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EDITORIAL NOTICE

Street railway news, and all information regarding changes of officers, new equipments, extensions, financial changes and new enterprises will be greatly appreciated for use in these columns.

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Contents of this Issue

Mr. Edison's Prediction

At the recent opening of the Copenhagen Exhibition, a letter was made public from Thomas A. Edison on the future of electric traction. Mr. Edison was asked as to his opinions concerning electric traction and aerial navigation, and replied as follows: "I believe that within thirty years nearly all railways will discard steam locomotives and adopt electric motors, and that the electric automobile will displace the horse almost entirely. In the present state of science, there are no known facts by which one could predict any commercial future for aerial navigation."

This seems at present a very bold prediction, but it is no more than if Mr. Edison, fifteen years ago, had said that 95 per cent of the street railways in the country within the same space of time would be in operation by electricty, yet this has come about within a half of three decades.

Block Signal Systems for Electric Railways

Several bad accidents which have occurred on electric railways during the past three or four weeks have called attention to the demand for reliable block signals on electric railways, and a correspondent in this issue suggests that the "staff" signal system, which is employed on steam railroads, is well adapted to electric railway operation. This is a very old system and consists, in its simplest form, in making the engineer of the locomotive, when leaving a turnout, carry with him a short staff, which gives him control of that section, as no other train is allowed to enter the section without this passport to it. The engineer leaves the staff at the next turnout to be taken back to the first turnout by the first train coming in the opposite direction. Modifications in the system have been made so that trains do not have to pass alternately in one direction and the other, by providing several staffs at each end of the section and an electrical connection between the two turnouts by which the removal of a staff in the signal box at either end locks the box. We are aware that the system is in use upon a great many steam roads, but we must confess that it does not appear superior to the usual method of signalling with lights, as it requires a stop at the turnout, and certainly as much delay, if not more, than with the usual electric system. As we have already pointed out editorially, the electric railway is at a disadvantage in some respects with the steam railroad when it comes to the introduction of a block signal system, because on the latter the rails can easily be insulated from each other, so far as the voltage of a low primary battery is concerned. This fact can be utilized in a block signal system, so that the passing of a train over the track can be used to short circuit the rails through the car axles and thus operate the block signal apparatus. On the other hand, the electric railway has an advantage over the steam railroad through the fact that a 500-volt circuit is always available, and this current can be employed for signalling purposes in a way not possible on the steam railroads. We do not claim, by this, that any or all of the present methods of block signalling in use on electric railways are perfect, but we do believe that the greatest factor in any system of this kind is the carefulness of the employees, and the maintenance of an intelligent set of rules for the manipulation and use of the safety appliances. Thus, the incident mentioned by the correspondent of the motorman or conductor on the road observed by him delegating the work of changing the signals to a passenger on the car who happened to be his friend, was, of course, a gross infraction of discipline. On the other hand, the danger of signals being tampered with by unauthorized persons, we believe, is very remote. In the first place, in any system depending upon the hand manipulation of the signals, the boxes usually are, or should be, locked so that no one but the person having the key can open them; again, any unauthorized change of signals of this kind in most States is a severe penal offense, as it should be, and we have never heard of a case of signals of this kind being mis-set. It might be said that mischievous or criminally inclined persons have an ample opportunity for changing the signals without being observed, as the signal boxes are often in parts of the country where such acts could not be detected, but there is the same danger that persons of this character could cause as much damage by placing ties or other obstructions on the track, and there is but little more opportunity for doing one than the other.

* * *

Another example of the importance of having some reliable system of block signalling on high-speed interurban electric railways was shown last month, by a very bad head-on collision on the new third-rail electric railway extending from Milan, Italy, to Porto Ceresio. This line, which was formerly operated by steam, extends from Milan north to Lake Lugano, and is equipped with the third-rail electric system. The line, which is about 30 miles in length, carries, at this time of the year, a very large traffic of excursionists to the Italian lakes. It is also very popular with many of the business men of Milan, who, to escape the hot nights in that city, have built country residences along the beautiful shores of Lake Lugano, and who use the line every morning and evening in going to and from their places of business. The precautions against accidents have seemingly been fairly good, in that the trains are despatched from regular turnouts by employees of the company, and no train is allowed to proceed beyond a turnout without special orders. The accident in question, however, indicates that any system of this kind which depends upon human judgment is fallible. The station master at Porto Ceresio, finding that the train which was due at that point at a certain time was late, assumed that he could stop it at the preceding turnout, at Biasuschio, and telegraphed to the station master at that point to hold the train there. Then without waiting for an answer he ordered the train at his station to proceed. The north train, however, had left Biasuschio before the receipt of the telegram, and the result was a bad collision between the turnouts, in which two passengers were killed and thirteen were badly wounded. Unfortunately, it did not occur to either of the despatchers after the trains had left their stations and they knew that an accident was almost inevitable to switch off the current from the third-rail. This, of course, would have brought both trains to a stop, and the engineers of both could have been notified of the condition of affairs. This possibility of the control over a train after it has left the station is one great safeguard in electric railway operation, although in this particular case no advantage was taken of it.

The Mediterranean Railway Company, which is the owner of the Milan-Porto Ceresio line, is now planning to introduce some system of automatic block signalling which will prevent a recurrence of any accident of this kind, a step which should have been taken before.

New York's Transportation Facilities

Mayor Low's letter upon the transportation needs of New York, which we published last week, is attracting much attention, as it is generally accepted as an official outline of the policy which the present city administration will pursue. The fact that the Mayor is a member of the Rapid Transit Commission lends additional weight to this utterance; his position and powers, moreover, will enable him to exert more influence in directing legislation upon this subject than any other individual engaged in the solution of these grave problems. It is gratifying, therefore, to find evidences at every step of careful and intelligent study of the subject. The Mayor appreciates fully the importance of the part which the transportation companies are playing in the development of the commercial interests of the city, and is evidently eager to afford them every opportunity of extending their sphere of influence.

* * *

Naturally, the first point taken under consideration is the necessity for relieving the congestion of traffic between Manhattan and Brooklyn. All plans providing merely for temporary relief are put aside. Whatever is now done must eventually form a part of the comprehensive plan which will ultimately secure complete unification of the several boroughs. It is proposed, first of all, to rebuild the suspended structure of Brooklyn Bridge, so as to adapt it to the largest possible use as a railroad thoroughfare. This would enable the operation of six-car trains instead of four, and at once increase the train capacity 50 per cent. Admitting that the moving sidewalk, which has been advocated so persistently by the present Bridge Commissioner, would double the present carrying capacity of the bridge, the plan is condemned by the fact that it would be a makeshift at best, and could not become a part of the completed system. The time and money spent in such a scheme would, therefore, be wasted, and would really entail further delay and additional expense in accomplishing the great permanent improvement which is now recognized as necessary to the future growth of the city. We cannot agree, however, with the Mayor's view that the southern connection, leading from the bridge to the financial district of Manhattan, can wait. Such delay would be an injustice to the great army of Brooklynites whose business brings them every day to the lower end of Manhattan. Everything possible should be done to relieve the present conditions, and the plans proposed by Mr. Parsons to solve this problem ought to be taken under consideration at once. The recommendations concerning the new Williamsburg Bridge and Blackwell's Island Bridge are along the lines proposed in Mr. Parsons' plan and are generally approved.

* * *

The needs of the northern section of the city form the subject of an interesting discussion, particularly that portion dealing with the service of the New York Central. The company's assurance that it will co-operate with the city in establishing points north of the Harlem River where passengers can change from the suburban trains to the subway and elevated lines is certainly a valuable advantage and ought to assist materially in securing a practical solution of one of the greatest problems that has confronted the Rapid Transit Commission. It is pointed out that it will not be necessary for the railroad company to secure additional powers from the Legislature to carry out these plans, and this removes an obstacle which might cause serious delay.

* * *

The last recommendation deals with the subject of increased facilities along the river front on the West Side, and does not seem practicable at this time. We doubt the wisdom of introducing an element into this discussion that cannot fail to arouse opposition, especially as it involves the handling of freight as well as passenger traffic. The volume of business that could be cared for by the plan proposed would be only a small percentage of that handled upon the river, and there is, moreover, no pressing demand for such a service. It seems to us in consideration of these facts that it would be much wiser for the Commission to deal simply with the question of furnishing adequate transportation facilities for passengers.

Regulation of Street Railways

The sentiment favorable to placing street railways under State regulation is growing in many sections where trolley lines are no longer restricted to local traffic, but have extended their field of operation to neighboring cities. The strongest objection that has been urged against this plan is that it is a serious invasion of the administrative powers of local authorities, but the force of this argument is lessened somewhat by the fact that the service now performed by electric railways is more in the nature of that which the steam roads are giving, and by the consideration that a municipality should not be permitted to regulate a system when the city may form only a part of the territory served. The change is advocated, in many cases, as, for instance, in Massachusetts, when Governor Crane's bill was under consideration, on the ground that local authorities are no longer to be trusted to regulate the transportation business, because it has outgrown the scope of municipal jurisdiction.

Before the introduction of electricity street car systems were almost entirely local in their character, but the displacement of horses by electricity has revolutionized methods, and now many street car companies operate in the municipal areas of a dozen or more cities and towns. For services of this kind it is essential that regulations should be adopted in many respects different from those which obtained in former times. There was no need ten or fifteen years ago for State Railroad Commissioners to concern themselves with the question of street railway locations, for the reason that it was distinctly a local subject, and local interests could be depended upon to secure adequate service. If the restrictions imposed upon a street railway company by the local authorities were such that the efficiency of the service was materially impaired, public opinion could be counted upon to correct in time such mistakes of this character as might occur. Now, the danger seems to be that the local authorities might enact restrictions that would affect not only their municipality, but an entire State. Public policy requires that local authorities shall not be permitted to interfere with the general well-being, and it is recognized that it would be dangerous to vest such power in the hands of irresponsible boards.

It is pointed out, for instance, that an electric railway may be planned to run through several independent municipalities, where the service may be of great advantage to the majority; yet in the case of one or two, immediate advantages in the way of transportation facilities may not be so evident, though there is little or no disadvantage in granting the interested company the location that it desires. But because the route is to be of manifest advantage to other communities, and is not immediately demanded by the people of one of the towns through which it passes, the board of that place considers itself justified in withholding approval of a location until a number of conditions have been accepted by the petitioning company. We have in mind one project where an electric railway was planned to extend through several small places, and a few larger ones, and the builders were met with many demands on the part of the local authorities, many of which were simply absurd. It must, for example, widen and pave at its own expense the street in which its tracks were to be laid; it must keep the roadway sprinkled and in repair; must light it at night and remove the snow from it in winter; it must carry the school children of the town either at a reduced fare or without charge. In this way financial burdens would be imposed greatly exceeding any possible return that could be obtained from the town itself, and some other community on the line would have to pay the bill.

Another consideration for established companies is possible interference where local authorities are empowered to revoke franchises. A wave of so-called reform is liable to sweep over any community and leave its institutions in badly crippled condition when the aldermen or trustees are left to their own sweet will, and there is nothing to prevent them from indulging in a destructive warfare upon corporations. In the case of an electric railway, for instance, having a continuous line running through several towns, it might at any time have its service cut in two by a revocation of its franchise in one of the midway towns until it would consent to make liberal donations in the way of public improvements.

These are some of the considerations that must influence corporations and communities in considering proposed legislation of this kind, providing for placing supervisory powers in the hands of State boards, instead of local officials. In some places very strong objections have been urged against such measures, as for instance, in Chicago; but on the whole the sentiment seems to be growing more and more favorable as the electric railways expand and the benefits of interurban systems become more apparent.

The Municipal Ownership Heresy

No civic subject has been more acrimoniously debated than this matter of the municipal ownership of public utilities, and none, to our knowledge, less fruitfully. Both sides of the question have legitimate arguments in their support, but in point of fact these have generally cut precious little figure in the discussion, which has usually turned to mutual abuse and misstatement. The end has been as futile as when Predestination and Free Will stormed in theological circles a century and a half ago. It is needless to say that we have consistently upheld the superiority of wise and well-regulated private ownership, but we must own that we occasionally smile at some of the stock reasons adduced in its favor, as well as at some of those advanced by the municipal socialists. Their old standby is the success of municipal street building, waterworks and the like, and they raise a querulous cry of triumph over these, and demand why municipal gas and electric lighting and street railways should not be equally successful. To which is promptly made the retort discourteous, by proving with a deftly marshalled array of statistics, that as a matter of experience municipal gas and electric works, when the accounts are rigorously overhauled, never do pay and that is the end of it. That municipal ownership and operation of waterworks pays, and would be necessary even if it did not pay, on the score of public health, cannot be doubted. The same is the case with the maintenance of the streets, for however corrupt the public works department may be it can be reached via the ballot-box with reasonable promptness, while under our present judicial procedure an unwilling corporation can not be forced to do anything without the expenditure of years and thousands.

Those who argue about gas and electric lighting and street railways, however, are generally heedless of the fact that these public utilities differ very widely from streets and waterworks in two important particulars. First, the former are, however desirable, to a certain extent, luxuries. In other words, they are not necessary, irrespective of whether they pay or not, as when public health and safety are involved. And, second, they differ very widely from street and waterworks in that they require a considerably larger proportion of skilled labor. Now, in a street cleaning gang it makes no difference whether the component heelers are of one political party or the other. The strenuous efforts of the foreman will, in either case, shake them into tolerable efficiency within a few days. But the higher in the scale of labor one goes the greater the difference between bad and good workmen, and the more serious the results of inexperience and inefficiency.

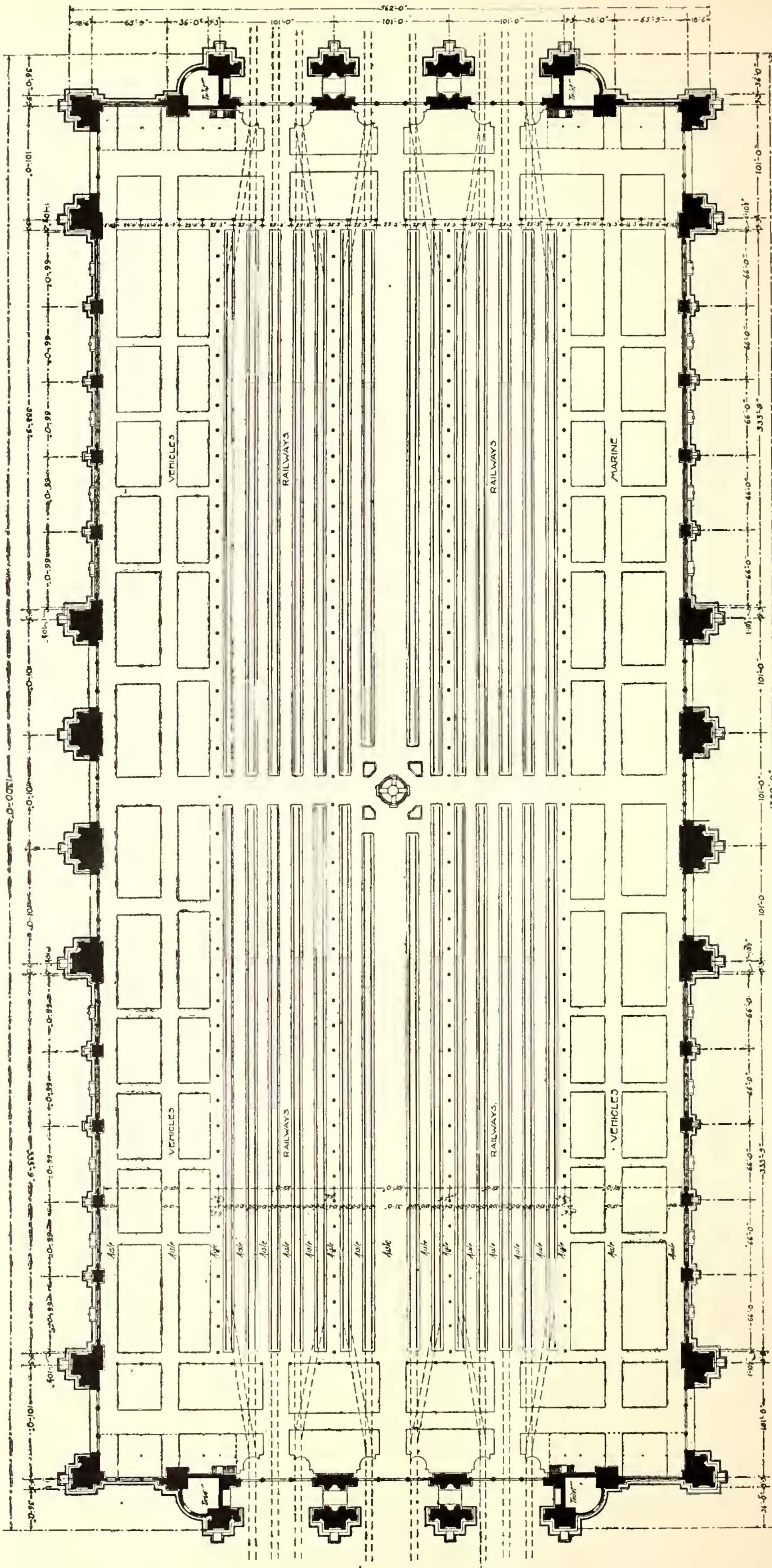
Hence, one may safely lay down the general principle that, under existing political conditions, the less skilled labor required on any municipal work, the better the relative efficiency attainable. Of course, we assume here the usual frank venality and unscrupulousness that is a normal characteristic of municipal politics. The less difficult and elaborate the work undertaken, the less chance for the gang to cover pickings and stealings, and the less mischief will be done by lack of skill. Here is, at once, a perfectly simple and adequate reason for the great and real practical difference between municipal waterworks and municipal tramway operation, or even municipal lighting. The former involves no large amount of skilled labor, and bad work is its own evidence, while the latter calls for a picked body of men, carefully trained, in order to insure either good returns or the safety of the passengers. The kind of gang we should get upon an American municipal tramway system, under existing political conditions, can better be imagined than described, and if our dear theoretical friends—the reformers—really want to make municipal ownership a thing to be tolerated even in hypothesis they will have to begin by reforming municipal politics. When they have done this they can fairly ask for a hearing on the merits of the case, and not until then. It is little use in involving civil service methods as a panacea, for in spite of indubitable merits in theory, in practice they too often act as a shield for inefficient mediocrity, and good or bad they are about as difficult to secure as is political purity in general. All things considered, it is a vast wonder that municipal lighting plants have even come within hailing distance of success, and Heaven help the city that tries municipal tramways. It is a beautiful thing for *doctrinaires* to chortle about, but in the concrete it would be a nightmare.

Transportation Exhibits at St. Louis

The plan for the transportation division of exhibits of the St. Louis World's Fair has been approved, and is presented herewith. The building will be 1300 ft. long and 562 ft. wide. The cut shows the arrangement of tracks, by which cars and locomotives can be hauled into the building and exhibited under conditions which will give those interested in the department an opportunity to judge of their respective merits and general appearance. A main aisle extends through the center of the building, 31 ft. wide, and another aisle about half the width crosses through the middle of the structure. It will be noticed that "Railways" are given the most conspicuous position, facing the main aisle throughout the entire extent on both sides, and occupying altogether about two-thirds of the available floor space. Back of these exhibits on each side are others, including vehicles not of the railway class and marine apparatus. The railway tracks will enter both ends of the building, and there will be ample facilities for handling exhibits of every class. The electrical features of the exhibit will be included among railways, but it is hoped that the management will also make provision for operating modern electric street cars on the grounds outside of the building.

The general plan of the building is rectangular. There will be no court. The distinguishing feature is the massing of the three entrance ways so that they will form an arcade, and this feature will be repeated along four sides of the structure. The three arched entrance ways will take up almost the entire facade on the east and west sides. On the north and south sides these arcade entrance ways are to be placed in the center.

This building will occupy the extreme northwest corner of the grounds. It is the most expansive structure yet designed for the Exposition, and when all the buildings are up it will be exceeded in size only by the palatial Agricultural Building. The east and west fronts will have three magnificent arches, which will comprise more than half of the entire facade. Each of these arched openings will be 64 ft. wide and 52 ft. high. Through these archways fourteen permanent railroad tracks will be laid from one end of the building to the other. At the sides of these three openings the projecting angles will be accentuated by tower or pylon effect, reaching to a height of 150 ft. to the base of the crowning statue. On the north and south fronts the architect has deemed it well to repeat the three massive archways, which will form the center feature of smaller fronts. This treatment is intended to break the unwieldy facade of 1,300 ft. On the north and south fronts the pylon feature will be omitted, but massive piers will be repeated at intervals and lend dignity to the design. Flanking these three openings on the long fronts will be great rows of magnificent windows as wide as the archways. Not only will visitors be admitted through the twelve huge portals, but subsidiary entrances will be provided at frequent intervals in the remaining stretch of walls. Over each of the big archways will be a



INSTALLATION PLAN FOR TRANSPORTATION DIVISION OF EXHIBITS AT ST. LOUIS FAIR lofty curve, which supplies a background for the architectural features.

The statuary will be placed in front and at the base of the main piers at the sides of the grand openings. This affords sixteen groups, which will illustrate Transportation in all its phases as well as the progress made by the United States in this science. There will also be four groups of statuary surrounding the four pylons, placed at the east and west fronts. The architect has subdued the use of sculpture in the building, depending on mass effects and on the grouping of masses; that is, on architecture rather than on tawdry decorations. The entire width of the building is spanned by five well designed uniform trusses. Special endeavor has been made to afford plenty of illumination by day without the use of skylights. Light will be introduced through the monitor windows over each span of the five trusses.

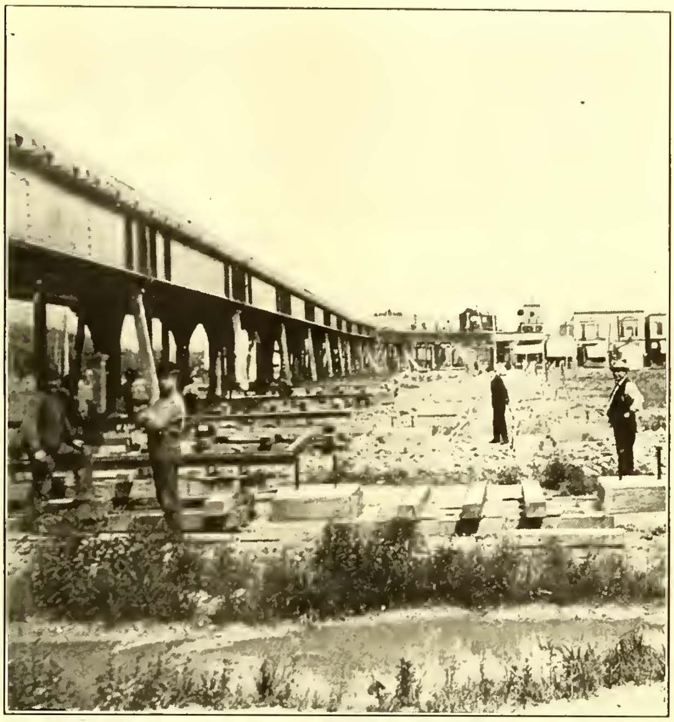
The building will contain about four miles of standard gage railroad track. Even with this immense trackage two entire bents of the building are left free of rails, to afford an exhibit space of 270,000 sq. ft.

Shifting Elevated Tracks at Chicago

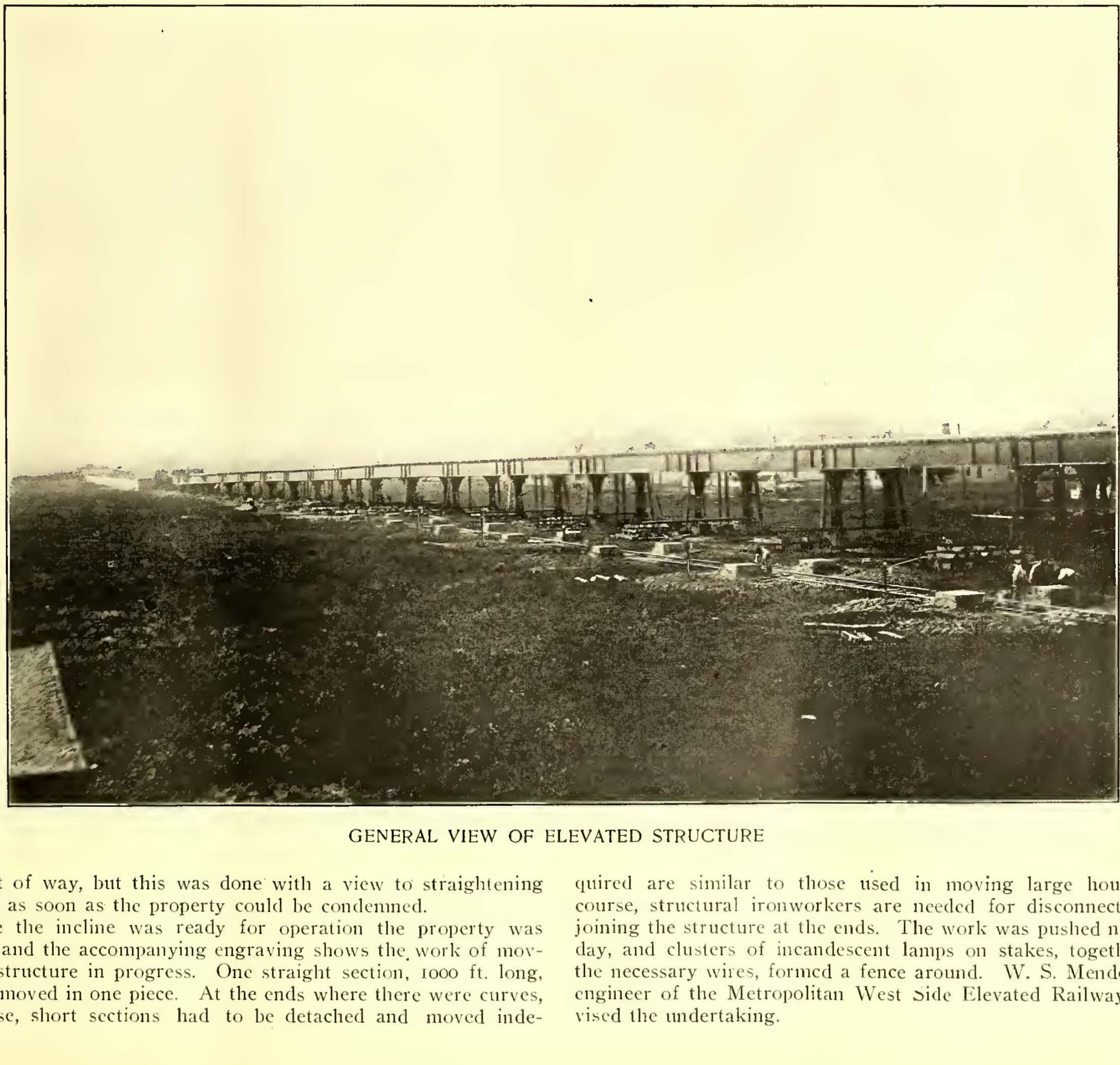
The Metropolitan West Side Elevated Railway Company, of Chicago, has recently extended its Garfield Park branch from Forty-Eighth Avenue to Fifty-Second Avenue. The structure for that distance is an incline, landing passengers at a station on the surface at Fifty-Second Avenue, where a transfer depot and terminals have been built for connection with the Aurora, Elgin & Chicago Railway, which terminates at that point.

The incline structure proper is about 1200 ft. long from Forty-Eighth Avenue to Fiftieth Avenue. When the structure was first built the company could not buy a certain piece of property which was directly in a straight line between the present Forty-Eighth Avenue terminus and the future terminal at Fifty-Second Avenue. As the Aurora, Elgin & Chicago Railway was nearing completion, the structure was built around the property which was obstructing the right of way, but this was done with a view to straightening the road as soon as the property could be condemned.

Before the incline was ready for operation the property was secured, and the accompanying engraving shows the work of moving the structure in progress. One straight section, 1000 ft. long, is being moved in one piece. At the ends where there were curves, of course, short sections had to be detached and moved independently. The method of procedure can be seen from the views herewith. The columns are jacked up and slid along on T-rails supported on false work. A Chicago house-moving company has the contract for the moving, as the methods used and tools required are similar to those used in moving large houses. Of course, structural ironworkers are needed for disconnecting and joining the structure at the ends. The work was pushed night and day, and clusters of incandescent lamps on stakes, together with the necessary wires, formed a fence around. W. S. Menden, chief engineer of the Metropolitan West Side Elevated Railway, supervised the undertaking.



METHOD OF MOVING STRUCTURE



GENERAL VIEW OF ELEVATED STRUCTURE

At the lower end of the incline structure the tracks enter a fenced-in terminal yard in which will be not only the transfer and terminal depot but shops and storage tracks for the Garfield Park division of the road.

METHOD OF MOVING STRUCTURE

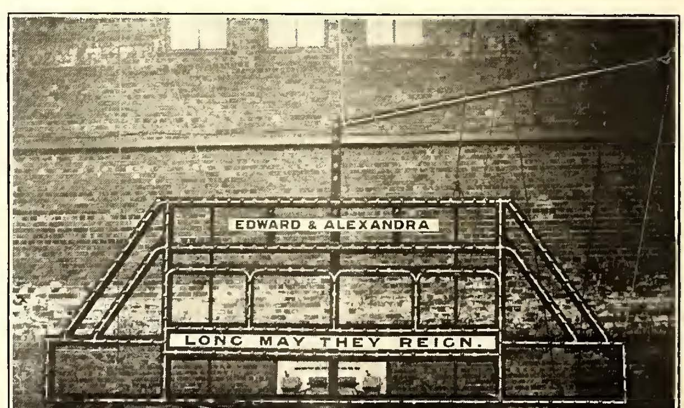
Decorative Effects at Manchester

Many of the tramway companies of Great Britain and the city corporations which operate electric railways made elaborate arrangements for utilizing their trolley systems in the celebrations which were to be held throughout England, June 26 and 27, at the time of the coronation of the King. Owing to the unfortunate and unexpected illness of Edward VII., the festivities throughout the kingdom were partially abandoned, but the news in regard to His Majesty's condition, on June 26, was so favorable that, at the express desire of the royal patient, many of the more quiet evidences of loyalty which his subjects had arranged were carried out according to the programme.

Although the advent of the trolley into Great Britain on a considerable scale is of comparatively recent date, the possibilities in the way of decorative effects were utilized on some of the systems, and some very tasteful displays were produced. Through the courtesy of J. H. F. Bale, resident tramways engineer of the Manchester Corporation, views of two of the features prepared by that company for the coronation celebrations are presented herewith. The first one of these is a handsome, double-deck car carrying 600 lamps. These were green, white and red in color, and arranged to show a coronet and spell "Long live the King." The top seats were left for a brass band, so that the car could make a tour of the principal streets.

The second illustration shows an attractive illuminated sign in the form of a trolley car of full size, which was hung on the front of the company's offices on Piccadilly. The sign contained 400 lamps. This method of decorating which, as far as is known, is original with Mr. Bale, was most effective and attracted wide attention.

ILLUMINATED CAR, MANCHESTER



OUTLINE OF CAR FOR DECORATIVE EFFECT

It is interesting to note, in this connection, that illuminated trolley cars were also prepared by the Liverpool Corporation Tramways, the Glasgow Corporation Tramways, and others, and evoked a great deal of admiration in their trips through these several cities.

The Convention of the International Tramway Union—II

In the last issue of this paper a report was published of the proceedings of the above association during the first two days of its convention in London last month. A report of the proceedings during the two final days follows:

THURSDAY, JULY 3

Mr. John Young, general manager of the Glasgow Corporation Tramways, was invited to preside at the meeting on July 3, and accepted. The chairman, who was well received, in a short opening address, said he had a very high honor that morning that he did not expect. He had been asked to take the chair for a few minutes before going to another meeting, and he did so with great pleasure. He had been asked to address a few words to the delegates, and as a tramway man he was, like every other tramway man, glad to welcome any gentleman to London or to this country who was either willing to give or to receive information on tramway matters. He was specially delighted, as a tramway man from Glasgow, which was a remote place in the northern part of this island, to be present, and to welcome tramway men from all parts of Europe. He had had the pleasure of being present at the congress in Paris two years ago, and of reading the papers which had been submitted there, from which he had derived a great deal of information, and he was glad that Englishmen were now able to reciprocate the many kindnesses that they had received from their friends on the other side of the channel. He desired to assure them of the hearty welcome that the congress received in this country from all tramway men. (Cheers.)

Mr. Poetz, engineer-in-chief of the Strassen-Eisenbahn Gesellschaft, of Hamburg, then read a paper on "Tramway Brakes," which will be published in an early issue. Mr. Poetz added to the information contained in his paper some figures with respect to a number of tests which had been made on the Continent with various types of brakes. The tests showed that when running at 14 km per hour the Helios electro magnetic brake pulled up in 15.5 m, and four other brakes in a distance of 9 m. At 20 km the results were as follows:

Siemens & Halske electromagnetic brake, 13 m; Schuckert, 15 m; Standard air brake, 16 m; Carpenter air brake, 16.7 m, and the Helios electric magnetic brake, 21 m.

In 28 km the results were: Siemens & Halske, 17.8 m; Schuckert, 24.5 m; Standard air brake, 23.6 m; Carpenter, 24.2 m, and Helios, 27.2 m.

In 32 km the results were: Siemens & Halske, 27.2 m; Schuckert, 43 m; Standard air brake, 38.8 m; Carpenter, 35.8 m, and Helios, 43.5 m. The conclusions he had arrived at were that electric brakes were more simple, and did not need so much attention, but the two systems were equally effective for ordinary work.

Mr. Thonet, in opening the discussion, said he could practically confirm the conclusions which had been arrived at by Mr. Poetz in his paper. There were two figures he would like to give the congress. The first was that the cost of the installation of the air brake at Marseilles was 2000 francs per motor and trailer, as against 600 francs for the electric. The results of the trial of speed—all at a speed of 20 km per hour—were in meters.

For one car, 14.0 for the air brake.
For one car, 12.5 for the General Electric brake.
For one car, 11.6 for the Thomson-Houston brake.
For one car and one trailer, 18.1 for the air brake.
For one car and one trailer, 15.6 for the General Electric brake.
For one car and one trailer, 11.7 for the Thomson-Houston brake.
For one car and two trailers, 20.7 for the air brake.
For one car and two trailers, 19.4 for the General Electric brake.
For one car and two trailers, 14.7 for the Thomson-Houston brake.

Mr. Gustave Koehler said he had the two systems running at Berlin. He did not agree with the conclusions come to by the author as to the superiority of the magnetic brake. His company started in Berlin with the electric brake, but they had now gone back to the air brake. Security was the great thing to be considered, and they found that they could obtain much greater security with the air brake than they could with the electric. The air brake had the advantage of being always ready for use; the conductor could always tell whether he had the power right by simply looking in his gage. That could not be done with the electric brake, and in many cases of accident they had not been able to fix the responsibility upon the conductor because his electric brake had not acted. He did not agree with the author as to the cost. He thought it was a good deal higher than that. The magnetic brake caused dirt to collect on the apparatus, and thus a bigger expense was caused for cleaning. The electric brake was nothing like so smooth in its working as the air, and it caused a good deal more shock in pulling up the cars. As far as expense was concerned, he went over the figures given by Mr. Poetz in his paper, and said that the cost of the electric brake for the car itself was 625 marks, for the trailer 425 marks, in all 1050 marks; for the air brake, for the car 1000 marks, for the trailer 200 marks, making 1200; that was to say 1200 for the air, as against 1050 for the electric. As regarded repairs, he found that the electric came out at 170 marks, as against 127 marks for the air; a net saving, roughly, of about 40 marks per car. Therefore, he could not agree that they should give a preference to the electric brake—on the contrary, he was decidedly of opinion that they should give the preference to air. However, he did not think that the question was sufficiently far advanced for the congress to be able to vote categorically on the question, and he therefore proposed that the subject be deferred and brought up at the next congress.

Mr. Poetz remarked that he could not agree with the objections raised by Mr. Koehler, for the reason that the Sperry (electric) brake was adopted by the Berlin Company five years ago, and that since that time very considerable improvements had been made in electric brakes, and the brake they were now using in Hamburg was a decided step in advance of the brake that was being used in Berlin. The higher cost which Mr. Koehler had attributed to the electric brake was due to the fact that instead of adopting the ordinary magnetic brake, they had adopted one which was more expensive in its installation.

Mr. Peiser said it was a very important thing in case of accidents for the conductor to be able to stop his wheels absolutely, and a good deal of the information they had had put before them was wanting in completeness. For one thing, they had no statistics or data of the actual power that was exercised by the shoe on the rim of the wheel.

Mr. d'Hoop said what they wanted to get, if possible, was such a brake that if the trailer parted from the motor car going up an incline, the brake should be able to pull up the trailer automatically.

Mr. Poetz observed that neither the brake used in Hamburg nor the Standard air brake would do that, and he did not think the point was of much importance.

Mr. Peiser asked what the improvements were which had been introduced since the Berlin tramways chose their brake five years ago, and which rendered the brake used in Hamburg superior to that used in Berlin.

Mr. Von Leber, speaking on behalf of the Austrian Government and not on behalf of the company interested, said that in Vienna they had tried a large number of different systems, including the Sperry brake. He agreed more with the conclusions arrived at by Mr. Poetz than with Mr. Koehler, and the experience they had gained in Vienna did not corroborate the experience gained in Berlin. In Vienna they were going in for the use of the electric brake, and not for the Sperry brake.

After further discussion it was agreed that the matter should again come up for consideration at a future congress.

Mr. de Burlet then read a paper on "Gages for Light Railways."

Mr. de Burlet's paper was devoted to light railways in general, for which he recommended a narrow gage, although he acknowledged that most of the companies in the Union using electric power recommended a standard gage. His argument was based on the much lower cost of construction, and he gave the follow- tables of costs for different characters of country:

Cost of Construction Per Km.

Nature of the Ground	Gage of the Lines	
	1 m 450	1 m 000
Plain	Fr. 37.500 à 62.500	Fr. 25 000 à 40.000
Slight undulation	" 57.250 à 87.500	" 37.500 à 62.500
Strong undulation	" 75.000 à 112.500	" 57.250 à 75.000
Slightly broken	" 100.000 à 150.000	" 62.500 à 87.500
Much broken	" 137.000 à 175.000	" 75 000 à 112.500
Slightly mountainous	" 162.500 à 200.000	" 100.000 à 137.500
Very mountainous	" 187.500 à 250.000	" 125.000 à 175.000

Cost of Operation

	Standard Gage		Narrow Gage	
	Per km	Per Train km	Per km	Per Train km
	Francs	Francs	Francs	Francs
Maintenance and renewal of the rolling stock and cost of traction	2.475	0.49	1.975	0.39
Maintenance, renewal and inspection of the track	1.725	0.34	1.475	0.29

Mr. Leslie S. Robertson said this was a subject to which he had given considerable attention, and he had had the opportunity on various occasions of visiting nearly all the light railways on the Continent and elsewhere, and although he knew that in this country engineers looked with certain distrust and certain disfavor on anything less than 4 ft. 8½ ins., yet he thought that there was a considerable amount of prejudice which had grown up, due to the question not having been studied with an open mind. No English engineer, he thought, would put down a 2-ft. 6-in. gage, or a 2-ft. gage, where he could possibly put down a 4-ft. 8½-in. gage, but there were cases where they could not get the money for a 4-ft. 8½-in. gage, and it was a question of a district going without railway facilities for a considerable number of years, and the whole of the property would not rise in value as it would if they put down a line which would pay on a small scale. He thought the talk of people about the inconvenience of transshipment was a good deal exaggerated. It certainly cost 1d. a ton, or a little more, but after all was said and done, the disadvantage of having to transfer goods from a small car to a bigger car was a bugbear, which was made too much of when it was a question of either making a railway or not. It was better to have railways with transshipment than to have no railways at all. (Hear, hear.) What could be done by a small gage had been wonderfully shown in South Africa. The standard gage there was 3 ft. 6 ins., but the whole of the war material, and the whole of the troops had been carried, and all the rest of the work done by the Cape Government Railways on a 3-ft. 6-in. gage. No doubt they would like in South Africa to have a 4-ft. 8½-in. gage if they could, but they had not the money. Then they could also take the military lines in North India, which were on a 2-ft. 6-in. gage, and they knew what a great deal could be done by that. But, as Mr. Burlet rightly remarked, each case must be considered separately, on its own merits, and they could not lay down any hard or fast rule in every case.

Mr. Janssen remarked that he would very much like to have the question considered from the point of view of the future, and as to what was to come when these two systems of broad and and narrow gage were fused under one management. He would very much like to have the opinion of the learned author of the paper on that point.

Mr. de Burlet said he wished to lay stress upon the fact that he was not discussing electrical tramways there. It was clearly a question of light railways, and they could not argue from one to another. The figures which had been given were not estimates, but were actual figures presented to the general meeting of their society last year, and they were absolutely correct. The figures given for Saxony were by Mr. Ziffer, and those for India were taken from the government statistics, and in England they would all admit that there were no more reliable figures than those relating to the Indian railways. Mr. Schendweiler had said that they were using curves of a very small radius. If they once got to standard gages, and enabled the railway stock of big companies to run over it, they would at once impose their own conditions. The question of transshipment was, he thought, made more of than it need be. They started with 25 centimes—about 2½d.—per ton, and they had now got it down to 1d. Of course, there was a little question of time, but he did not think that was of much importance. They found that the secondary lines which they had put down were working very satisfactorily as feeders to their main lines.

GROUP OF DELEGATES AT EXHIBIT HALL, MR. JANSSEN, PRESIDENT OF THE INTERNATIONAL TRAMWAY UNION, IN THE CENTER

The congress adjourned until 9.30 Friday morning.

In the afternon a number of the delegates, through the courtesy of Lieut.-Colonel Crompton, paid a visit to the Crompton Electrical Works at Chelmsford. Later in the afternoon the train was taken to the Crystal Palace, where a dinner was served in one of the dining-rooms connected with that building. The dinner was entirely informal, and at the close, after a short speech by Vice-President Röhl, toasting the absent president, the party adjourned to a balcony, which had been reserved, and from which a handsome display of fireworks was observed.

FRIDAY, JULY 4

The sessions of the union opened at 9.30 a. m. with President Janssen in the chair. The first business transacted was the presentation of a paper on the "Carriage of Luggage, Goods, and Mails," by Mr. G. Marsal, manager of the Biella Light Railways. It indicated that very little was done in this direction by European companies. There was no discussion.

Mr. Peiser, chief engineer of the Grosse Berliner Strassenbahn then read a paper on the heating of cars. According to Mr. Peiser, electric heaters were in use in Berlin, Hanover, Aachen, Christiana and Zurich.

An important report was then presented by Mr. Leon Janssen, managing director of the Brussels Tramways, and Mr. Geron, director of the Cologne Tramway Company, on the subject of a uniform system of accounting. The system differs considerably from that in use in America. It divides the expenses into nine "primary" accounts, viz.: 1. Management. 2. Operation. 3. Traction. 4. Electric conduits. 5. Rolling stock. 6. Tracks. 7. Buildings. 8. General expenses. 9. Sundries. Each of these is, in turn, divided into ten secondary accounts. For example, No. 1 (management) would be divided into the following secondary accounts (1):

10. Salary and emoluments of manager.
11. Salaries of the manager's staff.
12. Different expenses of the manager's staff.
13. Expenses for supplies.
14. Expenses for post, telegraph, telephone, etc.
15. Heating, lighting, cleaning.
16. Maintenance of fittings.
17. Assignable according to requirements.
18. Id. id.
19. Sundries.

In the same way primary account 2, *operation*, would be subdivided into the following ten secondary accounts:

20. Salary and emoluments of the operating manager and his office staff.
21. Salaries of the staff of the stations.
22. Salaries of inspectors, conductors and wattmen.
23. Equipment of the traffic employees in uniforms, etc.
24. Office expenses, office supplies as far as they relate to traffic.
25. Expenses for the traffic staff.
26. Heating, lighting and cleaning of the traffic offices.
27. Assignable according to requirements.
28. " " "
29. " " "

Mr. Janssen, after a few introductory remarks, proposed they should accept the principle of the scheme for electric tramways, and that the secretary and five members be appointed to form a committee to report on the details, so that they might lay a scheme before the union at a subsequent meeting.

Mr. Grialou, of Lyons, pointed out the difficulty of comparing car miles, as in some places the cars carried 100 passengers, while in other places they only carried twenty-six; therefore he considered that the report should be clearly indicated what was meant by a car.

Mr. Geron, in reply, said that by his scheme everything could be sub-divided. There was an elasticity in the scheme which enabled everything to be mentioned somewhere or other, either in the primary, secondary, or other sub-divisions. He believed it would not be a difficult point to settle what was to appear in the different accounts.

It was agreed that the committee, as suggested, be appointed.

Mr. P. V. McMahon, chief engineer of the City & South London Railway, read a paper on underground tube railways, which is published in another column.

Mr. Boulvin, of Brussels, asked for some information as to the coal consumption on the Central London Railway.

Mr. McMahon replied that he had not been able to get this information, but would endeavor to procure it.

A vote of thanks was accorded the reader of the paper on the proposition of the chairman.

Mr. Röhl said he had been asked to report whether anything new had been discovered or found out in reference to accumulators since the last meeting. There was something new, and that was that at the last meeting one gentleman who was interested in the Hanover Tramways, and who manifested a paternal liking for the accumulator system, and spoke in its favor, had now found out, in the course of time, that accumulators were absolutely ruinous, and that they had brought his enterprise to the brink of ruin. The system was too dear, and was absolutely unreliable. It had been found that the idea that the cost of the accumulator could be partly covered by the sale of the old lead was altogether erroneous, and that the lead did not bring in sufficient money to in any way lessen the cost. Accumulators were being given up everywhere, and, although in Hanover the authorities insisted upon having them, they had now been given up even there, and at Hagen, the birthplace of accumulators, they had been given up. It had been thought that in the case of automobiles accumulators would render them independent and reliable at all times, but in the case of snow with great unanimity automobiles stopped running altogether. He thought that the question might now be considered to be buried, although the process of burying it had cost an enormous amount of money.

Mr. Thonet said he could confirm everything Mr. Röhl had said as to the inefficiency of accumulators, and a striking illustration was to be had in the case of the Dunkirk Tramways. Those tramways were worked for nineteen years by horse traction, and paid a very fair dividend. Then the accumulators were put in, and immediately what used to be a paying concern became a losing one. Horse traction cost 86,000 francs per annum, and the accumulator system cost just about double. It was found that the batteries only lasted about five months; they got about twelve stoppages a day with the cars; in fact, the whole traffic was so disorganized that the authorities had to interfere. Having spoken of the enormous waste in batteries, and the large expense incurred, Mr. Thonet said that in nine months the cost of running eleven motor cars was 158,000 francs, and even then they had to be helped out with horses occasionally. The authorities had since insisted upon the substitution of the overhead trolley system, and had extended the concession twenty-five years in consideration of the difficulties and the expense to which the company was subjected by the accumulator system.

Mr. Koehler said that the future of the accumulator system in Germany was sealed and done for. Even in Berlin, where the authorities had first insisted upon the accumulator system, they had now turned completely round, and had insisted upon their use being discontinued. There were still two or three carriages run on the accumulator system, but they would be put out of work in a short time. The experience in accumulators, which had luckily been very short, had cost four million marks. Fortunately, owing to the shortness of the time the batteries were in use, they had not absolutely ruined anybody, although they had gone very near to doing so.

Mr. Boulvin said that at the congress in 1900 he mentioned that he had not much opinion of accumulators, and it was stated then that probably they would be so much improved as to be of practical use. At the time he said that, in his opinion, horse traction was better than traction by accumulators, but it was then considered that he made a joke. The experience, however, of the last two years confirmed the opinion he then held, in spite of the improvements which had been brought to bear. Facts had been brought to his notice which confirmed that opinion. For instance, the battery was supposed to be sufficient to take the car for 36 km. but as a matter of fact it only lasted for seventeen, and as the daily run of a car was 123 km, it followed that they had to be recharged five or six times a day. The coal consumption and maintenance of the cars, and generally the working expenses, came about the same as had been stated, viz., twice as much in the case of accumulators as in the case of the overhead trolley.

Mr. Lavalard said he had had experience of accumulators in Paris, and could confirm the opinions of the previous speakers as to their unfitness. In Paris they had to be used because the authorities objected to overhead wires. He would submit figures and other details in support of his views, which would appear in the minutes of the congress' proceedings.

Mr. Max Von Leber confirmed what had been stated by previous speakers, as regarded the accumulator system of Austria, where, indeed, it had been buried. As, however, persons were still endeavoring to push accumulators forward, the congress should pass a resolution to the effect that, having heard the previous writers and speakers on the subject, they unanimously confirmed the opinion that accumulators were costly, uncertain in their working, and were not to be recommended in any way.

Mr. Grialou questioned whether Mr. Von Leber's resolution was strong enough. He thought the congress ought to state plainly, in the interests of people who were thinking of establishing tramway lines, that the accumulator system was not only costly and uncertain, but was absolutely impracticable.

After some further discussion the following resolution was agreed to: "That the congress, having heard all the speakers on the subject of the accumulator system, affirm that this system is not to be recommended, either on account of its costliness or on account of its uncertainty, for any regular system of traction."

The president then delivered a speech, closing the congress, which was afterwards translated by Mr. Scotter. He said that the discussions at that, which was the twelfth international congress, had been very interesting, and especially had that been the case on many minute matters of importance. There had been several new elements introduced into the discussions which he hoped would be very useful to all engaged in the tramway industry. Their annual reunions were becoming year by year of more importance. They were becoming more and more the occasion for discussing all points in connection with the exploitation of tramways upon which they required enlightenment, and many points of importance had been put before them which constituted the beginnings of what might be great reforms. The congress had been distinguished by many important features. There were representatives present of many different nationalities, and the spirit of confraternity and union had found its way into all their deliberations. The delegates had applied themselves with great zeal to obtain those fruitful results which he felt sure would follow from the papers and the discussion. He hoped that the papers would be carefully read, and that members would return answers to the various questions, for the benefit of the coming general assembly. Any new points which any member might consider of sufficient importance, he invited them to send up, in order that they might be embodied in next year's programme. In the course of their visit to London they had received a most hearty reception, the cordiality and charm of which he was sure was appreciated by all the foreign delegates. He wished especially to thank the Tramways and Light Railways Association, of which Sir Charles Rivers Wilson was the honorable president, and also the proprietors of the "Tramway and Railway World." The reception committee deserved their gratitude, and especially would he desire to mention Mr. Scotter, the chairman, and Mr. Benedict, the secretary, for the work they had done. The arranging of excursions must have entailed a vast deal of labor upon those gentlemen and the committee, seeing the crowded state of London at the present time, and they had to thank them very heartily for the activity and zeal they had displayed in the matter. He thanked them in the name of the union with all cordiality. The congress also thanked the speakers who had taken such great trouble to prepare the replies to questions, and had done so much for the elucidation of many other points. The congress thanked the Mayor of Islington, the Tramways and Light Railways Association, the reception committee, Mr. Gerald Balfour, the Society of Mechanical Engineers, Mr. Cunningham and Mr. Graham (of the Central London Railway), Mr. Shenck (of the Crystal Palace), Mr. and Mrs. Swinburne, the Institute of Electrical Engineers, and the president of the Institute of Civil Engineers and Mrs. Hawkesley. The courtesy the members had received would be remembered by all of them. It was a very great pleasure, especially to see the delegates from foreign governments represented at the congress, and he hoped that all who were present would carry away with them the feeling that they had done some very excellent work. Finally the president thanked the members for the great attention they had paid to the congress, and the kindness they had extended to him personally.

Professor Luigi Rava, of Italy, briefly thanked the president and the congress generally for the kind words which had been used, especially in reference to the presence of delegates from foreign governments.

Mr. Schendweiler humorously referred to the difficulties in conducting a congress in which three languages had to be used, and said he felt those difficulties were likely to increase as the scope of the union increased, and they looked forward to it reaching as far as China. However, so ably had the translation been made that he believed the difficulties would not be insurmountable. In conclusion he called for three cheers for the president, which were heartily given.

The union then adjourned for the banquet in the evening.

The banquet, which was extended to the members of the union by the Tramways and Light Railways Association, was held at De Keyser's Royal Hotel and was very largely attended. The Right Hon. James Bryce, M. P., presided, and among others present, besides the foreign members of the union, were Lord Vaux, of Harronden; T. P. O'Connor, M. P.; J. Atherly Jones, M. P., and Alexander Siemens. Speeches were made by Messrs. Bryce, Janssen, Swinburne, Scotter, Perouse, Jones, Röhl and others. Mr. Ziffer and Mr. Von Leber presented an invitation to the association to meet in Vienna in 1904, a suggestion which was heartily applauded. The association, it is understood, has also received an invitation from the Brussels Tramways Company to hold its next meeting in that city, and the selection will be made by the executive committee.

Mr. Bryce in proposing "The Union Internationale Permanente de Tramways and the Electrical Traction Industry," said the delegates had just held the first of those international congresses connected with tramways and light railways which had met in England. He was glad to know that they had had a successful meeting. They had despatched their business with a rapidity not encumbered by any of that obstructive legislation which had checked the pace of tramways in this country. They had effected several permanent gains. They had helped in the direction of securing standardization, and they had undertaken to procure for the Board of Trade a statement as to the laws in force in regard to the electrical industry in foreign countries. We in England had been a little behind most of our Continental friends in this matter. In 1894, when he first saw light railways in an Alpine district, and subsequently in North Italy, he was struck by the fact that in England we had remained apparently blind, if not indifferent, as to what might be done by this means in country districts. In 1895, the government of which he was a member took steps, which had since been followed up, to develop the light railway interests, which had now undergone considerable expansion, but we were still behind Western and Northern Europe. He hoped the effect of their meeting would be to accelerate the progress which that industry had begun to make in England. When he saw what other countries had done, he was astonished that a land so populous as his own, and one that had suffered so much from agricultural depression, had not been more active in establishing easy and cheap communication. When he thought of what was effected in cheapening the transit of goods from the rural districts to the towns, and in affording facilities to the urban populations to live in the country, it seemed to him that they were doing one of the most important works that could be done at the present day.

Although the official proceedings of the union closed on Friday evening, a number of the delegates remained in England several days to visit the more important points of interest, and several accepted the invitations cordially given by W. M. Murphy, chairman of the Dublin United Tramways, to visit that city, and from the Lorain Steel Company to inspect the surface contact system installed by that company in Wolverhampton. Among those who took the Dublin excursion were Messrs. Lavalard and Coste, of Paris, Grialou, of Lyons, and Ziffer, of Vienna.

Tube Railways in London*

BY P. V. McMAHON,
Chief Engineer City & South London Railway

In 1884 when, after considerable opposition, the City of London and Southwark Subway got an Act of Parliament authorizing the construction of two tunnels from King William Street to the Elephant and Castle, the most sanguine had not even then dreamed of what was to follow, as shown by the number of tube railways (as they are now called) before Parliament this session. In 1887 another Act was obtained sanctioning an extension to Stockwell, and in 1890 the Act authorizing the extension to Clapham was passed, and the name of the undertaking changed to the City & South London Railway. The opening ceremony was performed by His Majesty, the King (then Prince of Wales) in November, 1890, and opened for public traffic on December 18, following.

About the time of the opening, the railway was looked upon, not only by English and Continental engineers, but by Americans, as a fine piece of engineering; the public, too, were loud in the applause for a while. The line, however, went on quietly carrying its 7,000,000 passengers per annum, and its existence was forgotten, except by its passengers, until the opening of the Central London Railway, when the pioneer line seems to have been rediscovered. It is true that the original line, although fulfilling in every way its functions as a railway and supplying a long-felt want, was not at first what could be called a huge financial success as a dividend-paying concern. Nevertheless, it paid a dividend from the start, and improved upon it every year, but the investing public preferred to speculate in other directions, and gave very little encouragement to the Waterloo and City Railway or the Central London Railway; in fact, it can safely be said that if the construction of these lines depended upon the investing public they would not now exist. The success of the Central London Railway, running through what is undoubtedly the finest route in the world, seems to have awakened the investing public to the fact that neither it nor its two predecessors were altogether philanthropic schemes. This, coupled with the fact that our enterprising American cousins came over to get a look in and have succeeded, seems to have roused up a sort of mania for tube railways, which, judging from the number of schemes before Parliament, are promoted upon the smallest provocation.

Looked at from the utilitarian standpoint, it appears that the tube railway is the only solution of the rapid transit problem in the interior of large cities. And it is only in large cities, where there is good traffic, that it is possible to make a tube railway pay, on account of the very expensive construction.

The question of a speed limit does not apply as in the case of a surface tram, as much higher speeds can be run in the tube, the limit being the cost, as high speeds on short runs are only obtained by rapid acceleration, and it will be shown later that very rapid acceleration will not pay unless one is forced to adopt

* Paper read at the meeting of the International Tramways Union, London, July 4, 1902.

it through competition. The question of safety must not, however, be overlooked in recommending very high speeds, on account of the short sections with intermediate signals, and it would appear that this point was not fully considered by some engineers who lately suggested speeds for tunnel work far in excess of anything we have at present.

Comparing the tube railway with the shallow tunnel tramway, it appears to the author that the deep-level tube line has the balance of advantages in its favor. Unless the shallow tunnel is made in a new street, the extra cost involved in diverting sewers, gas and water pipes, electric-light cables, etc., will bring the total cost per mile as high as the tube line. Again, if trams with top-seats are to be used, or the surface trams run below to avoid the passenger changing from one vehicle to another, the tunnel must be considerably larger and more costly than the tube. If a passenger has to change he might as well be taken down 50 ft. or 60 ft. in a lift and up again at the other end as walk down 20 ft. and up again. Experience has shown that the tube lines are free from fog, and it is questionable if this state of things would obtain in a shallow tunnel system.

The question as to whether separate locomotives or motor cars are more suitable for tube lines is, it appears, one which will have to be settled by experience, as opinions at present differ widely on the subject. Eleven years' experience on the City and South London Railway has shown that separate locomotives have many advantages; in fact, it may be mentioned that a motor car train was actually constructed and run in traffic about seven years ago, but was abandoned in favor of separate locomotives. This train certainly gave greater seating capacity for the same total weight, and, consequently, the coal consumed per passenger carried was slightly less than with separate locomotives. It was found, however, that a certain amount of time was lost unnecessarily at the terminal stations, due to the driver and assistant having to change positions from one end of the train to the other. With a crowded platform the time lost was increased. Thus, when the signal was given for the train to start, the driver was invariably not ready to start, and with a two and a half or three minutes' service a quarter minute lost in this manner was appreciably felt. An electrical failure, however small, may put the whole train out of running, but with a locomotive the same failure does not so seriously interfere with traffic arrangements. For the same reason, more spare carriages are required than with separate locomotives. Another objection to motor car trains is the siding accommodation. When the ordinary daily examination and overhauls have to be executed in the tunnel the sidings must be constructed of a larger diameter tunnel, on account of continuous inspection and repair pits in the case of motor car trains. With separate locomotives these pits are shorter and more getatable.

With traffic conditions such as obtain in London or any other large city—i. e., a couple of hours' very heavy traffic in the morning and again in the evening, with light or fairly light traffic during the remainder of the day—the matter of running trains lightly loaded deserves serious consideration, but has not yet been satisfactorily solved, so far as tube lines, pure and simple, are concerned.

On the City & South London line, after experimenting with motor car trains, two-coach trains were run during the period of light load and three-coach trains for the heavy morning and evening traffic. A short experience proved that the extra shunting involved with the two different sets of trains consumed quite as much coal as the heavier trains running all day. This state of affairs, of course, only applies to a line with sidings under ground and in a continuous line. If the train could easily be run to the surface and stabled as in ordinary fantail sidings, the expense and interruption to working would not be nearly so great, and this is borne out by experience of working on the Waterloo & City Railway. At the Waterloo end of the line the trains run out into an open yard with sidings branching out in the ordinary manner. Single motor car trains, weighing twenty-six tons average, are run from 11:30 a. m. to 4 p. m., and again between 7:30 p. m. and 10 p. m. At other times the four-coach motor trains, weighing 100 tons, are run, commencing at 7:30 a. m. The multiple unit system should afford a complete solution of this problem; but from the foregoing remarks it is apparent that to be quite, satisfactory the grouping of cars, etc., must be performed in the open.

Having dealt with what appears to be the general condition met with in tube railways, a brief description of the three existing tubes and a few results of working may prove interesting. The City & South London Railway with its extension is now about 6¼ miles long, and runs from Clapham Common through the city to the Angel at Islington, with thirteen stations, the average distance between stations being about 850 yds. The generating station is situated at Stockwell, about one mile from the south end of the line. Originally the line to King William Street was worked on the ordinary two-wire system at 500 volts, but with the extension north the two-wire system at 500 volts was no longer available, and the method of distribution was changed to the three-wire system with 1000 volts across the outers, the running rail forming the middle wire. There are two sub-stations, one at London Bridge, 2¾ miles from Stockwell, and the other at the Angel, 5¼ miles from the generating station. These substations are fed from Stockwell on practically a five-wire system, i. e., 2000 volts across the outers. A particular feature of the system is, that although distribution is effected at 2000 volts, the maximum voltage across any one commutator is 500 volts and only half of the electrical energy sent to the sub-stations is transformed, and thus a high efficiency is maintained.

One or two novel points had to be settled before installing the system. In the first place, there had been the problem of getting from the negative to the positive side, and several automatic devices had been considered, but the way out of the difficulty had finally resolved itself into a simple break of 30 ft. in the working

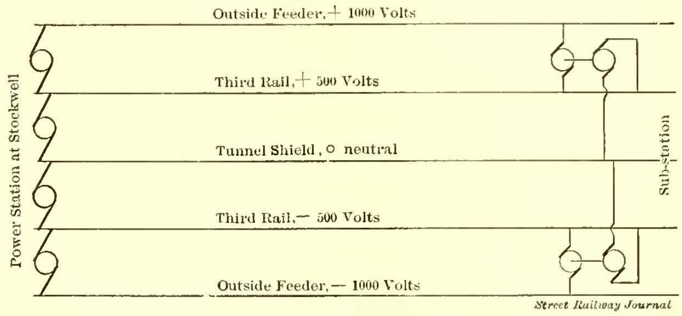


FIG. 1.—DIAGRAM OF DISTRIBUTION SYSTEM, CITY & SOUTH LONDON RAILWAY

conductor at the crossings. That had given rather a flickering light in the train, but the break had been reduced afterward to 15 ft. by putting conductors in the middle and a fuse between, so that if, by any chance, two locomotives were crossing and caused a short circuit, the middle piece would become disconnected from the main conductor. Another question decided had been whether two machines should be used at 500 volts, one on each side of the system, or 1000-volt machines across the outers, with smaller machines for balancing. Many things had pointed to the use of generators working at 1000 volts, but one point that had seemed to be very important was that a bad short circuit, such as might be caused by a car running off the road and directly connecting the third-rail to the ordinary running rail, might raise the pressure to 1000 volts between the running rail and the working conductor. The circuit-breaker would probably work, but in the meantime the pressure might be raised on the motor and lamps, and a lot of the lamps would be blown out by the temporary rise in voltage.

Reference was made above to the sub-station efficiency, and it may be mentioned that the continuous-current, high-tension reducers have an efficiency of 90 per cent at quarter load, 94 per cent at half load, 96 per cent at full load, and about 96 per cent at 50 per cent overload. This high efficiency is especially noticeable at the sub-station at the Angel, where the high tension reducer system with reversible boosters in connection with a large battery was in use; a very high efficiency, indeed, was obtained, because the high-tension feeders supplying the sub-station at 1000 volts had an almost steady load all day long of between 75 amp. and 80 amp,, while the current going from the sub-station bus-bars to the line varied between zero and 450 amps. If a system of that sort were applied all over, the size of the units in the generating station and the size of feeders could be reduced for the same number of trains. At London Bridge sub-station there was a battery almost as large, but it had failed to take the peaks with the ordinary boosters, and was not much good as a regulator; in fact, it would do very little work at all, unless additional cells were switched in and the battery was allowed to discharge on the whole. It was used in case of a heavy load, and the cells had to be switched in to make a discharge.

The lift and lighting circuits were fed from the same bus-bars, but in the case of a heavy short circuit on the working conductor an automatic cut-out operated, and threw the lifts and lights onto the battery, thus maintaining the station lighting and lifts supply in case of the working conductor blowing its fuses.

Comparing the continuous-current three-wire system used on the City & South London Railway with the three-phase system, it would be seen at once that a good deal less needed to be spent in copper, on account of the steady load on the feeders. There was very little difference in the rail drop between 5¼ miles and about three miles, and it would seem that the limits for the three-wire system had not, by any means, been reached. Previous to the installation of the system it had been thought there might be some difficulty in the balancing, but none had occurred. Ordinary balancers were installed at Clapham Common, Moorgate Street and the Elephant and Castle, and it was found that the continuous-current reducers acted so well as balancers that only one of the balancers needed to be used. The ammeters in the reducer motor armature circuit at the sub-station showed that the current was fairly steady, while the generator armature currents were varying from zero to the maximum, showing that they were acting as balancers as well as reducers.

The present City & South London train consists of four bogie carriages, having a total seating capacity of 128 passengers. The empty train weighs 28.16 tons, and 36.16 tons fully loaded.

The locomotives are each fitted with two gearless motors, one of which is capable of doing the work in case of the other getting temporarily disabled. The locomotive weighs complete 13.65 tons. Thus, the locomotive and fully loaded train weighs 49.8 tons. The maximum number of trains running at one time is twenty-five, giving a service slightly under three minutes between trains in busy traffic. This service is reduced to about eighteen trains during the periods of light load. The average speed, including stops, is 14.4 miles per hour, and, excluding stops at stations, 16.75 miles per hour.

The kw-hours per ton mile at the above speed measured on board the locomotive are 0.0552. At the generating station switchboard the unit per ton mile for the past half year was .068. This figure includes shunting, sub-station and cable losses, which are not, of course, included in the measurement on board

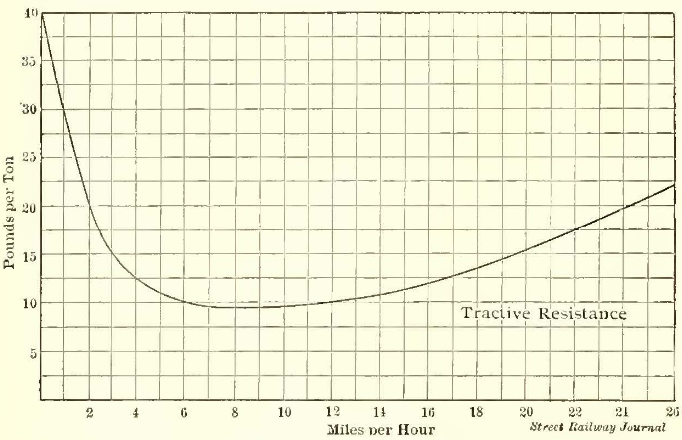


FIG. 2.—DIAGRAM SHOWING TRACTIVE RESISTANCE, CITY & SOUTH LONDON RAILWAY

the locomotive. For the same period the number of train miles run were 650,000, and the passengers carried, about 9,000,000. The coal per unit generated was 3.9 lbs., which includes all boiler house losses getting steam and banking fires. This result was obtained with North Country and Midland small coal. With a coal of a slightly higher calorific value, during a month of this period, the coal per unit (kw-hour) was 3.28 lbs., including all boiler-house losses.

Expressing this result as in steam railway practice, we get a coal consumption of about three ounces per ton mile, which compares favorably with main line practice, when one considers that published steam locomotive tests are specially taken and over a short period only. Also the traction resistance in tunnels, as shown by exhaustive tests on the South London line, is about double that which obtains on main lines, and short sections, which means that the train is being accelerated for about half the total running time. The output in Board of Trade units per half year is 3,781,000. The tractive resistance per ton in the City & South London Railway is given in Fig. 2.

While on the question of speed it may be well to discuss the matter of very rapid acceleration, which is receiving a lot of attention at the present moment. When the present South London locomotives were designed it was carefully considered how far the company could go in the direction of rapid acceleration without paying too much for it. It was found that with the locomotive under consideration, locomotives and trains weighing about 49 tons with passengers, the time taken on a short section of 2700 ft. would be 130 seconds, the maximum speed being 19.7 miles an hour, and the units per ton-mile 0.054, with an average speed of 14.25 m. p. h. It had been thought that a much better service might be obtained by having a four-motor equipment, the total weight remaining at 49 tons, but with a reduction in seating capacity. The units per ton-mile were reduced to 0.0377, the maximum speed was 20.6, and the average 14.25 m. p. h., as before. This reduced units per ton-mile were obtained by increasing the acceleration, but the peaks at starting were increased from 300 amps. to 600 amps. That had a very important bearing on the size of a generating station, and the copper in feeders and the size of the working conductor. The results given above assumed that the current could be shut off as soon as full speed was obtained and the locomotive allowed to coast, but that would hardly apply in practice. Running the above locomotives at their maximum speed and keeping the current on until the brakes were applied, the times for a 2700-ft. section were 122 seconds and 103 seconds, while the units per ton-mile were 0.0659 and 0.0745, respectively. Considering this effect on the power station of a line with ten such sections, allowing ten seconds at each station, and running a two-minute service with thirty trains leaving the terminus per hour, we found that the maximum current demand was 2085 amps., and with four motors, 4300 amps. The time for the journey with the two-motor equipment, was 21.8 minutes, and with the four-motor equipment 18.67 minutes. The difference was an increase of 13.5 per cent in the units per ton-mile, with the higher acceleration, and the power house had to be enlarged by 63 per cent, while only 14.3 per cent was saved in time. Unless the competition with trams and other means of locomotion was very severe, such extra expenditure, in order to obtain very high rates of acceleration, was not warranted. Another thing was that the power turned out would not be turned out so economically with a very varying load. It would almost

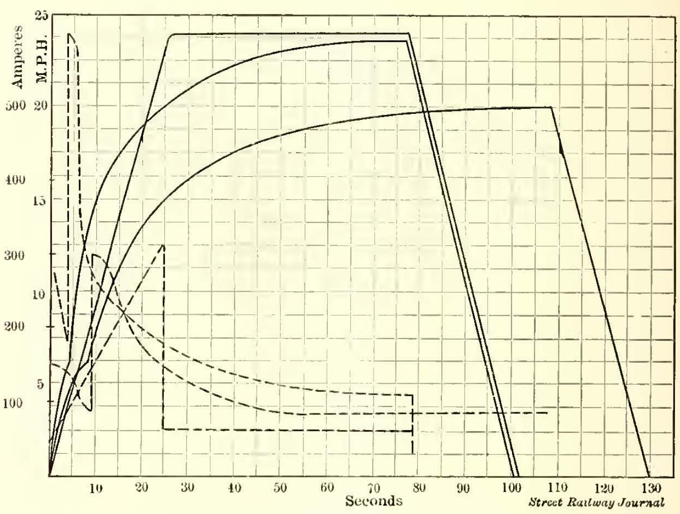


FIG 3.—DIAGRAM OF STARTING CURVES WITH TWO AND FOUR-MOTOR EQUIPMENTS

appear that when a very rapid acceleration was required some such system as the Ward-Leonard system, where there were not very high peaks, would meet the case, although it had not been tried.

However, the diagram (Fig. 3) shown illustrates the results of such a system in comparison with the two and four-motor equipment above referred to. The starting current is much lower, and a uniform acceleration obtained. Compared with the four-motor equipment the time for the section is the same, but the four-motor consumes less energy, taking 98.6 watt-hours as against 105 for the Ward-Leonard; but the latter requires a maximum current of only 318 amps. as against 600 amps. for the four-motor equipment. The two-motor equipment requires the same energy as the Ward-Leonard, but takes 20 seconds longer to run the section.

A practical example of the effect of very rapid acceleration may be found in the new motor on the Liverpool Overhead Railway, where the old motors took starting currents of 140 amps. to 150 amps. for an average speed of 12.5 m. p. h., and the new motors 700 amps. to 800 amps., the average speed being 19 m. p. h. The time for the journey is, however, reduced from 32 to 20.9 minutes. The increased generating plant, feeders, etc., is no doubt justified by tramway competition.

The Waterloo & City Railway, the second of London's tube railways, connects Waterloo Station, on the London & Southwestern Railway, with the Bank and the Central London Railway. The line is about 1½ miles long, with a station at each end, there being no intermediate stations. The generating station is at the Waterloo end of the line, and works on the two-wire system at 500 volts direct current.

At each station the line practically runs to the surface, and there are no lifts, which to a certain extent, helps to keep down the ratio of expenditure to receipts.

On this line motor car trains are used, there being two types to suit the varying traffic conditions. For the heavy morning and evening traffic four-coach trains are in service. The front and rear carriages have two motors on the leading and trailing bogie; these carriages seat forty-six passengers each, and the two intermediate carriages fifty-six each, making a total seating capacity of 204 passengers per train.

The motors have a normal rating of about 42 B. H. P., and a maximum of 60 B. H. P., representing a current of 70 amps. to 100 amps., at 500 volts per motor. These four-coach trains are run for about three and a half or four hours in the morning and evening. The weight of the train and motors, with the average load of passengers, is about 100 tons. The time taken for the journey from one station to the other, is five minutes, giving an average speed of about 18 m. p. h. The kilowatt-hour consumption being 0.05 per ton-mile at the above speed.

During the periods of light load, that is 11:30 a. m. to 4 p. m. and 7:30 p. m. to 10 p. m., the single motor cars are run. These cars weigh about 26 tons with average load, and require four minutes from station to station, the average speed being 22.5 miles per hour. A maximum speed of 40 m. p. h. is reached with these cars, and they ascend the 1 in 60 gradient at 30 m. p. h.; the kilowatt-hours consumption per ton-mile is .08.

The coal per unit generated taken over the half-year and including all boiler-house losses is 5 lbs. of Welsh steam coal.

The number of passengers carried per half-year is about 2.5 millions, and the train miles 82,800. The output of the generating station for the same period being 420,000 units.

The Central London Railway, the latest, and undoubtedly the finest of London's tubes, runs from the Bank to Shepherd's Bush, a distance of six miles, through what may be safely called the finest district for traffic in the world. There are thirteen stations, the average distance between each being very similar to the South London line. This railway was opened for public traffic at the end of July, 1900.

The generating station is situated at Shepherd's Bush, with sub-station stations at Notting Hill Gate, Marble Arch, and the post-office. Current is generated at 5000 volts three-phase, and reduced at the sub-stations by stepdown transformers and rotary convertors to 550 volts continuous current. The efficiency of the stepdown transformers and rotary convertors is given as 83 per cent at quarter load, 90 per cent at half load, 93 per cent at full load, and 92 per cent at 50 per cent overload, from which it will be seen that the double transformation is not quite as economical as the continuous current reducers in use on the South London line.

The train on the Central consists of seven carriages on eight-wheeled bogies, the total weight when unloaded being about 98 tons. The seating capacity is for 336 passengers. Separate locomotives are at present in use, but some new motor car trains are in the course of construction. The locomotives are fitted with four gearless motors, each of 117 hp; the motors on each bogie are mounted rigidly, the only springs being those between the bogie frame and the turnplate on which the body of the locomotive rests. In this respect the locomotives differ from those on the South London, whence practically the whole of the weight of the motor is spring borne. To this difference, no doubt, the vibration on the Central, which is absent on the South London, can be attributed. The spring borne load per axle on the Central being 3 tons and the unspring borne 8 tons, while the South London figures are spring borne 5.175 tons, unspring borne 1.65 tons per axle.

The maximum current which the locomotive is capable of taking at full load is about 1200 amps., and the weight about 44 tons. The train mileage for the half-year ending December, 1901, was 614,517, and the passengers for the same period were 20,802,650. The number of Board of Trade units output from the generator appear to be about 8¼ millions per half-year.

Meeting of the Pennsylvania Street Railway Association

The next annual meeting of the Pennsylvania Street Railway Association will be held at York, Pa., on Sept. 10 next. The meetings of this association are always well attended, and will undoubtedly be especially so this year, as the officials of the York street railway system have entertained the association before, and their bountiful hospitality is well known. The officers of the company this year are: John A. Rigg, president; John Ruth, secretary, and W. H. Lanius, treasurer, while the executive committee is made up of John A. Rigg, William B. Given, B. F. Meyers, S. P. Light and W. H. Lanius.

Plotting Speed-Time Curves—IV

BY C. O. MAILLOUX

The *Interpolation Method* is one in which the "component" curves are obtained by the modification of certain "fixed" reference curves. The method requires a "Chart of Acceleration," such as shown in Fig. 8, and a "Chart of Retardations," such as shown in Fig. 11. Each chart should contain various speed-time curves corresponding to several up-grades, to zero grade (level track), and to several down grades, together with the distance-time curve corresponding to each speed-time curve. The curves in Figs. 8 and 11 correspond, as already stated, to "zero" grade, and to 0.5 per cent, 1 per cent, 1.5 per cent and 2 per cent of both up-grade and down-grade, the down-grade curves being above and the up-grade curves below the curve for level track in both cases. The speed-time curves in both charts can be readily and quickly plotted by the "chart method" hereinbefore described. Where greater refinement is desired the curves may be plotted for every fifth of a per cent instead of every half per cent of grade. The distance curves are plotted from co-ordinates obtained by the integration of the corresponding speed-time curve by the planimeter or by the integraph, in the manner already explained. The scales of speed and time values used on these charts should, for obvious reasons, be exactly the same as those used in the run curves.

It may be interesting to note the fact that the acceleration curves in Fig. 8 have all been plotted on the assumption that the curve N on the Chart of Accelerations (Fig. 9) begins at the point a instead of the point b. This means that no allowance has been made in the curves for the increase in train resistance due to static friction at the time of starting. Theoretically the dip in the curve N at the point b should cause a short bend convex to the axis of x in each acceleration curve, such that a line tangent to the straight portions would not pass through the origin of x but through some point to the right of it. It will be doubtless interesting and perhaps reassuring to learn that, practically, the error resulting from the assumption aforesaid is less than one-twentieth of a second, and is consequently negligible even when the time values a and b have been determined by the curve or reciprocals giving the greatest accuracy (F in Fig. 10), and further, that the discrepancy in time values practically vanishes when using reciprocal curves corresponding to speed increments of 0.5 m.p.h. or 1.0 m.p.h. (curves B and A).

Fig. 14 gives an enlargement of the portion of Fig. 8, containing the speed-time curves comprised between the speeds of 45 m.p.h. and 60 m.p.h. and the time interval between the twentieth and fiftieth second of time, and also an enlargement of the corresponding distance-time curves. The heavier lines represent portions of run curve referred to later.

In using the interpolation method it is necessary to first plot the run curve upon tracing paper or tracing cloth, after which the curve may be transferred to or reproduced upon another sheet if desired. A tracing sheet having been placed upon the Chart of Accelerations (Fig. 8) we proceed to plot thereon the portion of run curve corresponding to the portion of O A of service run No. 11. The run curve over this portion will, obviously, begin at zero speed. The form of the curve will depend upon the "net equivalent grade" for this portion, which, according to Table II, is + 0.283 per cent, or the same as the actual grade, there being no track curvature. If an acceleration curve for this gradient be plotted in the regular way by the "chart method," beginning the plotting on the tracing sheet at the same point as the acceleration curves on the Chart of Accelerations, this curve will be found to pass between the curve for a level track (solid line) and the curve for a one-half per cent grade (first dotted line below the solid line), being slightly nearer the dotted line curve than the solid line curve. Let us now proceed to plot the same curve by "interpolation" between the solid line curve and the first dotted line curve. Since 0.283 of *one* per cent is equal to 0 + 283 x 2 = 0.566 of *one-half* per cent, it follows that the interpolation points will be 0.566 of the space between the two curves aforesaid, reckoning from the solid line curve. In this way any desired number of points may be located between the two curves. In practice the work of doing this may be simplified by using proportional dividers adjusted for the ratio 57.100, or by using proportional scales or other methods of proportional subdivision, well known in the drafting-room. On drawing this curve it will be found to coincide very closely with the curve previously plotted by the chart method. The divergence between the two curves represents the error due to the interpolation method. This

NOTE.—The first instalment of this paper appeared in the STREET RAILWAY JOURNAL July 5; the second part July 26, and contained Figs. 1 to 10, and the third part, Aug. 9, and contained Figs. 11 to 13.

error, however, is so slight that, in most cases, it may be considered negligible.

The method of interpolation may also be applied to the distance-time curve. The method would, in fact, have relatively little value if this could not be done—its principal advantage being to simplify the operation of "cutting off" each portion of curve at the proper distance points.

The distance curve corresponding to any interpolated acceleration curve is also prepared by interpolation in exactly the same way as the acceleration curve.

In Fig. 14, in the upper portion of the diagram, the line drawn with heavy dashes represents the upper end of the run curve corresponding to the portion of run, *O A*, and in the lower part of the diagram, the heavy line, *D*, represents the corresponding interpolated distance curve. The process of determining the terminal point *A* at which this portion of the curve should be cut off, is simple. The length of the portion *O A* being 0.306 mile, according

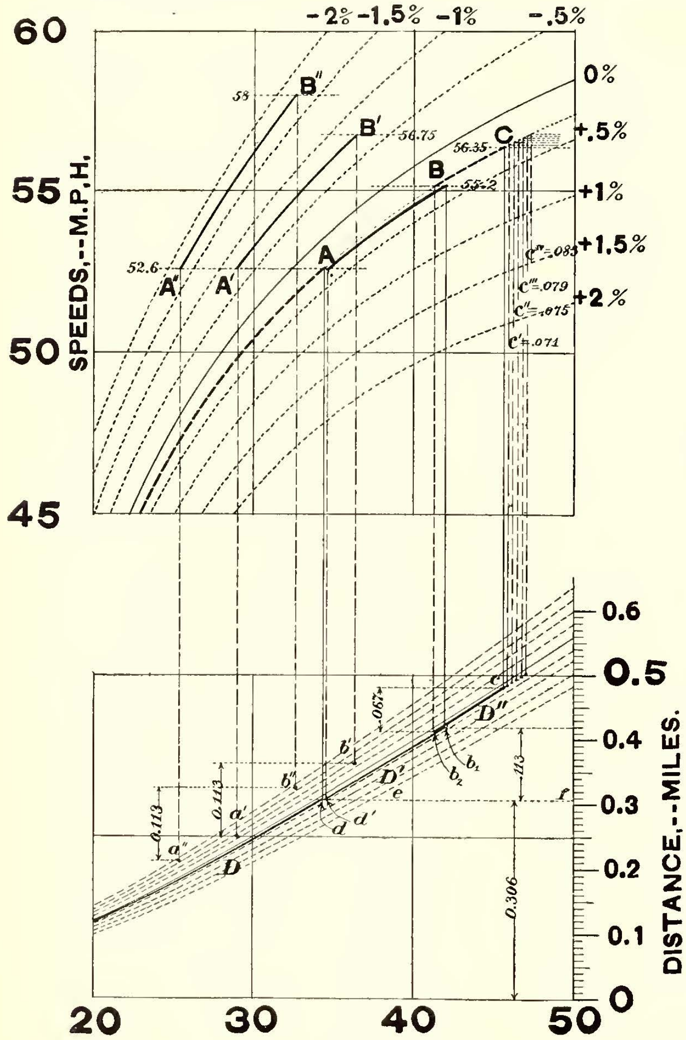


FIG. 14

to Table II, a horizontal line *c-f* is to be drawn in pencil on the tracing sheet at a point equal to this distance when measured by reference to the distance scale at the point *f* at the right-hand end of the diagram. This line is prolonged to the left until it intersects the distance curve *D*, at the point *d*. A vertical line (*d A*) is then drawn in pencil at this point until it meets the run curve at the point *A*, which will be the terminal point, or the point at which the portion of the curve *O A* is to be cut off. The point *A* corresponds in this particular case to a speed of 52.6 m.p.h., as indicated on the diagram.

We will now proceed to plot the second portion (*A B*) of the run curve, which, according to Table II, is 0.113 mile in length, on an up grade of 0.283 per cent, and has a track curve of 1 deg. 30 minutes, the net equivalent grade, including correction for track curvature, being +0.351 per cent (Column VII). Without disturbing the tracing sheet, a portion of acceleration curve, corresponding to the portion of run *A B*, is to be plotted and drawn on the sheet. This portion of run curve will obviously begin at some point on the horizontal dotted speed line passing through the terminal point *A* of the portion *O A*. If the "equivalent" grade (Column VII) were, for example, —1.75 per cent, the curve would begin at the point *A″* and would have the form represented by the heavy full line *A″ B″*. If the equivalent grade were —0.75 per cent, the curve would begin at the point *A′* and it would extend to the point *B′*. For the actual equivalent grade (+0.351 per cent), the curve will begin at *A* and will run to *B*, being located about 0.7 of the distance between the curves for 0 per cent and +0.5 per cent, so that it passes slightly to the right of the continuation of the previous curve (shown in dotted line).

To determine the length of the second portion (*AB*), we first drop a vertical line (*Ad′*) from the beginning of this portion as far as the corresponding interpolation point (*d′*) in the portion of the chart giving the distance curves. If this portion of run curve were on a —0.75 per cent grade, beginning at *A′*, the proper "interpolation" point in the distance curve would be at *a′*, while if the curve were on a —1.75 per cent grade, beginning at *A″*, the proper interpolation point would be at *a″*. Wherever this point may fall, the procedure will be the same; a horizontal line is to be drawn on the tracing sheet in pencil at a distance which, measured by the distance scale, at the right-hand end of the diagram, represents the length of the portion of run *A B*, namely, 0.113 mile, as given in Table II. On this line the terminal interpolation point (*b′*) is located. The interpolated distance curve (*D′*) itself may then be drawn, if desired, although that is scarcely necessary, it being sufficient to have the terminal point clearly indicated by a dot, such as shown at *b″* and *b′*. A vertical line drawn from this terminal point to meet the interpolated acceleration curve will cut the curve at the proper time point. If drawn from the point *b″* this line would cut the curve *A″ B″* at *B″*; if drawn from *b′* it would cut the curve *A′ B′* at *B′*; in the actual case, the proper line is the line *b′B* which cuts the curve *A B* at the point *B* (55.2 m.p.h.). The acceleration curves *A″ B″* have been purposely added to the diagram in this case to show graphically the important effect produced on the form of the acceleration curve by variations in grade. These curves show graphically the fact that the rate of acceleration increases greatly with the percentage of down grade, the direct effect of this, of course, being that the speed attained at the end of the corresponding portion of the run is very much higher on down grades of higher percentage, as clearly shown by the relative positions of the terminal points, *B*, *B′*, *B″*.

In the third portion of run *B E* it becomes necessary to anticipate, and to make allowance for, the track curve of short radius, which occurs in the fourth portion (*C H*). The speed at the end of the portion *B E*, or the beginning of the portion *E H*, is, as previously stated, set at 25 m.p.h. This is, therefore, a case in which we must plot in both directions—"forward" from the point *B*, and "backward" from the point *E*. The portion, *B-C-E*, will have three "component" curves, including an acceleration portion, *BC*, a drifting portion, *CD*, and a braking portion, *DE*. The real problem in this case is the determination of the points *C*, *D*, at which the drifting curve *CD* will begin and end. This has to be done largely by a "cut-and-try" process. We begin by plotting an acceleration curve for a net grade of +0.283 per cent, starting from the speed point *B*, (55.2 m.p.h.), and making the curve arbitrarily of some convenient length, such as may be thought suitable for the purpose. A vertical line (*B-b*) is dropped from the beginning of the portion *BC* to the proper interpolation point for the corresponding distance curve *D″*. Near the end of the portion plotted, a certain number of vertical lines (*c′ c″ c‴*, etc.) are dropped from the acceleration curve to the distance curve, and the distances corresponding to each of these vertical lines having been noted by reference to the distance scale, it is recorded in pencil opposite the letter or symbol representing each line, as indicated in the upper right-hand portion in Fig. 14. Thus, in Fig. 14, the distance covered, when the curve *B C* is cut off by the vertical line, *c*, would be 0.67 mile. The corresponding distances, when the curve is cut off by the vertical lines, *c′ c″ c‴*, etc., would be, respectively, 0.071, 0.075, 0.079 mile, etc., each successive line representing a "slice" whose area represents a distance of 0.004 miles. The number of such vertical lines, and their distance apart, may, of course, be varied as desired, and as may seem best in each particular case.

The next step is to lay out a braking curve, working backwards from the point *E*. This case is analogous to the upper portions (*FG* and *GH*) of the braking curve in Fig. 12, and, consequently, will correspond with either Problem 2 or Problem 3 in Appendix D, according to the term which is made the unknown quantity. It will correspond to Problem 2 when the distance covered, *s*, is given, and the entering speed (at the point *D*), is the unknown quantity to be determined. It will correspond to Problem 3 when the entering speed is assumed, and the distance covered, *s*, is the unknown quantity to be determined. It may be necessary to try both ways, assuming a given value for the distance in the first case, and for the entering speed in the second case. A few preliminary calculations made both ways, based upon different assumptions, will enable a rough approximation to be made, both as to the distance covered, and the entering speed, for the braking portion of the curve.

The next step is to plot, on a separate tracing sheet placed upon the chart of retardations (Fig. 8) a portion of drifting curve corresponding to the net equivalent grade (+ 0.283 per cent) indicated in Table II, and of such length as may seem proper to form a connecting link between the points *C* and *D*, allowing extra length at both ends. The corresponding distance curve is to be drawn by interpolation on the same sheet. This sheet is then superposed upon the tracing sheet containing the acceleration portions. Let us assume that it has been superposed in such manner that the upper end of the drifting curve crosses the continuation of the acceleration curve, *B C* (in Fig. 14), at a point corresponding to the vertical line, c'''. If preliminary calculations have been made for the braking curve in the manner previously indicated, the distance covered while braking, as obtained from these calculations, should be added to the distance covered during the acceleration portion BCc''', which, as indicated in Fig. 14, is 0.079 mile. The sum of the two distances corresponding to the braking and accelerating portions, subtracted from the total distance of the portion *BE*, namely, 0.374 mile, will give the distance remaining for the drifting curve (*C D*). If this calculated distance is greater than the distance indicated by the distance curve corresponding to the portion of drifting curves comprised between the vertical line, c''', and the vertical line corresponding to the assumed entering speed, *D*, it is an indication that this assumed value for the entering speed, *D*, is too high, or that the acceleration curve has been cut off to soon; and *vice versa*. We may first try the effect of changing the entering speed, *D*, and of locating it at different points along the drifting curve. In this case, the entering speed, *D*, being now known; we have a case corresponding with Problem 3 (Appendix D), and the distance covered is to be determined by reference to equation (*i*). The effect of changing the point *D*, however, is to also change the distance covered by the drifting curve. It may, therefore, be necessary to change the relation of the drifting curve to the acceleration curve, so as to change the point of intersection between these two curves. In many cases, the distance allowed for braking can be fixed, and, consequently, the entering speed, *D*, can be calculated as a case of Problem 2 in Appendix D, by means of Formula (1). This being done, the lower speed point of the drifting curve will also become fixed, and it will now be possible to make sub-divisions at the upper portion of the drifting curve similar to those made on the acceleration curve in Fig. 14, by the vertical lines c, c', c'', c''', etc., the distance corresponding to each line being recorded in pencil on the tracing sheet. When this can be done, the process of finding the point *C* becomes greatly simplified. For each position of the drifting curve, with respect to the acceleration curve, the distance values corresponding to the two component curves can be readily calculated. If the sum of the two distances is too small, the two curves must be moved farther apart; if too large, they must be brought closer together. In the actual case, the proper point of intersection between the acceleration curve, *BC*, and the drifting curve, *CD*, takes place at the point *C*, corresponding to the vertical line *Cc*, representing a distance covered, under acceleration (Fig. 14), of .067 mile, the speed at the point *C* being 56.35 m.p.h. The drifting curve beginning at this point continues until the speed has fallen down to 53.2 m.p.h., the distance covered being 0.129 mile. The braking curve represents a reduction of speed from 53.2 m.p.h. to 25 m.p.h., and a distance covered of 0.178 mile. The three component curves for this portion of the run aggregate exactly 0.374 mile, which is the distance given in Table II.

The fourth portion of the run (*E H*) also has three component curves, the first being the acceleration curve, which is to be plotted by interpolation, in the manner already described. It is cut off arbitrarily when it reaches the speed point of 35 m. p. h., that being, as already stated, the limit of speed for the track curvature occurring in this portion of the run. The distance covered is determined by the interpolated distance-curve, in the manner already indicated. A drifting curve for the portion *F G* is then plotted, either on a separate sheet or by placing the same sheet over the Chart of Retardations. The length of this drifting curve may be varied arbitrarily. This being an express run, it is desirable to regain a higher speed with as little delay as possible when leaving the curve. It is usual to turn on the current and to let the train again accelerate in speed before passing entirely out of the curve, it being found practicable and safe to run out of a curve at a considerably higher speed than would be allowable at the beginning, or in the first portion of the curve. In this case the current was turned on after drifting down to a speed of 31.1 m. p. h. and at a point .041 mile from the end of the curve. The acceleration curve, *G H*, having been plotted by interpolation in the way already indicated, and having been cut off by means of the distance curve at the point corresponding to the proper distance (.041 mile), the two succeeding portions, *H I* and *I J*, could then be plotted without difficulty, either on the same sheet or on separate sheets. On reaching the point *J* it becomes necessary again to anticipate for the final braking at the end of the run and to plot both ways. The process to be followed in determining the point *K* is substantially the same as that followed for determining the point *C*, and need not be further detailed.

After all the "component" portions of the entire run curve have been determined they are to be assembled on one sheet. This can be done easily by tracing these portions on another tracing sheet or the curves may be redrawn on a separate sheet after a certain number of co-ordinate points for each portion have been plotted on the sheet.

The curve *DDD* in Fig. 13 is the distance-curve obtained by integrating the service-run curve, *OABC* . . . . *N*. Its highest point corresponds, by reference to the scale of distance, exactly with the total length of the run (namely, 1.625 mile). The various bends in the curve are an indication of the irregularities in the service-run curve. The height of the curve at any time point, when gaged by the distance scale, measures the distance covered up to that time point.

Subsidiary Curves.—After the service-run curve has been plotted it becomes possible to plot various other curves, which could not be plotted without it, and which, for this reason, are sometimes designated by the general term, "subsidiary curves." The complete discussion of these curves is beyond the scope of this paper, but some of the curves are so closely related to the service-run curve that a brief reference to them is really necessary in order to give a general idea, at least, of some of the important uses which may be made of the service-run curve in determining many of the important factors of a given electric railroad problem. The distance curve, *DDD*, just referred to in Fig. 13, is an example of a "subsidiary curve." The most important of these curves are the electric-power input curves, the current-input curves, and also the integral curves derived from them.

The power-input curve is a time-function curve, showing the instantaneous values of the energy applied to a train. This curve begins when the current is applied to the motors, and it ends when the current is cut off. Each acceleration cycle in the service-run curve therefore corresponds to and is characterized by a power-input curve (and also an energy-input curve). Thus, in service run No. 7 (Fig. 12), in which, as already seen, there is only one acceleration cycle, there is only one power-input curve, which is indicated by a dotted line in the figure. On the other hand, in Fig. 13, where there are three acceleration cycles, there are also three power-input curves, which form the outlines of the three shaded areas in the figure.

The power-input curve and its integral curve, the energy-input curve, serve for the determination of many important factors, including the energy required for a given service, and also the size and character of power station necessary. The co-ordinate points for the power-input curve are calculated by reference to the "corrected" speed curve (*C*) on the sheet of motor characteristics (Fig. 5). The current value, corresponding to each speed value, multiplied by the mean voltage available at the motor terminals, gives the power value in watts corresponding to that speed. In this way the power values corresponding to all the speeds may be calculated. These values may also be plotted in the form of a power characteristic curve, in which speed and electric power (preferably expressed in kilowatts) are the co-ordinates. It should be borne in mind that when the series-parallel system of motor control is used the energy applied to the motors, while the motors are connected in series, as is the case when running below a certain critical speed, will be, for a given current value per motor, only one-half as much as when the motors are connected in parallel. In the case of the two service runs shown in Figs. 12 and 13 the critical speed at which the change from series to parallel connection occurs, is 19.6 m. p. h. This circumstance accounts for the low portion of the power curve at the beginning, as indicated at *P* in Fig. 13. The voltage available at the motor terminals is not really applied to the motors themselves, as is well known, until the controller resistance has been entirely cut out. However, since, in reality, we desire to know the energy *applied to the train*, whether this energy be applied wholly to the motors themselves or whether it be partly expended in heating the controller resistance, the portion *P* is plotted just as if the energy were expended entirely in the motors. In this case each car is assumed to have a four-motor equipment, and the acceleration current, as previously stated, is assumed to have a mean value of 400 amps. per motor. The mean voltage is assumed to be 600 volts. At the time of starting, there being two pairs of motors connected in series per car, the power input will be:

$$600 \times 400 \times 2 = 480 \text{ kw.}$$

This is the ordinate value of the portion *P* of the power curve, as will be found by reference to the scale of kilowatts per car at the left-hand end of the diagram in Fig. 13.

After the resistance has been entirely cut out, the rate of acceleration would diminish, unless the controller is changed from the series to the parallel connection. This will be made clear by a comparison of the acceleration curves marked *A* and *C* in Fig. 11. The lower of the two curves marked *A* is substantially the same as the acceleration curve for level track (solid line) in Fig. 7. The lower curve marked *C* is the acceleration curve that would be obtained if the parallel connection were not used—that is to say, if the acceleration were allowed to take place on the last step of the series connection, with the motors still connected in series, but with the controller resistance entirely cut out. (The upper curve, in each case, is that which corresponds to a higher gearing ratio than the gearing ratio used for the curves shown in Fig. 7.) When the change from series to parallel connection takes place, the total current per car will jump from 800 to 1600 amperes, and the power input curve also instantly jumps up to twice its value; it attains its highest point, *Q*, and there remains constant, as indicated by the straight line, until the controller resistance has again successively and entirely been cut out. It is at this moment that the acceleration begins to decrease (in accordance with the curves shown in Fig. 7, or with the curve *A* shown in Fig. 11), because the counter c.m.f. due to the increase of speed, begins to reduce the current passing through the motors. The power applied to the car therefore, begins to fall very rapidly, as indicated by the curved portion *R* of the power input curve in Fig. 13. The point (*C*) in Fig. 13 being, as we previously found, the point at which the acceleration ceases, it of necessity corresponds to the point at which the power is cut off; and the power curve suddenly drops down to zero at that point. In the second acceleration cycle, in Fig. 13, the speed (25 m.p.h.) at which the current is turned on, is higher than the "critical" speed; consequently the motor controller must be in the parallel position, with only a part of the resistance cut out. As the whole of this resistance has not yet been cut off by the time the speed point *F* is reached, where the current is again turned off, it follows that the power curve (*S*) will be straight. In the power curve corresponding to the third acceleration cycle, the curve begins with a straight portion, but as the speed soon attains the point (39.2 m.p.h.), at which the controller resistance is all cut out, the power values again rapidly diminish same as in the first cycle, as indicated by the curved portion, *U*

It should be noted that the portions, *P, Q, S, T*, will not, in actual practice, be absolutely straight lines. They will, in reality, be serrated or saw-shaped, with a number of humps or notches equal to the number of steps in the controller, or equal, rather, to the number of movements of the controller which the motorman makes during acceleration. These humps or notches are due to the fact that when the controller is moved from one step to the next, the current instantly jumps up to a higher value, and is then gradually reduced by the increase in e.m.f. due to the rising speed of the motor, the same process being repeated for each step or notch of the controller. With the Sprague multiple-unit system of control, it is possible to restrict, to some extent, the amount of fluctuation in current while the controller resistance is being cut out, so that the notches or teeth in the actual energy curve at the points *P, Q*, etc., will not be so large. This is due to the fact that the process of cutting out the controller resistance can, in this system, be made automatic, being controlled by the current passing through each motor. These current fluctuations theoretically react upon the acceleration, and tend to produce slight waves in the acceleration curves. Practically, however, their influence is negligible, being virtually obliterated by the inertia of the car.

Energy Curve.—If we integrate the area of each power or kilowatt curve, we obtain the value of the energy in kilowatt seconds (which may be reduced to kilowatt-hours) expended during the corresponding acceleration cycle. This is a valuable and useful quantity. If we integrate the power curve "by parts," we obtain the energy curve for each acceleration cycle. This has been done in Fig. 13, where the portions of curve, *Ea, Eb, Ec*, represent, respectively, the portions of energy input curve corresponding to the three acceleration cycles. The horizontal portions between the inclned portions merely indicate the fact that the total energy remains stationary between the different cycles. The aggregate energy for the three cycles, when read by reference to the scale of kilowatt-hours per car at the right-hand end of the diagram, will be found to be 14.22 kilowatt-hours. The portion of the total energy corresponding to each cycle may, likewise, be read separately by reference to the same scale.

Energy Consumption.—Having obtained from the energy curve the energy consumption during the run, and the weight of train and length of run being both known, the energy required in watt-hours per car-mile, or per ton-mile, may be easily calculated. The resulting data are given in Fig. 12 and Fig. 13. It will be seen that while in Fig. 13 the energy consumption is only 114 watt-hours per ton-mile, it rises in Fig. 14 to 168 watt-hours per ton-mile, notwithstanding the fact that run No. 11 is shorter than run No. 7. This is, of course, due entirely to the presence of the sharp curve in run No. 11, which necessitates reduction of speed and subsequent accelerations, as already indicated.

Current-Input Curve.—The current-input curve is obviously of exactly the same form as the power-input curve, its ordinate values being different from those of the power curve by a constant equal to the mean voltage assumed in computing the ordinates of the power curve. The current curve may, therefore, be derived from the power curve, or the power curve itself may be used, as if it were the current curve, with a different scale of ordinates. The current curve is useful in calculations regarding the feeder and distributing systems necessary for transmitting electrical energy to the car motors. It is also useful in determining the losses to be expected in the conductors as well as in determining the heating of the motors. For the latter purpose the current input curve should be integrated twice successively. From the second integration the value of the *mean square* can be obtained; the square root of this value will be the equivalent heating current for the run. The work of integration will be greatly simplified by the use of an integraph or of a so-called mechanical integrator. The well-known, highly ingenious "Amsler" mechanical integrator has been found by the writer to be very convenient and satisfactory for this purpose. While it does not draw the integral curves like the integraph, it has the advantage over the integraph in this case, of giving at one single operation the results of both integrations, namely, the current-time integral or the coulombs ($a/y\ d\ x$) and the current-mean-square-time integral ($b/y^2\ d\ x$), and even a third integration ($c/y^3\ d\ x$) if desired. A detailed description of the modus operandi is beyond the limits of this paper.

Intrinsic Power Curves.—These curves show the instantaneous values of the power actually utilized in maintaining the speed during the entire run. The formulæ usually employed for calculating these power values give the result in mechanical horsepower. It is preferable, however, to convert the horse-power values into equivalent kilowatt values. The curve showing the instantaneous power values has been called the "intrinsic power curve." The integral of this curve would be another curve called the intrinsic energy curve. When the intrinsic energy curve and the energy-input curve are both drawn to the same scale the ratio of final ordinates of the intrinsic energy curve to the energy-input curve, will represent the mechanical efficiency attained during the run.

The intrinsic power and energy curves are of interest and of utility in the minute analysis of railway problems.

(To be Continued.)

Taxes of Cleveland Railways

The two Cleveland companies have voluntarily increased their tax returns to nearly double the valuation placed on the property last year. This action immediately followed the defeat of Mayor Tom L. Johnson's plan to increase the tax valuations of all the big public service corporations. This defeat came in the shape of the overruling of the suit to compel the auditor to restore to the tax duplicate, the additions made by the board of equalization to the tax valuations of the five corporations, and these additions were subsequently taken off by the State board of tax remission. The action of the two companies in voluntarily increasing their taxes, is looked upon as a sharp move on the part of Mark Hanna, president of the Cleveland City Railway Company, and a large stockholder in the Cleveland Electric Railway, to defeat Mayor Johnson's bid for popularity, and the political control of the situation in Cleveland and Ohio. Further indication that Senator Hanna desires to detract from the weight of Johnson's argument about 3-cent fare and tax-dodging corporations, is seen by the fact that a committee appointed by the building trades' council, representing many thousands of voters, is investigating the books of the two big companies with a view to determining the lowest figure at which a street railroad can be operated, allowing for a good profit to the stockholders. Senator Hanna has informed this committee that he and his company would be willing to reduce their fares to a point where a fair profit on the investment remained possible.

The total valuation placed by the Cleveland Electric Railway on all tangible property was $1,693,924, compared with $868,000 in 1901. The returns of the Cleveland City Railway last year was about $600,000, and this year about $1,000,000. The tax rate is fixed at about 60 per cent of the cash value.

Leading officials of both companies deny the frequently published reports that they are about to ask for extensions of franchises on the basis of universal transfers and seven tickets for a quarter.

Block Signal Systems for Electric Railways

BY H. D. EMERSON

The recurrence or rather the increase of collisions on high-speed electric railroads is beginning to alarm the public, and popular newspapers of the yellow variety are making a feature of the full publication with details as harrowing as possible of accidents which occur. The thoughtful student of electric railway operation has realized for some time that the conditions which exist on electric railroads do not differ materially as far as the operation of trains is concerned from those which exist on steam railroads. That is to say, that many years of experience in operating trains by means of steam has developed certain rules and principles which cannot be violated without danger of accident. On the other hand, the conditions which exist on most trolley roads are more favorable to safe operation, especially as regards collisions, than on steam roads.

It would seem that a principle and a method which has been in use for many years, and which is being used with extreme satisfaction and absolute safety on steam roads, and which is particularly adaptable to the operation of high-speed trolley lines, should not be overlooked. When, in addition to the fact that the principle is right and the method simple, the cost of the appliances are less than any other form of signaling apparatus, it would appear that its use would be much more extended on trolley lines than it is at present. I refer, of course, to the block system and its application by means of the "train staff." Nearly all of the single-track steam railroads in Great Britain are operated by means of the train staff, and under various modifications it is used all over the world.

The steam road proposition usually is to operate a number of trains of various speeds in contrary directions at extremely irregular intervals. The ordinary steam road train schedule, for example, provides for a number of trains into a large city in the morning and an equally large number returning in the afternoon; running contrary to these trains are a comparatively few, so the making of a schedule of this kind provides for trains following each other and meeting a less number in the opposite direction. But this passenger schedule is complicated by freight trains, both regular and extra, and is also daily disturbed by express and through trains, which may be many hours off their proper time. The result of many years of experience in conducting the operation of American railroads has resulted in a system whereby the movement of the trains is controlled from a central point by one man, called the train despatcher, who gives orders direct to the crew of each train. He fixes the points at which the trains meet and pass, and changes these points as the exigencies of the service may demand, in order to facilitate and accelerate the train movement. This system works very well up to a certain point, beyond which experience proves that other systems are more economical and safe. These latter systems are all variations or modifications of the so-called block system. In England all steam railroads are operated on the block system, but in this country, owing to the perfection and adaptability of the train despatcher system, the block system has been adopted only by railroads of large traffic; hence it is that most people, in considering methods of train operation, take it for granted that the block system is adaptable only to roads of dense traffic. This idea has been impressed and emphasized on the minds of the public by the expensive signaling apparatus installed in this country on the roads of heavy traffic, in order to facilitate the use of the system. It should be noted, however, as a matter of fact, that the block system can be used on any railroad and that the appliances absolutely necessary are extremely inexpensive. It is not necessary to erect block signal stations nor even to construct a telegraph line to get the full benefits of absolute safety, if it is so desired.

Electric railroads lend themselves particularly to the use of an absolute block, because trains are usually run at definite intervals and at constant speed. Some trolley lines have installed so-called block signal systems; that is, they have installed apparatus designed to indicate whether or no the next block or section of track was occupied or not. Some of these systems are worse than useless, because of the fact that if the signals are not properly operated and understood they may mislead the motorman and causes him to run at higher speed and with less care than he would if the road was not provided with this apparatus. As a case in point I noticed on a trolley road, some weeks ago, which runs cars weighing twenty-five tons at extremely high speed, that when we approach the end of the block the motorman asked a friend to get off and throw the handle of the so-called block signal. The indications to the motorman are by a combination of lights, the handle by which the signal is operated is located at easy reaching distance to anyone standing on the ground, but cannot be reached from the platform of the car. When I got off the car at a wayside point I was interested to note the length of time it would take the car to run the succeeding block, and so stood watching the signal. Presently a man came along and moved the lever, changing entirely the indications of the light. Whether the man that moved the lever was an employee of the road or not and whether the signal indicated safety or danger I do not know. On returning to the terminus of the line that afternoon, I inquired as to the success of the operation of the railroad and was told that they had several collisions within a comparatively short time, one of which was very serious, being a head-on collision of two heavy cars going at high speed. Instances of this kind, and others, illustrating a lack of knowledge of the basic principles of the block system are numerous; this particular instance is cited, because it illustrates the violation of the two most fundamental principles of blocking which are, first, a definite positive indication which cannot fail to be understood; and, second, such discipline of employees that they can only, by the grossest carelessness, which will be obvious to the most casual observer, violate the rules of the block.

The block system simply means that the railroad be divided into sections of suitable and convenient length, and that but one train or car be on each block at once. The simplest form of apparatus for indicating and carrying into effect this principle is the old English staff system. When a train approaches the end of a block it must come to a standstill, and before it can proceed into the next block the engineman must receive the staff controlling the block. As there is but one staff for each block, there can be but one train on the block at one time. On receiving this staff, the engineman proceeds into the block, and at the end of the block delivers his staff over to the proper official. The next train going into the opposite direction receives the staff and returns it to the other end of the block. This system had to be modified for steam railroad operation, as it presupposes an equal number of trains in opposite directions and each train alternated on each block by a train in the opposite direction. The modification, in order to adapt this system to steam railroad operation, is called the electric staff, a very ingenious device which has a number of staffs enclosed in boxes at each end of the block. When one is removed the boxes at both ends are locked and another staff cannot be taken out until the one removed has been replaced. But electric railway operation has exactly the condition described for the operation of the train staff system. Trolley schedules provide for an equal number of trains or cars passing over the road and alternating each with the other on successive blocks, so it would seem that there would be no reason why the absolute block system, as operated by the train staff, should not be adopted on all high-speed electric railroads. The staff might consist of a large ring 10 ins. in diameter, with a metal tab showing the number of the block, a simple hook could be placed on a pole with the corresponding number painted on the pole. This should be placed near enough to the track so that the motorman could reach out and remove the staff from the hook and hang it on a hook in the car without stopping his car, and at the end of the block he would replace the staff on a hook and take aboard the staff for the next block. There are objections to this system, but none which are serious and none which outweigh the absolute safety which it provides against both head and rear collisions.

One objection which will be raised to this system of operation is that it does not provide sufficient flexibility to care for increased traffic. This objection is only partially true, for extras can be run over the road at any time with absolute safety. Their number, of course, is limited by the length of the blocks, and consequently the permanent interval between cars. Perhaps the best method of giving increased carrying capacity to the road, and yet not to increase the number of cars or trains sufficiently to cause vexatious delays, is to increase the carrying capacity of each car or train. This can be easily accomplished by coupling two or more cars together, and if steam railroad operating experience goes for anything, this method will result in diminished operating expense. There are very few high-speed trolley lines which require a service of oftener than once in fifteen minutes and a frequency of thirty minutes is undoubtedly sufficient for the majority. Assuming then, that the superintendent works out an operative schedule with passing points properly placed for a definite frequency, he can train his men to run on it and protect against collisions absolutely by using the train staff system. When additional carrying capacity is desired, he simply increases the capacity of his regular cars or trains. If the company is a prosperous one and is earning dividends, so that the directors are willing to have expenditures made for permanent improvement of the plant, permanent block signals can be installed which will be operated either automatically or by hand. If operated manually, they should be so arranged that the lever is out of reach of people standing on the ground, and when it is thrown for the block can not be changed until the car has passed the block. Automatic signals are excellent, and there is a great variety on the market which are economically operated and safe. Any block signal should be so arranged that if any accident happens to it or the line becomes deranged or the mechanism out of order, it will show the danger indication.

If it is desired to use the block theory and operate by means of permanent signals controlled either by electricity or air at the ends of the block, certain principles thoroughly established by many years of disastrous and heart-breaking experience should not be overlooked. The first is that the signal should be simple and should have but two indications, it should say definitely, clear or definitely blocked; that is, it should say "go" or "stop." This can be best accomplished by the semaphore arm. When it is horizontal or extending over the track everyone understands that it means "stop," whereas if it is dropped at an angle it indicates "clear," and the car can proceed. In the same way the lights for night signaling should be position signals; two red lights horizontally placed indicating "stop" and two green lights vertically indicating "clear." This is the result of signal practice the world over, and is understood and is understandable by all concerned in railway operation and by most of the patrons of railroads. The cost of providing signals, as described, would not be any greater than the cost of providing the present signals now installed on many lines.

Restrictions on Electrical Supply by Street Railways

BY ALTON D. ADAMS

Interurban extensions of street railways have carried them through many towns where there are no public systems of electrical supply. The present rapid expansion of these railway systems is constantly adding to the number of such towns. Even the older type of 500-volt direct current distribution to street railway lines is readily adapted to general electrical supply, through the medium of sub-stations, and the newer alternating lines are even more easily available for lighting and power to stationary motors. Managers of electric railways have not been slow to perceive the advantages of a lighting load for their stations, the heaviest part of which would come at times when the demands of traction are not at a minimum, and would have engaged in general electrical supply long since but for legal restrictions. In the great majority of cases the charters of street railways have not given them lighting powers, and such powers when applied for have frequently been denied by State legislatures. At the present time the lack of legislative consent is the main impediment to the rapid acquisition of large loads by electric railways in the general supply of light and power. The practical problem is thus to secure this consent in the various States. One of the main difficulties to be overcome is the disinclination in the minds of legislators to give a public-service corporation a varied field of activity, but electric lighting by street railways is so clearly for the public good that the arguments in its favor must ultimately prevail. The easiest means by which street railways can gain legal entry to the field of electrical supply are perhaps as various as the legislation of the several States, but a plan that has proved successful in Massachusetts may be useful elsewhere. During several years the street railway companies of Massachusetts have struggled for the legal right to enter directly the lighting field, but without success.

In the Legislature of 1902, a bill, House No. 171, was introduced giving street railway companies the right to furnish electric light in cities and towns where no public service of this sort exists, provided the consent of the local authorities be first obtained, but this bill failed of passage. Besides this general measure some half dozen or more bills were introduced at the same session, giving certain street railway companies the right to do electric lighting in specific towns, on consent of their local officers, but these bills fared no better than the one applying to all the electric roads.

What could not be done directly was next attempted and accomplished indirectly. Street railways could not secure authority to engage directly in electric lighting, but they were authorized to sell electrical energy to any town that contains no general system of electrical supply, and wishes to distribute electric light for either public or commercial purposes. This authority is contained in Chap. 449, Acts of 1902, approved June 5 of the present year. Both street railways and the class of towns named are thus left free to enter on contracts that should prove of decided advantage to all concerned. The main object of the street railways is to sell energy, and a business done in bulk with each town will probably be quite as desirable as one done with a large number of small consumers.

Under the plan provided for by the act in question, the entire expense and care of the local distribution systems falls on the towns, and the street railways simply deliver energy through one or more meters in each town. After a town and a street railway company have entered into a contract for the purchase and sale of electrical energy, the contract must be approved by the Railroad Commissioners before it becomes operative. This provision of the law will no doubt prevent the sale of energy at prices that do not represent fair profit on the cost of its production, since sales below cost would interfere with the functions of the street railways as common carriers. When only a single street railway enters a town it will usually be unwilling to sell energy without making a fair profit, but with two or more railways in the same town, as is often the case, the interposition of the Commissioners may sometimes be necessary to keep up rates. At the start neither a street railway or the town are under any obligation to make any contract or purchase or sell any electrical energy. After a contract that has been freely made for the sale of energy expires, however, if the town and the street railway company concerned are unable to agree on the manner in which the energy is to be furnished to the town in the future, or on the price to be paid for it, then the town may apply to the Railroad Commissioners to determine these points, and the Commissioners are required to fix the manner in which the energy shall be furnished and the price to be paid for it. The street railway company is then required to furnish the energy in the manner and at the price determined by the Commissioners. While large powers are thus placed in the hands of the Commissioners, it is no greater than that which they already exercise as to rates of fare on steam and electric lines, and their conservative rulings in the past are a good indication of what may be expected in this new direction.

This legislation opens a wide field for street railways in electric lighting. All the cities of Massachusetts are already served by systems of general electrical supply, and do now come within the provisions of the above act. The State, however, contains 319 towns, and of this number only about 100 contain electric lighting systems, so that more than 200 towns are free to contract for supplies of energy from the circuits of street railways. Many of the towns that are now without electric lighting already contain street railways. Most of the remaining towns will soon be reached by the trolley lines that are fast uniting the remote corners of the Commonwealth.

Consolidation of Manufacturing Companies

S. Marsh Young, of the American Union Electric Company, announces that the company, in addition to its purchase of the Union Railway Power & Electric Company, Morris Electric Company, The Falcon Electric Manufacturing Company, Electric Motor Specialty Company, Fountain Manufacturing Company, The Federal Manufacturing & Specialty Company and Refrigerator Machine Company, has added to its line of purchases the Metropolitan Switch Board Company. The American Union Electric Company has purchased all the capital stock of the Metropolitan Switch Board Company from Charles L. Eidlitz, T. J. Murphy and G. A. Annable.

The American Union Electric Company intends to continue to operate the factory of the Metropolitan Switch Board Company at West Twenty-Ninth Street as an auxiliary to its plant at Ampere, N. J., and in the Twenty-Ninth Street factory will handle all switchboard and special panel board work under the supervision of T. J. Murphy, former president of the Metropolitan Switch Board Company.

The purchase of the Metropolitan Switch Board Company by the American Union Electric Company carries with it the ownership of the "Murphy" patents, which cover all forms of installation of panel boards, as well as built-up panel boxes and the divisible panel board.

There has been considerable controversy between the Metropolitan Switch Board Company and the several manufacturers of paned boards, but the American Union Company announces that it will probably turn in these patents to the general benefit of the panel board business, and will issue licenses to about a dozen of the principal panel board manufacturers, its object being to strengthen the general situation and to enable the legitimate panel board manufacturers to receive a fair return on their investment.

The new additions to the factory of the American Union Electric Company at Ampere, N. J., covering about 23,000 sq. ft. of floor space, are about completed, although plans are being prepared for the still further addition of a new brick building, 300 ft. x 50 ft., for a general machine shop, as well as office building and warehouse.

Topics of the Week

The Rapid Transit Commission, Board of Aldermen and Pennsylvania Railroad Company were represented at a conference last week, in which Mayor Low presented arguments in favor of an immediate settlement of the question of granting a franchise to the railroad for a tunnel from Jersey under Manhattan and through to Long Island, with terminal facilities in New York. It was decided to have committees appointed to represent the Board of Aldermen and Rapid Transit Commission to prepare a contract that would meet the objections raised to the first one. The company intimated that it would accept the following modifications: The franchise to be controlled by a subsidiary company to be organized under the laws of the State of New York; the department of health to have sanitary supervision of the tunnel; the granting to the city of the use of the tunnels for fire and police telegraph wires; indemnifying the city against suits for damages by the closing of Thirty-Second Street; the Mayor and Board of Aldermen to have a voice in the readjustment of the compensation at the end of the twenty-five-year period; that the compensation for the first twenty-five years shall not be taken as a precedent for the fixing of the payment for the second or subsequent terms, but that the readjustment shall be made on an entirely new basis, and the company to name a definite time within which it will avail itself of the franchise, and the elimination of the power of the Rapid Transit Commission, as now provided, to extend the time for the completion of the work. The conditions desired by the Aldermen, upon which no agreement was reached yesterday, were: The insertion of a clause fixing eight hours as a day's work; the payment of the prevailing rate of wages; the limitation of the life of the franchise, and the building of pipe galleries in the tunnel.

A prominent business man in a Western city, who has been deeply interested in the development of street railway enterprises, recently withdrew from the management of a company which was seeking a franchise for an interurban road, and explained that he had found it utterly impossible to make any progress in securing the passage of an ordinance through the City Council without the liberal use of money, to which he declined to be a party. The franchise ordinance of this company has been blocked repeatedly, and there is talk of withdrawing the application so far as it relates to the town in question. The road would open up a rich farming country.

The people of Cuba are anxious to enjoy, not only the blessings of liberty, but all the advantages and material comforts of a free people. They are already displaying a fondness for such American institutions as seashore resorts, connected with the cities by trolley lines, and several enterprises of this character are now under way. American capitalists are building an electric railway 12 miles long, connecting Havana with the seashore. A casino, theater, hotel, summer gardens and other features are planned for the beach resorts, which is to be opened by the railway.

"How not to do it," is the title of a graphic illustration of the manner in which most women alight from a street car. It is published in a Western daily newspaper, with the explanation that most of the accidents for which the street railway companies are blamed, are really due to the carelessness of patrons and the habit of facing the rear and trusting to Providence when they leave a car. In winter the conductors can guard against these accidents in a large measure, but with open cars it is often impossible to prevent patrons from stepping off backwards.

An example of the methods employed in conducting the affairs of cities is afforded by the finding of a certificate of stock owned by the city of Rochester, which entitled the city to draw semi-annual dividends from the Rochester and Genesee Valley Railroad Company (Erie road lessee), at the guaranteed rate of 6 per cent per annum on $300,000. All that any present city official knew about the matter was that the city had bonded itself years ago in the amount of the stock and received the certificate. The bonds have nearly all been paid off, but the certificate was missing. The document was found in the city treasurer's office. The records of the city showed that the certificate must have been lost in 1885, and as several changes have since been made in the administration of this office, the matter evidently was entirely forgotten.

The Northwestern Elevated Railroad Company, of Chicago, has made that city a gift of a public playground for children in a crowded district. The piece of property so donated is 300 ft. long and 85 ft. wide, located along Alaska Street, between Larrabee and Town Streets. The company will not only donate the land but fit it up for a playground. As it is in one of the poorer districts it should be a great benefit to the neighborhood.

New York has been agitated during the last week on the question whether there would be a strike on the elevated railway. The engineers, who receive $3.50 a day, claimed that the company was requiring them to make more trips in a day with the new electric trains than with the steam equipment and that they were being worked longer hours. Several interviews were had with General Manager Skitt on the subject, and in the final conference, held Aug. 12, the disputed points were finally settled. The agreement made at that meeting was not made public, but the following statement was officially issued, covering the principal points in question: "The matters in dispute were finally narrowed down to the question of hours for a day's work, and the limit of ninety miles per day. The engineers waived the question of miles and the company conceded the nine-hour day. Agreement was signed and conference ended."

Papers at the Detroit Convention

A complete list of the papers to be presented at the convention of the American Street Railway Association, at Detroit, has been announced by the secretary. It is as follows:

"The Registration of Transfers," by C. D. Meneely, of the Brooklyn Heights Railroad Company; "The Benefit Associations," by Oren Root, Jr., of the Metropolitan Street Railway Company, of New York City; "The Discipline of Employees by the Merit System," by W. A. Satterlee, general manager of the Metropolitan Street Railway Company, of Kansas City, Mo.; "Transportation of Light Express and Parcel Delivery," by Geo. W. Parker, general express and passenger agent of the Detroit United Railway; "Steam Turbine Engines," by E. H. Sniffin, of New York; "Signals for Urban and Interurban Railways," by some officer of the Old Colony Street Railway Company, of Boston; "Adjustment of Damage Claims," by M. B. Starring, counsel of the Chicago City Railway Company.

In addition to the above papers reports are expected from the committee on standards, which was appointed two years ago, and which rendered a report on this important subject last year, and also from the committee on rules for the government of employees, which has been appointed during the last year by President Vreeland, in accordance with action taken by the association at its last annual meeting. These two committees are composed as follows:

COMMITTEE ON STANDARDS

N. H. Heft, New Haven, Conn.
E. G. Connette, Syracuse, N. Y.
C. F. Holmes, Kansas City, Mo.
John I. Beggs, Milwaukee, Wis.
E. A. Newman, Portland, Me.
R. T. Laffin, Worcester, Mass.
Will Christy, Akron, Ohio.

COMMITTEE ON RULES FOR THE GOVERNMENT OF EMPLOYEES

J. C. Brackenridge, Brooklyn Heights Railroad Company.

E. C. Foster, Old Colony Street Railway Company, Boston, Mass.

T. E. Mitten, Buffalo Railway Company.

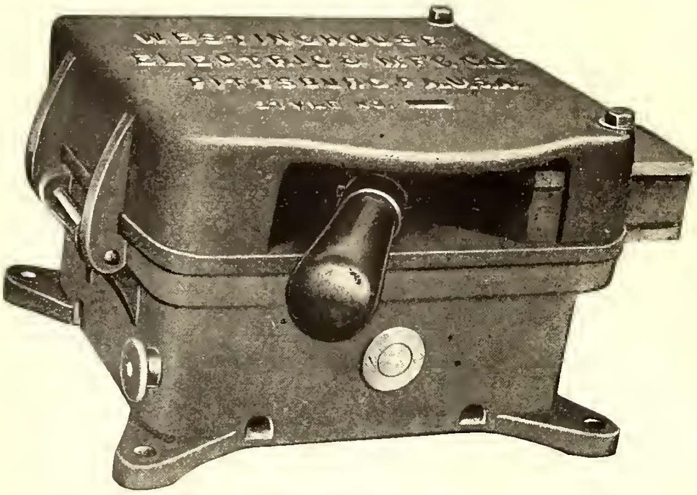
W. E. Harrington, Camden & Suburban Railway Company, Camden, N. J.

Bishop M. J. Hoban, John Mitchell, president of the mine workers; Wm. C. Corliss, president of the Scranton Typographical Union; W. F. Hallstead, former general manager of the Delaware, Lackawanna & Western Company, and W. H. Taylor, a merchant, comprising the board of arbitration to settle the dispute between the Scranton Railway Company and its union employees, rendered a decision Aug. 6. One of the clauses of the agreement made at the close of the six months' strike on April 7, 1902, was that after a certain time preference as to runs should be regulated by length of service. The company maintained that this meant that the returned strikers should have their term of service date from April 7, when they came back to work. The men contended that it was understood they should be credited with the time they had served prior to the strike.

The arbitrators decided in favor of the men, but made a ruling that the non-union employees who came to work during the strike and who were retained by the company shall not be disturbed. If the company cannot provide regular runs for all the former strikers, who by "length of service" should be preferred to the men who took runs during the strike, it is to pay them a bonus that will make their wages equal to those they would receive if they had regular runs.

Automatic Car-Type Circuit-Breaker

The protection of railway motor equipments by the use of a fuse has until recently been generally recommended, but the fuse frequently fails to blow at the proper time, or to give the equipment the best protection under all conditions of service. The necessity of carrying extra fuses, as well as the inconvenience of stopping the car to replace a blown-out fuse, is another objection,



WESTINGHOUSE AUTOMATIC CAR CIRCUIT-BREAKER

and many railway companies are now replacing the fuse block with the automatic car circuit-breaker, which will open automatically when the current reaches the value for which it is set.

Aside from the protective feature of a circuit breaker the convenience in resetting it is obviously of great value. The motorman in throwing the handle of the breaker after a heavy overload or short circuit, is not required to leave his position at the controller to put the car in service. In most cases it is not necessary to stop the car, as the breaker can be reset while drifting.

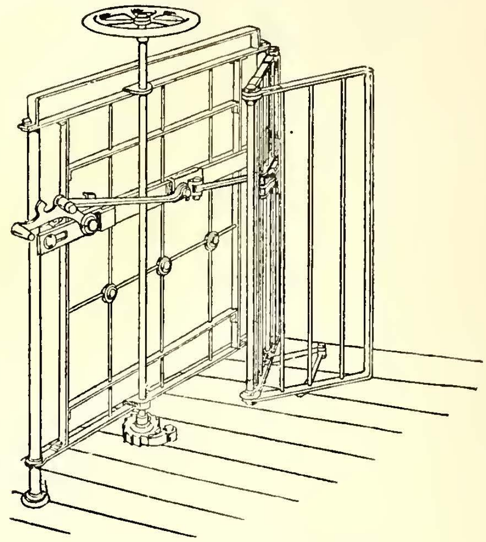
The automatic car circuit-breaker manufactured by the Westinghouse Electric & Manufacturing Company performs the function of the fuse block by opening an overload or short circuit. It is also intended to replace the platform or canopy switch, in that it provides a hand-opening for the circuit. In construction the instrument is thoroughly fireproof, of the best material and workmanship throughout, and all parts are interchangeable. Its design prevents any arcing at the current-carrying contacts, as the arc is broken on extra contacts, especially provided for the purpose, and assisted by a powerful magnetic blow-out, which will open the severest short circuit without damage. The breaker is calibrated, and can be set to open at any current within the limit of its range. The automatic opening device insures action when the current reaches the predetermined value.

An Improved Platform Gate for Elevated Service

The accompanying illustration gives a good idea of the details of a new platform gate now being put on the market by the R. Bliss Manufacturing Company, of Pawtucket, R. I. This gate combines the well-known features of safety and economy of space which has made the gates manufactured by this concern for surface cars so popular with a large number of operating men throughout the country, with the combination of an actuating handle for opening and closing from the middle of the platform. The gate is a modification of a high gate for elevated service, recently perfected by the Bliss Company, but instead of having lazy tongs at the top of the gate they are placed at the bottom. In this position they serve their purpose of giving the gate its proper rigidity in any position as well as if they were above, but greatly reduce the liability of pinching the passengers' fingers while the gate is being operated. If anything, it is claimed, the new gate is stronger than the ordinary straight gate, and the danger of passengers being thrown from the car by a sudden lurch or by crowding is reduced to a minimum.

As in the well-known surface-car folding gate, one of the principal features of merit is the small amount of space occupied by the gate when opening, and it is claimed for the new gate that it will save the room of three people on the platform, as in opening it doubles in half its reach. While more particularly intended for use on elevated roads the gate can be employed as well for surface-electric and steam cars, and is applicable to double doors and vestibule cars. It is simple in construction and manipulation, and its action is claimed to be absolutely positive, locking in and out both ways, so that whether open or closed there is no danger of its being thrown unintentionally.

The general features of the gate are shown in the illustration. The workmanship and material employed is of the best, all parts being thoroughly manufactured and fitted to the gate as assembled.

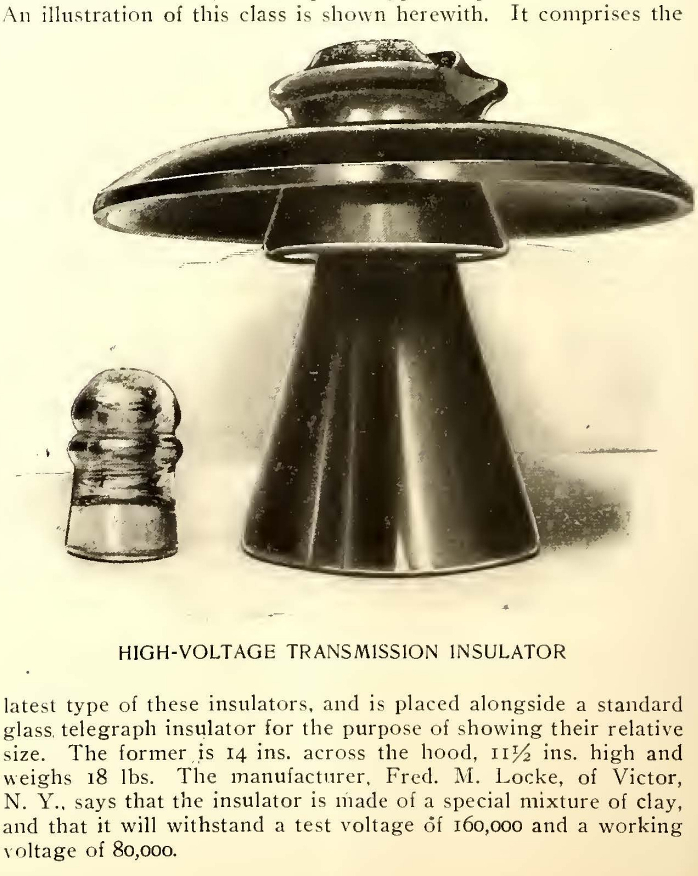


IMPROVED PLATFORM GATE

Instead of a bell crank on the handle a straight lever is used, hinged at the bottom, and connected to the actuating sleeve by a solid link. This gives the gateman a powerful leverage and enables the gate to be forced to with precision under the most trying conditions of crowding. The R. Bliss Manufacturing Company has had a great deal of experience in the manufacture of all kinds of car gates, and this latest production from their designing room contains the best features of safety, strength and durability that the company has developed.

Insulator for High-Voltage Transmission

With the rise in transmission line voltage insulation problems have been introduced of no mean proportions in long-distance power transmission engineering, and to meet these new conditions there has been worked out special types of pole-line insulators. An illustration of this class is shown herewith. It comprises the



HIGH-VOLTAGE TRANSMISSION INSULATOR

latest type of these insulators, and is placed alongside a standard glass telegraph insulator for the purpose of showing their relative size. The former is 14 ins. across the hood, 11½ ins. high and weighs 18 lbs. The manufacturer, Fred. M. Locke, of Victor, N. Y., says that the insulator is made of a special mixture of clay, and that it will withstand a test voltage of 160,000 and a working voltage of 80,000.

Sale of Omaha Street Railway.

A syndicate of New York bankers, headed by J. & W. Seligman Company, has elosed a deal for the purchase of the Omaha Street Railway. The purchasers secure all of the stock, and the purchase price is reported to have been $92 per share for stock of a par value of $100.

The property eonsists of the Omaha Street Railway, the Council Bluffs & Suburban Company, the Omaha & Council Bluffs Bridge & Motor Company, and a bridge over the Missouri between the two cities. It constitutes a monopoly of the street car traffie of the two cities.

Strike at New Haven

Under what are said to have been the most extraordinary conditions surrounding any conflict between capital and labor that has ever been waged in Connecticut, the Fair Haven & Westville Railroad was completely tied up from Aug. 6 until Aug. 10, through a strike of conductors and motormen. With the exception of the operation of mail cars, street railway service in New Haven was entirely tied up while the strike was in progress. Immediately after the strike had been declared, a committee representing the business interests of the city began an effort to bring about an amicable settlement of the differences between the company and its employees, and it was through the efforts of this eommittee that the strike was terminated. Following is the agreement under which the strike is settled, signed by the company, through H. S. Parmelee, president:

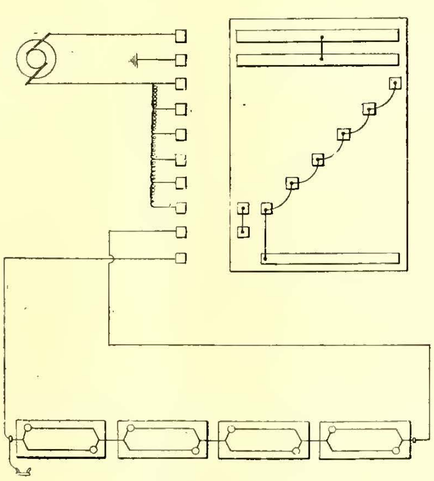
To the Motormen and Conductors of the Fair Haven & Westville Railroad Company: Your eommunication of this date is received. The Fair Haven & Westville Railroad Company will receive, at all reasonable times, a committee consisting of employees of the company only to receive and consider the grievances that may arise, and will use all reasonable effort to redress them fairly. Membership in the Amalgamated Association of Street Railroad Employees is not now and will not be in the future just cause for discharge from employment of said company. If desired, copies of all assurances made to the Business Men's Committee will be given, addressed to the motormen and conductors of the company, signed by the president, and, as stated to the committee of business men, if the strike be terminated speedily the twenty-one men recently discharged will be reinstated unconditionally.

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 AUG. 5, 1902

706,020. Train Control System; F. E. Case, Schenectady, N. Y. App. filed Jan. 7, 1901. Means are provided for preventing the further operation of the master controller in case any of the subcontrollers fail to operate.



PATENT NO. 706,295

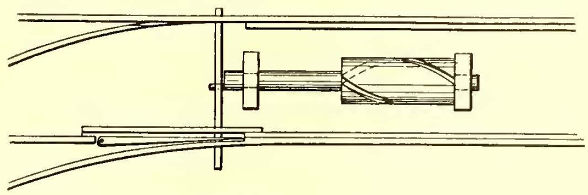
706,024. Switch Operating Mechanism; G. L. Cooper, Bridgeport, Conn. App. filed Dec. 6, 1901. The switchpoint is thrown and reset by devices on the car.

705,041. Car Fender; A. M. Ferguson, Ste. Cunégonde and J. A. U. Beaudry, Montreal, Can. App. filed Nov. 14, 1901. Details.

706,092. Trolley Pole Catch; J. A. Norton, Wilkesbarre, Pa. App. filed Nov. 19, 1901. In case the trolley pole strikes a cross wire and is thereby thrown violently downward, it is automatically caught and held by a latch.

706,106. Electric Railway; W. B. Potter, Schenectady, N. Y. App. filed Nov. 18, 1896. A third rail system which at stations or crossing is changed into a sectional normally dead system.

706,147. Brake-Shoe Lubricating Filler; R. D. Baldwin, Chicago, Ill. App. filed Oct. 26, 1901. The face of the shoe contains a lubricating composition insert.



PATENT NO 706,266

706,211. Trolley Wheel; R. H. Apelt, Boston, Mass. App. filed March 30, 1901. Structural details.

706,266. Switch; G. H. Smith, Boston, Mass. App. filed Sept. 25, 1901. A drum having a spiral groove is engaged by a pin carried by the car, and is rotated to throw the switch.

706,295. Starting Mechanism; J. B. Blood, Newburyport, Mass. App. filed Aug. 28, 1901. Pressure controlling devices located on each car have to be in coincident condition in order to send forward the starting signal.

706,338. Trolley Wire Finder; L. C. Nolan, St. Paul, Minn. App. filed April 11, 1902. A pivoted fork arranged to be thrown above the wheel.

PERSONAL MENTION

MR. FRANK MILLER, formerly superintendent and passenger agent of the Worcester & Webster Street Railway, Worcester, Mass., has accepted the position of salesman with C. J. Harrington, of New York, manufacturer of electric railroad and line material. Mr. Miller will cover the New England territory.

MR. WILLIAM E. DICKEY, who was recently connected with the United States Navy as past assistant engineer, has opened an office at 16 Murray Street, New York City, where he will represent The Goulds Manufacturing Company, of Seneca Falls, N. Y., and The West Point Boiler Works, of Pittsburgh, Pa.

MR. E. T. SELIG, late superintendent of the Citizens' Railway Company, of Fort Scott, Kan., has been appointed secretary and manager of the Mount Vernon Electric Railway Company and the Mount Vernon Electric Light Company, of Mount Vernon, Ohio, to succeed Mr. G. E. Johnson, who resigned on account of ill health.

MR. D. W. DOZIER resigned his position as chief mechanical engineer of the Metropolitan Street Railway Company, of Kansas City, Mo., on Aug. 1. Mr. Dozier installed the first engines for the cable line of the Grand Avenue Railway Company, and upon the completion of the plant was retained in the service of the company. He has ever since been identified with the Kansas City street railways.

MR. CLARENCE FROST HORTON died at San Fernando, P. I., from brain fever on July 31. He was born in Peekskill, N. Y., thirty years ago, and was educated at the public schools, the Peekskill Military Academy and Columbia School of Mines. He was graduated in 1894 and then was appointed to a responsible place on the engineering staff of the Rapid Transit Commission in New York. Later he did private work in surveying and engineering. Then he accepted a place in the United States Geodetic Survey. A year ago last month he was sent to the Philippines and was soon made a provincial supervisor with headquarters at San Fernando. He leaves a young wife, formerly Miss Bertha Carrick, of Delmar, Albany County, whom he married in December, 1900, and who accompanied him to the East. He is survived also by three brothers and two sisters.

FINANCIAL INTELLIGENCE

THE MARKETS

WALL STREET, Aug. 13, 1902.

The Money Market

Notwithstanding the influx of currency from the interior, and the continued heavy disbursements by the National Treasury on account of pension payments, a decidedly firmer tone prevails in the money market. This is due principally to a further demand in the local bank reserves of over $4,000,000, and an increased demand from borrowers made necessary by the larger transactions in stocks and bonds. Money on call rose from 2¾ to 4 per cent, while time contracts are hard to obtain under 5 per cent. The supply of lendable funds appears to be much smaller than a week ago, and indications point to a continued firmer market for an indefinite period. The movement of money to facilitate the handling of the crops has already begun in the West, and it is only a question of a comparatively short time when the local institutions will be called upon to furnish funds for this purpose. Preparations are now making to that end, and as the crops promise to be extremely large, the movement from this centre will probably be sufficient to keep rates at the present level. Shipments of gold to Europe have been arrested by the sharp advance in sterling rates at Paris, and it is not considered likely that this movement will be resumed during the present season, as bills against grain and cotton shipments are expected shortly in sufficient quantities to keep the rates of exchange below the gold export point. Aside from a temporary advance in the discount rate at Berlin, the condition at the principal European centres are about unchanged. Call loans are made freely in the open market at from 3½ to 4 per cent, while time contracts are made at 5 per cent for from three to six months on good mixed collateral.

The Stock Market

While there has not been any great activity in the market, the trend of values is to a higher level. The upward movement, however, is kept on a legitimate basis by frequent reactions. The market is now absolutely in the control of the speculative forces as represented by the so-called Western contingent, better known as the Gates interest, whose operations are on a large scale. The one strong feature of the speculative situation is the concentrated manner in which securities are held. While the high prices have brought out a considerable amount of stocks from strong boxes, these have readily been absorbed, and the floating supply is too small to admit of any aggressive operations for the bear account. The Gould stocks have been and may continue conspicuous, and with an outlet to the seaboard for the Wabash through the Western Maryland, at Baltimore, the Gould system of roads probably will receive more attention. The anthracite coal strike is on its last legs, and it will be only a short time before operations are resumed at several of the important mines. Interest centres in the action that will be taken on the Reading dividend, but it is pretty certain that the dividend on the first preferred will be declared as usual, and that the voting trust will be terminated. This accounts for the strength of the coal shares. The very favorable crop report, and the prospects of a yield of 2,600,000,000 bushels of corn, and an average crop of wheat, will impart a healthy tone to general trade, and with an active commercial business the railroads will earn more money than ever before in their history. The industrial stocks are growing in favor, as a result of the determined stand taken by the United States Steel Corporation in fighting all attacks. The opinion is widely held that this class of securities and the lower-priced railroad shares will be the centre of activity during the next two months.

The local traction group have been quiet. Interest centered in Manhattan by reason of the strike agitation. When the possibility of the engineers striking first developed, the professional traders made haste to sell the stock. The floating supply was too small for the successful carrying out of an aggressive bear campaign, and when a compromise between the men and the company was arrived at, the stock rallied sharply. The Street inclines steadfastly to the belief that the acquisition of the elevated system by New York Central interests is only a matter of time. This in addition to the expected increase in business to follow the installation of electricity on all the Manhattan lines, precludes heavy selling of the shares. The other traction stocks have been dull and featureless, without noteworthy change in quotations.

Chicago

There is not much to be said about the week's trading in Chicago traction stocks. The whole volume of transactions probably did not exceed 2000 shares, and no one issue came into any particular prominence. Metropolitan Elevated bonds were well bought around 101 on the excellent earnings of the company which are attracting a good deal of comment. We published the fact last week that the increase for July amounted to 23 per cent over the gross receipts of a year ago. It is expected that the August comparison will be equally good. Metropolitan shares have been in fair demand, with small sales of the common at 39. The activity in Northwestern Elevated, remarked a week ago, has completely subsided. Lake Street recovered a half point or more, and was steady around 10¼. South Side sold at 110. Scarcely anything at all has been done in the surface line stocks. City Railway changed hands at 215, but Union Traction was neglected. West Chicago selling ex-dividends, declined from 95⅝ to 95.

Philadelphia

Interest in the Philadelphia traction properties during the week has been taken up mainly with the plans and rumors of plans of the syndicate behind the Rapid Transit deal. Union Traction reached a new high record of 47½, but Philadelphia Rapid Transit did not reach again the previous high figure of 13⅞. Both issues during the last few days have reflected heavy profit-taking by speculators who benefited by the rise. On the other hand, Fairmount Park Transportation, which had begun to advance a week ago, was bid up very sharply to 30¼—a gain of 10 points in a fortnight. The movement was based entirely upon the story that the Rapid Transit people were seeking control of the road, and that they had offered 30 for a controlling interest. This report was denied from official sources, but the denial did not have much effect upon speculation in the stock. Philadelphia Traction, on moderate trading, held very steady at 99¾. American Railways was stronger and more active than in some time past, selling up to 48¼. A few sales were reported in Rochester Railway common at 66½ and in Indianapolis Street Railway, which also touched a new high record—89.

Other Traction Securities

Practically nothing has been done in the Boston stocks during the week. Massachusetts Electric continues to reflect some pressure, the common selling down to 40 and the preferred to 97½. Sales of a few odd lots were reported in Boston Elevated at 162 and West End common at 96. In Baltimore it has also been a very dull week. Nashville Railway maintains strength on pool support, the 5 per cent certificates selling up to 74¾ from 73¼, and the stock holding stiff around 6. United Railway incomes are a shade lower at 70⅛, and the 4s at 97¼. Other sales include Newport News and Old Point 5s at 109½, City & Suburban (Baltimore) 5s at 114¾ and Baltimore Traction 5s at 117¾. Accumulation of North Jersey Railway securities in the local markets continues, the stock getting up above 35 and the 4 per cent bonds selling at 83¾. No further information is obtainable, however, concerning the much-talked-of consolidation in that territory. The New York curb sales for the week include New Orleans Railways 4½ per cent bonds at 89 and 89⅛, Toledo Railway at 33½, San Francisco common at 22½, and the preferred at 63⅛ down to 61⅞.

Sales of traction stocks on the Cleveland Stock Exchange last week numbered only 2482 shares, as compared with almost 10,000 for the week before. Cincinnati, Dayton & Toledo again held the center of the stage, total sales being 1417 shares, opening at 25¾ and closing at 26¾. Northern Ohio Traction preferred went to 90 on sales of 300 shares. The common was steady at 45; 100 shares selling. Toledo Railways & Light was steady at 33; 175 shares selling. Cleveland Electric Railway advanced to 86¼ for 150 shares. Lake Shore Electric advanced to 19¼; 150 shares selling. The speculation in this stock is rather surprising, in view of the fact that the details of the financing plan for reorganizing the company have not yet been perfected, and there is possibility of immediate assessments. C. D. & T. 5 per cent bonds brought 84 on par value of $6000, and Western Ohio 5s par value $15,000 sold up from 83 to 83¾. Monday, $31,000 C. D. & T. 5s sold at 84¾ and 85, and $10,000 Western Ohio 5s went at the same mark. Seven hundred shares of Cincinnati, Dayton & Toledo sold at from 26⅝ to 27, the latter the closing figure. A small lot of Lake Shore Electric common went at 18½.

Security Quotations

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

	Closing Bid Aug. 5	Aug. 12
American Railways Company	47	50
Boston Elevated	164	161½
Brooklyn R. T.	69	67⅝
Chicago City	215	210
Chicago Union Tr. (common)	15½	15⅛
Chicago Union Tr. (preferred)	50	48
Cleveland Electric	86¼	86
Columbus (common)	52	54
Columbus (preferred)	107¼	107
Consolidated Traction of N. J	69½	71¼
Consolidated Traction of N. J. 5s	110½	111
Detroit United	85⅝	85⅝
Electric People's Traction (Philadelphia) 4s	99½	99¾
Elgin, Aurora & Southern	43	40
Indianapolis Street Railway 4s	87¾	—
Lake Street Elevated	9½	10⅜
Manhattan Railway	136⅛	134
Massachusetts Elec. Cos. (common)	41	41
Massachusetts Elec. Cos. (preferred)	97¾	97¾
Metropolitan Elevated, Chicago (common)	39	39½
Metropolitan Elevated, Chicago	91½	91½
Metropolitan Street	149	148½
North American	123½	123
Northern Ohio Traction (common)	44½	41½
Northern Ohio Traction (preferred)	89	90
North Jersey	30½	35½
Northwestern Elevated, Chicago (common)	37	36½
Northwestern Elevated, Chicago (preferred)	84	—
Philadelphia Rapid Transit	13¾	14
Philadelphia Traction	99⅝	99¾
St. Louis Transit Co. (common)	31½	31⅜
South Side Elevated (Chicago)	110	112
Southern Ohio Traction	72	77⅛
Syracuse Rapid Transit	27¾	30
Syracuse Rapid Transit (preferred)	76	74
Third Avenue	132	130
Toledo Railway & Light	30	32½
Twin City, Minneapolis (common)	123½	125
United Railways, St. Louis (preferred)	83½	*85
United Railways, St. Louis, 4s	87¼	87¼
Union Traction (Philadelphia)	47	47⅛
Western Ohio Railway	25¼	25¼
New Orleans Railways (common)	16	—
New Orleans Railways (preferred)	56¼	57½

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

Iron and Steel

The condition of the iron and steel market continues to be about the same as described last week; that is, the demand continues to run far ahead of the production in the leading branches of the trade, and fancy premiums have to be paid for prompt delivery. In the meantime there are reports of the arrival of large lots of foreign pig and billets. Many of the companies report orders for delivery extending far into next year. The quotations are as follows: $21.75 to $22. for Bessemer pig, $32 for steel billets and $28 for steel rails.

Metal

The quotations for the leading metals are as follows: Copper, 11.60 cents; tin, 28.50 cents; lead, 4⅛ cents; spelter, 5⅜ cents.

CHICAGO, ILL.—The Metropolitan Elevated Railroad Company has declared a semi-annual preferred dividend of 1½ per cent, payable Aug. 30; books close Aug. 16 and reopen Aug. 30.

CHICAGO, ILL.—It is said that the plan for the reorganization of the Lake Street Elevated Railroad will be announced about Sept. 1.

WORCESTER, MASS.—The Railroad Commissioners have authorized the Worcester Consolidated Street Railway Company to issue 3500 shares of new stock at $116 a share, to purchase real estate, rolling stock and equipment and for building extensions.

NORTH ADAMS, MASS.—The Railroad Commissioners have authorized the Hoosac Valley Street Railway Company to issue 300 new shares of stock at $105 per share for extensions and additions to the railway property.

ST. LOUIS, MO.—July was a record-breaking month in earnings of the St. Louis Transit Company. The monthly statement, issued Aug. 6, shows gross earnings of $575,173, as against $505,723 in July, 1901, a total gain of $69,450. This is the largest gain made during a single month in the history of the company. Officials of the company say that all the roads are on a better earning basis now than at any time since they were merged. Indications are that the deficit of last year, amounting to $525,630, will be wiped out by the next annual meeting, and that a substantial balance will be shown.

ST. LOUIS, MO.—The stockholders of the St. Louis & Suburban Railway and the St. Louis & Meramec River Railway Company, a constituent of the former, have been requested to meet on Sept. 24, to pass upon certain important propositions. The trustees, who are reorganizing these roads, propose to increase the present capital of the Suburban from $2,500,000 to $7,500,000, and the capital of the St. Louis & Meramec River Railway Company from $2,000,000 to $3,000,000. The bonded indebtedness of the Suburban, now $2,585,000, will be increased to $7,500,000, the old bonds being retired. In the case of the second road the bonded indebtedness of $1,000,000 is to be increased to $2,000,000, and the old indebtedness retired.

NEW YORK, N. Y.—The shareholders of the Interborough Rapid Transit Company will vote, Aug. 26, upon a proposition to increase the capital stock of the company from $25,000,000 to $35,000,000.

BROOKLYN, N. Y.—The Brooklyn Rapid Transit Company reports earnings as follows:

June	1902	1901
Gross receipts	$1,165,287	$1,181,023
Expenses, including taxes	732,152	732,740
Net receipts	$433,135	$448,282
For twelve months ending June 30		
Gross receipts	$12,789,704	$12,101,197
Expenses, including taxes	8,952,214	7,970,634
Net receipts	$3,837,490	$4,130,563

ROCHESTER, N. Y.—A certificate of consolidation of the Rochester & Sodus Bay Railway and the Irondequoit Park Railroad Company has been filed with the Secretary of State. The new corporation is to be known as the Rochester & Sodus Bay Railroad Company, and its capital stock is $1,850,000. The directors are: T. J. Nicholl, G. G. Morehouse, Rochester; Benjamin Strong, F. K. Trask, C. A. Burbank, Joseph E. Beckley, New York; D. W. Gibbs, Montclair, N. J.; John L. Lockwood, Jr., Rosland, N. J.; Arthur C. Vaughn, Garden City, N. Y.

NEW YORK, N. Y.—The committee on stock list of the New York Stock Exchange has granted the application of the Metropolitan Street Railway to list $12,780,000 of its 4 per cent refunding one hundred-year gold mortgage bonds. The mortgage securing the bonds is a refunding mortgage to secure an issue of not exceeding $65,000,000 of bonds bearing interest at a rate not exceeding 4 per cent per annum, which by the terms of the mortgage are subject to issue as follows: $48,196,000 is reserved to retire existing funded obligations of the Metropolitan Street Railway Company and various subsidiary companies aggregating said amount, and $11,000,000 is subject to issue upon the order of the board of directors. The remainder, $5,801,000, is reserved, subject to the terms of the mortgage, for refunding purposes, until Jan. 1, 1920, after which date any balance not required for refunding purposes may be issued upon the order of the board of directors.

DOLGEVILLE, N. Y.—The Little Falls & Dolgeville Railway was disposed of at public auction on mortgage foreclosure a few days ago. The property was bid in for $260,000 for a committee of first mortgage bondholders, Judge Robert Earl, of Herkimer; Dumont Clark, of New York, and George R. Smit.., of Little Falls. It is said that the road will be equipped with electricity.

COLUMBUS, OHIO.—The Central Market Street Railway Company has increased its capital stock from $500,000 to $1,500,000; three-fourths of the amount of increase is in preferred stock. S. B. Hartman is president, and F. W. Merrick secretary of the company, which was formed to operate the city portion of the interurban lines by the Appleyard syndicate.

COLUMBUS, OHIO.—The Everett-Moore holdings in the Scioto Valley Traction Company, amounting to 60 per cent of the capital stock, have been sold. The road is being built from Columbus to Circleville, and from Columbus to Lancaster. A reorganization of the company has been effected. Col. J. C. Hooven, of Hamilton, was elected chairman of the pool entered into by those who purchased the Everett-Moore holdings. Edwin R. Sharp, of Columbus, was chosen president; Frank H. Davis, treasurer; Willam Burdell, vice-president. The office of president, which was vacated by Barney Mahler, of Cleveland, will be filled later. Columbus people now own 70 per cent of the stock of the company, and the balance is held in Cincinnati.

CINCINNATI, OHIO.—Stockholders of the Mill Creek Valley Street Railway Company and the Hamilton, Glendale & Cincinnati Traction Company will meet on Aug. 27 to vote on the proposition of leasing the lines to the Elkins-Widener Syndicate. The two companies are practically identical, and cars operate over their line from Cincinnati through to Hamilton. The deal has been held up for some months on account of litigation, which has been keeping the line out of the center of Hamilton. This difficulty, however, has now been settled. The Mill Creek Company is capitalized at $1,750,000, of which $750,000 is 5 per cent preferred stock. The Hamilton, Glendale & Cincinnati has $250,000 capital stock, all of which is 5 per cent preferred. The proposition made by the leasing is to guarantee the 5 per cent interest on $1,100,000 preferred stock and a graduated scale of interest starting at ½ per cent and scaling to 4½ per cent in seven years, on $1,000,000 common stock. The proposition increases the preferred stock $100,000. The officers of both companies are: H. H. Hoffman, president; Bayard Kilgour, vice-president; Henry Burkhold, secretary-treasurer. The lease will probably mean the entrance into Cincinnati of the large interurban traffic, which heretofore has been kept out of the city.

PHILADELPHIA, PA.—President Parsons, of the Philadelphia Rapid Transit Company, is quoted by the Philadelphia News Bureau as saying that negotiations for the purchase of the Fairmount Park Transportation Company are not now, or never have been, in progress. "We have not the slightest idea of acquiring the property, and the matter has never been formally discussed by our directors," President Parsons is quoted as saying.

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., June '02	67,631	36,589	31,041	14,121	17,021
	1 " " '01	58,191	32,123	26,069	13,056	15,946
	6 " " '02	318,937	185,362	133,575	77,556	56,018
	6 " " '01	268,967	164,458	104,510	63,494	41,016
	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., July '02	140,209	89,013	51,197	23,866	27,331
	1 " " '01	134,370	79,638	54,732	------	------
BINGHAMTON, N. Y.						
Binghamton St. Ry. Co.	1 m., May '02	17,194	9,118	8,075	------	------
	1 " " '01	15,678	9,341	6,337	------	------
	10 " " '02	187,658	103,986	83,672	------	------
	10 " " '01	169,756	94,355	75,401	------	------
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., June '02	1,165,288	* 732,152	433,136	------	------
	1 " " '01	1,181,023	* 732,740	448,283	------	------
	12 " " '02	12,789,705	*8952214	3,837,490	------	------
	12 " " '01	12,101,198	*7970635	4,150,563	------	------
BUFFALO, N. Y.						
International Tr. Co.	1 m., May '02	264,184	146,787	117,398	97,330	20,068
	1 " " '01	291,666	161,077	130,589	92,020	38,569
CHARLESTON, S. C.	1 " " '00	209,309	115,487	93,823	78,250	15,572
Charleston Consol'ted Ry. Gas & El. Co.	6 m., May '02	399,572	208,325	191,248	75,826	115,422
	6 " " '01	245,745	159,425	86,320	76,714	9,607
CHICAGO, ILL.						
Chicago & Milwaukee Elec. Ry. Co.	1 m., July '02	23,591	7,586	16,005	------	------
	1 " " '01	23,459	7,689	15,770	------	------
	7 " " '02	102,531	45,638	56,892	------	------
	7 " " '01	88,920	42,091	46,829	------	------
Lake Street Elevated	12 m., Dec. '01	786,462	388,799	397,663	------	------
	12 " " '00	757,954	378,661	379,293	------	------
Union Traction Co.	12 m., June '02	7,942,468	4,570,719	3,371,749	3,619,277	† 247,528
	12 " " '01	8,158,809	3,942,194	4,216,615	4,058,040	158,575
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., May '02	217,563	------	------	------	------
	1 " " '01	187,049	------	------	------	------
	5 " " '02	962,890	------	------	------	------
	5 " " '01	854,594	------	------	------	------
	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., June '02	25,198	13,026	12,172	------	------
	1 " " '01	22,236	9,736	12,501	------	------
	6 " " '02	128,392	77,728	50,664	------	------
	6 " " '01	107,027	64,259	42,768	------	------
	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., June '02	17,747	9,520	8,227	------	......
	1 " " '01	15,748	8,035	7,714	------	------
	6 " " '02	79,557	44,670	34,857	------	------
	6 " " '01	65,449	36,228	29,221	------	------
	12 " Dec. '01	164,971	* 87,102	77,869	72,500	5,369
	12 " " '00	141,112	* 89,592	71,520	72,500	† 980
COVINGTON, KY.						
Cincinnati, Newport & Covington Ry. Co.	1 m., June '02	77,545	* 42,671	34,875	15,614	19,261
	1 " " '01	72,201	* 42,147	30,054	15,746	14,308
	6 " " '02	422,150	*247,877	174,273	93,025	81,248
	6 " " '01	384,638	*235,852	148,786	94,105	54,681
DENVER, COL.						
Denver City Tramway Co.	1 m., Apl. '02	124,516	66,533	57,983	32,865	26,119
	1 " " '01	116,357	62,866	53,490	31,304	22,186
	4 " " '02	481,348	261,118	220,230	131,259	88,972
	4 " " '01	435,297	236,915	198,382	125,622	72,759
	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., June '02	291,470	* 159,333	132,137	------	------
	1 " " '01	260,109	* 139,412	120,697	------	------
	6 " " '02	1,600,675	* 907,044	693,631	395,739	297,892
	6 " " '01	1,384,181	* 775,347	608,834	345,119	263,715
	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
Detroit and Port Huron Shore Line (Rapid Ry. System)	1 m., Apl. '02	29,611	18,392	11,219	10,568	651
	1 " " '01	28,877	18,062	10,816	9,692	1,124
DULUTH, MINN.						
Duluth-Superior Tr.	1 m., June '02	48,497	22,136	26,361	9,655	16,705
	1 " " '01	39,265	20,076	19,189	9,188	10,001
	6 " " '02	245,406	132,413	112,992	57,844	55,148
	6 " " '01	208,339	119,603	88,736	54,765	33,970
ELGIN, ILL.						
Elgin, Aurora & Southern Tr.	1 m., July '02	40,472	21,197	19,275	8,333	10,941
	1 " " '01	36,454	16,218	20,236	8,333	11,903
	7 " " '02	226,929	136,723	90,206	58,333	31 873
	7 " " '01	204,102	119,142	84,960	58,333	26,627
FINDLAY, O.						
Toledo, Bowl'g Green & Southern Traction Co	1 m., June '02	20,714	9,909	10,805	------	------
	1 " " '01	16,257	8,999	7,388	------	------
	6 " " '02	111,972	60,838	51,134	------	------
	6 " " '01	80,340	51,464	28,876	------	------
HAMILTON, O.						
Southern Ohio Tr. Co.	1 m., Apl. '02	27,774	15,245	12,529	7,500	5,029
	1 " " '01	23,530	14,405	9,125	7,500	1,625
	12 " " '02	353,141	186,365	166,779	90,000	76,779
	12 " " '01	303,704	166,757	136,946	90,000	46,946
LONDON, ONT.						
London St. Ry. Co.	1 m., June '02	13,643	8,558	5,084	2,287	2,797
	1 " " '01	13,917	7,997	5,920	2,046	3,874
	6 " " '02	65,064	43,167	21.897	13,593	8,304
	6 " " '01	60,112	39,951	20,161	11,932	8,229
MILWAUKEE, WIS.						
Milwaukee El. Ry. & Lt. Co.	1 m. June '02	222,450	107,193	115,257	66,015	49,242
	1 " " '01	202,416	94,430	107,986	62,780	45,207
	6 " " '02	1,274,629	612.304	662,325	389,554	272,771
	6 " " '01	1,123,765	586,463	537,302	365,323	171,978
	12 " Dec., '01	2,442,342	1,185,534	1,256,808	755,139	501,669
	12 " " '00	2,220,698	1,129,787	1,090,911	824,665	266,247
MINNEAPOLIS, MINN.						
Twin City R. T. Co.	1 m., May '02	296,991	136,964	160,028	58,733	101,294
	1 " " '01	251,946	114,340	137,605	56,633	80,971
	5 " " '02	1,356,556	649,003	707,553	292,800	414,752
	5 " " '01	1,178,257	563,664	614,593	273,093	341,498
MONTREAL, CAN.						
Montreal St. Ry. Co.	1 m., June '02	187,662	80,655	107,007	19,391	87 615
	1 " " '01	180,926	97,782	83,144	14,272	68,871
	9 " " '02	1,445 180	846 893	598,287	144,299	453,989
	9 " " '01	1,355,026	841,469	573,557	90,268	423,288
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 '02	15,866,641	7,385,883	8,480,758	4,815,421	3,665,337
	12 " " '01	14,720,767	6,755,131	7,965,636	4,534,068	3,431,567
OLEAN, N. Y.						
Olean St. Ry. Co	12 m., June '02	56,055	29,118	26,937	16,318	10,619
	12 " " '01	52,018	26,228	25,790	16,755	9,035
PHILADELPHIA, PA.	1 m., July '02	119,870	------	------	------	------
American Railways	1 " " '01	89 65	------	------	------	------
	12 " June '02	1,009,509	------	------	------	------
	12 " " '01	841,298	------	------	------	------
ROCHESTER, N. Y.						
Rochester Ry.	1 m., June '02	89,236	46,809	42,426	24,754	17,672
	1 " " '01	85,227	45,814	39,413	26.704	12,709
	6 " " '02	527,742	288,005	239,737	148,608	91,130
	6 " " '01	495,226	306,966	188,259	147,157	41,102
SYRACUSE, N. Y.						
Syracuse R. T. Co.	1 m., June '02	60,863	34,780	26,064	19,025	7,039
	1 " " '01	56.952	30,942	26,010	18,947	7,063
	12 " " '02	693,281	384,265	309,019	228,246	80,773
	12 " " '01	621,299	340,830	280,469	223,918	56,550
TOLEDO, O.						
Toledo Ry. & Lt. Co.	1 m., June '02	122,682	65,143	57,539	37,854	19,685
	1 " " '01	112,900	53,923	58,978	24,271	34,707
	6 " " '02	671,284	352,382	318,902	227,033	91,869
	6 " " '01	598,928	303,402	295,526	145,625	149,901
	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
NEW BRIGHTON, S. I.						
Staten Island Elec. Ry.	3 m., June '02	56,635	35,622	21,013	25,000	† 3,986
	3 " " '01	56,936	35,600	22,336	25,000	† 2,663