STREET RAILWAY JOURNAL

SATURDAY, APRIL 19, 1902.

PUBLISHED WEEKLY BY
THE STREET RAILWAY PUBLISHING COMPANY
MAIN OFFICE:
NEW YORK, BEARD BUILDING, 120 LIBERTY STREET.

BRANCH OFFICES:
CHICAGO.....Monadnock Block
PHILADELPHIA.....929 Chestnut Street
LONDON.....Hastings House, Norfolk Street, Strand
Correspondents in other Principal Cities of the World.
Long Distance Telephone, "New York, 4044 Cortlandt."
Cable Address, "Stryjourn, New York,"—Lieber's Code used.

TERMS OF SUBSCRIPTION.

In the United States and Canada.....$4.00 per annum
Single copies, first issue of each month, 35 cents; other issues, 5 cents.
In all Foreign Countries, per annum..... $6.00 / 25s / 31fr
Subscriptions payable always in advance, by check (preferred), money order or postal note, to order of C. E. WHITTLESEY, Treasurer.

Entered as second-class matter at the New York Post Office.

Contents of this Issue

The Interurban Electric Railway..... 473
As Others See Us..... 473
The Car Ahead..... 474
Practical Operation of Electric Trains..... 474
The Port Chester Decision..... 475
The Value of Perspective..... 475
A Handsome Drafting Room..... 476
The Boston & Maine Railroad Builds Another Electric Railway..... 476
Electrifying a British Railway..... 476
Another Road between Buffalo and Rochester..... 477
Application of the New York & Port Chester Railroad Granted..... 477
Multiple-Unit System..... 477
Thirty-two Thousand Volt Transmission Line of the Union Traction Company, of Indiana..... 477
Discussion on the Relation of Energy and Motor Capacity to Schedule Speed in Moving Trains by Electricity..... 478
N. W. Storer's Discussion of Selection of Electrical Motors for Railway Service..... 481
Mr. Dodd's Reply to Dr. Hutchinson's Criticism..... 482
London's Traction Problems..... 483
Meeting of the New England Street Railway Club..... 484
Cast-Welding on the Kingsbridge Road..... 486
Boston Subway Hearing..... 486
London Letter..... 487
An Important Pennsylvania Decision..... 489
Electricity on Swiss Railways..... 489
Chicago Elevated Road Traffic for First Quarter, 1902..... 489
J. G. White & Company's Australian Contracts..... 489
Consolidation of the Underground Lines of London..... 490
Electric vs. Steam Roads in Pennsylvania..... 490
Everett-Moore Situation..... 490
Street Railway Patents..... 490
Personal Mention..... 491
Financial Intelligence..... 492

The Interurban Electric Railway

There is no department of electric railway operation in which greater advances have been made during the past five years than in that of interurban railway construction and operation. With the exception of the general use of the double-truck cars and improvements in details, there have been few radical changes in city electric railway construction. But the interurban electric road is an entirely different proposition than five years ago. The first roads of this kind were patterned after suburban city work and little effort was made to secure higher speeds or to put down a more substantial construction than was required in such suburban extensions. The modern interurban road, however, is distinctly a type by itself, and has become possible principally through the development of alternating-current transmission, by which the length of the road has been practically independent of economical considerations, so far as the cost of feeder copper is concerned. Many of the steps in the evolution of the interurban road are described in a paper read recently on the subject before the New England Street Railway Club, and published elsewhere in this issue. To Mr. Hodge's excellent article we wish to put especial emphasis on the necessity of substantial track construction. If the interurban road is to last as long as its steam railroad rival, its roadbed must be patterned after the same lines and made certainly as substantial, if not more so; for economy in this direction is apt to prove the worst kind of extravagance before the road has seen three or four years of operation.

The future value of the interurban roads which are now being built will undoubtedly depend largely upon the speeds which can be made upon them, and as high speeds are absolutely dependent upon the roadbed, the importance of this feature is self-evident. Most of the existing interurban cars are running at speeds which do not average between termini much over 12 miles to 15 miles an hour. We have no idea, however, that this will long continue. The stress of competition will compel, before long, a higher speed if the road is to carry its share of the traffic, and as a change of motors is easily made, the track and overhead construction should be built for the future, and of a type which will be readily serviceable for average speeds of 40 miles to 50 miles an hour. The overhead construction recommended by Mr. Hodges, of a straight trolley wire without breaks or switches for each direction of running and a grooved wire with straight underrunning surface, is perfectly adapted to such speeds if they are required in the future, and so equipped, with their own right of way and few curves and grades, there is nothing to prevent the active competition of such roads with paralleling steam roads.

As Others See Us

It is well for us occasionally to see ourselves as others see us; not because we are likely to be encouraged or flattered by the opinions of contemporaries, but rather that we may realize how our work is regarded and the estimate our neighbor puts upon our ability. The rule of individuals is the rule of nations generalized, expanded, broadened; and in this particular case its application may be enjoyed if it is not accepted, approved and engrossed among our national records.

We hear so much nowadays about the conquests of American mechanical and scientific genius that we are liable to forget or overlook the claims of others, but we must not flatter ourselves that our rivals abroad are less zealous, watchful and persistent than we are. Therefore, when we calmly point to our development in the electrical field, especially in the transportation department, we must be prepared to learn that there are other claimants for honors as pioneers, and that our "pretensions" are ridiculed in such learned circles as the Society of Arts. The Journal of that very respectable body contains proof of this fact in the report of a recent gathering presided over by that paragon, Professor Silvanus P. Thompson, and participated in by such lights as Mr. Alexander Siemens, Mr. W. M. Mordey and Mr. Ferranti.

The subject of the evening's paper, which, by the way, was pre-

sented by Mr. J. Clifton Robinson, was "Tubes, Trams and Trains of London"—not very intimately associated with American enterprise, to be sure, unless we reflect upon the part that American capitalists, promoters, manufacturers and engineers are expected to take in affording relief to the English capital. The speakers united in denouncing the policy and tendency of adopting American methods and machinery, and they contended that we were not entitled to the credit that had been given us for our work in this particular branch. A sharp Yankee trick had been played in reality; our confiding English cousins had been betrayed; their ideas, inventions and plans had been stolen and the rest of the world had been hoodwinked into giving to the despoiler credit which rightly belonged to Englishmen. We are gravely told by Mr. Mordey, for instance, that priority of title to the electric road of to-day rests in England. We presume he bases this claim upon the establishment of the Portrush line, which is conveniently designated as a British enterprise for this occasion. If our English cousins have lost any credit for the work they have done in the electric railway because of the location of the first line in Ireland, they should attribute their failure to secure it to a Fenian conspiracy. But how are we to explain later transactions of similar aspect? Here is an indictment presented by Mr. Mordey:

> England was the pioneer of electric traction. Years before any tramways were running in the States street tramways were running in England by the method now in use in America. When the first tube railway—the City and South London—was opened in 1890, the Americans sent over a deputation of engineers, who reported that it was impossible for such a system of traction to take the place of steam traction on the overhead railways. After the Liverpool overhead railway was opened another American deputation was sent over, with the result that a Chinese copy of that system was installed on the Chicago overhead railway. Yet the Americans when they visited England were welcomed as the pioneers of electric traction.

The worst is yet to come. Mr. Mordey denies us all credit for progressiveness. "America, having no roads fit to walk or ride on," he says, "and no horses or 'buses, has been driven to establish electric traction services. It was not due to the enterprise of Americans, but to the absence of any other facilities for getting about, that the great tramway work had been done in the States." We fear that Mr. Mordey must have gotten his ideas of America from Dickens' description of Martin Chuzzlewit's experience in Eden. It looks very much as if the Water-Toast Association of United Sympathizers had been transplanted to England, or had at least imparted its spirit to the Society of Arts.

"The Car Ahead"

One of the unnecessary difficulties under which street railway companies labor, and which causes all manner of inconvenience to both public and railway companies, is the passage of useless and foolish acts by the local authorities who know nothing about practical railway operation. The result of these acts, if they were enforced, would be to defeat the very object which they were presumably passed to secure, that is, the comfort and rapid transit of the passengers. A good instance of this class of interference is shown by the action of the New York Board of Aldermen on April 15, when an ordinance was passed providing that all street railway companies must operate their cars through to the destination corresponding with the sign visible on the front of the car, and fixing a penalty for every passenger who is made to "take the car ahead" when the car on which he is riding is switched back before it gets to its destination as shown by its sign. A number of Aldermen spoke strenuously in favor of the ordinance, and related in feeling tones their experience in being put off in the rain and snow to transfer to another car. One of them thought that the only fault with the ordinance was that it did not go far enough. He advocated the construction of shelter stations by the company at all important points where passengers were transferred. The ordinance was passed by a vote of 57 to 2.

We do not say that such a regulation cannot be fulfilled by the railway company, but we do affirm that where cars are run in crowded streets, as are most of the thoroughfares of New York, such a rule, if followed to the letter, will produce all sorts of inconvenience, and will absolutely prevent any reasonable regularity of headway in the operation of the cars. It is a well-known fact that a street blockade, which is of frequent occurrence in the congested portions of New York, will produce a long line of cars on one of the tracks, say the down track, while there will be a resulting long gap between cars on the up track. The only way to bring back a normal condition of affairs is to switch some cars from the down track to the up track, and not try to drive them all through to the terminus. Such a condition is not produced by any act of the railway company itself, and its occurrence cannot be foreseen. The inconvenience to the passengers in the cars transferred from one track to the other is slight and unavoidable if people wishing to take the car up town are to be accommodated with any sort of car service. It is one of the anomalous facts of our system of government that the power to make regulations governing an important industry like street railroading is put into the hands of persons who have absolutely no qualification for the task. We do not believe that the ordinance will ever become a law, but the incident simply shows that matters of this kind, in which the convenience of the community at large depends to such an extent, should be in the hands not of a popularly elected body, but in those of a trained commission, who would understand the practical requirements of railway operation.

Practical Operation of Electric Trains

Continuation of the discussion of Dr. Hutchinson's paper in this issue by Messrs. Dodd, Gerry and Storer emphasizes the objections that have been recorded against certain of the conclusions of the author of the original paper. Mr. Gerry, for instance, contends that the paper does not embrace a sufficient number of operating conditions to justify such general results as are reached by Dr. Hutchinson; in fact, Mr. Gerry declares that each particular case should be considered separately, and he intimates that general conclusions in railroad work have little practical value. He cites, for illustration, the requirements of certain elevated and suburban roads where schedule speed is the all-important consideration, as it determines the amount of traffic that can be handled. Here, he contends, it is not a question of power, but one of maximum schedule speed between stations, and consequently the most rapid acceleration obtainable is usually the most desirable. This is diametrically opposed to the theoretical conditions, which he points out are rarely the most desirable or economical.

Mr. Dodd's first contribution to the discussion describes a series of experiments he conducted along somewhat different lines from those followed by Dr. Hutchinson, and, like Mr. Gerry, he reached the conclusion that the higher acceleration is the more economical, not only in power house but on equipment. Mr. Dood's second paper takes up some points which Dr. Hutchinson defended in a supplementary paper. One of these bears directly upon the point considered in Mr. Gerry's discussion. Mr. Dodd says: "I cannot conceive of a variation in the initial acceleration which does not necessarily involve a corresponding variation in the use of the motor curve, the power of the equipment and the schedule speed being maintained constant. This, I have always considered, is the secret of the economy of high acceleration."

Mr. Storer's contribution deals particularly with Mr. Potter's criticism of the method of rating railway motors, which was proposed some time ago by Mr. Storer. The author admits that the method of obtaining the temperature constants for the field and armature by means of a series of car tests, made under all possible schedules and conditions of service, is laborious in the extreme. He also concedes that car tests are necessary for a determination of the ratio between the temperature rise in shop and in service for different schedules and other conditions, but he believes when this ratio is determined for one motor it should be practically the same for motors tested under the same conditions, especially if the motors are completely enclosed, as they are in a majority of cases. Moreover, he contends that the constants may easily be obtained in shop tests, where the distribution of losses may be absolutely determined, and when the distribution

of temperature rise will be practically the same as in service. We know of no paper presented to the Institute which has involved so much discussion as this, a fact which shows the lively interest taken in electric railway subjects.

The Port Chester Decision

The action of the Board of Railroad Commissioners of New York State in granting the request of the New York & Port Chester Railroad Company for privilege to construct a high-speed line between 132d Street, New York, and the State line at Port Chester seems bound to have an important bearing on high-speed electric railway construction in the future. The plans of the Port Chester Railroad Company in this direction are familiar to our readers, through the reports of the hearings which have been published in these columns, and it is a significant fact that in the opinion of the Railroad Commissioners a line of this kind, 21 miles in length, is considered as being required by public convenience and necessity, although the proposed termini are already connected by a steam railroad which parallels, to a greater or less extent, the entire route of the proposed road.

If the service provided in the past on the present steam road had been at all adequate to the requirements, the need of the new electric line would not have been so evident. But the testimony given before the Railroad Commissioners conclusively showed that but scanty attention had been given to the reasonable demands of the large commuter traffic between New York and Port Chester, and the fares charged were very much higher than those which the new company proposes to institute. A striking commentary on the feeling of the residents along the line was shown by the unanimity with which they endorsed the construction of the proposed electric line, and held mass meetings urging favorable action upon the proposition. We do not mean to say that satisfactory service could necessarily have been given by the old line with its existing steam equipment. But there is no good reason why the old road could not have recognized the advantages of electricity as quickly as the promoters of the new line have done. Instead they confined their opposition at first to a vain attempt to show that the use of electricity, as proposed, was impracticable and only desisted when the utter futility of such an attempt had been brought home to them by the testimony of prominent electrical engineers.

This ignorance of many steam railroad men in regard to the advances which have been made in electrical engineering during the past few years, and which are matters of public knowledge to all who have followed the subject at all closely, has perhaps never been more clearly demonstrated than in these hearings, and the sufferers from this policy of insensibility to the outside world will have none but themselves to blame. The New Haven road has had a monopoly of the traffic in the territory covered by its lines for so long, and has done so little to improve its opportunities, that it will have very little sympathy from the outside public in the case of successful competition. Although New York and Boston are only 214 miles apart by its most direct lines, the company runs only two five-hour trains each way between the two cities, the same number which it ran fifteen years ago, and both of these trains are in the middle of the day, when they are practically of no use to business men. Important improvements have been made, it is true, in the company's track construction during these years, but this has effected no reduction in the running time or fares, and the company has blocked, as far as it could, all local competition by electric railways parallel to its main and branch lines. With the exception of some noteworthy and valuable experiments in third-rail traction, initiated through the enterprise of its electrical department, on a few of the branch lines, and which could have been extended to advantage, the company's policy has been one of extreme conservatism. We sincerely trust that the lesson taught this and similar corporations by the granting of rights for high-speed electric competition will be taken to heart, and that steam railroad officials will be more prompt to recognize, in the early future, the advantages of electricity as a motive power.

The Value of Perspective

It is sometimes very difficult for the manager of a street railway to get a just outline of his own work. No class of men are more tied down to their work and have fewer chances to put aside care and see how things really look. The cars must run if the heavens fall, and it is necessary first to get there, and then to consider the route over which one came. Now, this sort of energy accomplishes much, but it runs some risk of missing much. One gets, too, so much into the habit of working for daily results that the next year seems a very long ways ahead. And sometimes in this way necessary things get put off season after season until there comes a time of rude awakening, and a tremendous scramble to make up for lost time. We have just now particularly in mind the engineering side of the work from every aspect. A road, for instance, grows and prospers, throwing out long feelers into the suburbs, and making connections with the road in the next city. The feeders are strung out as the line advances, and presently the time comes when there begin to be operative difficulties: the cars do not make time and the cost of motive power gets up. Finally there is lull enough in the daily struggle with things imperative, and the superintendent looks up to find that the whole feeder system has become inadequate. The growth has been so gradual that the real condition of things was not realized until it became intolerable. Or the bonding of a long line has been deteriorating. Reports came in of bad bonds, and the track gang went out at once and fixed them, but the general tone worked gradually down until nobody paid any attention to a bond that was only moderately bad, and so the game went on until an apparently good line was found to be thoroughly bad. This is no fancy picture drawn to point a moral; every superintendent knows of such a case, on his neighbor's road if not on his own.

For a variation on this theme take the rolling stock. We assume that it is, on the whole, well kept up; but what would you think if you did not hear those incipient flat wheels or see the general looseness of things around the car? Thorough system in the inspection of all the details counts for much, but it cannot do everything. You cannot have your inspector squealing for reform every time the least bit of wear and tear shows; things have to wear out sooner or later. But it is absolutely necessary that some one should have a wide, general outlook on the way things are going, else out of a few little things wearing out will gradually creep in a general lowering of the whole tone of the system. It is astonishing to note how far this can sometimes go before you can put your finger on any one thing and say, "This is wrong and must be attended to."

Country ministers have a practice of exchanging pulpits once in a while, and rubbing up for a day against a new congregation in a fresh place. Street railway men can hardly swap jobs in that easy-going way, but they can at least swap sermons, as it were. The Street Railway Association does a deal of good in that way, but does it only once a year. We believe it would be a good thing if every board of directors would direct the heads of departments to take at least one week per year, in the line of duty, to get out of their regular harness and round up some of their neighbors in the business. Most street railway men do not get enough rest to hurt them anyway, and a watchful trip would pay for itself many times over. A visit to the car houses and power stations of several neighboring lines, or of others further distant, a ride over the lines and a talk with the superintendent or manager will often throw light on some knotty problem in one's own conditions. There is no royal road to perfect operation, any more than to knowledge, and a visit of this kind may often show a better way of doing some things, as well, possibly, of some things to avoid, which is just as valuable. No man knows it all, and when one cannot learn anything from his neighbors he is fit only for a niche in a museum.

A Handsome Drafting Room

The Metropolitan Street Railway Company, New York City, has recently opened the drafting room shown in the accompanying engraving. These new quarters for this very important department of the company are in a newly constructed addition on the roof of the Cable Building, 621 Broadway, where the main offices are located. The room is about 75 ft. x 33 ft. and is exceptionally light and airy, making it an ideal place for the purpose for which it is intended.

The chests of drawers seen in the center and at the side of the room contain blue prints of practically all the working drawings in use by the engineering department. The original tracings are kept in a special vault conveniently situated near the drafting room, where they are thoroughly protected against fire or other danger of destruction. The immense amount of new construction work which is being done continually by the Metropolitan, both in the track department and in connection with new car houses and other buildings, keeps from fifteen to twenty draftsmen busy at all times. Before the electrification of any of the horse car lines, such as is now being done on Ninth Avenue, a complete survey is necessary and the conduit construction laid out in the drafting room from the surveyor's notes.

NEW DRAFTING ROOM FOR THE METROPOLITAN

President H. H. Vreeland has shown his appreciation of the value of his drafting department in providing such excellent accommodations as the new quarters. The plans for the drafting room were prepared, in co-operation with the architect of the company, by C. E. Corby, the chief of this department, through whose courtesy the photograph reproduced herewith was obtained. Mr. Corby has been with the Metropolitan Company since 1891, and, as will be seen from the arrangement of his work room, has as keen an understanding of the requirements of his men and as great a regard for their comfort as he has a thorough familiarity with all the details of the great system with which he has been so intimately connected.

The Boston & Maine Railroad Builds Another Electric Railway

The Concord & Montreal Railroad Company, whose property is leased and operated by the Boston & Maine Railroad, is building an electric railway between Concord and Manchester, N. H., to serve also the towns of Hooksett and Suncook, the street railway lines being on the opposite side of the river from the old Concord railroad. It is understood that, while the charter permits the road to build as far south as Nashua, nothing will be done toward construction below Manchester at present. The route over which the road is being built is an extremely difficult one, the grades being very heavy. In fact, it was found so difficult to transport gravel for ballast for the roadbed that it was not until the company had purchased a mountain engine that it was able to convey gravel from the pits to the points where it was needed in the construction of the roadbed. This is the second electric railway to be built by the Boston & Maine, but it is stated on good authority that the company has no intention of entering other fields in New Hampshire with new systems. The first electric railway to be built by the company was between Hampton Beach and Portsmouth.

Electrifying a British Railway

In view of the preparations that are being made to introduce electricity in the operation of the New York Central tunnel, the plans that are now being executed for electrifying a British railway similarly situated will have considerable interest.

The Mersey Railway, which connects Liverpool and Birkenhead, and which passes under the river Mersey, is being converted from steam to electric traction by the British Westinghouse Company. The tunnel is double-tracked. The route of the railway is about four miles and a half long, the total length of track, including sidings, being about twelve miles.

The only competition in the handling of passengers and freight between these two important business cities is formed by ferryboats over the river. The number of passengers carried on this line, even with the old steam locomotive system, amounts to between seven millions and eight millions a year, with the tunnels reeking with sulphurous, pungent fumes, dirty, enervating and altogether calculated to scare away any would-be passenger. What the business of the railway will amount to when the electric motor has supplanted the steam engine is altogether beyond approximation.

The power-generating station, the machinery and the track work are all being pushed rapidly to completion.

The railway is of standard gage, laid down in accordance with heavy steam railroad practice. The rails are of the ordinary English "bullhead" type, weighing 86 lbs. per yard. The third-rail system will be adopted with the conductor rail laid alongside and just outside of the running track, after the manner of the Manhattan construction in New York. There is an important departure from ordinary electric traction practice, however; the running-track rails will not be used as the return electrical conductor, but a fourth rail is to be put down between them solely for this purpose, thus giving both insulated lead and insulated return conductors. It is claimed for this feature that it will be a source of considerable economy in operation, and that it will prevent any electrical or magnetic disturbance in the neighborhood of the railway, and that it will effectually eliminate any destruction of the track rails or buried pipes in the vicinity by electrolytic action. The third and fourth rails will be similar in size and in arrangement. The rails are to be of T-section in 60-ft. lengths and weighing 100 lbs. per yard. They will be effectively bonded and carried on stoneware insulators spaced at intervals every 7 ft. or 8 ft. apart.

The power-generating plant will have an aggregate output of 6600 hp, of which 6000 hp will be utilized in the operation of the railway proper and 600 hp will be supplied for the complete lighting of the plant.

The rolling stock will comprise sixty cars. These cars will be exceptionally large for England, being 60 ft. long and having seating room for sixty passengers. The trains will be formed of five cars each. No locomotives will be used. The first and last cars of a train will be motor cars, each equipped with four 100-hp motors and the necessary apparatus for their simultaneous control from the leading motor car. The Westinghouse electro-pneumatic system of train control is to be used. The cars will also be fully equipped with air brakes of the quick-acting type.

It is expected that the trains will run on three minutes' service. The tunnel and the seven stations of the system are to be electrically lighted throughout.

Terre Haute, Ind., furnishes a striking example of the extremes to which unionism is carried. The miners of Seeleyville, near Terre Haute, took from the school at that place all their children, because the school teachers of the town patronized the cars of the Terre Haute Electric Company, employees of which are on strike. The teachers, it is said, were obliged to agree not to patronize the cars before the children were allowed to return to school.

Another Road between Buffalo and Rochester

The Buffalo & Depew Railroad, which extends from the Buffalo city line through Depew, a distance of 7 miles, and which is now owned by the Railways Company General, of Philadelphia, is to be extended to Rochester, a distance of 69 miles. The road will be built over the old State road through Lancaster, Looneyville, Crittenden, Corfu, West Batavia, Batavia, Stafford, Caledonia, Mumford and Garbutt to Scottsville, where the river road will be taken to Rochester. The road will be double-tracked the greater part of the way, and there will be no grade crossings for the entire distance between Buffalo and Rochester. The plan of the company is to lay the line with 70-lb. rails and employ stone ballast. The contract for construction will be awarded as soon as the engineering details have been completed, and it is expected that construction will be well under way before summer. George A. Ricker, of Buffalo, is preparing the plans for the line.

Application of the New York & Port Chester Railroad Granted

At a meeting of the Railroad Commissioners of the State of New York held at Albany, April 8, the application of the New York & Port Chester Railroad Company to build an electric line from 132d Street, New York, to the village of Port Chester, distance about 21 miles, was granted. The trains are to be operated by the third-rail electric system and the entire line will be built on the company's own right of way, with no grade crossings of streets or village highways or of railroads. The hearings of the Commission on this road extended over a period of four months, prior to which there were two hearings, so that a period of eight months elapsed from the time application was made to the board until the granting of the application. The board believes that the proposed road is required by public convenience and necessity.

No objections now exist to making public the commercial interests which are associated with the proposed line, and which were communicated privately to the board during the hearing. The road has the financial backing of parties connected with the New York Subway Construction Company, combined with large interests controlled by President W. C. Gotshall, and this union will be known as the Gotshall-Belmont Syndicate. This extremely promising financial condition leaves nothing to be desired on this score, and the granting of the company's application will probably be soon followed by the commencement of construction work.

Multiple-Unit System

The latest patent in the multiple-unit system was issued April 1 to Frank J. Sprague, No. 698,880, application having been made on Dec. 16, 1898. This patent describes an improvement over the earlier forms of this equipment, under nine headings, and also the differences between these systems. With the new arrangement it becomes possible to effect with four train wires substantially everything accomplished in the more elaborate form of the system shown in the old application with five train wires, one speed-determining wire of the latter combination being dropped. Mr. Sprague considers this last patent as one of the principal patents on the multiple-unit system. The first was No. 660,065, granted in October, 1900, which may be called fundamental in its character. The next was No. 660,066, which related to the individual throttling of the several equipments in a train, and the third, No. 696,880, just issued, is for alternative devices and connections of the general scheme of multiple-unit control.

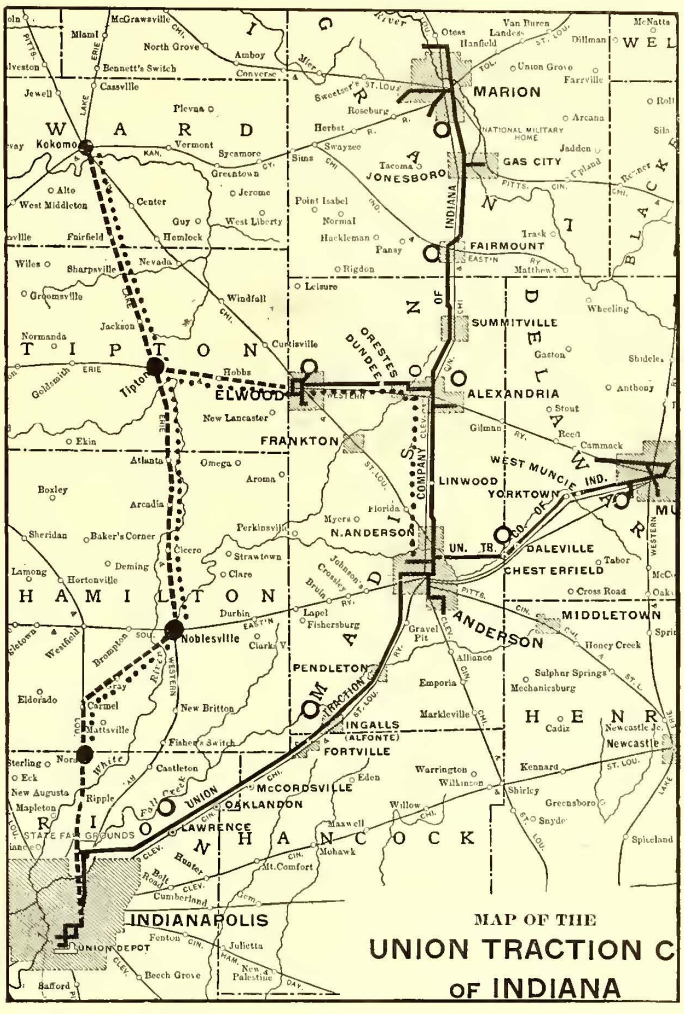
It is explained at the outset that "many of the features are not limited to a purely electrical equipment, but the system actually employed is electrical; and, viewed in this specific aspect, it consists, in its general features, as does that of the other application, of a train system made up of car systems and a train line. There are one or more motor equipments, each with one or more motors on each car, a reverser switch, a current-varying controller, which includes a rheostat, and usually a series-multiple switch for each motor equipment, and one or more operator's switches or master controllers, with instrumentalities on the different cars for operating these devices, and train connections whereby a train of cars may be made up of any desired number of cars in any desired order or end relation and the entire system be operated as a unitary system from an operator's switch."

The general opinion is briefly described in the patent as follows: "That in the operation of a single car or a train of cars from any point on the car or train like movement at any operator's switch will correspond to like relative track movement of the car or train." The system of control is described, as are also the reverser switch and series-multiple switch, the pilot mechanism and the train line and couplers.

Attention is called to the fact that this patent describes the first controllers used on the Brooklyn Elevated Railroad, having in many respects departures of details from those used where the system was originated in commercial practice in Chicago.

Thirty-Two Thousand Volt Transmission for the Union Traction Company, of Indiana

The Union Traction Company, of Indiana, which is already noted over the country for its pioneer work in heavy electric interurban construction, is soon to have the further distinction of being the first electric railway company in the Central States to employ more than 26,000 volts in power transmission for its railway system. The extensions which will be built to its 97-mile interurban system are



MAP OF INDIANA HIGH TENSION LINES

to have power supplied to them from the generating station at Anderson, Ind., over 32,000-volt, three-phase transmission lines. The road at present in operation is supplied over 14,000-volt lines. The right of way has been secured for 75 miles of new line, as shown by the accompanying map. From Elwood the present line will be extended west to Tipton. There it will join a north and south line running from Kokomo to Broad Ripple, a suburb of Indianapolis, where it will connect with the Indianapolis city system. Substations will be located at Kokomo, Tipton, Noblesville and Nora.

The new 32,000-volt line will run north from the power station at Anderson to Alexandria and then west to Tipton, following the railway right of way. At Tipton will be a high-tension switching station, at which the load can be thrown on to either one of the two high-tension transmission lines that will be provided. The longest distance of transmission will be 60 miles, to the Nora sub-station. Glass line insulators are to be used. This will be a considerable advance in voltage and distance over any power transmission yet carried out in the East, though in the Far West this distance and voltage has been equaled and exceeded in at least three prominent cases.

Discussion on the Relation of Energy and Motor Capacity to Schedule Speed in Moving Trains by Electricity

The paper on this subject, presented before the American Institute of Electrical Engineers, Jan. 24, by Dr. Cary T. Hutchinson, was published in the Street Railway Journal for Feb. 1, but the extended discussion and papers contributed by others, some of them after adjournment, have only just become available. Four of these papers, viz., those by Messrs. Gotshall, Storrer, Potter and Duncan, together with a supplementary paper by Dr. Hutchinson, were printed in the issue of this paper for April 5. Two other papers submitted at the meeting in discussion of this subject by M. H. Gerry, Jr., and S. T. Dodd are given below, as are two further papers contributed after adjournment by Messrs. Dodd and Storer. The engravings referred to in Mr. Gerry's paper are those in Mr. Hutchinson's original article.

REMARKS BY M. H. GERRY, JR.

The paper by Dr. Hutchinson contains a very interesting and able theoretical discussion of certain problems in connection with moving trains by electricity. While any general discussion on this subject is of great value, it does not seem that this paper embraces a sufficient number of the operating conditions to justify such general conclusions as stated by the author. In fact it is highly improbable that any complete mathematical discussion can be had which will give correct general conclusions on these points. The conditions of practical railroading are so varied, and the results to be obtained depend to such an extent upon the traffic arrangements, that it is almost essential that each particular case be considered by itself. On certain elevated and suburban roads, the question of scheduled speed is of first importance, as on it depend the amount of traffic which can be handled, and hence the amount of income received. In a case of this kind it is not a question of power, but rather one of maximum scheduled speed which can be regularly and safely maintained, with stations at certain fixed distances apart; and the most rapid acceleration obtainable is usually the most desirable, for the reason that the fastest schedule can be obtained by the highest rate of accelerating up to the point of applying the brakes, and then retarding as rapidly as possible until the train is at rest.

As far as train efficiency is concerned, it is, of course, well known that the least energy will be required with the highest acceleration up to a point at which the power is cut off and the train allowed to coast until such a speed is reached that the brakes, by causing the maximum retardation, will just bring the train to rest at the proper point. Such theoretical conditions are, however, rarely either the most economical or the most desirable ones in practice. As a usual thing, certain distances between stations, maximum speed, number of trains, amount of traffic, etc., are determined by conditions entirely outside of those of power, and it then becomes the problem to operate a train service as economically as possible. The curve (Fig. 1) from a power standpoint represents conditions about as poor as it is possible to obtain; but, nevertheless, it was the best obtainable with certain steam locomotives on a suburban division. If it had been possible to accelerate more rapidly, and then either coast or maintain a nearly constant speed until the point of applying the brakes, a great saving might have been effected; but owing to the motive power and traffic conditions, the particular curve shown was the best that could be obtained. On many surface roads, and especially on street railways, the maximum speed is the limiting factor. In a case of this kind it would be the best practice to make use of a moderately rapid acceleration, up to, approximately, the maximum speed allowed, and then to maintain this speed until it became necessary to apply the brakes in order to make the required stop. This would produce a flat-topped curve, something like Fig. 2, and while not representing the most economical conditions from a power standpoint, it would still represent the most desirable practical conditions, as it would produce the highest schedule speed, keeping within the limits of maximum speed, and with the smallest consumption of energy, under these conditions. Where maximum scheduled speed is of the first importance, and there are no limitations as to maximum speed, then, of course, it is merely a problem of accelerating as rapidly as possible, up to the point of applying the brakes, thus producing a speed curve like Fig. 3.

The energy required to move a train between given points is made up of three parts: First, that due to the grade, or the amount required to actually lift the train, regardless of speed; second, the energy to overcome train resistance, i. e., friction; third, the energy required to bring the mass of the train to a certain velocity, i. e., the kinetic energy, which is afterward wasted by the brakes: this energy varying approximately as the square of the speed at the time the brakes are applied. In some cases the kinetic energy is a very large percentage of the total, this occurring where the distance between stations is short and the velocity relatively high. On the other hand, where the stops are infrequent, the stations being at long distances apart and the velocities comparatively low, then the kinetic energy at the time the brakes are applied is comparatively a small percentage of the total energy required, the greater part of which is due to overcoming train resistance and grades. In a case of this kind there is no necessity for rapid acceleration. In fact, there is no general rule which can be made to apply to all conditions of railroading in this respect.

The author makes certain deductions based on the common one-hour rating of railway motors which are hardly in accord with the results of practice in the use of such motors. There is an important distinction between the power which a motor will develop at any particular instant and the average load which it will carry on an all-day basis. As a matter of fact, the one-hour rating has only a slight relation to either the maximum or the average load, but has been adopted by the manufacturers as a fair test for heating, by which different motors can be compared. As far as commutation goes, any modern railway motor will produce power for short intervals of time very greatly in excess of its rating; in fact, this is one of the chief advantages of electric motors for this purpose. The conclusion of the author, that the motor capacity must be increased in proportion to the power required during the time that the train is accelerating, is hardly correct. The motor capacity required is more nearly proportional to the work done than to the power, and hence it does not follow that an increased acceleration necessarily means an increased motor capacity. The final conclusion of the author of this paper, that the lowest acceleration is best under practical conditions, is not in accordance with either the experience or the deduction of most engineers who have had under consideration problems of this kind. Furthermore, the conclusion that the single advantage for rapid acceleration is the saving in energy is hardly borne out by practice, where often the more rapid scheduled speed obtained is of even greater importance than the saving of energy. Then, too, it cannot be admitted that the investment is necessarily greater, or that there is an increased cost of maintenance, or that the station load factor is poorer, with increased acceleration of the trains. These conditions may or may not hold, depending more upon the design, the system adopted and the ends to be obtained than upon the mere fact that the train acceleration is either increased or decreased in any degree. It is desirable, of course, to avoid extremes and keep within practical limitations, and in doing this it can be safely said that there is no fixed rule, but that each particular case must receive special treatment.

The conclusions to this paper I believe to be entirely too general, and to be misleading as applying to certain classes of railroading.

MR. DODD'S PAPER

I wish to express my appreciation of the method and results of this paper. Many of us have spent a good deal of time juggling with motor curves and working out results for particular cases. General formulæ of universal applicability for determining the distance traversed, the energy expended, the speed, etc., for problems in motor acceleration have been needed for a long time, and if, as appears from this paper, the writer has developed such formulæ of convenient and general application, he has made a decided advance in the study of such problems. I do not feel sufficiently familiar with the paper to critise its general results or to say how convenient the formulæ may be for everyday use, but it appears that the results should be of a good deal of assistance to us.

Some time ago, I spent a good deal of time on the investigation of some problems in acceleration, and in view of the results arrived at in that investigation I have been particularly interested in the conclusions of this paper, namely, that the lowest acceleration possible under "practical conditions" is the best. It appears to me that there is a possibility here of a very interesting general investigation to carry this conclusion further and to determine what are the practical conditions under which one or another acceleration is advisable.

This thought has led me to take up again my old problem and apply to it the formulæ of Dr. Hutchinson's paper, and if my results differ from his, it is to be attributed to the assumptions that I have made in my particular case and to the fact that I have developed my investigations along slightly different lines from his, or perhaps to the fact that I have not appreciated the limitations of his formulæ and curves.

Let us consider a car equipped with motors of such a capacity as to give it an acceleration of 2 m. p. h. per second up to 15 m. p. h. at rated load of the motors. This is an acceleration which is

ordinary, or at least is frequently met with in practical conditions.

We will assume that during acceleration we do not exceed the rated load of the motors, i. e., while cutting out resistance we work along the line $a = 2$ at the point 100,100 of Curve Sheet 5, and that at the point where all resistance is cut out the speed, β 100 = 15, therefore $\beta = .15$. Assume, moreover, that b, the negative acceleration during coasting, equals .2 or the train resistance is equal to 18.2 lbs. per ton. Applying now formula (18) the power developed per ton by this equipment is $P = 18.2$ $(a + b)$ $a x = 6$ kw or 8 hp. This would correspond, for example, to a 15-ton car equipped with two 60-hp motors. We will assume that this equipment is making a run with a distance of 1500 ft. between stations. The energy expended, distance traversed, and speed of the equipment may be determined directly from Curve Sheet 7. Now, the question I wish to investigate is: Suppose the same equipment were geared for a higher or lower speed, but was started in every case at its rated load, what would be the effect of this change of gearing on energy consumption, schedule speed, etc.?

($a = 2$). We will study first the case where the car is geared for an acceleration $a = 2$ at its rated load. The results can be de-

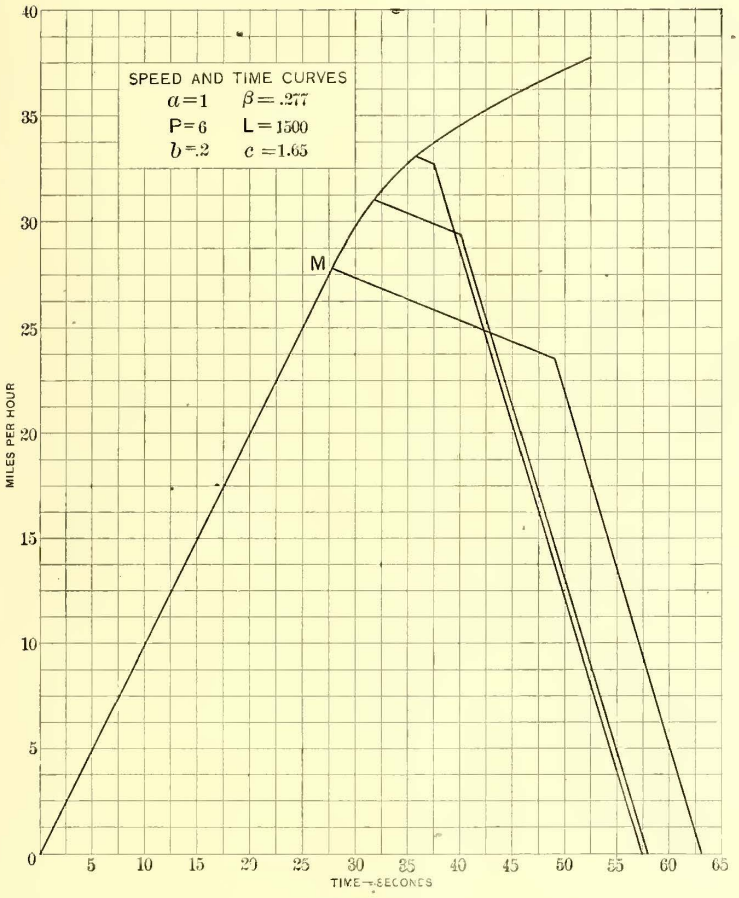


FIG. 1

rived from Curve Sheet 7 and are tabulated in Table A. The first row of figures in this table corresponds to the time up to the point M on the speed curves where all the resistance is cut out The succeeding rows correspond to the values 30, 60, 90, etc., of x on Curve Sheet 7.

The first column gives the time elapsed since the starting, and is derived by multiplying each value of $x \times \beta$ and adding the result to the initial value of t (7.5 sec.) given at the top of the column.

The second column gives the speed read from the velocity curve.

The third column gives the distance traversed, read from the distance curve and added to the initial value of distance 3670 β or 82½ ft.

The fourth column gives the energy expended, read from the energy curve and added to the initial value 522 β or 11.75 watt-hours.

Now let us assume that the power is shut off at any one of these points and the car is allowed to "coast" and finally braked and brought to rest at a distance of 1500 ft. from the starting point. We will assume the frictional retardation (b) is .2, corresponding to 18.2 lbs. per ton, and the braking retardation (c) is 1.65, corresponding to 150 lbs. per ton. Knowing from

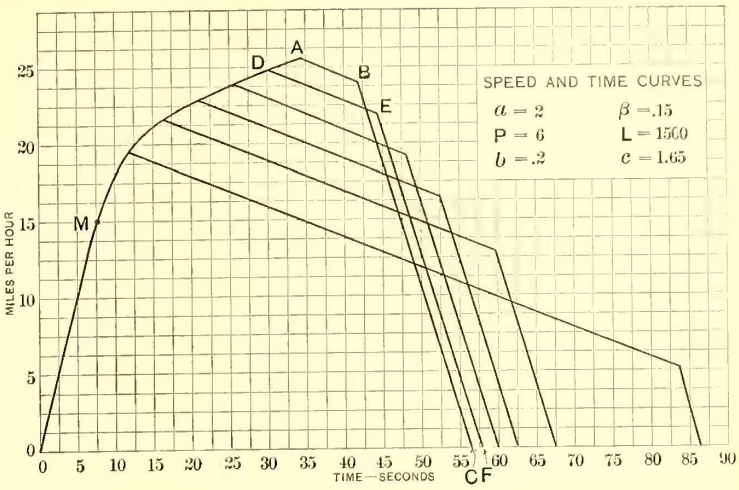


FIG. 2

Table A the velocity V and the distance to be traversed during coasting and braking (1500—d), we can find y, the time during which the car will coast, and z, the time during which it will be under braking retardation.

The formulæ connecting these two quantities are as follows:

$$b\,y^2 + c\,z^2 + 2\,b\,y\,z = 2\,(1500 - d)\,.682$$

$$b\,y + c\,z = V$$

$$\therefore z^2 = \frac{V^2 - 1.364\,(1500 - d)\,b}{c\,(c - b)}$$

$$y = \frac{V - c\,z}{b}$$

The values of V and d from Table A, substituted in the first of these equations, gives the time z during which braking will take place. Values of V and d such that V^2 is less than 1.364 (1500—d) b, give imaginary values of z, i. e., indicate that the car, if allowed to coast from such a velocity, will stop from frictional resistance before traversing 1500 ft. Values for which V is less than $c\,z$ indicate that the car, even if braked with "no coasting," would have traversed over 1500 ft. before being stopped.

Let us first assume the power shut off at the time $t = 34½$ sec. Applying the formulæ for y and z we find the car will coast 7.5 sec. (y) and be brought to rest under the brakes in an additional 14.45 sec. (z). The relative amounts of acceleration, coasting and braking are most satisfactorily shown in the "speed-time curves" for $a = 2$ by the curve O, M, A, B, C. The intercept on the base line shows the total time the car has been in motion is 56.45 sec. Adding to this 15 sec. for the stop at the station we get the schedule time for a run of 1500 ft. from which the schedule speed 14.28 m. p. h. can be calculated. If the power is shut off at the time $t = 30$ the coasting curve is longer and consequently the schedule speed is less. This is shown by the curves O, M, D, E, F, of the same sheet.

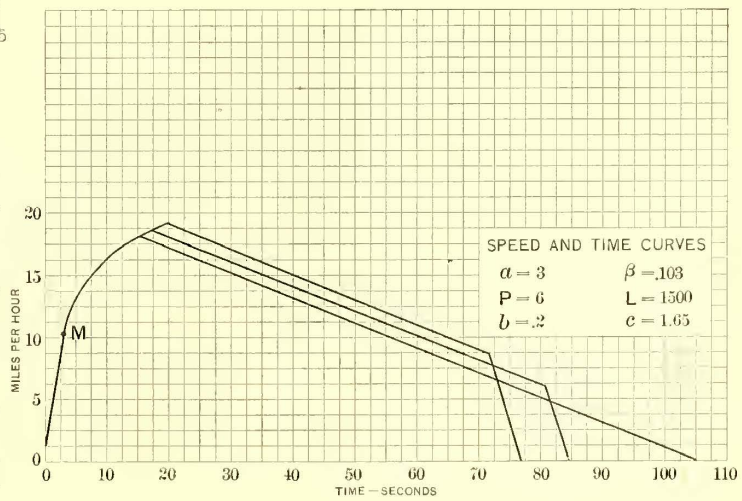


FIG. 3

The successive straight lines starting from the acceleration curve on this sheet show the effect of shutting off power and beginning coasting at the successive times shown in Table A and the schedule speed calculated from the intercepts on the base line are tabulated in the fifth column of that table.

Values of V and d at the time $t = 7.5$ give imaginary values of z, showing that the car would not cover 1500 ft. if allowed to drift from this point.

As said above, the fourth column of Table A gives the energy expended per ton up to the time under consideration. If the power is shut off at this point, this represents the total energy used in traversing 1500 ft.; multiplying this by 3.52 gives the energy expended per ton for traversing 1 mile. The sixth column of Table A gives the watts-hours per ton mile thus calculated.

($a = 1$). Let us now assume this equipment geared for a higher speed and lower horizontal effort, so that at its rated load it will develop an acceleration $a = 1$. Since the horse-power of the equipment is the same as before, we have from formula (18)

$$P = .182\ (a + b)\ a\ x$$
$$6 = .182\ (1.2)\ \beta\ 100$$
$$\beta = .277$$

The results of this are tabulated in Table B and illustrated in the "speed-time curves," for $a = 1$. The values in the Table B are derived from Curve Sheet 8, as those in Table A were from Curve Sheet 7. It will be seen that only a few readings are possible, as beyond $t = 33$ sec. we get negative values of y. The "speed-time curves" show that this means nearly all the time is spent in acceleration up to the motor curve and in braking down from it.

($a = 3$). Let us now assume the equipment geared for a low speed and high horizontal effort, so that at its rated load it will give an acceleration $a = 3$. Again, from equation (18) we derive the value of $\beta = .103$ and from Curve Sheet 6 we derive the values of distance, energy, etc., shown in Table C. Here, again, we are limited to only a few readings, as those below $t = 15.8$ sec. give imaginary values of z, showing that the car would not run 1500 ft. if power were shut off below this point. I have not attempted to carry the curves much beyond the points shown on Curve Sheet 6. It would be interesting to study the results in this case beyond this point, but the readings we have are sufficient to show the character and relations of the curves.

We are now in a position to answer the question we started to investigate, as to the relative amounts of energy used by operating with different accelerations. We have the data in the fifth and sixth column of each table from which to plot the relation between schedule speed and energy expended for the different rates of acceleration. This has been done on the sheet of "energy and speed curves." The curves on this sheet show for any given initial acceleration the effect on the energy consumption of introducing more or less coasting in operation and thereby modifying the schedule speed. Two or three points are worth noting on these curves.

(a). The watt-hours per ton mile vary from about 50 to 200, according to the character of the acceleration and amount of the drifting.

(b). The energy is a minimum at the "no braking" point, which is the minimum speed and increases with the speed slowly at first but quite sharply as we approach the "no coasting" point. This is to be expected, as the higher values represent greater losses in brake friction.

(c). The $a = 2$ curve is shown throughout nearly its whole length from the "no braking" point to the "no coasting" point.

The $a = 1$ curve is shown from the beginning of the motor curve to the "no coasting" point.

The $a = 3$ curve is shown only a short distance up from the no braking point. It would be interesting to carry the curve further and see its character at higher schedule speed.

(d). Comparing the $a = 1$ curve and the $a = 2$ curve it appears the average watts expended per ton mile with an initial acceleration $a = 1$ is nearly 100 per cent greater than the watts expended with an initial acceleration of $a = 2$ with the same starting currents and the same schedule speeds.

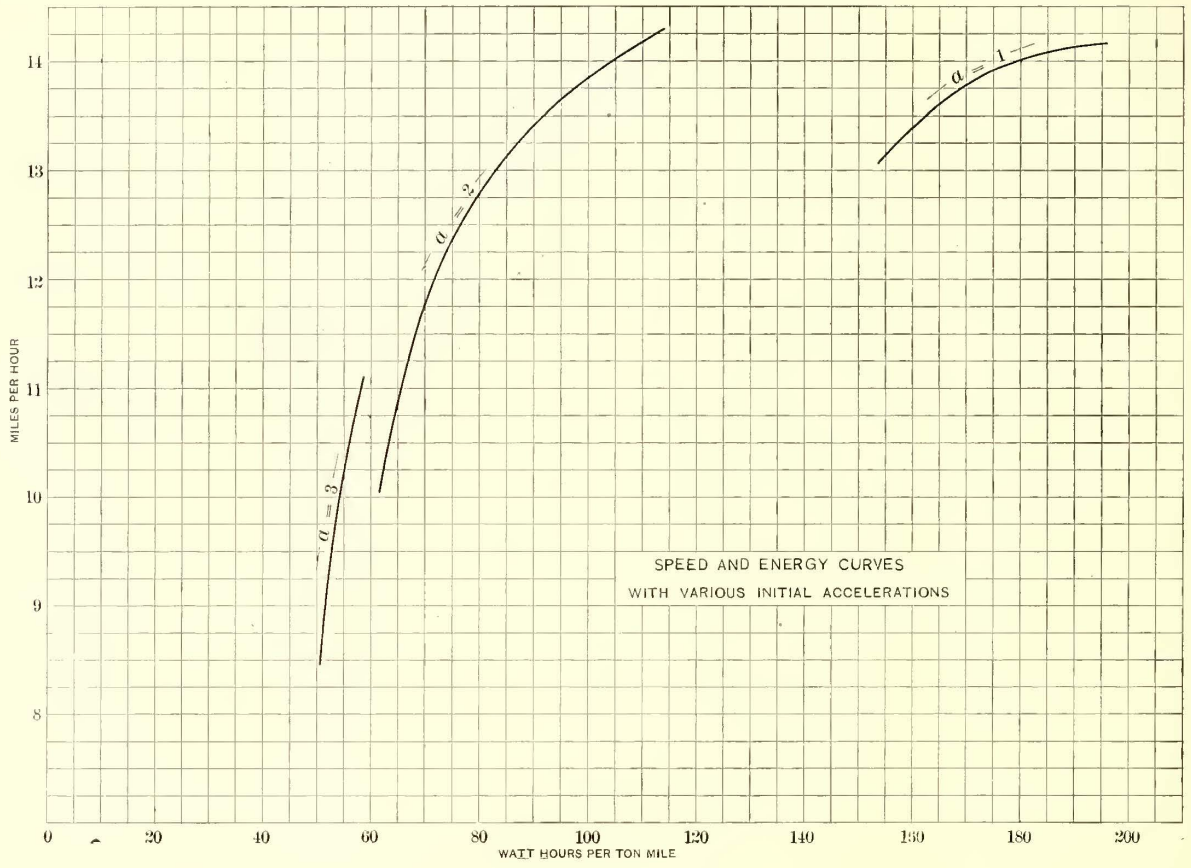


FIG. 4

The $a = 2$ curve shows an expenditure of energy about 10 per cent greater than the $a = 3$ curve for the same schedule speed. Whether these curves would continue to be approximately parallel to each other, or whether as the $a = 3$ curve approached the "no coasting" point it would cross the $a = 2$ curve, can only be determined by carrying the curves of Curve Sheet 6 to higher values. It is evident from an inspection of the "speed-time curves" for the two cases that it would not be possible to attain the same maximum schedule speeds with the $a = 3$ curve as with the $a = 2$ curve.

The conclusion which this investigation appears to indicate is that in this particular case the higher acceleraton is the most economical, not only in power house, but on equipment. You will note that we have assumed in every case that we have the same equipment, and it is started with the same starting current, but in one case is geared for a high speed and in the other for a low speed, and the curves show that at the same schedule speeds the average power consumption is less for the higher rate of acceleration.

As I understand Dr. Hutchinson's paper, his general conclusions are directly opposed to this, at which I have arrived. He is more familiar than I am with the methods and reasoning of his paper and may be able to point out the difference in our assump-

tions or reasoning which has led to this apparent discrepancy. I started to follow out this investigation with the intention of testing the convenience of working from his formulæ and curves and trust that the results are of sufficient interest to warrant me in contributing them to this discussion.

TABLE A

$a = 2$ $\beta = 15.0$ $L = 1500$ ft.

Time Seconds	Speed m.p.h.	Distance Feet	Energy w.-h.	Schedule Speed m.p.h.	W.-h. per Ton Mile
7.5	15.0	82.5	11.75	----	----
12.0	19.5	195.0	17.4	10.05	61.7
16.5	21.6	330.0	21.3	12.36	75.0
21.0	22.8	472.0	24.4	13.16	86.0
25.5	23.8	622.0	27.1	13.65	95.5
30.0	24.7	792.0	30.0	14.02	105.0
34.5	25.35	982.5	32.45	14.28	114.2

TABLE B

$a = 1$ $\beta = .277$ $L = 1500$ ft.

Time Seconds	Speed m.p h.	Distance Feet	Energyw.-h.	Schedule Speed m.p.h.	W.-h. per Ton Mile
27.7	27.7	565	43.6	13.05	153.5
31.85	31.0	756	50.9	14.0	179.0
36.0	33.0	947	55.9	14.15	196 7

TABLE C

$a = 3$ $\beta = .103$ $L = 1500$ ft.

Time Seconds	Speed m.p.h.	Distance Feet	Energy w.-h.	Schedule Speed m.p.h.	W.-h. per Ton Mile
3.44	10.3	26	5.38	----	----
15.80	17.92	281	14.6	8.48	50.7
17.86	18.5	334	15.66	10.27	55.1
19.92	19.0	392	16.71	11.1	58.8

N. W. STORER'S DISCUSSION OF MR. POTTER'S PAPER*

In Mr. Potter's able paper on the "Selection of Electrical Motors for Railway Service," he has made some statements which, as Dr. Hutchinson remarked, can hardly be considered otherwise than as a criticism of the method of rating railway motors which was proposed by the writer and adopted by the Westinghouse Electric & Manufacturing Company. I am very glad the subject has been brought up by one who is so well qualified to discuss railway motors, and to feel that while there are some minor points of difference, on the larger questions of motor selection we are in substantial agreement. The idea of determining the fitness of a motor for a certain service by means of a continuous shop test at a current giving the average copper loss and at a voltage giving the average core loss was presented by the writer in the STREET RAILWAY JOURNAL of January, 1901, and was supplemented by another article in the November number of the same paper. But in order to place the matter clearly before the Institute, a brief statement as to the method proposed is necessary. First, let it be understood that it is not so much a method of rating as a method of stating the service capacity of railway motors.

It is rather unfortunate that the old method of rating railway motors in terms of the output it will develop for one hour should have been brought into the present discussion, and especially that it should have been defended as a means of serving the commercial necessity for a relative measure of capacity between different motors. The defects of this method, not only for finding the service capacity of a motor, but as a means of comparing two motors commercially, are very well known, and every argument which has been brought up against the method of comparing motors on the basis of their continuous capacity at lower voltages applies with double force to the old method of rating. The one-hour test represents no condition of service, and the comparison of two motors on the basis of the load that each will carry for one hour at the normal voltage, with a certain rise of temperature by thermometer measurement, is obviously very inadequate and misleading. It may be granted that this one-hour rating, by being well known, does afford a kind of comparison, or an indistinct idea as to the size of the motors under consideration. It affords an idea as to the limits of commutation that may be expected, and, therefore, as to the momentary load allowable, but it cannot give an adequate idea as to the continuous load which the motor will safely carry in regular service. In his discussion of Dr. Hutchinson's proposition, that a railway motor will carry its rated output one-fourth of the time, Mr. Potter has given excellent reasons to show that the commercial rating is not a safe criterion to follow in selecting a motor, in the fact that motors differ so much in losses and radiating capacity. In addition to this, the measurement of temperature by thermometer method is misleading. A test of one hour is of too short duration for the motor to reach its maximum temperature, and the inside of the coils will be relatively much hotter than the outside. In street railway motors the ratio between the rise of temperature in the field coils by resistance and by thermometer methods varies between 1.25 and 2, depending on the number of turns of wire and the kind of insulation. If the armature is unventilated, there may be nearly as great a difference there. For this reason the temperature should be measured by resistance method. Again, the distribution of losses between the iron and copper may be, and probably will be, entirely different in the one-hour test from what it would be in actual service. This will give an improper distribution of temperature rise, so that if the motor is designed to give the same rise in temperature in the fields as in the armature on a one-hour run, it will be found that in regular service the field coils will be overworked, while the armature will be comparatively cool. But it is unnecessary to discuss the one-hour rating further; its defects are so well known that few engineers now attempt to select a motor for any service on that basis.

Now the question is, If this method of rating does not meet the requirements for a measure of the service capacity of the motor, of what use is it? If it does not correctly define the service capacity of the motor, it is obviously incorrect to compare motors on that basis. It is certainly necessary that there should be some method of comparing two motors on the basis of service capacity, and such a comparison must be made as simple as possible. It was to meet this condition that the writer proposed a comparison of the carrying capacity of railway motors on the basis of the currents which they would carry at 300 volts and 400 volts. Mr. Potter agrees "that the equivalent heating or reproduction of a given service by running a motor with a current giving an equivalent copper loss and at the voltage giving the average core loss would be convenient and correct, providing the effective amperes of the given service are determined and applied at the proper voltage."

The question is, then, whether it is correct to compare the motors on a basis of their continuous current capacity at a definite voltage. Mr. Potter has discussed this at considerable length and his chief objection is found in his statement that different motors when properly geared for a given service may show considerable variations in the equivalent currents and voltages necessary to reproduce that service. This statement is substantiated by a table showing the equivalent current and voltage for a certain schedule for four different motors. This shows maximum variation in current from 25.9 amps. to 32.4 amps., and for the same motors a variation of from 310 volts to 372 volts; the other two motors are very close. The statement is made that the motors are properly geared in each case for the service, but, as there are different ideas concerning the selection of gears for motors, it may be pertinent to inquire upon what basis the selection of gears was made; whether the gears were selected to secure the highest efficiency or the lowest losses in the motor, to allow a certain fixed time and distance for coasting, to allow a certain margin for increased speed, or upon some other basis. With this table there is not sufficient data to put it on a firm footing before the Institute. It is quite certain, from an inspection, however, that if the motor which requires 35.9 amps. at 310 volts were geared for a lower speed, that both the amperes and voltages would approach nearer to those of the other motors, and if the motor which requires 32.4 amps. at 372 volts were geared for a higher speed, the result would be to bring its current and voltage closer to those of the other two motors. This is in line with the statement that "the above current and voltage would, of course, vary with different percentages of coasting." A further inspection of this table indicates that the motors were geared for a much lower speed than is allowable to secure the usual margin for making up time. It indicates a much lower margin than is allowed in almost any commercial service. But, even with the gear ratios assumed, it is practically certain the average core loss would be reproduced by a voltage of 300 or less, if any time is allowed for series running or longer stops, which are inevitable in any street railway service. The voltages of 300 or 400 were selected by the writer as representing the average requirement for city and suburban service only after a considerable number of tests, all of which showed the equivalent voltage on the motors in city service to be below 300. They were selected as meeting practically all requirements because the influence of the voltage on the tempera-

* Forming part of the discussion on Dr. Hutchinson's paper at the meeting of the American Institute of Electrical Engineers, but contributed after adjournment.

ture rise of the motor in the continuous tests were comparatively small. This may be seen from the slight difference in the current capacity of the motors for 300 volts and 400 volts. Where the current capacity has been determined by the maximum rise in temperature, as measured by resistance method, of 100 degs. C., in the shop test, it has repeatedly been found that a difference of 33 1-3 per cent in voltage is balanced by a difference of only about 5 per cent in current. There will undoubtedly be very small differences in the equivalent current and voltages of different motors for the same service as there are undoubtedly slight differences in the efficiency and the speed curves of motors. But the differences will be so slight as to be negligible, and this continuous test, while giving, in the simplest form, the service capacity of railway motors, is the only accurate and rational method yet proposed of comparing the service capacity of two railway motors by a shop test.

A further statement is made that this method of rating assumes that the temperature rise and distribution of temperatures of a motor tested on the stand will hold good under service conditions. The method does, indeed, assume that the relative rise in temperature in field and armature is the same on the stand as in service, but it is a little surprising to see a repetition of the statement that the temperatures have been assumed to be the same. This objection was fully covered in the writer's article in the November number of the Street Railway Journal by a quotation from one of the circulars of the Westinghouse Electric & Manufacturing Company, as follows:

"Owing to the improved ventilation which is secured when the motors are under a moving car, the actual rise of temperature in service with this current would probably not exceed 55 degs. C. by the thermometer, instead of 75 degs. C., as obtained in the shop."

The temperature rise of a motor in service will certainly be less than when run with the same average losses in a shop test. Just how much less will depend on the schedule speed, the number and duration of stops, the conditions of the weather, etc., but for average service the temperature rise of the motor will be about 25 per cent less than in the shop test. It is quite true that a higher schedule speed with the accompanying long runs will cool the motor more than a slow speed with a large number of stops, but unless the duration of the stops occupies a far larger proportion of the time than is usually the case in any street railway service, the temperature rise of the motor should always be lower than when run with the same average losses in the shop. In this connection it must be understood that the greater the number of stops the lower will be the equivalent voltage and the less will be the iron loss, so that, while the rate of radiation of heat is less for a great number of stops, the decrease in core loss will counterbalance it and the temperature rise will be about the same as if run at a higher equivalent voltage and speed.

The statement has been made that experience has shown the desirability of determining the losses and consequent heating of the field and armature independently for each particular case. This is quite true for the designers of motors, but what the practical engineer needs is to know the safe load that a motor will carry, and the question as to the exact rise in temperature of the different parts of the motor rarely enters into the question. It is the maximum temperature that limits the capacity of the motor.

The method of determining the temperature rise of the different parts of the motor by means of the watts loss in each part and the ratio between armature and field loss is an excellent one, although it would be more nearly correct if the constants were plotted in terms of ratio between $I^2 R$. and iron losses, instead of the ratio between so-called field and armature losses, since it is a fact that a part of the iron loss in a railway motor is in the pole face instead of being altogether in the armature.

The method of obtaining the temperature constants for the field and armature by means of a series of car tests, made under all possible schedules and conditions of service, is laborious in the extreme, and it seems to me unnecessarily so. Car tests are necessary for a determination of the ratio between the temperature rise in shop and in service for different schedules and other conditions, but when this ratio is determined for one motor it should be practically the same for other motors tested under the same conditions, especially if the motors are completely enclosed, as they are in a majority of cases. The constants may easily be obtained in shop tests, where the distribution of losses may be absolutely determined, and the distribution of temperature rise will be practically the same as in service.

I heartily concur with Mr. Potter in the statement that the equivalent current and voltage should be determined as far as possible for each case. At the same time I submit that street railway motors should be compared on the basis of their continuous capacity in shop tests, which should also meet the requirements for a simple measure of their service capacity.

Mr. Scott's remarks on the inertia of the rotating parts of a train are valuable, as they plainly show the inaccuracies to be found in car tests. He admits that the fly-wheel effect is there, but the deductions he makes from the fact that the tests did not show it are most surprising. The statement that it might prove to be a "positive benefit to have a larger armature, and, therefore, store more energy," has absolutely no foundation theoretically. It is admitted that the rotating parts of a train possess energy, by reason of their rotation. This energy they must receive from the line. The amount of energy stored in them is proportional to the square of the maximum speed attained. The amount restored in coasting is that represented by the difference in energy possessed by them when the power is cut off and when the brakes are applied. The remainder of the energy, which is much the greater part, is lost. Therefore, to say that no power is used by a train on account of the inertia of the rotating parts is as unreasonable as to assume that no additional power is required on account of the weight of the passengers.

In this connection it is interesting to note a statement which appeared in the *Electrical World and Engineer* of Jan. 25, in the description of the train equipment of the Manhattan Railway system. It is stated that the inertia of the rotating parts of the train, amounting to an equivalent weight of 20 tons, was carefully considered in calculating the power required for acceleration.

MR. DODD'S REPLY TO DR. HUTCHINSON'S CRITICISM.*

I had not intended to participate further in the discussion of Dr. Hutchinson's paper, but some of the statements in his revised reply to my original discussion demand a little further attention. Dr. Hutchinson agrees that I have "deduced results which are directly opposite to" his results, and as in his endeavors to explain that fact he falls back on the plea that I have handled his data and formulæ in an "incorrect manner," I wish to reply to his criticisms.

His first criticism is that I have made "an arbitrary substitution of $\beta 100 = a x$." I reply that this substitution is perfectly justified by the definitions of his paper and by the data of my problem. From Curve Sheet 5 of the paper, the speed at full load is determined by the point $X = 100$, $Y = 100$ and by the equation "Velocity $= \beta Y$ in m. p. h.;" therefore, on my assumptions, for the case, $a = 2$, $\beta 100 = 15$ or $\beta = 15$. In obtaining the value for β in the other cases, I make use of equation (18). The equation in question is

$$P = 0.182 \quad (a + b) \quad a x \qquad (18)$$

where, according to the definitions of the paper,

$P =$ power per ton developed at the car axle.

$a =$ initial acceleration.

$b =$ coasting retardation.

$x =$ time in seconds during which the acceleration a has been acting.

$\therefore a x =$ velocity in miles per hour at the end of the time x.

In getting an expression for the power developed by the motors at their full load I assume x is the time necessary to accelerate the load up to full-load speed of the motors, i. e., up to the instant when the rheostat is cut out and the motors begin to work on the motor curve. Therefore $a x$ is the full-load speed of the motors, or 15 m. p. h. The equation "$\beta 100 = a x$" is not true as a general equation, and I have not used it as such; but at the instant under consideration, when the motors are developing their rated horse-power, the identity $a x = \beta 100$ is simply a mathematical statement of my assumption that the speed $(a x)$, at the instant after the initial period of acceleration is completed, is equal to the full-load speed of the motors $(\beta 100)$, and I have a perfect right to substitute one of these quantities for the other.

The values of β thus derived, substituted in Curve Sheets 6, 7 and 8 of Dr. Hutchinson's paper, give me the speed, distance traversed, and energy expended per ton, tabulated in my tables A, B and C, and summarized in the curves of my Fig. 4 for the accelerations $a = 1$, $a = 2$, and $a = 3$. Stated as a practical problem, I have only assumed that it is possible to gear the same equipment for a higher or lower initial acceleration with the same full-load current of the motors, and I have derived from the formulæ of the paper, the characteristics of operation corresponding to the accelerations $a = 1$, $a = 2$, $a = 3$.

Dr. Hutchinson is guilty of another error when he says I have "used the wrong equation to calculate the input, the equation (23) is the correct one." If he had noted my words he would have seen that I have nowhere used equation (18) to calculate the

* Forming part of the discussion of Dr. Hutchinson's paper at meeting of American Institute of Electrical Engineers, Jan. 24, 1902, but contributed after adjournment.

input, but have uniformly used it, as defined in his paper, to express the power developed by the motors at the car axle. It is, however, absolutely immaterial to me what equation I used to obtain the values of $'\beta$ corresponding to various values of a. Any equation in his paper expressing the relation between these two quantities would have served my purpose as well. Suppose we use equation (23):

$$P = .213\ (a + b)\ '\beta\ X \qquad (23)$$

The coefficient differs from that in (18) by the factor .85 expressing the efficiency of the motors, but the relation of β to a is exactly the same as was derived from equation (18), and for the same equipment I can derive the same values of β corresponding to different values of a as I have already derived from equation (18).

I wish to criticise, in this connection, Dr. Hutchinson's use of P in (23) as expressing input to the motors, while the same symbol is used in (18) to express a different quantity, the power developed by the motors.

I maintain that the above review of my discussion effectually disposes of Dr. Hutchinson's statements that I have incorrectly handled his formulæ.

His only remaining criticism is in regard to my interpretation of the results summarized in the curves of my Fig. 4. While he admits the curves show a maximum energy consumption with a minimum acceleration at the same schedule speed, he claims that "these values are not comparable, as they are obtained under entirely different conditions." On the contrary, the conditions are absolutely the same. We have assumed the same equipments, taking the same starting currents, the same length of run, and have arrived at curves showing the energy used for making the same schedule speed with different initial accelerations. He says my results only "show the difference in energy required for more or less use of the motor curve." I am perfectly aware that the increased economy is due to increased use of the motor curve. I cannot conceive of a variation in the initial acceleration which does not necessarily involve a corresponding variation in the use of the motor curve, the power of the equipment and the schedule speed being maintained constant. This, I have always considered, is the secret of the economy of high acceleration. If, however, Dr. Hutchinson has "elaborated a method that gives the effect of varying the initial acceleration on the energy and motor capacity" and by which he can maintain the same amount of use of the motor curve while he varies the initial acceleration, and still make the same schedule speed over the same length of run, he has failed to develop that phase of his investigation very clearly in his paper.

In closing I wish to say that I do not wish to be understood as making any criticism on the general conclusion of his paper, in which he states: "The best initial acceleration to adopt is that acceleration giving the minimum motor capacity." Of course it is understood that the words "for a given schedule speed" are tacitly assumed in this conclusion. With that correction, that is a statement which it did not require the array of figures Dr. Hutchinson has marshaled, to command the assent of every railroad engineer, whether practical or otherwise.

What I do criticise is his further conclusion that the lowest acceleration is the most economical, or, as he stated in his paper, "the result is always that the energy used per mile is less for the lower accelerations." It was this conclusion that I challenged in my discussion, and I maintain that by applying the formulæ and curves of his own paper to a particular case, such as would be met with in ordinary operation, I have proved that at least this is false as a general conclusion, and is not of universal applicability.

Pennsylvania Tunnel Bill Signed

Governor Odell, of New York, has signed the Stranahan bill, which allows the Pennsylvania Railroad to construct a tunnel to bring its road into New York City. His action was taken at the request of Mayor Low. The bill gives the Rapid Transit Commission of New York City the power to grant a franchise to any railroad corporation for constructing and operating a tunnel railroad from a point within the city to a point within an adjoining State. The Commission is to fix the route of said road and to prescribe such regulations as it may deem necessary for the conduct of such road. The grant is to be for twenty-five years, and the Commission is given power to fix the amount of the fee which the railroad shall pay to the city. The bill, however, does not in any way interfere with the powers of the State Railroad Commission over the road. The State is exempted from liability for damages resulting because of any act of omission of the Rapid Transit Commission.

London's Traction Problems

The Society of Arts, London, listened to a paper by Mr. J. Clifton Robinson, March 19, in which he recited the history of the development of transportation facilities in London, the effect of legislation in retarding the extension of the present lines and adoption of modern methods, and the outlook for the immediate future.

"Within the last twelve months two pressing problems regarding rapid transit have come prominently before the public mind, taking front rank among the immediate questions of the day. One of these is how the 'tangle of locomotion' in the metropolis is to be straightened out and relieved—the other is the question of a greatly extended use of electricity in locomotion. The intimate relation between these subjects is now universally recognized, for in one it is seen we have the solution of the other."

One of the obstacles that confronts the electric railway projector at the outset, and continues to bother him persistently and consistently throughout his career, is the multitude of public boards and officials vested with sufficient authority to delay progress on one pretext or another and create confusion by insisting upon the adoption of ideas not in harmony with the general scheme proposed. The condition of affairs is bad enough when these officials have merely supervisory functions, but when the enterprise becomes a public undertaking and is entrusted to them it seems to be well-nigh impossible to secure anything like satisfactory results.

"From the earliest period," Mr. Robinson declares, "I have been the zealous advocate of such enterprises being in the hands of incorporated or joint stock companies rather than in the hands of local authorities. There may be cases—though I know of none—where the advantage lies the other way. Even in the largest of our provincial cities difficulties have already arisen in the extension of tramways where populous districts have begun to arise beyond the civic boundaries. In London, with which we are more immediately concerned, the argument in favor of a company undertaking such works is especially powerful. And I say this in face of a strong desire shown in many places, that all the tramways here should be in the hands and under the management of the London County Council. The Council does not govern the whole of the metropolitan area, and even within its own bounds it possesses only a joint authority with a multitude of municipalities. How could even the initial 16 miles of the London United have been brought into existence and worked had it been left to any combination of local authorities to project, construct and work them?

"We have been, it is true, at a great disadvantage from the multitude of local authorities with whom we have had to deal. But we have unity of purpose, and even the negotiation with three County Councils and thirty, or thereabouts, District and Urban Councils did not daunt us. We knew our own mind, and could consistently throughout pursue one definite policy. I have admitted elsewhere that this "multitude of councilors," and of Councils, might have projected and constructed each its own bit of line, and that they might have got these fragments operated as one system. Each little Pedlington would have its staff of Parliamentary agents, engineers and contractors, each one would demand its share of the profit, if any could arise, from such a hugger-mugger of ownership and management. The accounts would be voluminous, and their accuracy would be practically impossible, while the hosts of officials would be as disastrous to the funds as a cloud of locusts would be to a green crop.

"At the present moment the London United Tramways system—already operating, or under construction and authorized—traverses the territory of the London County Council, the Middlesex County Council and the Surrey County Council, while to name the vast number of subordinate local councils would be as uninteresting as a list of Homer's heroes."

Concerning the most practical method of securing immediate relief that will be more than temporary, Mr. Robinson advocated the overhead trolley.

In the discussion that followed, Messrs. E. T. Scammel, Alexander Siemens, S. Z. de Ferrantis, Ernest Benedict, W. M. Mordey, John Leighton, Leon Gaster and Peter McMahon participated, and the chairman, Prof. S. P. Thompson, summarized the evening's contributions in an interesting address. The remarks made by the several speakers indicated that the lack of harmony complained of by the writer of the paper was not confined to governing bodies and that the present condition of affairs may be attributed in part, at least, to the engineers, who should be most interested in securing united action.

Meeting of the New England Street Railway Club

The regular monthly meeting of the New England Street Railway Club was held on March 27 at Wesleyan Hall, Boston. President Spring submitted his resignation to the club in view of his having accepted an offer from a Western road, but the resignation was laid upon the table for the time being, and the meeting adjourned to hear an address by Gilbert Hodges, of Boston, upon "Overhead and Track Construction in Connection with Interurban Railways."

Mr. Hodges said:

"The present type of interurban road calls for a roadbed and track as good as that of any steam railroad, and as its location is often either alongside of, and independent of, the highway or on a private right of way altogether, the character of the construction is, or should be, quite like steam railroad work.

"The cars now in use will often weigh 40 tons when loaded. They are propelled at high rates of speed, and, therefore, there should be a well-built roadbed, of a good alignment and easy grades, strong and durable bridges and a substantial track.

"The evolution of the rails for street railways has curiously enough followed almost exactly that of steam railroads, both as to the gradual increase in weights and lengths. We have struggled along upward from the 30-lb. Tee to 70 lbs. and even 80 lbs., and from the 30-ft. rail to the 60-ft., and backward to the 30-ft. again, as did our friends of the steam roads before us. We have also had something of their experience as to joints. They started with the short cast-iron chair, thence to the plain fish-bar 10 ins. to 12 ins., thence to the angle-bar ranging from 18 ins. to nearly 3 ft., and back to the shorter but more improved joint, such as the continuous or the Weber, both of which are most efficient at about 24 ins. in length.

"We are just coming into line in the matter of ties also. It does not seem so very long ago to some of us when we were using very small-faced ties not over 6 ft. 6 ins. long, and these spaced very far apart, in many cases 4 ft. and 5 ft.

"We have in our experience had occasion to examine a road in this State where the ties were found to be 8 ft. apart throughout.

"The quality of the tamping material underneath and around ties is receiving more attention each year, and on the best interurban roads good, clean, sharp gravel or even broken stone is being used for ballast; great pains is being taken to have plenty of this ballast, and to see that all ties are well and thoroughly tamped to a good and solid bearing throughout.

"The electrical connections in the rails and other parts of the track which are intended to provide a path for the return of the current to the power station have developed from the No. 4 galvanized-iron wire through the silicon bronze and small-sized copper wire single bonds, with a supplementary wire, to two No. 0000 or other large-sized bonds at every joint, and with large-sized cross-bonds every few hundred feet, and the method of their application has been changed from the riveting hammer to the quietly working but more practical pressure riveting.

"This, then, is the history of the evolution of the ancient tramway into the modern well-built interurban track.

"The development of the overhead system covers a very much shorter period, going back only to about 1886 or 1887.

"First, there was a double-trolley wire with a trolley having four wheels. This was found to be impracticable and the single-trolley wire was adopted, the contact being obtained by means of the fish or trolley pole and single-trolley wheel as now.

"All kinds and sizes of wires have been used for trolley wire, from the small silicon bronze wire to the large No. 0000 figure 8 pattern.

"The requirements of a modern first-class and fully up-to-date interurban electric railway as to the track and overhead system are substantially as follows:

"First, a location that will admit of the most direct route with as few curves as possible, and so laid out as to grades as to make them as easy as possible. In arriving at this condition, it has been found not only desirable, but to be the best economy, to purchase private rights of way, make heavy cuts and embankments and build costly bridges and culverts.

"The cross section of the roadbed at subgrade should give a full and sufficient shoulder beyond the ends of the ties of not less than 3 ft. on either side.

"There should be provided suitable drains or culverts under the track wherever water is liable to accumulate, to prevent washouts.

"All bridges should be designed by a competent engineer, and made strong enough to carry a car weighing 40 tons on a 17-ft. wheel base with perfect safety and with a sufficient factor of safety to insure the same to be done without any material tax upon any portion of the structure.

"If the bridges are to be of wood they should have short spans of from 12 ft. to 16 ft., and where several spans are required they would naturally have either pile or timber trestle bents. All timber entering into the framing of a bridge should be of long-leaf Southern pine, of the best grade to be obtained in the market, well framed and thoroughly fastened in every way.

"Where piles are used they should be of upland white oak if possible to obtain it. Red oak, chestnut oak and chestnut do not make satisfactory or durable piles. No piles grown in swampy or low-lying soils should be allowed, as they will generally be found to have a coarse, spoongy wood, which is sensitive to moisture and liable to early decay.

"Great care must be used in the driving of piles, to see that they not only reach a firm foundation, but also that they are not split or broomed at the small end by injudicious hammering.

"This work should always be done under the inspection of a competent engineer.

"Where steel bridges are used they should be either of eye beams, plate girders, riveted trusses or pin and link trusses.

"Eye beams of proper size and number may be used with safety and economy for spans as high as 30 ft., plate girders from 30 ft. to 100 ft., riveted trusses from 100 ft. to 200 ft., and for all spans over 200 ft. in length the best practice is to use what is known as the pin and link truss.

"All bridge floors should have ties not less than 10 ft. long, and spaced not further apart than 8 ins. in the clear. On the outer end of these ties there should be a guard stick between the ties and securely bolted to every third or fourth tie. The office of these guard sticks is not, as is generally supposed, to prevent a derailed car leaving the bridge, for it is in such a position, generally, that should the car go so far as to reach it the tendency would be for the car to topple over the side regardless of this slight obstruction, but it is to serve as a spacer for the ties, and to keep them in place longitudinally so that they shall not bunch up, hence the importance of their being gained down not less than an inch on the ties.

"For the purpose of keeping a derailed car from leaving the bridge, there should be a heavy rail placed inside each track rail and spaced about 8 ins. away from them, securely spiked and fastened to the ties.

"These rails, if properly spaced, will permit of a car dropping between them and the track rail, and will generally keep the car in that position, thus carrying it along in the direction of the track and preventing its leaving the bridge or striking the trusses.

"Guard rails should extend for a distance of not less than 60 ft. from each end of the bridge and then be brought to a point at the center of the track.

"No bridge, however small, should be without a protection of this kind.

"Assuming that the roadbed has been carefully graded and brought to subgrade, the drains, culverts and bridges built, we then come to the work of track-laying.

"On the subgrade, as prepared, are laid the ties, which should be not less than 6 ins. x 6 ins. x 8 ft., of good, sound chestnut if possible to obtain. Ties should be hewn, in preference to sawed, and should be straight and lay level and true on their beds. They should be spaced not more than 2 ft. on centers.

"To these ties are spiked the rails, which should be of a good section of T-rail, weighing not less than 60 lbs. to the yard. Most interurban roads use 70 lbs., and some use 75 lbs. and even 80 lbs.

"These rails should be 30 ft. in length and should have an improved joint, such as the continuous or the Weber joint. Joints need not be over 24 ins. long if of either of the two kinds mentioned, as too long a joint is as much of a detriment to track as too short a one.

"These joints may be laid either squarely across the track or they may be staggered or broken, as desired. The discussion on this question is still going on and each side has many sponsors.

"An allowance for contraction and expansion should be made at every point, usually about one-eighth of an inch for every 30-ft. rail laid at the average temperature. The spikes should be 5½ ins. x 9-16 in. and of the best quality of tough material. There should be four spikes to each tie: those on the inside so driven that they do not come directly opposite those on the outside of the rail; very careful and thorough driving is quite essential.

"In placing the joint plates in position, care should be taken that they have a good bearing upon the rail, the nuts screwed up on the outside and the whole joint made rigid and firm. Care should be taken to have gage lines of the two rails coincide at all joints.

"After the rails have been spiked to the ties to a true gage, the

ballast should be put in place. This ballast should consist of good, clean, sharp gravel or of broken stone of a suitable size, and should have a depth of 2 ft. and extend for at least 2 ft. beyond the ends of the ties.

"In bringing the track to its proper surface and alignment, shovel tamping may be allowed, but no shovel tamping should ever be allowed on finished work. After the track has been thoroughly tamped, the ballast should be rounded off on the sides and the entire roadbed left in a neat and smooth condition.

"When the track has been made secure in true line and surface, the electrical connections may be made. All holes for electrical connection should be carefully drilled, and they should be reamed out or otherwise made bright and clean throughout their perimeter, immediately before the bond is applied.

"There should be two rail-bonds of not less than 0000 capacity each at every joint; and cross-bonds of the same capacity should be put in place once in every 300 ft. These bonds should not be applied by hammer riveting, but should be put in place by pressure either of screws or by hydraulic pressure to insure the best possible contact.

"We are free to say that the track return on electric railways has so far not proven to be entirely satisfactory. Various attempts have been, and some are now being, made to discover a more practical and more reliable means of carrying the current by the joints, but so far it does not appear that any better means have been devised than that described herein, and, therefore, with the knowledge that the best we have is not absolutely certain to keep up the voltage a long distance from the sources of power, it is evidently wise for us to use the best methods and best appliances that have so far been found.

"All curves of 500-ft. radius or less should be well guarded, not with another rail or other makeshift, but by either a bolted-on Z-guard or by a rolled guard rail.

"On curves of very short radius both rails should be guarded, and wherever it is possible all curves should be well elevated to insure the safe and comfortable passage of cars at high speed. Curves of sharp radii should be either compounded or laid with spiral or easement curves at their ends.

"The turnouts or side tracks for interurban roads should have split switches of the Lorens or other similar pattern, with spring frogs, and their leads should be not less than 60 ft.

"Wherever the car houses are located, their switches, curves and connecting tracks should, if possible, lead out of a side track or turnout rather than out of the main line.

"Wherever cross connections are used in double-track lines, they should, if possible, be what is known as trailing cross-overs, that is so that cars on passing on their proper tracks would pass through the heel of the switch first.

"To sum up these remarks on track work:

"Prepare a good foundation.

"Use large ties, close together.

"Lay thereon good, heavy rails.

"Have plenty of good ballast put in place.

"Make the best possible electrical connections and slight nothing.

"Do not forget for one minute that good, substantial, well-laid track is a vital factor in the economical operation of a road, and is a large factor in the earning capacity.

"Next to the track work in the construction and equipping of an electric railway comes the overhead system.

The first item to be considered in overhead construction will naturally be that of poles. These should be of good, sound chestnut if possible to obtain, and unless otherwise restricted by local requirements. Hard pine poles are to be avoided, as they are often very short-lived, and therefore very expensive to maintain, as well as being somewhat more costly at the outset.

"If square or hexagon poles are absolutely required within the limits of cities or thickly settled villages, it will be found to be economical to obtain good-sized chestnut poles and have them sawed to shape, for they will have the longer life. We know of one urban road in this State that now has large numbers of this kind of poles and they have found them to be entirely satisfactory so far as we have been informed.

"All chestnut or round poles designed for an interurban railway should be not less than 35 ft. in length; they should finish not less than 7 ins. in diameter at the small end, and should be no less than 10 ins. in diameter 7 ft. from the butt, or large end, and they should be straight and sound.

"Hard pine poles, if used, should be of good, sound, long-leaf Southern pine 10 ins. x 10 ins. x 35 ft., with tops not less than 7 ins. x 7 ins.

"The poles should be fitted with two cross-arms to provide properly for both direct and alternating current transmission wires, as well as the necessary telephone and block signal circuits. These cross-arms should be of such sizes, and so arranged, as to meet the requirements, which will probably not be the same on any two roads.

"Generally it is thought well to have one two-pin arm above and a four-pin arm below. It is hardly necessary to say that cross-arms should be so placed as to come on opposite sides of adjacent poles in order to form what is known as a storm line. Locust pins are used on straight lines, and iron pins or guard irons should be used on all curves or wherever any unusual strain is brought upon the pins.

"All poles should be well gained and roofed and entirely stripped of bark before setting. They should be well set to a true line and with sufficient rake to present a good appearance when the line work is finished.

"Poles should be set 6 ft. in the ground on straight lines and at least 7 ft. on curves. The earth or other filling should be thoroughly rammed around the pole, so that it will be firmly bedded and held solidly in place. No pole should be placed less than 5 ft. from the nearest rail, and no two poles should be further apart than 100 feet.

"Some interurban roads have cross-suspension or span-wire construction throughout, on account of the heavy trolley wires and the correspondingly heavy overhead material. Where brackets are used, the flexible or Craighead type has been found to be the best. They should have extra heavy brace rods and be not less than 9 ft. long. They should be securely fastened to the poles at a uniform height from the rail.

"Spans should be made of seven-strand 5-16-in. wire, all guy wires of No. 4, and all anchor and pull-off wires of No. 6 best grade of galvanized wire fastened to the poles by 5/8-in. eye-bolts with 5-in. thread.

"It is considered good practice to have two trolley wires on long-distance interurban roads. They are generally of large size, either 000 or 0000, and of what is known as a grooved pattern. The wire should be hard-drawn, and of not less than 95 per cent conductivity. They should be strung not less than 18 ft. above the rail and may be placed higher. Grooved trolley wires are supported by mechanical clips of brass or composition, and of a length sufficient to produce an even surface for the wires.

"First-class hard rubber or compressed mica surrounding the metallic portion of the hanger is considered the best insulation. The very best overhead material that is made is none too good and quality and durability should govern in the selection of all overhead material rather than price.

"The feeder and return wires may be of copper or aluminum. The latter is very much lighter than copper; it is generally used at about 61 per cent conductivity, and at that value it weighs about one-half as much as copper of 95 per cent conductivity. At present prices of copper it is about the same cost for wire, while a saving will be made in freight, cost of handling and labor of erection. It is strong and durable when in the form of a stranded cable, and has been proved for efficiency and economy.

"Where high-tension wires are to be put in place they should have special insulators tested for the high voltage, of a good design and reliable manufacture.

"These high-tension wires may be of No. 4 or No. 6 B. & S. gage, and they are usually arranged for a three-phase system. This will, however, be governed by the types and the voltages of the instruments at the power station. All direct-current feeders should be tapped to the trolley wire often enough to give a good distribution of the current; this spacing of taps will be governed by the location of heavy grades and the size and number of trolley wires in use.

"The overhead system should be divided into sections convenient for the operation of the road and so obviate the crippling of the service in case of breakdowns, storms or other emergencies on the line.

"It is not necessary to paint the poles, nor has any form of preservative so far been used that has proved to be of much value for prevention to decay at the ground line. Painted poles, however, present a better appearance, and in the villages and thickly settled districts they will be found to be desirable.

"The third-rail system has for a number of years been in use both in Europe and in this country, but until recently has not been used much for surface roads. In order to have this system of practical value it should be applied to such roads only as are largely outside of the highways and where the highway travel will not reach it.

"In other words, a road using this system should be located on a private right of way. Of course this would not prevent the using of the highways at terminii or at important points en route, where the overhead system would be necessary. There should, however, be long stretches of road where the third rail can be safely used before it would be economy or good judgment to put it in use.

"We have not had sufficient experience in third-rail roads to

warrant going into details of construction to any great extent.

"When they were first brought into use a hooded or yoke rail was used of a special pattern which was costly to roll. This rail was put in place in the center between the two track rails, but has been superseded by a T-rail on insulating blocks placed either midway between the two track rails or to one side of the track, according to the location of the contact brushes on the cars.

"The track construction on a road of this type should be fully up to the standard of the road which we have just described. The overhead system will, of course, be done away with, and in its place a rail having a low percentage of carbon, with the necessary joints, insulators, cables at crossings and other appliances, must be put in place.

"When the third rail is located outside of the track rails, it has been placed about 26 ins. away from the nearest rail and it is elevated above the track rails in order to give sufficient insulation. For this purpose extra long ties, about 9 ft. 3 ins., are necessary once in about 10 ft. These ties should have sawed faces and be of such wood as will hold bolts or lag screws.

"The insulators, besides having the required insulating quality, should also have strength to sustain the heavy third rail, which usually weighs about 80 lbs. to the yard. As before stated, this rail should be of a stated mixture of metal and have an exceedingly low percentage of carbon, manganese and phosphorus.

"It is the custom to provide in the third rail sufficient capacity to carry the entire current between sub-stations without any added feeders, and on this account the bonds at the joints must be of a capacity to carry this current, probably upward of 400,000 circ. mil in most cases. These joints can be applied to the bottom of the rails, where they are out of the way and where a very satisfactory attachment can be made. Under-ground cables are used at highway and farm crossings to complete the circuit, on account of the rail being broken at those places.

"In addition to a very careful fencing of the right of way, it will be necessary to construct cattle guards at all points where crossings or openings into the highway occur.

"There are at present, in New England and vicinity, but two roads which use the third rail, outside of the Boston Elevated Railway, which, of course, is a purely city road and is not of the class now under consideration.

"It is not the province of this paper to speak of merits, demerits or relative cost of the several types of roads, but we think there is some doubt as to the difference in cost which has been given at times to the public.

"With reference to the general subject of the need of the best, most substantial and most carefully planned roadbed, track and overhead system for interurban roads, we wish to reiterate what we have before said as to its importance, its ultimate economy and advisability from all practical points of view.

"When we consider that 40 miles per hour will be the possible speed of the cars upon a road now being built in Massachusetts, which is, we are informed, to adopt a schedule time of 20 miles per hour, including all stops, and that we ourselves have ridden on a single-track interurban road in Ohio at the rate of 60 miles per hour for 21 miles on a special trip, and that the schedule on that road calls for nearly 50 miles in places, it is evident that the money carefully and judiciously spent to secure the very best construction in all parts of a property which go to make up the way for the passage of the cars, at these high rates of speed, is well spent, and any scrimping or saving in this direction is not only poor economy, but is the most unwise policy that can be pursued.

"It is a source of satisfaction to those who have long advocated the building of roads in a substantial manner, and have endeavored to have roads under their supervision so built, to see at last the owners and operators of railway properties fast coming into line and constructing their roads more and more in accordance with what is the best and most modern practice."

Cast-Welding on the Kingsbridge Road

The Falk Company, of Milwaukee, has secured, through its New York representatives, Wendell & MacDuffie, a contract for cast-welding the Kingsbridge Road from the Interurban Street Railway Company, in behalf of the Metropolitan Street Railway interests. The contract calls for a large number of joints. Up to the present time the Falk Company has cast-welded the following lines in New York City: The Third Avenue line, the Union Railway, Lexington Avenue, Twenty-Third Street, Columbus Avenue and Lenox Avenue. The contract just awarded is evidence of the satisfactory character of the work and the excellent results secured by the use of Falk joints.

Boston Subway Hearing

Another hearing on the proposed Washington Street subway in Boston was held April 4 before the legislative committee on metropolitan affairs. Attorney Pillsbury, representing the Boston Elevated Railway Company, stated that his company had no position to state until it knew what was before the Legislature in complete form.

A substitute to the Matthews bill was presented by John P. Fox for the assistance of the committee. He advocated the deep-tunnel plan, and urged the creation of a permanent subway commission in Massachusetts, empowered to construct new subways as they are needed and to lease them as it sees fit. Three members are to be appointed by the Governor, and the Mayor and city engineer of Boston are members ex-officio. The commission shall supersede the present Transit Commission and have all the powers of that body. The bill further provides that the commission shall construct the proposed Washington Street subway from Broadway and Washington Street to Adams or Haymarket Squares or Causeway Street. Work on this subway shall be paid for by the elevated railway company, not exceeding $6,000,000, and the title shall be vested in the city of Boston. The company shall have the exclusive use of the subway for a term of not over forty years, and its payment of the cost and maintenance charges shall be in lieu of any rental for the term of years fixed.

The commission may from time to time investigate the subject of transportation in Boston and construct any new subways as needed. The cost of all these shall be borne by the elevated company, but no new subway shall be begun until the company consents and has made a contract for its use. The clause relating to the taking of lands and damages are those of the Matthews bill. A section allows the commission to place underground wires or pipes in subways, but the owners of such pipes shall pay the cost and be responsible for damages. This section of the act provides for building of pipe galleries, allowing the city to charge a rental for their use and giving it power to order them into such galleries.

Section 8 of the act allows the Railroad Commissioners to order the removal or relocation of surface tracks within 1000 ft. of any subway, and gives it power to revoke any locations. Another section gives the city the right to appropriate not more than $50,000 a year for the commission's expenses.

Upon the termination of the existing leases or leases to be made, "except the deep tunnel," the commission may make leases to the elevated company for a rental of not less than 4 per cent of the cost of the subway. If the company does not elect to lease within sixty days after being requested, the commission may make leases to other responsible parties for not less than 4 per cent per annum for twenty years or less. This lease may be assigned to another corporation, which may use the tracks of the elevated, exclusive of the deep tunnel and the elevated tracks.

The commission shall also construct a deep tunnel for elevated trains covering practically the same part of the city as the Washington Street subway. It shall not be less than 30 ft. below the surface. The cost of this is to be borne by the company in lieu of a rental, and the tunnel shall be the property of the company The company is given power to build elevated roads from the terminals of the deep tunnel to its present elevated structure. The deep tunnel is to be considered a part of the elevated system, and its control is to be placed under the Railroad Commission. When the deep tunnel is in operation the company shall discontinue the running of surface cars in the existing subways, and shall bear the cost of replacing surface cars.

The act proposed by Mr. Fox is to be accepted by the Mayor of Boston and constitutes a contract by which the title to the subways now built and the East Boston tunnel is vested in the city. Mr. Fox stated his belief in the safety of going ahead with construction and the undesirability of waiting another year for a special commission to report upon the matter. The deep tunnel is proposed because it is not possible to build a four-track subway near the surface of Boston's narrow streets.

Mayor Collins then stated the position of the city of Boston to be that when any new subway is built it should be owned and built on the credit of the city, offered for lease to the elevated company or its successors in title, and in case the elevated road declines to take the lease it shall be offered to the next responsible corporation or body of men who may undertake to operate it. Whatever bill is passed should be referred to the people for final decision. The rent of any subsequent subway to be built by the city on its credit and leased to anybody should carry a rental substantially the same as the present subway bears—4⅞ per cent. This would provide for the extinguishment of the debt and pay interest and sinking fund. Mayor Collins advised the extension of the present subway lease ending in 1917 to 1927, with the new subway lease expiring then, the latter date being the utmost limit. He further

stated his belief that the relief of Washington Street by a subway similar to the present one under Tremont Street to be the great need in Boston transportation to-day. He cited the congestion of the present Park Street station as an instance of how little the future growth of traffic was realized when the Tremont Street subway was planned, and recommended four or six tracks, if necessary, for the new subway.

London Letter

(From Our Regular Correspondent.)

The directors of the Oxford & District Tramways Company, Oxford, at a recent general meeting of the shareholders, decided that the time had arrived when electric traction should, if possible, be adopted. They are therefore preparing a scheme which will in due course be submitted to the corporation for approval.

The resignation of Mr. Wharam as general manager of the tramways of the Leeds Corporation has now been followed by the appointment to the position of general manager of Mr. John Baillie Hamilton, who has for eight years been traffic manager of the Glasgow Tramways. No advertisements were given out for this position as the Leeds Tramways committee have long had a desire to secure Mr. Hamilton's services. Mr. Hamilton has had the most valuable kind of experience in Glasgow and no better man for the appointment could possibly have been secured. Having been assistant to Mr. Young, of Glasgow, and having passed through all the experiences of electrical equipment in that city, he will bring to Leeds a knowledge of electric traction and traffic management which probably could not be equalled by any man in this country.

The Kearsley District Council has recently established a new electric tramway route in connection with the systems of the Bolton Corporation and the Farnworth District Council. The new Kearsley line, which has recently been inspected by the Board of Trade, will eventually join the Clifton, Pendleton and Manchester lines, thereby establishing a through electric tramway route between Bolton and Manchester.

The promoters of the bill for the proposed electric railway between London and Brighton will probably have difficulty in getting their bill passed through Parliament this year as there seems to be considerable evidence as to the non-compliance with the standing orders of Parliament. Mr. Campion has been examining the allegation and if he decides that the standing orders have not been complied with the bill will, of course, be thrown out of Parliament for a year.

The station at the Dingle end of the Liverpool Overhead Railway, which was practically destroyed by fire some time ago and which was reported in this column, has now been entirely rebuilt of non-inflammable material. The platform of the station is now composed of stone and the side walls of brick. The signal-box has also been rebuilt of brick, and wood and inflammable material have been as little used as possible throughout. A chemical engine and automatic fire-alarm system has also been installed and everything done to make the station as fireproof and safe as possible.

The London County Council have accepted the supply of track-rail, slot-rails, conductor-rails, fish-plates, etc., from P. & W. MacLellan, Ltd., of Glasgow, who are tendering on the rails of a Belgian firm. The fact that the Belgian rails have been accepted has given rise to a great deal of sentiment as to the purchase of rails of foreign manufacture as against placing the order with British manufacturers, even at a difference in price of £10,000 to £11,000. Though many efforts were made to induce the London County Council to accept the British-made tender, they have decided that it would be unwise to sacrifice such a large sum of money and have accordingly ordered the Belgian rails. Several of the proposed bills for tramways of the London County Council have been abandoned for this year, it having been proved that they do not comply with standing orders.

Reference has been made in these columns to the growing impurity of the air in the tubes of the Central London Railway and it is now gratifying to note that serious efforts are being made to purify the atmosphere. It is reported that in a very short time apparatus will have been installed by which the atmosphere in the tube will be completely changed once every twenty-four hours.

The bill under which it is proposed to incorporate a company for the purpose of constructing a tube railway under the Tyne between North and South Shields has been passed by the select committee of the House of Lords.

It is now definitely stated that the Baker Street & Waterloo Railway, which is one of the tubes in course of construction, and which was controlled by the London & Globe Corporation, has been sold to the Metropolitan District Electric Traction Company, Ltd., for the sum of £360,000. This latter company is the company which was formed by Mr. Yerkes and doubtless the work will now be pushed forward with all speed, as there certainly is a great necessity for a tube railway running north and south. Considerable work has already been done on this tube, but it has been at a practical standstill ever since the collapse of the London & Globe Corporation.

The Liverpool & Garston Light Railways has placed the contract for three 150-hp dynamos with D. Bruce Peebles & Company, of Edinburgh.

Good progress is being made by the Wallsend Slipway & Engineering Company with the two large sets of indicated horse power engines on order for the Newcastle Corporation electrical extensions, the principal parts being already well advanced, which is characteristic of the vigor of the general manager, Mr. Andrew Laing. The engines are of the four-crank triple expansion type, the cylinders and cranks being specially designed to combine a good dynamic balance with a satisfactory torque both when working condensing and non-condensing, prior successful experience with large marine engines having been fully utilized by the designers. It will be of great interest to electrical engineers to compare the performance of these engines when completed with the present largest units of similar type in the country, viz., those in the Glasgow Tramways station. From the records of some of the earlier engines installed by the Wallsend firm for electrical purposes a most marked improvement in economy as compared with American practice—which is well represented in the Glasgow station—is looked for.

The General Electric Company, Ltd., are at present engaged in removing their engineering department from their Manchester works to their new works at Witton, where they will be able to deal with the largest electrical machinery of every description.

The order for the whole of the sub-station equipment, required in connection with the South Lancashire Tramways, has been placed with Witting Bros., Ltd., electrical engineers and contractors, of London. The contract comprises the complete electrical equipment of the two sub-stations at present arranged for, together with some auxiliary machinery for the power station; there will be three 250-kw and three 150-kw synchronous motor generators; one 56-kw, one 20-kw and one 35-kw positive feeder boosters; three 8-kw and three 10-kw negative feeder boosters; one 40-kw, one 14-kw and one 24-kw reversible boosters for battery charging; and one 240-amp., one 80-amp. and one 140-amp. milking boosters, complete in all respects with the necessary spare parts. The whole of the power station equipment, including steam generators, condensing plants, cooling tower, cranes and motor generator, together with the equipments of the first fifty cars, is being furnished by Witting Bros., Ltd., electrical engineers and contractors, all this work being well in hand. Altogether the order for electrical machinery alone amounts to 11,500 hp. Messrs. Witting Bros., Ltd., have also secured the order for the first extensions required for the Brighton system. There will be ten complete motor cars, each consisting of a Milnes car body of latest type, mounted upon a Brush truck, the electrical equipments being of Witting Bros. standard pattern throughout.

A meeting of Torquay Town Council was recently held to consider a recommendation of the electric lighting committee: "That this committee, having reviewed the whole question of tramways, is of opinion that it is expedient for the Council to take such steps as may be necessary to apply for a Provisional Order to authorize the construction of tramways, and recommends the Council accordingly." The Mayor presided.

The profit of the City of Birmingham Tramways Company, Limited, for the year to Dec. 31, amounted to £66,200. It is proposed to pay a dividend at the rate of 5 per cent per annum, together with a bonus of 5 per cent (making 10 per cent for the year), on the ordinary shares, to place £35,366 to reserve, and to carry forward £2,083. The number of passengers carried during the year was 46,384,291, and the gross earnings £236,057.

One of the largest switchboard contracts (involving an expenditure of about £30,000) has recently been placed with Messrs. Ferranti (Limited), of Hollinwood, Lanc., for the Manchester Corporation. This contract includes a switching gear for controlling and distributing a capacity of 12,000 hp to be generated at the new Stuart Street station, and it also includes complete high and low tension equipment for ten sub-stations, which are to contain motor generators for traction and lighting loads. The whole is to be delivered complete within nine months.

At the half-yearly general meeting of the Metropolitan District Railway, Mr. R. W. Perks, M.P., who presided, regretted that the report was the worst that had been presented in the history of the company. Their position was a very serious one, as there was

a loss of £53,000. This loss he attributed to the serious competition of the electric railways and trams, and also to the reduction of fares which this competition has imposed upon them. It was not for him to explain the reason why, ten years ago, they did not foresee and prepare for the contingencies that had arisen. However, he was pleased to be able to inform them that they would only have to bear the result temporarily, for they had succeeded in inducing the Board of Trade to give judgment in their favor regarding their dispute with the Metropolitan Railway as to the system of electric traction to be installed.

The British Insulated Wire Company, Prescot, Lancashire, has been awarded the contract for the overhead equipment of three of the horse car routes of the Aberdeen tramways. The supply and laying of cables for the same work is entrusted to the Anchor Cable Company, Leigh, Lancashire. What is probably the largest single order for boilers ever placed in this country has just been awarded to Messrs. Babcock & Wilcox, Limited, Farringdon Street, E. C., by the Metropolitan District Electric Traction Company, Limited. It consists of forty-eight boilers, each of 5200 sq. ft. heating surface, and fitted with superheaters.

A special meeting of the Gloucester City Council has been held for the purpose of giving final consideration to the offer of the proprietors of the Gloucester Tramways, to sell their concern for £26,000. The idea is to put down electric traction at a cost of £100,000. After a considerable amount of discussion, the necessary resolution empowering the Corporation to apply to the Light Railway Commissioners was carried. A further resolution consenting to the purchase of the existing tramways for £26,000 was passed, and it was decided to apply to the Board of Trade for their consent to the purchase, and for sanction to a loan to cover the expenses.

The electric power and lighting committee of the Liverpool Corporation have agreed upon a resolution recommending that an application be made to the Local Government Board for their sanction to the borrowing by the Council of the further sum of £300,000 for purposes connected with the supply of electrical energy.

For the substitution of electric traction in the place of steam-power on the fourteen miles of tram lines in Huddersfield, the tender of Messrs. E. Nuttall & Sons, Manchester, has been accepted. The amount of the whole of the contracts for the undertaking is £109,977 18s. 4d. Work will be carried on night and day by nearly 800 men, and the lines will be ready, it is expected, by June. Twenty-five new cars have been ordered, of which some have been completed. They are of a lighter type than the cars generally in use on electrically equipped routes.

The following resolutions were passed at a special general meeting of the Incorporated Municipal Electrical Association at the Westminster Palace Hotel, Feb. 21, 1902, John H. Rider, president, in the chair.

(1) With reference to the resolution passed by this association at the Glasgow convention, 1901, authorizing the Council to approach the president of the Local Government Board and the Secretary of State for Scotland, with the object of obtaining leave to suspend the operation of sinking fund during the first three years of the loan, and to take such further steps as may be necessary to accomplish this object, this meeting approves the action of the Council in approaching the Borough Treasurers' Association in order to insure their co-operation, and unanimously agrees that the operation of sinking fund should be suspended for three years from the date of loan without, however, increasing the period allowed for repayment, and that this suspension should apply also to moneys borrowed for the purpose of extensions from time to time. Carried unanimously.

(2) That in the opinion of this association, electricity supply undertakings having to be maintained in a thorough state of efficiency out of revenue, no depreciation or further writing off of capital is necessary when the period allowed for repayment of loans is not greater than thirty years, as the equated life of the plant exceeds this period. Carried, with three dissentients.

(3) That with regard to the formation of a reserve fund, this association is strongly of the opinion that such should be formed, up to the limit allowed by the Provisional order, before any contribution is made in relief of the rates. Carried unanimously.

At the general meeting of the London United Tramways Company, whose system was recently described in these columns, a report was presented by which it was shown that the company have promoted a bill in Parliament in connection with their various extensions to incorporate a new company for the purpose of constructing the London United Electric Tube Railways. As is well known the London United Tramways Company own about 90 miles of electric tramway route chiefly in the vicinity of Hammersmith, and it is now felt necessary to connect their line from Shepherds Bush and Hammersmith Bridge by a tube under the river with a terminus on the south side of Hammersmith Bridge, from which point the tube would proceed eastward through Kensington under Hyde Park and St. James Park to Charing Cross, where a loop terminal would be formed. There is also proposed in the same bill an important north and south line which would commence at Marble Arch and would run south under the park and give facilities for interchange with the other tube at the top of Sloane Street, passing under the river near Chelsea Bridge and continuing past Battersea Park to a terminus at Clapham Junction.

J. G. White & Company have recently been in receipt of a number of small contracts for the equipment of electric railways, among which may be mentioned the Barnsley & District Light Railway, which includes a contract for the permanent way and the overhead construction of about 4½ miles. Ninety-four-lb. rails will be used and stone, wood and macadam as required. They have also secured a contract for Sheerness & District Light Railway, which also includes the permanent way and overhead construction amounting to about 3 miles. The Bournemouth Town Borough Council have also awarded them the contract for overhead equipment outside of the town of Bournemouth. This is, of course, in addition to the large contract which they already have for the conduit system which they are installing in that town.

According to the Board of Trade's annual return relating to tramways, the total expenditure on capital account to June 30 last was £26,799,000, of which £14,057,700 was in respect of lines, etc., belonging to local authorities, and £12,741,300 in respect of lines, etc., owned by companies. The mileage of the latter was 616 and of the former 689, so that the cost per mile of private construction works at about £20,700 and of public construction £20,400. The working results of all tramway undertakings during the period mentioned, distributed among the three divisions of the United Kingdom, were as follow:

	Gross Earnings. £	Working Expenses. £	Net Receipts. £
England and Wales	4,793,775	3,652,017	1,141,728
Scotland	743,068	569,056	174,012
Ireland	424,219	304,076	120,143
Totals	5,961,062	4,525,179	1,435,883

It is interesting to note that of the total returns for Scotland more than half are furnished by Glasgow alone. Altogether 1,198,226,800 passengers were carried, Glasgow leading with 132,557,700, and the principal records outside London being Liverpool with 93,767,900, Manchester with 63,522,300 and Birmingham with 45,187,700.

The purchase of the London & Globe Finance Corporation's controlling interest in the Baker Street & Waterloo Railway by the Metropolitan District Electric Traction Company has again called attention to the latter company. From particulars of this company which appear in the *Financial News*, it appears that the capital is £1,000,000 in 50,000 shares of £20 each. Only 3700 of these shares are in British hands, the balance, with the exception of 250 held in Berlin, being owned in America. Mr. Yerkes himself is the owner of 11,950 shares, and among the other large holders may be mentioned T. J. Coolidge, Boston, 2250; F. Ayer, Boston, 2400; Lee, Higginson & Company, Boston, 1000; C. G. Weld, Boston, 1000; Pemberton, McAdoo & Company, New York, 1000; J. G. White & Company, New York, 2000; M. T. Herrick, Cleveland, 1500; Maryland Trust, Baltimore, 2500; P. Calhoun, New York, 2500, and H. H. Rogers, New York, 2500. Messrs. Brown, Shipley & Company, London, are put down for 2500, and Govett, Sons & Company, London, for 1000, these being the only British holders of importance. The shares have all been allotted and £5 per share called up, the amount so far received being £235,000. The company has for some time virtually controlled the Metropolitan District, and has just acquired a controlling interest in the Baker Street & Waterloo.

The Metropolitan Railway Company, Ltd., of London, has decided to award the important contract for the machinery necessary for the electrical working of the line to the British Westinghouse Electric & Manufacturing Company, Ltd. There are to be three combined sets of steam turbines and three-phase alternators. The output of each set will be 3500 kw as a normal load, while for short periods the capacity will be 50 per cent in excess. Two of the main sets only will be run at one time, the third being for spare, and the boiler power, consisting of nine units, is only for driving two of the sets. Three separate exciters, to be operated by engines, will also be supplied. The boiler capacity will be added to later. Part of the machinery will be manufactured in the United States.

An Accident Case Involving the Use of Fenders

The administrator of the estate of a boy who was run over by a car of the Albany Railway Company, of Albany, N. Y., on May 29, 1897, brought action against the company to recover damages, alleging that the company was negligent in many ways, and, among others, in operating the car in question without a fender;

and after a jury had found for the plaintiff, and the judgment had been affirmed by the Appellate Division, the Court of Appeals has handed down a decision reversing the judgment of the two lower courts and granting a new trial. The company, in its answer to the suit, denied negligence on its part, and charged that the death of decedent was caused by his own negligence, and alleged that it used due diligence to equip its cars with fenders as soon as required by the Common Council. Now, it seems that, on May 17, 1897, twelve days before the accident, the Common Council of Albany adopted a resolution requiring that every car operated by electricity within the city limits should be provided with a "Providence fender;" and the jury based its finding that the company was guilty of negligence on the fact that there was no fender on the car which ran over the boy. The day following the adoption of the resolution the fenders were ordered by the company. No fender had arrived when the accident happened, and as to the charge that the company was guilty of negligence in not using reasonable diligence in providing the fenders, Judge Vann, of the Court of Appeals, says: "The company had a reasonable time to obey the command of the local Legislature, and it used that time with diligence. It was under no obligation to order fenders in advance of the approval of the Common Council, for that might have involved useless expense, as there were several kinds in use. All that was required was prompt action as soon as it knew what fender to order, and prompt action was conclusively proved."

An Important Pennsylvania Decision

Judge Butler, of the Chester County Court, in an opinion in the celebrated quo warranto case of The Commonwealth against the Uwchlan Street Railway Company, in which was sought the forfeiture of the defendant's charter, has handed down an opinion dismissing the rule for a new trial. The suit was instituted in the name of the State, with the consent of the Attorney-General, by George Quintard Horwitz, of Philadelphia, counsel for the Coatesville & Downingtown Street Railway Company, which latter claimed rights in its charter which had been granted to the Uwchlan Company.

The case has been pending since last September, and the opinion by Judge Butler is the first authoritative decision on the Emery amendment to the railway act approved June 7 of last year. The provision under which the suit was brought cites that "wherever a charter, after the approval of this act, shall be granted to any company to build a road as provided by the act, no other charter to build a road on the same streets, highways, bridges or property shall be granted to any other corporation."

The Coatesville & Downingtown Company secured its charter on June 10, 1901, which permitted it to construct a road over a route including Brandywine Avenue, a street extending from the southern limits of the borough of Downingtown north to Lancaster Avenue, a distance of about 1600 ft. On June 26, 1901, an exemplification of the record of an extension by the Coatesville & Downingtown Company over Wallace Avenue, a street extending from the terminus of Brandywine Avenue at Lancaster Avenue to the northern limits of the borough, a distance of about 2600 ft., was filed in the office of the Secretary of the Commonwealth. On July 10, 1901, a charter was issued to the Uwchlan Street Railway Company to construct a road over a route including Wallace and Brandywine Avenues. The Coatesville & Downingtown Company promptly sought municipal consent to the construction of its road, but has failed to obtain that of the borough of Downingtown. The Uwchlan Company, however, secured the requisite consent from the borough and proceeded to construct its road.

In the decision of the court Judge Butler states that no charter could lawfully issue after June 26, the date of filing the exemplification, as the court finds the routes are coincident. Continuing, the opinion says: "That the State can successfully demand the cancellation of a charter not authorized by law, whether the charter was issued wholly outside of the provisions of the act or whether under legislation providing for the granting of such a charter, is not, we think, open to doubt. We are in no doubt of the power of the court to revoke this alleged charter. It never was a charter. It was not authorized by any act of Assembly, and is absolutely void."

Electricity on Swiss Railways

Engineers of Switzerland who are interested in railroad operation are discussing the question of replacing steam with electric power developed by numerous waterfalls. It is claimed that sufficient power is obtainable from these falls for the operation of the entire railway system of the country. No figures have been presented, however, showing the relative economy of steam and water power, and it is doubtful whether all the conditions have been considered. There is a fair prospect of this subject receiving careful attention very soon, as it is proposed to form an engineering association to study problems of this kind, and the manufacturing companies have guaranteed the funds for the necessary expenses. The *Aargauische Nachrichten*, commenting on the project, says that "the Swiss government, which will within a few years own the principal Swiss railway lines, recognizes the importance of the plan. Competent officials have expressed the opinion that the authorities will not fail to subsidize the proposed experiments. The question of rendering Switzerland more and more independent of foreign coal by utilizing her water-power through electricity is of vital importance to the country."

Chicago Elevated Road Traffic for First Quarter, 1902

Three elevated railways of Chicago have issued statements on passengers carried for the first quarter of 1902. The Northwestern carried a daily average of 65,362 passengers in March, an increase of 8169, or 14.3 per cent over the traffic in March last year. The figures also exceeded the daily average for February by 602. The South Side Elevated carried a daily average of 803,313 passengers, a gain of 4044, or 5.3 per cent over the number in March last year. The Metropolitan carried a daily average of 105,512, an increase of 7173, or 7.29 per cent over the number in March last year.

Following are the comparative figures on the three roads for the first three months of the year:

METROPOLITAN

	1902	1901	Inc.
January	98,029	89,699	8,330
February	100,466	97,659	2,807
March	105,512	98,739	7,173

SOUTH SIDE ELEVATED

	1901-02	1900-01	Inc.
January	79,154	71,137	8,017
February	79,386	74,525	4,861
March	80,313	76,269	4,044

NORTHWESTERN ELEVATED

	1901-02	1900-01	Inc.
January	62,010	52,022	9,988
February	64,760	55,256	9,504
March	65,362	57,193	8,169

J. G. White & Company's Australasian Contracts

The Auckland (New Zealand) Electric Tramways Company, Ltd., has just increased its capital, by the flotation in the London market, through the Electric & General Investment Company, of some $1,250,000 of ordinary stock, for the purpose of extending its system, which is being built largely with American material. The company, which is now capitalized at about $4,250,000, has acquired from the British Electric Traction Company, Ltd.—a concern in which J. S. Morgan & Company, of London, are largely interested—7½ miles of horse tramways which, together with 2½ miles of other road, is being converted into electric motive power; the contract for which was recently secured by J. G. White & Company's London interest. The contract, which is valued at over $1,300,000, calls for the construction of the lines and power house; in fact, provides for everything except cars and car houses, owing to the cheapness of wood in New Zealand. The road is to be extended for a distance of 8¼ miles. The Kalgoorlie Electric Tramways Company has been floated in the London market, with a capital of $1,250,000, "to acquire concessions, rights and privileges for the construction of tramways and railways in Australia and elsewhere, and to carry on the business of carriers of passengers and goods, to act as electrical engineers, electricians, manufacturers of and dealers in railway, tramway, electrical and other apparatus supplies of electricity, etc." The existing electric traction system at Kalgoorlie—which place is one of the centers of the West Australian mining districts—is being built by J. G. White & Company. The road is to be considerably extended, and it is anticipated that the construction of the proposed electric traction system in Great Boulder City will be undertaken by the Kalgoorlie Company.

In England J. G. White & Company has just secured a contract for the equipment, the building of the permanent way and the carrying out of the overhead construction of the Barnsley & District Light Railway. The road will be about 4½ miles in length. The rails are to be of 94-lb. weight. The White interests have also been allotted the contract for the permanent way and overhead construction for some 3 miles of line for the Sheerness & District Light Railway. American equipment will be largely used in the construction of these roads.

Consolidation of the Underground Lines of London

Speyer Brothers, of London; Speyer & Company, of New York, and the Old Colony Trust Company, of Boston, have formed a syndicate for £5,000,000 to take the shares of the Underground Electric Railway Company, of London, Ltd., which has just been incorporated in London. The objects of the new company are to include the acquisition and working, in whole or in part, of the future undertakings controlled by the Metropolitan District Electric Traction Company, Ltd., of London, namely: The Baker Street & Waterloo Railway Company, the Brompton & Piccadilly Circus Railway Company, the Great Northern & Strand Railway Company and the Charing Cross, Euston & Hampstead Railway Company. Agreements in connection with electrification of the Metropolitan District Railway and also general powers to carry out other similar works are included in the scheme. Stockholders of the Metropolitan District Electric Traction Company will take shares in the new company for their holdings. Charles T. Yerkes will be one of the directors of the new company and the first chairman of the board of directors. It is generally understood that the capital will eventually be increased to £15,000,000.

Steam vs. Trolley Roads in Pennsylvania

The fight between the Philadelphia, Bristol & Trenton Railway and the Pennsylvania Railroad Company, over a strip of land at Croydon, near Bristol, Pa., was believed to have been settled a few weeks ago, when the Bucks County courts gave the trolley company the right to build over the disputed strip, provided a bond for $20,000 was filed, but another suit has been instituted by the steam railroad, and the trouble starts off on its seventh year quite as vigorously as ever. The trolley company found it impossible to get past the land in dispute under its street railway franchise, and a couple of years ago the Bristol & Bridgewater Railroad Company secured a steam charter for the purpose of completing the link, and after fighting the condemnation proceedings through the courts, the company was about ready to begin work upon the extension, when the Focht-Emery bill was passed by the Pennsylvania Legislature. This act prevented trolley cars from being run upon steam railroads, and practically knocked out the Croydon project unless it should be desired to operate the extension perpetually as a steam railroad and transfer the passengers, which was not desirable. The new act provided, however, for the incorporation of elevated railways with the right of eminent domain, and the Neshaminy Elevated was chartered. After nine months' fight the court decided that the company could build by securing Henry M. Gaw, the opposition property owner, who was associated with the Pennsylvania Railroad, by a bond of $20,000. This was given, and the work commenced upon the mile break a short time after. A clash between the railroad and elevated workmen followed the early work, and an injunction was secured by the Pennsylvania restraining the elevated company from building pending the termination of the suit. Now the Pennsylvania Company has brought suit to have the act declared unconstitutional. The suit is likely to be desperately fought, not so much by the Neshaminy Elevated Company as by the new companies which have recently obtained franchises in Philadelphia to construct elevated and underground railroads. The declaration by the courts of Pennsylvania that the Focht-Emery law is unconstitutional would mean the upsetting of all the plans of the Philadelphia promoters to secure franchises in that city. The Neshaminy Elevated would have but little to lose by the unconstitutionality of the law, as it would remove the restriction regarding the use of steam railroad tracks and would enable the company to complete the Bristol & Bridgewater road, at less expense and in a more satisfactory manner than the elevated. The chief drawback to the loss of the Neshaming Elevated charter would be the delay caused in completing the road. It is said that the knocking out of the elevated franchises in Philadelphia would be the signal for John B. Hoefgen to make an offer similar to that made to Cleveland, Ohio. The late Albert L. Johnson offered three-cent fares and other considerations to Philadelphia, and this was followed by an offer of $2,500,000 in cash by John Wanamaker. In the event of the elimination of the elevated franchises, by reason of the unconstitutionality of the act, it is probable that Mr. Johnson's followers would repeat the offer, possibly with a cash consideration added. The suit will be watched by every trolley and railroad company in Pennsylvania, as its outcome means so much to them, whichever way it is ultimately decided.

The Everett-Moore Situation

Members of the Everett-Moore bankers' committee look forward to an early and successful consummation of their plans. Several important deals are under consideration, and it is believed that within the next thirty days the bulk of the liabilities of the syndicate will have been cared for. It is now believed that as soon as this is effected the committee will withdraw from the active charge of affairs. It has recently developed that the bankers' committee is not, and never has been, in absolute control of the syndicate properties, by reason of the fact that it has been unable to secure consents of all of the creditors to an eighteen months' extension. The large majority signed the agreement, but a few did not, so that it has been impossible to place the original plan into effect.

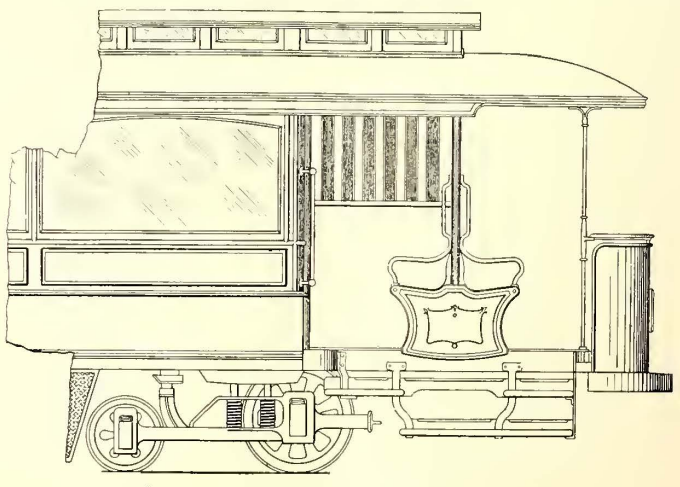
The syndicate has given a fifteen days' option on the property of the Northern Ohio Traction Company to J. R. Nutt, one of the members of one of the sub-committees of the bankers' committee. Mr. Nutt and his associates are already interested in the property. It is understood that the option price is $35 for common stock and $85 for preferred, which is a trifle lower than the figure originally asked by the committee. A Cleveland syndicate has also been formed for the purpose of acquiring the Everett-Moore interests in the Detroit United Railways. These interests amount to 40,000 shares, or one-third of the entire capital stock. The new syndicate will endeavor to combine with the Detroit and Cincinnati parties, who have heavy holdings in the property and will thereby secure a controlling interest. It is believed, also, that there will be important developments this week in the matter of the sale of the Everett-Moore interests in the Toledo Railways & Light Company. The option held by the Strang Construction Company on the Detroit & Toledo Shore line will, in all probability, be closed this week. It is expected that the property will go to the Wabash Railroad, and that it will be converted into a steam road.

Street Railway Patents

[This department is conducted by W. A. Rosenbaum, patent attorney, Room No. 1203-7 Nassau-Beekman Building, New York.]

UNITED STATES PATENTS ISSUED APRIL 8, 1902

697,122. Life Guard; T. E. C. Wilson, Liverpool, Eng. App. filed June 18, 1901. When an obstruction is encountered, a trigger is operated to lower the fender.



PATENT NO. 697,288

697,208. Folding Step for Cars or Other Conveyances; E. J. Hunt, New York, N. Y. App. filed June 26, 1900. The folding step moves into a position under the next adjacent fixed step.

697,238. Switch Operating Device; T. Cope, New Waterford, Ohio. App. filed Jan. 3, 1902. Either of two cams are caused to act upon a rod attached to the switch point, the cams being carried by the car and operated by the motorman.

697,288. Tram Car; E. A. Stanley, Preston, and J. E. Anger, Southport, Eng. App. filed Feb. 6, 1902. In an open car where the cross seats extend over the steps, provision is made for entering the car by two steps, one beneath the projecting end of the seat and the other opposite the space between the seats.

697,293. Folding Car Step; O. F. Thomas, Adams, N. Y. App. filed Jan. 27, 1902. The lower step folds into the back of the lower fixed step.

"Power" in a New Form

Commencing with the April issue the magazine *Power* appears in a new form. The size of the pages has been considerably reduced and a cover has been added, making the paper more convenient to handle and much more attractive in make-up. The alteration in appearance is the first step in a general improvement of the paper under its new management, the American Machinist Press having recently purchased *Power*, which will in future be published by this well-known concern. Editorially, the policy is expected to remain the same as in the past, but the new form is better adapted to the typographical improvement contemplated by the present owners.

PERSONAL MENTION

LORD KELVIN and Lady Kelvin sailed from England on the S. S. Campania on April 12 for New York. The reception to be held at Columbia University next Monday promises to be one of the most enjoyable functions of the season.

MR. A. E. DAVIES has been appointed general manager of the Chicago Electric Traction Company, of Chicago, Ill., succeeding Mr. E. R. Gilbert. Mr. Davies was formerly superintendent of the company.

MR. WALTER C. LUSK, formerly attached to the foreign department in the New York offices of the General Electric Company, has been appointed the representative of the company in British India, with headquarters in Calcutta.

MR. GEO. B. DARNELL, formerly connected with the Columbus, Grove City & Southwestern Railway Company, of Columbus, Ohio, has been appointed assistant to Mr. H. A. Fisher, general manager of the Columbus, London & Springfield Railway, of Columbus, Ohio.

MR. H. E. BRADFORD, superintendent of Division 1 of the Worcester (Mass.) Consolidated Street Railway Company, has resigned his position with that company. Mr. Thomas A. Leach has been appointed acting superintendent. Mr. Bradford has not yet made public his plans for the future.

MR. JOHN R. GRAHAM, second vice-president of the Old Colony Street Railway Company, Boston, who has spent the greater part of the winter in Mexico, recovering from a recent severe illness, is home again, fully recovered, and is receiving the congratulations of his many friends in New England and elsewhere.

MR. E. W. GOSS, treasurer and general manager of the Milford, Holliston & Framingham Street Railway Company, Milford, Mass., was in New York the first of this week on a brief business trip. The object of his visit was to obtain attractions for his park at Mendon, now known as Nipmuc Park, which will include not only entertainments for the outdoor theater, but a small menagerie as well.

MR. J. B. O'HARA, formerly editor of the *Western Electrician*, of Chicago, has accepted the position of associate editor of the STREET RAILWAY JOURNAL, and will be connected with the main office of the paper in New York. Mr. O'Hara's ability as a technical writer is well known in electrical circles, and he will hereafter give his entire time to the editorial department of this publication.

MR. DUFFIELD PRINCE, designing and constructing steam engineer of the Edison Electric Illuminating Company, of Brooklyn, resigned his position with that company on April 2 to accept a similar position with W. S. Barstow, consulting engineer. Mr. Barstow has found his present offices in the Bowling Green Building too small for his requirements, and has therefore taken larger quarters in the same building, which he will occupy after May 1.

MR. JOHN LUNDIE, of New York, the well-known consulting engineer, has just been given by the University of Edinburgh, Scotland, the degree of Doctor of Science (D. Sc.), in recognition of his work and researches in the electric traction field. This degree is comparatively rare as conferred on engineers, and is only granted in recognition of original work. Coming from the university of Maxwell, Tait and Jenkin, the degree is particularly gratifying, and is a high testimonial to the work accomplished by Mr. Lundie.

MR. GEORGE B. FRANCIS, chief engineer of the Rhode Island Suburban Railway Company, Providence, gave an instructive talk before the Massachusetts Street Railway Association, at Boston, on April 9, on the subject of "Improvements in Street Railway Construction." Much important work has been done in Providence during the comparatively short time Mr. Francis has been connected with the company, and his remarks on the new power station, car house and shops were listened to by the members with great pleasure.

MR. E. W. FARNHAM, of Chicago, was in New York this week with a working section of his safety third-rail system. A number of prominent railway men of the metropolitan district inspected the apparatus, which was on exhibition at the Fifth Avenue Hotel, and congratulated Mr. Farnham on the manner in which he had worked out the details, especially in regard to the block signaling device, which is a feature of the system. Mr. Farnham is president and general manager of the Rapid Traction Construction Company, general and electric railroad contractors, which makes a specialty of the manufacture of his inventions.

MR. JAMES D. ANDREW, mechanical engineer of the Metropolitan Street Railway Company, New York City, was married to Miss Laura E. Ward, of Napanee, Ontario, at the home of the bride, on March 31. The wedding was such a quiet one that few of his many friends were aware of the cause of his absence, but his associates learned the facts in time to present to Mrs. Andrew a handsome cut-glass service as a slight token of their regard. On his return from a short wedding trip Mr. Andrew was greeted at the Ninety-Sixth Street power station by flying flags and tooting whistles, and the entire force turned out to offer him its congratulations, to which the STREET RAILWAY JOURNAL wishes to add its own.

MR. CHARLES CHURCHILL, managing director of Charles Churchill & Company, Ltd., of London, England, is making a somewhat extended visit to this country, expecting to sail for home on May 24. Mr. Churchill's firm represents the British interests of over one hundred machine tool manufacturers in the United States. In a recent interview Mr. Churchill said that the prejudice of the English people against American machinery which was so prevalent a few years ago has now practically disappeared, and that over 300 manufacturing firms in Great Britain use American tools. The government has been one of the most extensive purchasers recently on account of the Boer war, and all classes of American machine tools have been supplied to it for the making of ordnance and other military supplies. The cessation of hostilities, which it is hoped will soon occur, will, however, greatly increase the trade all around and more than make up for the falling off of government purchases.

MR. C. JEROME SIMMONS, formerly president of the Atlanta Rapid Transit Company, of Atlanta, Ga., has disposed of his interests in the street railways of Atlanta, and will not be officially identified with the Georgia Railway & Electric Company, of Atlanta, which is a consolidation of the Atlanta Rapid Transit Company, Atlanta Railway & Power Company, Georgia Electric Light Company and the Atlanta Steam Heat Company. Mr. Simmons has been identified with the street railways of Atlanta for about ten years, and has been a prominent factor in the upbuilding of the city. From a small road, known as the Chattahoochee River line, built in the western part of the city, Mr. Simmons extended his operation until he had successfully launched the Collins Park & Belt Railway. This road, however, met with serious financial reverses, and was reorganized and succeeded by the Atlanta Rapid Transit Company, operating 38 miles of road. Mr. Simmons succeeded in interesting powerful Northern financial interests in this company, and it was these interests that succeeded in accomplishing the organization of the Georgia Railway & Electric Company. Mr. Simmons was a prominent lawyer of Atlanta before becoming interested in the street railways of the city.

MR. F. L. DAME, who has been superintending the reconstruction of the system of the Union Electric Company, of Dubuque, Ia., has been appointed general manager of the company, succeeding Mr. W. J. Browne, resigned. Mr. Dame is a graduate of the Massachusetts Institute of Technology, of Boston. After completing his studies he entered the employ of the Westinghouse Electric Manufacturing Company, where he had the advantage of practical experience in the cities of the East. He was appointed district engineer for the Westinghouse Company of the States of Oregon, Washington, Idaho and British Columbia, and for the last ten years has been in that territory in the employ of the Westinghouse, the Thomson-Houston and the General Electric Companies. As the representative of these companies Mr. Dame had charge of the electrical construction work for them in those States, and he personally planned and superintended the installation of railway and lighting systems in several of the most important cities on the coast. For the five years immediately preceding his connection with the Union Electric Company Mr. Dame was general superintendent of the Tacoma Railway & Power Company, of Tacoma, Wash. The latter company is a consolidation of the local lighting and railway companies at Tacoma, and the company's entire system was reconstructed under the supervision of Mr. Dame.

FINANCIAL INTELLIGENCE

THE MARKETS

The Money Market

Wall Street, April 16, 1902.

The immediate money situation has improved decidedly during the past week. With the $2,500,000 gold engagement for Paris, export of gold came to an abrupt halt. Currency receipts from the interior at the same time underwent a marked increase, and direct loans by trust companies and foreign bankers reached such a volume as to reduce the outstanding account at the Clearing House by over $6,000,000. All these successively favorable developments represented the automatic workings of the money market, by advancing the local bid for money, to relieve an uncomfortably close condition. The higher money rate attracted fresh offerings of foreign capital, which promptly forced down sterling exchange well below the specie shipping-point; it stimulated the natural April movement of funds toward this center from the domestic interior; and it increased the disposition of lending institutions outside the Clearing House Association to draw down their balances for direct relending in the market. By this means, while the supply of available credit was not curtailed, both loans and deposits of the Associated Banks were reduced and the margin of surplus reserve enlarged. These several recuperative processes are, however, entirely contingent upon relatively high money rates, and it is doubtful whether any relaxation could occur in the near future without again endangering the security of the local banking position. At all events, for the immediate present the market has to choose between maintaining high rates for the use of credit and shipping gold in quantity to Europe. There is no question as to which alternative must be chosen. The more active speculation on the Stock Exchange has so far injected no serious complication into the money situation. This is because trading by the outside public, involving the borrowing of large sums to carry stocks on margin, is at a minimum. The enormous buying in Louisville and other stocks by prominent operators and cliques has required assistance from the banks, but it turns out that most of the money for these purposes was provided for some time ago in long-term loans.

Money on call, representing bankers' balances at the Stock Exchange, has frequently touched 7 per cent, but the average has been around 5½ per cent to 6 per cent. Time money for all dates is quoted at 4½ per cent on the better class of railroad securities.

The Stock Market

The whole stock market has been thrown into an abnormal condition by the sensational fight for control of the Louisville & Nashville Railroad. Nothing that has happened since the famous Northern Pacific contest last May has so profoundly stirred the financial community. At the present writing it is too early to discuss the probable outcome, as nothing is known beyond the fact that control of the property has been secured by a powerful clique of Western speculative interests whose enormous operations in various quarters make up the stock market history of the past month or more. The leader of the clique has publicly stated that the Louisville stock was acquired as a simple investment, but there are few people in Wall Street who believe this to be the truth. According to the common view, the whole transaction was an audacious speculative coup, the motive of which was to turn over the controlling interest to one or another of the railroad companies which are naturally most concerned with the disposition of the Louisville property. As it now appears, the situation resolves itself into a question whether the Morgan party, which owns the Southern Railway; the Harriman party, which owns the Illinois Central and Southern Pacific, or the Belmont-Rothschild party, which were the former majority in the Louisville & Nashville, will be the bidders for the holdings of the Gates clique. The suggestion that one of the first two named may eventually secure control of the Louisville road has raised misgivings, lest the same sort of situation, with the same principals as were found in the great struggle for ascendency in the Northwest a year ago, may be repeated now in the South. Until this uncertainty is disposed of the movement of the general stock market will be a matter of some doubt. The price fluctuations of the last few days have been extremely erratic, and the characteristics of the trading have been a repetition, on scarcely an inferior scale, of the exciting market of a year ago.

So completely has speculative interest been absorbed in the railroad situation that the local traction issues have come in for only slight notice during the past week. The sharp decline in the various securities and options connected with the Metropolitan transfer deal has, however, been a very striking feature. A week ago the rights to subscribe to the new Metropolitan Securities stock were quoted as high as 12¼ on the curb. But from the moment they were taken in on the Stock Exchange the quotation has steadily fallen until it touched 5⅝ yesterday. At the same time Metropolitan Securities shares, "when issued," have declined on the curb from 124¾ to 111, and Metropolitan Street Railway on the regular board selling ex-rights went down no less than 20 points from the figure which it commanded when the new financial programme was first announced to the public. For the general reasons already noted, Manhattan and Brooklyn Rapid Transit have been comparatively neglected in the week's trading. They have sold down more through inaction than through any pressure of liquidation.

Philadelphia

Active interest continues to center in Union Traction, the dealings in which this week have continued on a large scale. A further advance from 43¾ to 44⅛ brought out enough stock, however, to check the upward tendency and cause a reaction to about the figure of a week ago. The strong pool operating in these shares seems to have the speculative situation well in hand, but it has not seemed this week to encourage another advance. News concerning the lease of the property is singularly absent. An active demand for Camden & Trenton Railway carried the stock up sharply from 4 to 5. The buying presumably is connected with the rumors of a Philadelphia-New York traction system, which just now are being circulated in a lively fashion. The rest of the week's traction dealings on the Philadelphia Exchange are of scant importance. Small lots of American Railways sold at 44 up to 44½, Railways Company General at 6, Philadelphia Traction at 98, Easton Electric at 19¾, Fairmount Park Transportation at 25 and Consolidated Traction of New Jersey at 70⅜. In the bond division, sales were recorded in Electric-People's Traction 4s at 98½, Union Traction of Indiana 5s at 101½, Consolidated of New Jersey 5s at 110⅞, People's Passenger 4s at 106¾ and 106¼, Indianapolis Railway 4s at 86¼ and United Traction of Pittsburgh 5s at 116¾.

Chicago

The principal Chicago surface line shares have made no further progress toward a higher level during the week, but they have held their previous advance very well. Dealings in Union Traction have continued heavy on a range between 19¾ and 21 for the common and 57 to 58 for the preferred. City Railway has not been at all active, a few lots only changing hands at 220. There is nothing fresh to be noted in the franchise tax matter. Speculators in the traction market find abundant inspiration, however, in the remarkable show of current earnings. Receipts of the City Railway are larger now than at any time since the World's Fair year. It is predicted for the elevated roads, also, that their April traffic returns will break all records for the month. The principal stocks of these companies have varied very little in price during the week. Metropolitan common is steady around 40, and the preferred, after going up to 92, is selling around 91⅛. South Side is off a half point to 114, Lake Street is unchanged at 12⅜, and Northwest is firm at 37. Nothing new has developed in the joint traffic handling proposal between the Northwestern Elevated and the St. Paul Railroad. Officials of the former say that the question now rests entirely with the railroad company to decide. A working agreement between the Metropolitan Elevated and the Burlington road with respect to the handling of the elevated's suburban traffic over the railroad company's line is believed to be near at hand.

Other Traction Securities

The steady accumulation which has been evident for some little time in the market for Massachusetts Electric stocks gave way this week to a sharp rise of 3 points in the common and 1½ in the preferred. The movement seems to be based entirely upon the company's excellent earnings. For the month of March an increase of $28,000, or 7 per cent, over last year was reported. A speculative rumor that the company would absorb the Boston Suburban receives no credence in well-informed circles. Boston Elevated, after selling up to 171, dropped back to 164 on light transactions. United Railways of Baltimore, after some reaction toward the end of last week, have recovered to nearly top figures. The indications that no more "strike" legislation against the company is to be feared are responsible for the continued strength of its stock and bonds. Other Baltimore traction sales for the week include Richmond Traction stock at 46, City and Suburban (Baltimore) 5s at 116, Baltimore Traction 5s at 118½, Atlanta Street Railway 5s at 107 and 107¼ and City and Suburban (Washington) 5s at 94. Bids on Syracuse

Transit and Rochester Railway shares have been raised sharply by leading New York specialists. Syracuse common is now quoted at 24 and the preferred at 64, and Rochester common at 50. New Orleans securities in their home market have risen to 31¾ for the common and 108¼ for the preferred, the high level of the recent upward movement. Twin City Rapid Transit has ceased its late display of activity and is lower on the week, and North American also has been comparatively inactive. San Francisco Street Railway issues on the New York curb continue to occupy a prominent place in the trading, with their prices showing an upward inclination. The common is up from 23⅞ to 25, the preferred from 62⅛ to 62½. The subscription rights are comparatively stationary at 102 and the bonds at 90. The stock of the Southern Ohio Traction Company was very active on the Cleveland Stock Exchange last week, the cause being the proposed consolidation of this property with the Cincinnati & Northwestern; also the report that the Western Ohio Railway Company is soon to be absorbed by the consolidated company forming a through Cincinnati-Toledo line. During the week 1300 shares changed hands at from 63 to 65; the week previous this stock sold at 58½. Western Ohio Railway was quoted on the Stock Exchange for the first time, and 50 shares sold at 21, which is considered very good for a starter. Reference to the earnings of this road, which has just commenced operations, is made in another column. Four hundred of Detroit United sold at from 68 to 69½, a slight gain over last week. Early in the week a block of Elgin, Aurora & Southern sold at 37½, and later it sold at 41 and 42 for small lots. About 400 shares of Northern Ohio Traction common sold at 33, stationary figure. Cleveland Electric made a slight gain, small blocks selling at 83¾. On Monday Detriot United advanced to 69¼, 350 shares going at that figure. Fifty Elgin, Aurora & Southern sold at 42. Last week 3000 shares of Southern Traction sold to Cincinnati parties in one block on the Cincinnati Stock Exchange.

Security Quotations

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

	Closing Bid	
	April 8	April 15
American Railways Company	43⅝	44
Boston Elevated	168½	163½
Brooklyn R. T.	65⅝	65
Chicago City	220	a220
Chicago Union Tr. (common)	19⅜	20½
Chicago Union Tr. (preferred)	57	56½
Cleveland & Eastern	a30	a30
Cleveland Electric	82¾	83
Columbus (common)	51½	54
Columbus (preferred)	102	*101
Consolidated Traction of N. J.	70¼	70
Consolidated Traction of N. J. 5s	110½	110¾
Consolidated Traction of Pittsburgh (common)	24⅜	..
Detroit United	66	69½
Electric-People's Traction (Philadelphia) 4s	93¾	98¾
Elgin, Aurora & Southern	35	40¾
Indianapolis Street Railway 4s	85	86
Lake Street Elevated	12⅜	12⅜
Manhattan Ry	134½	132½
Massachusetts Elec. Cos (common)	39½	43⅛
Massachusetts Elec. Cos. (preferred)	96	97
Metropolitan Elevated, Chicago (common)	39½	39½
Metropolitan Elevated, Chicago	91	91
Metropolitan Street	165	b153
New Orleans (common)	30	31½
New Orleans (preferred)	104	108¼
North American	125¼	125
Northern Ohio Traction (common)	33	33
Northern Ohio Traction (preferred	a84¾	..
North Jersey	30	30
Northwestern Elevated, Chicago (common)	37	37
Northwestern Elevated, Chicago (preferred)	85½	85¼
Philadelphia Traction	98	98
St. Louis Transit Co. (common)	30⅝	30½
South Side Elevated (Chicago)	a114½	113
Southern Ohio Traction	62⅞	63½
Syracuse (common)	21	24
Syracuse (preferred)	54	64
Third Ave.	130	130
Twin City, Minneapolis (common)	120¼	120¼
United Railways, St. Louis (preferred)	83¾	83
United Railways, St. Louis, 4s	88¾	88¾
Union Traction (Philadelphia)	43¾	43⅝

* Ex-dividend. † Last sale. (a) Asked. (b) Ex-rights.

Iron and Steel

The efforts to check the advancing tendency of prices continue with great persistence, but their success is still extremely doubtful. A further decrease during March in the already meager furnace stocks on hand has emphasized the scarcity of material of all kinds, and consumers who buy for immediate delivery are ready to pay from $1 to $2 per ton above the nominal price quotations. These urgent demands are making difficult the task of the United States Steel Corporation, which is trying to prevent a runaway market. In making their contract for the fourth quarter of 1902 and the first quarter of 1903 with the Bessemer Furnace Association the Corporation was forced to concede a higher price than they had stipulated for. This circumstance has tended to unsettle the feeling in the trade still more regarding the future. The scarcity of steel has again led to some orders being placed in the foreign markets. Quotations are as follows: Bessemer pig, $18.25@$18.75; steel billets, $31@$32; steel rails, $28.

Metals

Quotations for the leading metals are as follows: Copper, 12 cents; tin, 27¾ cents @ 28 cents; lead, 4.10 cents @ 4.15 cents, and spelter, 4.45 cents.

SAN FRANCISCO, CAL.—A meeting of the stockholders of the United Railroads of San Francisco has been called for June 5 to vote on the proposition to issue bonds to the amount of $35,275,000. The object of the issue is to provide for the cost and indebtedness of the various lines of the system. The bonds are to run twenty-five years and bear 4 per cent interest.

INDIANAPOLIS, IND.—The Indianapolis & Western Traction Company has filed a mortgage covering both the Martinsville and Plainfield-Danville lines, now under construction, to secure $500,000 in bonds. The mortgage is given in favor of the Union and Security Trust Companies, of Indianapolis.

HELENA, MONT.—Judge Knowles, of the Federal Court, has signed a decree of foreclosure in the action of the Central Trust Company, of New York, against the Helena Power & Light Company. The company has been in the hands of N. L. Walker, as receiver, since October, 1901. The company operates about twenty-four miles of electric railway and is a consolidation of the Helena Electric Railway, Helena Rapid Transit Company, Helena Electric Company and the Helena Gaslight & Coke Company.

TRENTON, N. J.—The American Elevated Railway Company has filed a certificate increasing its capital stock from $1,000,000 to $5,000,000. The company is the one which it has been asserted would run trains on an elevated railway between New York and Philadelphia at a rate of 150 miles per hour.

PORTLAND, MAINE.—The capital stock of the Portland & Brunswick Street Railway Company, which plans to build between Portland and Brunswick, has been increased from $80,000 to $200,000.

CLEVELAND, OHIO.—On May 7, at Hamilton, the stockholders of the Southern Ohio Traction Company and the Cincinnati & Northwestern Railway will meet to ratify the action of the directors of the two companies, looking toward a consolidation of the properties. The new company will be known as the Cincinnati, Dayton & Toledo Traction Company, and it will have an authorized capital stock of $5,060,000. Under the terms of the consolidation, the stockholders of the Southern Ohio Traction will receive for their $2,000,000 of stock $2,000,000 in the stock and $1,200,000 in the bonds of the new company. Stockholders of the Cincinnati & Northwestern will receive $1,000,000 in the stock of the new company for their property. The remaining $2,000,000 of the stock of the new company will be held in the treasury for future extensions and the purchase of other properties. It is practically admitted by the Pomeroy-Mandelbaum Syndicate, which owns the properties mentioned, and the Western Ohio Railway Company that it is the intention to consolidate the last-named road with the other, thus forming, as the name of the new company implies, a thorough line from Cincinnati to Toledo. The Western Ohio Railway is being built to Findlay, where traffic arrangements would bring it into Toledo.

YOUNGSTOWN, OHIO.—Needham, Reynolds & Company, promoters and brokers of Cleveland, are said to have completed a deal for the consolidation of the Youngstown Park & Falls Railway Company, of Youngstown; the United Power Company, of East Liverpool; the East Liverpool & Wellsville Street Railway, of East Liverpool; the Chester Street Railway Company, of Chester, W. Va., and the Wellsville & Steubenville Traction Company, of Wellsville. The consolidated company will be known as the Ohio River & Youngstown Railway Company. Bonds to the amount of $4,000,000 are to be issued. It is the chief aim of the consolidation to build an interurban line from Youngstown to East Liverpool, a distance of 55 miles, touching Columbiana, Leetonia, Washingtonville, Lisbon, Salem and other towns; also a line from Wellsville to Steubenville. It is claimed that a 40-ft. private right of way over the two routes has been secured, and that work on the interurban lines will start at once. The Youngstown Park & Falls Railway Company owns 7 miles of line in Youngstown and a large park in that city. The United Power Company is a recent consolidation of the East Liverpool Railway Company and the Ceramic City Lighting Company.

CLEVELAND, OHIO.—At a special meeting of stockholders of the Cleveland, Painesville & Eastern Railway Company, held April 10, the capital stock of the company was increased from $1,500,000 to $2,000,000. Out of the $500,000 increase $69,000 will go to pay for the Fairport extension, which was completed last year. The balance of the increase will remain in the treasury for future improvements. The company is planning to purchase new rolling stock and other equipment.

ST. CATHARINES, ONT.—The Niagara, St. Catharines & Toronto Electric Railway Company is seeking parliamentary power to increase its bonds by $250,000 for the purpose of paying for two new purchases, the Port Dalhousie, St. Catharines & Thorald Electric Railway and the Niagara, St. Catharines & Toronto Navigation Company. The company also desires to acquire and guarantee the securities of other electrical and navigation companies; also to acquire some small lines and branch lines connecting with its lines.

TABLE OF OPERATING STATISTICS

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

Company	Period	Total Gross Earnings	Operating Expenses	Net Earnings	Deductions From Income	Net Income, Amount Available for Dividends
AKRON, O.						
Northern Ohio Tr. Co.	1 m., Mar. '02	51,204	29,620	21,584	12,500	9,084
	1 " " '01	41,674	24,573	17,100	10,417	6,684
	3 " " '02	141,134	86,335	54,799	------	------
	3 " " '01	122,653	78,558	44,095	------	------
	12 " Dec. '01	617,011	*350,845	266,166	136,162	130,004
	12 " " '00	513,725	*317,475	196,249	141,133	55,117
ALBANY, N. Y.						
United Traction Co.	1 m., Mar. '02	115 652	86,131	29,521	23,453	6,067
	1 " " '01	111,194	75,405	35,788	19,901	15,887
	9 " " '02	1,098,699	756,239	342,460	192,220	150,240
	9 " " '01	1,031,188	699,485	331,703	179,532	152,171
BINGHAMTON, N. Y.						
Binghamton St. Ry. Co.	1 m., Mar. '02	14,610	9,074	5.536	------	------
	1 " " '01	14,137	8,737	5,399	------	------
	9 " " '02	155,621	85.026	70,595	48,498	22,097
	9 " " '01	140,084	75,794	64,290	44,384	19,906
BOSTON, MASS.						
Boston Elev. Ry. Co.	12 m., Sept. '01	10,869,496	7,336,597	3,532,899	2,896,359	636,539
	12 " " '00	10,236,994	6,828,110	3,408,884	2,932,839	476,044
Massachusetts Elec. Cos	12 m., Sept. '01	5,778,133	3,915,486	1,862,648	937,206	925,442
	12 " " '00	5,518,837	3,659,337	1,859,500	994,294	865,206
BROOKLYN, N. Y.						
Brooklyn R. T. Co.	1 m., Jan. '02	996,825	* 784,361	212,464	------	------
	1 " " '01	917,750	* 663,893	253,857	------	------
	7 " " 02	7,533,752	*5300232	2,233,520	------	------
	7 " " '01	7,055,707	*4565945	2,489,762	------	------
	12 " June '01	12,135,559	*7216008	4,919,551	4,341,748	577,803
	12 " " '00	11,768,550	*7106373	4,662,177	4,135,405	526,772
BUFFALO, N. Y.						
International Tr. Co.	1 m., Feb. '02	230,744	132,920	97,824	94,276	3,548
	1 " " '01	235,021	118,273	116,748	84,411	32,338
	8 " " '02	3,519,491	1,664,285	1,855,206	789,124	1,066,081
	8 " " '01	1,998,050	972,319	1,025,731	641,057	384,674
CHICAGO, ILL.						
Chicago & Milwaukee Elec. Ry. Co.	1 m., Mar. '02	10,954	5,873	5,081	------	------
	1 " " '01	8,636	5,807	2,829	------	------
	3 " " '02	31,692	17,705	13,987	------	------
	3 " " '01	23,599	17,030	6,569	------	------
Lake Street Elevated	12 m., Dec. '01	786,462	388,799	397,663	------	------
	12 " " '00	757,954	378,661	379,293	------	------
CLEVELAND, O.						
Cleveland & Chagrin Falls	1 m., Feb. '02	3,454	2,255	1,199	------	------
	1 " " '01	2,435	3,016	† 581	------	------
	12 " Dec. '01	47,976	* 32,002	15,974	13,023	2,951
	12 " " '00	49,646	* 33,272	16,374	13,294	3,080
Cleveland & Eastern	1 m., Feb. '02	4,916	3,616	1,300	------	------
	1 " " '01	3,525	4,037	† 512	------	------
	12 " Dec. '01	90,390	52,022	38,368	43,678	† 4,310
	12 " " '00	62,893	36,672	26,221	36,148	† 9,927
Cleveland El. Ry. Co.	1 m., Feb. '02	168,462	97,446	71,016	22,170	48.846
	1 " " '01	151,805	90,251	61,554	18,875	42,679
	3 " " '02	356,544	203,452	153,092	43,945	109,146
	3 " " '01	318,537	189,514	129,023	37,851	91.172
	12 " Dec. '01	2,296,898	1,265,953	1,030,945	244,231	786,714
	12 " " '00	2,061,505	1,121,037	940,467	258,483	681,984
Cleveland, Elyria & Western	1 m., Mar. '02	22,071	12,969	9,102	------	------
	1 " " '01	17,425	10,836	6,589	------	------
	3 " " '02	57,084	38,369	18,715	------	------
	3 " " '01	47,030	33,873	13,156	------	------
	12 " Dec. '01	249,260	136,865	112,394	57,023	55,371
	12 " " '00	179,698	102,393	77,304	34,562	42,742
Cleveland, Painesville & Eastern	1 m., Feb. '02	8,918	5,893	3 025	6,258	† 3,234
	1 " " '01	7,807	4,926	2,881	6,042	† 3,161
	2 " " '02	19,119	12,314	6,805	------	------
	2 " " '01	16,841	10,363	6,478	------	------
	12 " Dec. '01	164,971	* 87,102	77,869	72,500	5,369
	12 " " '00	141,112	* 89,592	71,520	72,500	† 980
DENVER, COL.						
Denver City Tramway Co.	1 m., Feb. '02	112,666	64,769	47,897	32,621	15,275
	1 " " '01	98,403	56,596	41,806	31,642	10,164
	2 " " '02	232,308	129,053	103,316	65,647	37,669
	2 " " '01	206,814	113,487	93,327	63,013	30,314
	12 " Dec. '01	1,507,293	818,321	688,965	383,180	305,785
	12 " " '00	1,302,290	722,458	579,839	374,291	205,548
DETROIT, MICH.						
Detroit United Ry.	1 m., Mar. '02	269,094	152,875	116,219	65,216	51,004
	1 " " '01	229,884	125,041	104,843	57,360	47 482
	3 " " '02	755,631	435,655	319,976	193,753	126,223
	3 " " '01	650,268	365 742	284 526	172,065	112,462
	12 " Dec. '01	2,919,171	*1596765	1,322,046	652,277	670,129
	12 " " '00	2,575,277	*1439058	1,136,219	616,468	519,751
Rapid Ry.	1 m., Dec. '01	30,984	* 17,678	13,306	9,692	3,614
	1 " " '00	27,873	* 18,735	9,138	9,692	† 554
	12 " " '01	386,624	* 223,730	162,894	116,300	46,954
	12 " " '00	290.673	* 170,237	120,436	81,315	39,121
DULUTH, MINN.						
Duluth-Superior Tr.	1 m., Feb. '02	33,419	20,780	12,639	9,563	3,077
	1 " " '01	29,303	18,895	10,408	9,064	1,344
	2 " " '02	70,121	43,939	26,182	19,228	6,954
	2 " " '01	61,551	38,385	23,166	18,180	4,986
ELGIN, ILL.						
Elgin, Aurora & Southern Tr.	1 m., Mar. '02	30,535	19,148	11,387	8,333	3,054
	1 " " '01	27,687	16,256	11,431	8,333	3,098
	10 " " '02	314,496	176,079	138,416	83,333	55,082
	10 " " '01	274,349	174,442	99,907	83,333	16,574
HAMILTON, O.						
Southern Ohio Tr. Co.	1 m., Mar. '02	27,698	15,040	12,658	7,500	5,158
	1 " " '01	23,297	13,462	9,835	7,500	2,335
	12 " Dec. '01	337,741	182,954	154,787	90,000	64,787
	12 " " '00	294,907	154,465	140,542	90,000	50,542
LONDON, ONT.						
London St. Ry. Co.	1 m., Mar. '02	10,233	6,691	3,542	2,313	1,230
	1 " " '01	9,295	6,563	2,731	2,032	699
	3 " " '02	29,246	20,328	8,918	6,560	2,357
	3 " " '01	26,696	19,137	7,559	5,809	1,750
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co.	1 m., Mar. '02	216,642	101,062	115,580	65,699	49,881
	1 " " '01	188,481	99 917	88,564	61,020	27,544
	3 " " '02	627,500	302,122	325,378	193,793	131,585
	3 " " 01	544,473	301,432	243 041	180,681	62,360
MINNEAPOLIS, MINN.						
Twin City R. T. Co.	1 m. Feb. '02	244,781	120,271	124,509	58,516	65,993
	1 " " '01	215,580	106,461	109,117	52,698	56,419
	2 " " '02	516,939	252,691	264,247	117.033	147,214
	2 " " '01	451,854	221,685	230,168	106,028	124,140
MONTREAL, CAN.						
Montreal St. Ry. Co.	1 m., Feb. '02	133,645	103 915	29,729	14,581	15,149
	1 " " '01	127,612	87,654	39,958	8,774	31,184
	5 " " '02	767,844	491,761	276,082	74,211	201,872
	5 " " '01	726,527	461,276	265,251	45,814	219,438
NEW YORK CITY.						
Manhattan Ry. Co.	3 m., Dec. '01	3,038,435	1,404,971	1,633,465	753,135	880,329
	3 " " '00	2,728,598	1,340,696	1,387,902	749.857	638,045
	12 " Sept. '01	10,455,872	5,328,649	5,127,223	2,683,132	2,444,091
	12 " " '00	9,950,735	5,195,312	4,755,423	2,688,644	2,066,779
Metropolitan St. Ry.	3 m., Dec. '01	3,887,936	1,723,972	2,143,964	1,151,140	992,824
	3 " " '00	3,786,030	1,699,649	2,086,381	1,138,467	947,914
	12 " June '01	14,720,767	6,755,131	7,965,636	4,534,068	3,431,567
	12 " " '00	14,437,134	6,631,254	7,805,880	4,445,720	3,360,160
OLEAN, N. Y.						
Olean St. Ry. Co.	1 m., Mar. '02	3,994	2,411	1,584	1,146	438
	1 " " '01	3,835	2,043	1.79.	1,187	604
	9 " " '02	41,735	21,611	20,124	12,343	7,781
	9 " " '01	39,270	19,276	19,994	11,068	8,925
PITTSBURG, PA.						
Consolidated Traction	1 m., Dec. '01	304,669	140,941	163,728	91,548	72,180
	1 " " '00	277,439	109,069	168,370	89,807	78,563
	9 " " '01	2,649,656	1,145,651	1,503,905	807,667	694,238
	9 " " '00	2,471,696	1,013,240	1,458,456	799,704	658,752
PHILADELPHIA, PA.						
American Railways	1 m., Mar. '02	80,413	------	------	------	------
	1 " " '01	65,066	------	------	------	------
	9 " " '02	730,958	------	------	------	------
	9 " " '01	627,060	------	------	------	------
RICHMOND, VA.						
Richmond Trac. Co.	1 m., Sept. '01	20,991	15,669	5,322	3,196	2,126
	1 " " '00	20,727	10,770	9,957	3.843	6,115
	12 " " '01	218,569	139,542	79,027	38,618	40,410
	12 " " '00	203,057	108,198	94,859	37,608	57,250
ROCHESTER, N. Y.						
Rochester Ry.	1 m., Feb. '02	81,934	48,866	33.068	24,672	8,396
	1 " " '01	75,949	51,074	24,875	24,172	703
	2 " " '02	172,900	99,464	73,436	49,520	23,916
	2 " " '01	158,980	106,295	52,685	48,416	4,269
SCRANTON, PA.						
Scranton Ry. Co.	1 m., Oct. '01	2,638	29,300	adf26661	------	------
	1 " " '00	48,781	34,787	13.993	------	------
	10 " " '01	507,989	295,079	212,910	------	------
	10 " " '00	504,852	298,122	206,730	------	------
SCHENECTADY, N. Y.						
Schenectady Ry. Co.	3 m., Dec. '01	84,061	46,949	37,112	13,454	23,658
	3 " " '00	30,876	14,517	16,359	6,087	10,272
SYRACUSE, N. Y.						
Syracuse R. T. Co.	1 m., Feb. '02	52,501	30,775	22,126	19,025	3,101
	1 " " '01	47,676	26,540	21,136	18,588	2,548
	8 " " '02	458,390	251,952	206,439	152,146	54,293
	8 " " '01	404,872	222,231	182,641	148,928	33,714
TOLEDO, O.						
Toledo Ry. & Lt. Co.	1 m., Feb. '02	99,450	52,523	47,427	37,833	9,593
	1 " " '01	89,079	44,962	44,116	24,271	19,846
	12 " Dec. '01	1,311,084	* 636,407	674,677	415,168	259,509
	12 " " '00	1,182,517	* 616,945	565,572	409,051	156,521
W. NEW BRIGHTON, S. I.						
Staten Island El	1 m., Dec. '01	15,080	11,916	3,163	8,559	df.†5,396
	1 " " '00	13,177	11,237	1,940	8,333	†6,394
	6 " " '01	125,977	88,229	37,749	52,774	†15,025
	6 " " '00	120,277	76,395	43,882	52,348	† 8,466