; length of line 1 1-3 miles; extending along the River Road leading from Dravosburg to West Elizabeth, Allegheny County, to Peters Creek; the entire line being in Jefferson Township, Allegheny County. The president is Hugh Miller, of Dravosburg, and the other directors are: L. E. King, John Herron, H. A. Ward, C. M. Clarkson.

Selin's Grove & Freeburg Electric Railway Company.—Capital, $30,000; length of line 5 miles; extending from Market and Pleasant Streets, Selin's Grove, along the public road and Middle Creek to Kautz Village and Freeburg, Snyder County. The directors are: E. M. Leader, Shamokin; F. P. Llewllyn, T. H. Hutchinson, H. N. Harter, George W. Wagonseller.

Shannopin Electric Railway Company.—Capital, $36,000; length of line 6 miles; extending from Shannopin, Beaver County, through New Sheffield, the entire line being in Beaver County. The directors are: S. H. Dugan, Coraopolis, president; R. Burgher, James A. Newell, J. E. Wilson and D. G. Dugan.

Shenango Street Railway Company.—Capital, $12,000; length of line 2 miles; extending from Greenville, Mercer County, and crossing the Shenango River to Third Avenue, covering a number of streets in Greenville. The consent of the Greenville Electric Railway Company to the use of certain portions of its system by the new company has been secured. Edwin Ripley, of Sherman, N. Y., is president, and the other directors are: C. G. Glatzan, E. C. Emery, W. M. Waugh and E. A. Henry.

Friendship Avenue Street Railway Company.—Capital, $15,000; length of line 2½ miles; extending from Liberty Avenue and Denny Streets, Pittsburg, and passing over Denny, Mifflin, Fortieth, Main, Carroll, Edmund, Friendship, St. Clair and Baum Streets and Avenues. The directors are: Moulton J. Hosaek, Pittsburg, president; Roger Knox, James M. Magee, Chas. K. Robinson and W. D. McBryan.

Linden Street Railway Company.—Capital, $27,000; length of line 4½ miles; extending from Neville and Bayard Streets, Pittsburg, and over Amberson, Westminster, Pitcairn, Fifth, Wilkins, Beechwood Boulevard, Linden, Thomas, Braddock, Susquehanna and Dunbar Streets and Avenues to the line dividing Pittsburg and Wilkinsburg. The directors are the same as those of the Friendship Avenue Street Railway Company.

Beaver Falls & New Castle Street Railway Company.—Capital, $60,000; length of line 10 miles; extending from Morado Park, College Hill, Beaver County, to Homewood, and Kopple, Hoytdale, Wampum, with a branch from Hoytdale to Ellwood City. The directors are: U. B. Duncan, president; Jordan Johnston, W. Bliss Dewey and George B. Nye.

Wampum Electric Railway Company.—Capital, $36,000; length of line 2 miles; extending from Main Street, in Wampum, and over various streets in Wampum. The directors are: H. W. Hartman, of Ellwood City, president; C. Carland, C. A. Glaser, J. R. Atwood and S. B. Depney.

Wampum & New Castle Electric Railway Company.—Capital, $42,000; length of line 7 miles; extending from Wampum to Newport, thence to Moravia and Mahoningtown (New Castle). The directors are the same as for the Beaver Falls & New Castle Electric Railway Company.

NEW PHILADELPHIA & WESTERN SYNDICATE PROPOSED

It is reported in New York that it is proposed to form a syndicate to retire all funded and other outstanding obligations of the Philadelphia & Western Railroad, which is building an interurban line out of Philadelphia. At present the subscribers of cash will be given certificates of syndicate participation, and after the road is opened and the earnings of the property demonstrated the certificates will be convertible into common and preferred stocks and bonds on what is considered a favorable basis. It is believed the road will earn $500,000 per annum, and that it can be operated at 50 per cent of the gross receipts. The road will, as now projected, run through West Chester, Lancaster and to Harrisburg. It is also proposed to build to York and in Southeastern Pennsylvania.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED JAN. 8, 1907

840,619. Pivoted Car Step; Gust Hagberg, Warren, Pa. App. filed Sept. 26, 1906. Provides a pivoted step for cars which may be swung up in elevated position while the car is in transit to prevent any one from boarding or alighting from the car while the same is in motion.

840,649. Trolley Pole Connection; Jacob M. Olinger, Spring-field, Ohio. App. filed April 28, 1906. Provides a trolley pole readily removable from its socket or support, and consists of a support having a pair of hooks which are engaged by a specially constructed latch, spring impelled into position so as to prevent dislodgement of the pole by vibration or other accidental cause.

840,697. Railway Frog; Edwin S. Hippey, York, Pa. App. filed Oct. 12, 1906. Consists in the provision of two intersecting grooves formed in the upper face of the frog and extending parallel with the direction of extension of the two crossing rails and in alignment with and adapted to receive the blind flange of a worn car wheel as it passes over the frog.

840,733. Derailment Guard; August Anderson, Birmingham, Ala. App. filed Oct. 29, 1906. A derailment guard connected and movable with the axles and wheels and with respect to the truck and having depending arms standing in alignment with the flanges of the wheels, the outer sides of the depending arms being beveled at their forward and rear edges.

840,801. Elevated Railway System; Daniel M. Pfautz, Germantown, Pa. App. filed May 23, 1906. Details of construction of an elevated structure from which cars are suspended.

840,865. Electrically Propelled Vehicle; Mathias Pfatischer, Philadelphia, Pa. App. filed Nov. 25, 1906. Relates to electric trucks provided with a trolley pole and shoes to contact with track rails, so that the vehicle can proceed along an electric roadway when available. At other times the vehicle runs by storage battery.

840,866. Electrically Propelled Vehicle; Mathias Pfatischer, Philadelphia, Pa. App. filed Nov. 29, 1905. Relates to modifications of the above.

840,950. Railway Rail and Chair Therefor; Robert Morgan, St. Paul, Minn. App. filed Aug. 29, 1906. The rail is provided with two heads, so that it may be reversed to present a new head when one of the heads has become unfit for further use. The chair is made of one piece and is slipped on over the end of the rail and the jaws thereof wedged to the web of the rail.

840,988. Combined Tie and Rail Fastener; Erick P. Bergman, Concordia, Kan. App. filed Sept. 14, 1906. A metal tie having an integral rail engaging shoulder on one side and a locking plate attached to the rail on the other side of the rail.

840,991. Beamless Brake for Car Trucks; Edward S. Coffman, Clifton Forge, Va. App. filed April 13, 1906. Two brake levers, each pivoted intermediate of its ends as a brake head, and each having its long arm offset from the plane of the wheel, and means for connecting the long arm with a brake rod.

841,046. Railway Signal; William M. Ralston, Fostoria, Ohio. App. filed Sept. 21, 1906. A plurality of spaced tappets pivotally mounted in the roadbed, and adapted to be actuated by the car wheels to display a danger signal at a semaphore arm when the train is traveling in one direction, and to effect no actuation of the signal when traveling in the opposite direction.

841,084. Fare Register; Charles E. Gierding, Newark, N. J. App. filed Sept. 28, 1906. The object of the invention is to adapt the transmitting mechanism of the numeral wheels to form effective zero stops for the units-wheel, and such other numeral wheels as may have a wheel of higher value to the left of them.

PERSONAL MENTION

MR. HARRY WHERLAND has resigned as superintendent of transportation of the Spokane Traction Company, of Spokane, Wash.

MR. FRED D. POTVIN, of Grand Rapids, Mich., has been appointed manager of the Citizens' Railway & Light Company, of Muscatine, Ia., to succeed Mr. A. L. Lindner, resigned.

MR. MARSHALL E. SAMPSELL has resigned as clerk of the United States Circuit Court, in order that he may devote all of his time to his duties as receiver of the Chicago Union Traction Company and to the practice of law.

MR. GEO. A. ILER has been appointed superintendent and electrical engineer of the Las Vegas Railway & Power Company, of Las Vegas, N. Mex. Mr. Iler formerly was connected with the Western Maryland Railroad as electrical engineer and superintendent of machinery.

MR. J. E. SEWELL, who was recently appointed to continue as general manager of the properties embraced in the system of the Connecticut Railway & Lighting Company, of Waterbury, Conn., taken over by the Consolidated Railway Company, acting for the New York, New Haven & Hartford Railroad, has resigned from the company.

MR. THOMAS N. McCARTER, president of the Public Service Corporation, retired from the directorate of the Prudential Insurance Company, Monday, Jan. 14, and Mr. John K. Gore, for many years actuary of the company, was elected in his stead. Mr. McCarter was not a candidate for re-election, for the reason that he desires to devote his entire time to the Public Service Corporation.

MR. C. C. BENSON, assistant manager of the Santa Clara Interurban Railroad Company and also assistant manager of the San Jose & Santa Clara County Railroad Company, writes that he has not left the services of those companies as stated in a note in this department in the issue of Dec. 15. It is a pleasure to make this correction. Mr. Benson is well known in the East, as for a number of years he was superintendent of the Citizens' Street Railway Company, of Newburyport, Mass. He was also for some time connected with the early electrical work on the West End Railway, of Boston, and later with the contracting firm of Woodbridge & Turner. In 1902 Mr. Benson accepted the position of manager of the San Juan Light & Transit Company, of Porto Rico, where he remained two years. Upon his return he went to California, where he has been engaged in engineering and railroad work.

MR. F. R. SLATER, consulting electrical engineer, announces that he has formed a partnership with Mr. H. N. Latey, under the firm name of Latey & Slater, for the general practice of engineering, with offices at 100 Broadway, New York. Both Mr. Latey and Mr. Slater have been closely identified with the electrical work on the New York Subway, Mr. Latey having been principal assistant engineer on the electrical equipment of the subway during construction, and for the past three years electrical engineer of the Interborough Rapid Transit Company, while Mr. Slater was assistant engineer in charge of the construction of the direct-current distribution system and later principal assistant engineer, succeeding Mr. Latey. Mr. Latey is a graduate of Massachusetts Institute of Technology in electrical engineering, and is a member of the American Society of Civil Engineers, and an associate member of the American Institute of Electrical Engineers. Upon graduation in 1893 he entered the shops of the Westinghouse Electric & Manufacturing Company, at Pittsburg, and was subsequently engineer in charge of erection in the St. Louis district. In 1898 he became principal assistant to the consulting engineer of the Manhattan Elevated Railway Company, in New York, on extension work and estimates and calculation for electrification, and from 1899 to 1901 was connected with the electrical construction department of this road on equipment work. In 1901 he became principal assistant engineer of the Rapid Transit Subway Construction Company, in connection with electrical equipment, where he remained until the completion of the subway. Mr. Slater is a graduate of Cornell University in 1894. After completing his course in electrical and mechanical engineering he was engaged for a short time in the design of the power station of Columbia University, after which he entered the designing department of the Otis Elevator Company. On the outbreak of the recent war with Spain he decided to engage in military service, and served as adjutant in the First United States Volunteer Engineers. After the close of the war he joined the forces of the Manhattan Railway Company, of New York, which was then converting its elevated lines from steam to electricity, and remained with this company until he joined the engineering forces in the building of the New York Subway. He is an associate member of the Amercan Institute of Electrical Engineers and an associate member of the American Society of Mechanical Engineers.

TABLE OF STATISTICS OF NEW YORK STATE

The accompanying table gives the capital stock, funded debt, receipts, operating expenses, charges, dividends and surplus of the different companies of New York State for the year ending June 30, 1906. This table is made up from reports rendered by the different companies for the year mentioned to the Railroad Commissioners of the State, and will appear in detailed form in the full report of the Commission, which is usually issued some time in March. Through the courtesy of the Commission, however, the figures are reproduced on the following page:

TABLE SHOWING CAPITALIZATION AND OPERATING STATISTICS OF NEW YORK STATE STREET RAILWAY COMPANIES.

NAME OF COMPANY.	On June 30, 1906.		Year Ending June 30, 1906.					
	Capital Stock.	Funded Debt.	Total Receipts, All Sources.	Operating Expenses.	Charges on Earnings.	Dividend Paid. Amount.	Dividend Paid. P. C.	Surplus for Year.
Interborough Rapid Transit Co.	$35,000,000	$15,000,000	$20,411,097	$8,400,823	$8,841,383	$2,887,500	8¼	$281,391
New York City Ry. Co.	9,361,500	1,761,000	19,092,385	9,576,511	12,802,189	......	..	Def. 2,286,315
Brooklyn Rapid Transit Co.	45,929,759	78,690,680	18,473,328	10,441,377	5,612,934	......	..	2,162,609
Brooklyn Heights Railroad Company	200,000	250,000	13,329,864	7,294,747	4,701,575	......	..	1,333,542
Nassau Electric Railroad Company	15 000,000	15,000,040	3,414,654	1,922,271	1,008,333	390,000	6	94,050
Rochester Railway Company	6,000,000	4,557,000	2,105,421	1,204,903	556,952	270,000	4 and 5	73,566
International Traction Company (all systems)	19,269,500	13,852,000	4,766,393	2,755,623	1,152,130	652,820	4	205,819
United Traction Company	4,999,600	5,141,000	1,785,113	1,116,037	347,071	249,980	5	72,025
Coney Island & Brooklyn Railroad	2,000,000	3,500,000	1,663,279	1,193,824	307,961	160,000	8	1,494
Union Railway Company, New York City	2,000,000	2,000,000	1,521,182	1,060,637	285,308	......	..	174,237
Brooklyn, Queens County & Suburban	2,000,000	3,500,000	1,520,345	776,139	448,158	......	..	296,048
Syracuse Rapid Transit Railway Company	4,000,000	3,861,000	1,027,340	579,268	258,812	......	..	189,260
42d St., Manhattanville & St. Nicholas Av. Ry.Co.	2,500,000	2,800,000	1,004,103	700,814	395,227	......	..	Def. 91,938
Utica & Mohawk Valley Railway Company	6,250,000	2,957,000	902,321	523,291	180,090	......	..	198,940
Schenectady Railway Company	600,000	2,000,000	882,206	559,448	211,096	......	..	111,662
New York & Queens County Railway Company	3,235,000	3,000,000	852,193	564,346	203,987	......	..	83,860
Fonda, Johnstown & Gloversville Railroad	2,500,000	6,537,000	776,885	374,360	357,144	......	..	45,381
Hudson Valley Railway Company	3,000,000	7,845,000	570,689	327,354	265,975	......	..	Def. 22,640
Thirty-Fourth Street Crosstown Railway	1,000,000	1,000,000	553,417	208,033	70,557	......	..	214,826
Dry Dock, East Broadway & Battery Railroad	1,200,000	2,050,000	477,863	344,620	180,438	......	..	Def. 47,195
Yonkers Railroad Company	1,000,000	1,000,000	341,258	239,074	110,593	......	..	Def. 8,409
Westchester Electric Railroad Company	500,000	500,000	332,273	277,546	103,169	......	..	Def. 48,442
Auburn & Syracuse Electric Railroad Company	1,750,000	1,050,000	311,109	183,355	75,831	23,750	..	28,173
Binghampton Railway Company	964,749	1,671,000	291,943	150,889	87,791	24,049	..	29,214
Albany & Hudson Railroad Company	1,750,000	1,750,000	265,671	168,960	92,804	......	..	3,907
Richmond Light & Railroad Company	2,875,750	2,200,000	264,539	225,959	115,786	......	..	Def. 77,206
Rochester & Eastern Rapid Railway	1,500,000	1,500,000	237,905	144,947	85,010	......	..	7,948
New York & Long Island Traction Company	1,000,000	1,000,000	207,301	102,998	52,903	......	..	51,400
Elmira Water, Light & Railroad Company	1,000,000	2,861,000	206,570	155,892	49,514	......	..	1,164
Staten Island Midland Railroad	1,000,000	1,000,000	196,266	144,259	57,787	......	..	Def. 5,780
Long Island Electric Railway Company	600,000	600,000	184,808	129,132	37,962	......	..	17,714
Twenty-Eighth & Twenty-Ninth St.Crosstown R.R	1,500,000	1,500,000	162,037	129,442	87,415	......	..	Def. 54,820
Jamestown Street Railway Company	100,000	300,000	157,794	104,296	33,431	......	..	20,067
Niagara Gorge Railroad Company	1,000,000	1,000,000	143,272	72,730	52,993	......	..	17,549
New York & Stamford Railway Company	500,000	426,000	137,477	83,973	24,895	......	..	28,609
Kingston Consolidated Railroad Company	400,000	700,000	131,144	74,797	39,600	......	..	8,747
Orange County Traction Company	325,000	425,000	129,991	86,792	31,423	......	..	11,776
Tarrytown, White Plains & Mamaroneck R.R. Co.	300,000	300,000	128,548	113,445	31,686	......	..	Def. 16,583
Western New York & Pennsylvania Traction Co.	300,000	413,500	128,465	63,607	32,182	......	..	32,676
Hamburg Railway Company	350,000	300,000	126,696	80,785	17,961	......	..	27,950
*Oneonta, Cooperstown & Richfield Springs Ry	1,464,000	1,364,000	116,767	154,631	4,133	......	..	Def. 41,990
Ithaca Street Railway Company	325,000	315,000	110,944	74,539	21,370	17,875	..	Def. 2,848
Poughkeepsie City & Wappingers Falls Electric Railway Company	750,000	370,000	107,152	85,180	18,474	......	..	3,498
Syracuse Suburban Railroad Company	400,000	550,000	106,078	61,318	33,942	......	..	10,819
Peekskill Lighting & Railroad Company	650,000	575,000	100,699	33,493	33,857	7,200	6	33,349
Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Company	450,000	450,000	90,755	54,766	22,078	......	..	13,911
Kingsbridge Railway Company	8,600	......	88,120	73,573	86,960	......	..	Def. 72,413
Black River Traction Company	45,000	55,000	84,918	79,338	5,262	......	..	318
Syracuse, Lake Shore & Northern Railroad	500,000	......	75,883	53,973	2,758	......	..	19,152
Rochester & Suburban Railway Company	420,000	450,000	74,388	38,560	70,939	......	..	Def. 35,111
Waverly, Sayre & Athens Traction Company	200,000	150,000	72,738	46,831	10,628	......	..	15,279
Chautauqua Traction Company	500,000	126,000	70,750	39,156	10,357	......	..	21,237
Dunkirk & Fredonia Railroad	173,250	100,000	64,945	48,539	7,260	......	..	9,146
Cortland County Traction Company	320,000	500,000	59,143	35,473	13,129	......	..	10,541
Van Brunt Street & Erie Basin Railroad	200,000	65,000	57,541	38,552	4,869	10,000	5	4,120
Cohoes Railway Company	120,000	84,000	55,063	44,353	6,890	......	..	3,820
Oswego Traction Company	300,000	288,000	54,501	34,347	13,487	......	..	6,667
Ocean Electric Railway Company	35,000	20,000	54,281	58,937	2,383	......	..	Def. 7,039
Wallkill Transit Company	350,000	300,000	54,255	37,264	16,218	......	..	773
Corning & Painted Post Street Railway	100,000	100,000	48,157	26,248	7,516	4,000	..	10,393
Coney Island & Gravesend Railway	35,400	......	48,028	26,042	1,009	......	..	20,977
Benington & Hoosick Valley Railway	200,000	182,000	47,332	32 410	11,457	......	..	3,465
Fishkill Electric Railway Company	50,000	50,000	47,303	30,329	11,710	......	..	5,264
Southern Boulevard Railroad Company	250,000	250,000	46,785	44,317	19,166	......	..	Def. 16,698
Buffalo Southern Railway Company	547,200	300,000	44,266	34,632	1,053	......	..	8,581
Eastern New York Railroad Company	300,000	300,000	39,258	27,231	15,030	......	..	Def. 3,003
Buffalo & Williamsville Electric Railway Company	75,000	117,500	33,872	21,288	7,223	......	..	5,361
Troy & New England Railroad Company	180,000	183,725	32,958	20,191	6,009	......	...	6,916
Fulton Street Railroad Company	500,000	500,000	30,931	28,880	21,298	......	..	Def. 19,247
Ogdensburg Street Railway Company	150,000	150,000	30,655	18,536	14,829	......	..	Def. 2,710
Penn Yan, Keuka Park & Branchport Railway	94,000	100,000	26,195	17,248	6,555	......	..	2,392
Hornellsville & Canisteo Railway Company	50,000	80,000	25,689	12,235	4,078	......	..	9,376
Rome City Street Railway Company	150,000	200,000	24,922	17,445	10,867	......	..	Def. 3,390
Plattsburg Traction Company	100,000	80,000	24,034	15,525	6,449	......	..	2,060
Rochester, Charlotte & Manitou Railroad	97,500	81,250	22,493	18,839	5,068	......	..	Def. 1,414
New Paltz, Highlands & Poughkeepsie Trac. Co.	100,000	100,000	21,372	13,693	4,883	......	..	2,796
Lake Erie Traction Company	500,000	400,000	20,921	19,111	20,351	......	..	Def. 18,541
Hornellsville Electric Railway Company	50,000	70,000	20,645	17,416	3,793	......	..	Def. 364
Keesville, Ausable Chasm & Lake Champlain Railroad Company	60,000	150,000	19,218	17,171	3,830	......	..	Def. 1,783
Marcellus & Otisco Lake Railway Company	200,000	200,000	19,116	13,648	6,833	......	..	Def. 1,365
Catskill Electric Railway Company	138,000	132,000	17,383	16,087	7,487	......	..	Def. 6,191
Huntington Railroad Company	30,000	26,000	17,360	11,918	1,941	......	..	3,501
Westchester Traction Company	300,000	600,000	15,944	22,600	8,460	......	..	Def. 15,116
Oneida Railway Company	15,000	10,000	14,012	13,379	1,260	......	..	Def. 627
Elmira & Seneca Lake Railway	300,000	300,000	13,130	14,850	3,924	......	..	Def. 5,644
Buffalo & Depew Railway Company	305,000	350,000	12,496	27,153	18,695	......	..	Def. 33,352
Port Jervis Elec. Lt., Pwr., Gas & R.R. Co.	150,000	95,000	12,249	14,930	5,692	......	..	Def. 8,373
Buffalo, Dunkirk & Western Railroad	3,500,000	750,000	11,342	8,904	39,697	......	..	Def. 37,259
Pelham Park Railroad Company	50,000	27,750	10,703	11,159	1,123	......	..	Def. 1,579
City Island Railroad	50,000	27,873	10,231	7,975	1,774	......	..	481
Lima, Honeoye Electric Light & Railroad Co.	Private	ownership.	9,890	10,443	187	......	..	Def. 740
Nassau County Railway Company	35,000	......	9,499	9,625	667	......	..	Def. 793
Northport Traction Company	45,000	......	8,340	8,437	239	......	..	Def. 336
†Glen Cove Railroad Company	10,000	......	8,089	8,862	......	......	..	Def. 773

* July 1, 1905, to May 9, 1906. † November 16, 1905, to June 30, 1906.