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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.

All matter intended for publication must be received at our office not later than Wednesday morning of each week, in order to secure insertion in the current issue.

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Contents of this Issue

British Railway Statistics

The manner in which the net revenues of English railways have been falling off is remarkable. The decline seems to be due rather to the increase of operating expenses than to any falling off in freight or passenger traffic. The figures are summed up in a striking article by H. Allaway, the well-known Wall Street expert of the New York *Times*, who analyzes the returns of the fifteen great English systems, and shows for last year a net falling off in revenue for them of nearly $7,000,000. Mr. Allaway predicts that the English investor will sell out and turn his attention to American "rails," which undoubtedly show up to much greater advantage. That is a shrewd view and doubtless a true propheey; but it may not go quite far enough. English railways are already beginning to feel a new competition, that of the electric trolley system, but they are themselves peculiarly suitable for the use of electricity, with short runs, dense population, and separate sets of rails suited to different classes of traffic. We may be wrong, but we have an idea that the first great illustrations of the use of electricity on large railroad systems will be seen in England rather than America, and that the roads there will thus be restored to their wonted prosperity.

Worse for the "Coo"

Many years ago in the early days of electric railway work Leo Daft had a low-tension third-rail road in the outskirts of Baltimore, and it was quite instructive to see ducks and other bipeds, as well as quadrupeds, get astride the system. We have been told there were some damage cases, but it is not understood that collection was ever made. As Stephenson said, when advocating steam railroads before a committee of the House of Commons, in reply as to what would happen if a cow contested the right of way with his locomotives: "So much the worse for the coo." We now note that Mrs. Mary Wynne, a resident of Union Hill, N. J., has instructed her counsel to begin an action to recover damages from the North Hudson Railway Company because one of its trolley cars killed one of her chickens. Mrs. Wynne says she wants the value of the chicken, which she admits is about 50 cents. The tragic fate of the chicken is another warning of the uncertainty of life, but we submit to Mrs. Mary Wynne that it would hardly be fair to the other inhabitants of the good State of New Jersey to suspend traffic on the North Hudson line and "turn off the juice" every time one of her chicks, through her carelessness, strays from its coop.

The Trolley and the Ferries

The opening of the Cortlandt Street branch of the Metropolitan Street Railway in New York, and the rapid pushing of the work on the track leading to the Christopher Street Ferry will shortly give the company a command of the West Side ferry situation, which will be most advantageous to management and patrons alike. A month or two ago we illustrated the construction work then being done in the neighborhood of Cortlandt Street, whereby a loop system could be installed in the somewhat narrow and congested routes in that district. This line was opened last Sunday, and cars are now running by electricity directly up town on both Sixth Avenue and Eighth Avenue. With the generous system of transfers practiced by the Metropolitan, passengers can soon be transported from the Jersey ferries to any part of the city by the payment of a single fare, and the popularity of this service is assured. While the Twenty-Third Street and Forty-Second Street ferries have long been adequately supplied with transportation facilities at their New York terminal, the travelers by the downtown routes have felt the necessity of some better means of reaching their destinations. To such the two new ferry lines will immediately give considerably increased satisfaction with the service, but, as always happens in such cases, there will undoubtedly be created a new traffic which formerly took other routes. It is to be regretted that some similar branches can not be run out to the lower East River ferries, but the physical difficulties encountered in this section of the city are very

great, while, on the other hand, the completion of the new bridges, if they are built, and in any event the trend of business uptown will probably send a large portion of the local traffic further north.

Trolley Cramps

It is stated that Brooklyn, N. Y., just at present is suffering from cramps and stomach ache, due to an injudicious use of the trolley car. For ourselves we should be inclined to attribute the new-fangled disease, if it really exists, to intemperance in other directions, by which, of course, we do not mean insobriety or inebriety. A pretty fair diagnosis of the complaint is as follows, given by a well-known physician:

The tendency of the average Brooklynite to ride on the front seats of the trolley cars and get the air is responsible for these pains in the stomach. The weather during the summer has been trying to people with sensitive stomachs. People drink and dine wonderfully at this time of year. They imbibe large quantities of iced water and eat melons of one kind and another. Then they go for a ride to one of the beaches. The ordinary Brooklynite thinks he knows the seat of advantage in a trolley car. It is as near the front as he can possibly get, and there he sits taking the air, while the car runs on. He is all overheated, and a current of cool air made by the car as it hurries along gives him some kind of relief. Unknowingly he takes cold in his stomach, and when he gets up the next morning he can not go to business. A little precaution would do away with all of this suffering. Men are more liable to be afflicted at this time of year than women. They throw open their coats on the cars, and in that way get the full benefit of all currents of air that are passing. The soda fountain in the drug store and the charming ice-cream soda are also accountable for many of these aches. A person, overheated, will stop at a soda fountain, and in one or two gulps take cold orange phosphate, which chills and shocks the stomach.

After all, it would not appear that the trolley car is to blame. We have heard a dyspeptic, hay-fever victim speak of the fan motor disrespectfully as a "pneumonia screw," but the fan motor and the trolley car have done much more good than harm in cooling off the great public in the hot weather. At the same time, a trolley trip may ofttimes prove inadequate to check the ravages of a diet of orange phosphate and pink watermelon.

Two Class System of Fares

Not long ago in discussing the complaints of passengers who could not find seats and elbow room in the cars in the rush hours, Mr. Vreeland, president of the New York Metropolitan Street Railway system, remarked that such people ought to resort to the automobile cabs or horse coaches, and thus secure the comfort they required. As a matter of fact, the Pullman service on our main steam roads long ago established a two-fare system, but it has not yet become part of the trolley traffic. Mr. Nyssen, vice-president of the Citizens' Union, in Brooklyn, is out in advocacy of it, however, and says:

The trouble is we are prejudiced against anything which looks like a separation into classes. Nevertheless, we have class distinction now in transportation and in places of amusement, but we are afraid to call things by the right name. I do not want to create class distinctions. I simply desire a public recognition of those distinctions which already exist. I think a man who wants better service should not be compelled to put up with the transportation facilities afforded the multitude. If I had control of the street-car service of this city I would put first and second class cars on tomorrow. It would be so arranged that a poor man could go to his work and return for a fare of perhaps 5 cents, while the man who prefers the first-class car would have to pay, perhaps, 15 cents. The cars would be all alike, except that they would be marked first and second class. That wouldn't be class distinction, because a man could take his choice. But it would give our wives opportunity to get more comfortable transportation by the payment of a little more money, and would enable any man who does not like to be jammed up in a mob to get into a car with men and women of his own station in life as regards dress, customs and occupation.

Now, there is a good deal in all this, but so far as we have observed, such a system, if ever adopted on American street cars, will be forced by public demand. The managers prefer the one fare, one car, one type of service, and do not want to bother with anything else. They are providing the public with many variations for which a price is charged, such as theater cars, trolley parties, moonlight rides, etc., but when it comes to the ordinary, regular service, we have not yet met the manager who desires to increase the burden of investment in a varied car equipment. Summer and winter cars are enough for them.

Peruvian Poetry

When one reads of the virulent opposition that is often made against the construction of a trolley line, it is impossible not to be reminded of the manner in which prejudice and ignorance still govern human conduct. It is easy to conceive conditions which render the presence of a trolley line objectionable, but a careful study of the various cases arising shows that the objections usually come from the few rather than from the many, the trolley, the postoffice and the daily newspaper being three of the most democratic institutions ever devised. In many instances the objections are about as reasonable as those of the dwellers along a certain thoroughfare in a far Western town, who having successfully driven the trolley line off to an adjacent avenue, tried not many months after to get an injunction compelling the company to build a parallel line along their street, from which practically all business had been swiftly and inevitably diverted. Now and again, and much more emphatically in these latter days, there is a warm welcome for the trolley, and it is even provocative of poetry. A case in point is a poem by S. W. Gilliam, from which we can not refrain quoting one stanza:

When Horatio played first at the Tiber,
  When the cackling of geese preserved Rome,
When the Liberty bell told the story
  Of a roused people fighting for home,
When wee Charley Ross was abducted,
  When a ball pierced old Sumter clean through—
Then excitement was high; but 'twas higher,
  When the street cars ran into Peru.

The poet explains that all this excitement was due to the fact "That at last, after ages of waiting, a whole street car had entered Peru." In most towns, doubtless, more excitement would be caused by seeing a fragmentary car running through the streets, but, aside from that, the Peruvian welcome was worthy of the occasion, and in no wise to be contemned.

Women as Car Conductors

It is stated that at a recent meeting of the Indiana State Board of Tax Commissioners, representatives of the Madison Street Railway Company appeared to ask for a reduction in their assessment, and in doing so some interesting facts were elicited from C. J. Thompson, who explained to the board why the company discharged all its women conductors. He said the company was dissatisfied with the men in its employ and decided to try women conductors as an experiment, believing they would attract patronage and would be more refined than men. At first the company's expectations were fully realized, for patronage was attracted to the lines and the receipts were greatly increased. In a little time, however, the women conductors began to show marked preferences for certain men, and this caused other men to withdraw their patronage, and this was followed by the women of the city, many of whom refused to ride on the cars. "It soon happened," concluded Mr. Thompson, "that the patronage fell away till a car contained only one passenger and he was talking to the conductor."

This is all very interesting and instructive. There are a good many places in this country where young women have been put on the cars to collect fares in aid of some local church or charity, and the results have usually been very satisfactory; but when it comes to steady daily work of the same kind, the innovation is a failure. It is said that in one or two South American cities women are successfully employed as conductors, but evidently in North America the average conditions are against it, and if we stop to think of the weary and wearing task of the conductor, this should not be surprising. Mr. Thompson is not very gallant in his explanation, but probably told the truth bluntly. We doubt whether in a busy city like New York or Chicago the most attractive young women would have much time for flirting; while,

on the other hand, the general nature of the traffic is such as to preclude any serious idea of their employment.

The question of opening up any new channel of occupation to women is always of interest and importance. Electricity has certainly widened the area of their employment, and at one time it used to be said that the whole operation of a street car system could now be turned over to them. As a matter of fact, while there are a few women prominent in the management of street railways, there are hardly any on the cars or in the power houses, and the Madison incident shows that even as conductors they are not wanted. Cookery, children and church may be less attractive than the car to many of them, but if the "girl bachelors" can not hereafter run the car, they may find some consolation in ejaculating "hello," or "what number," instead of "all aboard" and "step lively."

The London "Busser"

This country, as is well known, exports annually to England large quantities of electric railway material, and nearly all the apparatus used on the roads of Great Britain is made under American patents. But while America has established a tremendous lead in the manufacture of apparatus for electric railways, London has retained, in its 'bus horse, a type of motive power which has always been considered distinctly English—whose stoicism, lumbering intelligence and lack of annoying ambition have caused hundreds of Americans fleeing from the terrors of the "servant-girl problem" to liken him to that tried and trusted individual, the English "man." It has been quite evident to such that nothing but long generations of similar servitude could have created so perfect a fitting to his position, and it comes as something of a shock to read in a recent issue of the New York *Herald* that even this phase of British traffic has finally fallen into the hands of American traders. Whereas, until lately, England and the Continent supplied the thousands of horses used annually in this service, the United States has at last practically gobbled the trade, and it is stated on good authority that fully 90 per cent of the London "bussers" are raised in this country. They find a good place in their new home, however, for the 'bus horse is probably one of the best treated and best cared for work horses in the world, his daily labor being comparatively light, and the feed, stabling and attention he receives being unsurpassed. The general type is akin to that of the express horse—a short backed, short legged, deep ribbed, smoothly turned animal, weighing in the neighborhood of 1250 lbs., with plenty of bone and not too much daylight under him, and with a good degree of snap and activity. An interesting fact which shows that the qualities of the type are appreciated is that the owners of these horses are subsidized by the English government so much per head per year, being paid by the War Office for the right to draft the animals on short notice for military service.

The A. I. E. E. Convention

The eighteenth annual convention of the American Institute of Electrical Engineers was probably enjoyed by more railway men than any previous meeting of the kind. Holding it at the Pan-American Exposition naturally greatly increased the attendance by the addition of those who took the opportunity to "kill two birds with one stone," but the rapid introduction of alternating distribution on urban as well as suburban roads, the joint operation of railway and lighting plants in small towns, the bringing together of men who have drifted into various branches of the profession and other reasons, have made the meetings of the institute in recent years of greater and greater interest to street railway engineers. Elsewhere in this issue we print two extremely interesting papers on street railway subjects which were presented at the convention last week, and it is greatly to be regretted that even more railway men than were present could not have heard them read and partaken in the discussion. While the street railway business is, perhaps, not as strictly confined to electricity as that of lighting, telegraphy or telephony—the subjects of cars, trucks, tracks, schedule and management of employees necessarily occupying a large part of the operators' time—still the importance of keeping abreast of the times in regard to the generation and utilization of the motive part can not be too strongly advocated, and membership in the A. I. E. E. for the engineer of an electric road should be as much a matter of course as that of membership in the A. S. R. A. is for his company. The two papers read by Messrs. Armstrong and Berg show that there is plenty of material in the railway field from which excellent papers can be developed, and if the railway engineers already members can but interest their colleagues there should be, during the coming winter, other valuable discussions on railway subjects. It is a well-known fact that a very large proportion of the output, measured in dollars, of the large manufacturing companies is for railway work, so that, commercially, as well as scientifically, railway topics are of the greatest interest to the electrical profession.

Present Day Practice

The daily papers of New York have lately had various letters about the street cars, chiefly, of course, on what might be done, rather than in favor of what is done. Sometimes a car behind schedule does not stop to pick up a passenger who insists that it shall first come to a dead halt; sometimes in the wet, people have to change cars in order that other people elsewhere in greater numbers may be accommodated; sometimes, the transfers are not frequent enough, and often there are no seats. Far be it from us to insist, with Dr. Pangloss, that whatever is is best; but as those whose constant aim and desire it is to promote improvement in the industry with which we are identified, we can not refrain from saying that much of this criticism does appear either ignorant or perverse; and that when suggestions are offered they point to retrogression rather than embody any "counsel of perfection." For example, a Mr. Callahan, who has been objecting to a variety of things, would change arrangements which we can say from personal observation have been worked out solely in the interest of the traffic, *i. e.*, for the welfare of the passenger. We are glad to note that another correspondent is ready to controvert his views, against the longer car, etc., and we venture to quote the reply, as follows:

> Regarding length of cars, it will be a benefit to all concerned when every car run in the streets of New York is at least 38 ft. in length, which is the length of the longest cars now run by the Metropolitan Company. Even this is less than the length of many of the cars in New Jersey, Massachusetts, and other States. The interests of pedestrians, teamsters and wheelmen are all conserved by long cars. If in one case fifty persons are carried on a car at a time and in another case only twenty-five persons are so carried, it is self-evident that, equal numbers being carried in a day by the two lines, pedestrians and teamsters have to look out for only half as many cars on the line that has fifty-passenger cars as they have to on the line that carries only twenty-five persons to the car. With the shorter cars also the number of stops to take on and let off passengers is greatly increased, thus still more congesting the streets and interrupting other traffic, besides reducing the average speed of travel, which is now altogether too slow.

Now, there can be no doubt as to the benefit to be derived by both company and public from longer cars, up to a certain point. That point depends almost entirely upon the length of car which one conductor can easily take care of, and this in turn depends upon the frequency with which passengers enter and leave the car. Thus it is easy to see that one conductor on an interurban line where the passengers enter and leave at a few points could collect the fares and make the required stops for a very much larger number of passengers than on the Broadway line, for instance, where there may be a change in passengers every block. Nevertheless, the public discussion of these and similar questions is to be commended in so far as it educates people to a true knowledge of the conditions. An alert public sense is a good thing, but it needs to be not less intelligent than alert. This is forgotten by many who would be, and are, the quickest to resent the application of similar criticism to their own methods of conducting business, where it chances to touch the public.

Storage Battery Crosstown Line of the Metropolitan Street Railway Company of New York City

Although this line is not considered as yet either fully completed, or that there is necessarily any finality in the present arrangement of its apparatus, a general description of it may prove of interest, as the only storage battery railway now in operation in this country.

The road runs from the Weehawken Ferry, Hudson River, along Forty-Second Street to Tenth Avenue, down Tenth Avenue to

STORAGE BATTERY CAR, NEW YORK

Thirty-Fourth Street, and then along Thirty-Fourth Street to the Long Island Ferry, East River. It has a length of about 2¼ miles in all, or 4½ miles of single track.

With the exception of the following grades, the line is practically level. There is a 2 per cent grade about 300 ft. long on Tenth Avenue, going north from Thirty-Fourth Street. A 4¾ per cent grade, about 220 ft. long, on Thirty-Fourth Street, going east from Tenth Avenue. A grade of 3½ per cent to 4½ per cent on Thirty-Fourth Street, going west from Third Avenue, about 980 ft. long. In one round trip this makes about 63 per cent of the distance in up grades varying from 2 per cent to 4¾ per cent. The charging station and car house is on the north side of Forty-Second Street, near the river front. It is fully equipped with its own charging generators, battery pits, cars, etc. There are three charging generators, of General Electric make, each consisting of a 400-hp induction motor, direct connected to a 300-kw eight-pole direct-current generator, and run at 500 r. p. m. The motors are run direct from 6600-volt, three-phase mains. The generators have a normal voltage of 180, but have quite a wide voltage variation in order to charge the batteries by progressive rise, or step-up in voltage. Recently, however, a battery booster has been installed by which three bus-bars of different voltages are provided, 164 volts, 174 volts and 180 volts, as will be described later.

The motors are started with a compensation, having several taps connected to points of a special switch, the voltage being gradually stepped up as the motor comes to speed. There is the usual arrangement of switches and pneumatic oil circuit-breakers used in this class of work by the Metropolitan Street Railway Company.

The batteries are connected to the switchboard on one side, through a common return cable, and in the separate leads for the other side there is a current indicating device on the switchboard for each battery. A system of colored lights is used, one set for each battery, and operating simultaneously on the switchboard and at each battery, showing whether the battery is charging or is charged.

Each panel of the charging board has twelve three-way switches, the stud of each of which is connected to the positive feeder leading to a different battery table. By means of this three-way switch the feeder can be thrown on to the low, intermediate or high bus-bar already mentioned, as required. The change from one to the other is made by the station attendant, acting under instructions from the battery attendant. The instructions are given by telephone, as the battery pits are some 500 ft. from the charging station. The novel practice is to charge on the low voltage until the battery takes 60 amps., then change to the intermediate until 75 amps. are reached, then to the high bar until the battery is charged. Each board also carries three ammeters which can be connected in shunt with the several feeders. As there are eight such panels, each with twelve three-way switches, the board has accommodation for ninety-six charging feeders.

The main panel is the booster panel and carries two Thomson astatic voltmeters for each of the two station or booster batteries, also a large throw-over three-way bus-bar switch.

A loop from the street tracks runs in through the front of the car house and out again to the street. It divides into two tracks inside the car house, and runs over the ends of the battery pits, which are just below the floor. There are four openings, occupying the entire width between the rails (two for each battery pit), through which batteries are transferred to and from the cars. There are two battery pits, which run back at right angles to the street, and each has stands for fifty batteries, twenty-five on a side. A hoisting and transfer car runs on a track in the center of each pit.

The cars themselves are mounted on special four-wheeled trucks of the Lorain Steel Company's make, and carry the batteries between the axles, while the motors are carried outside of the axles. The motors are of the G. E. 72 type, and are rated at about 50 hp, the voltage being 140.

The batteries are moved to and from the cars from below by a hoisting and transfer car, which runs on a track in the center of the pit. This transfer car is operated entirely by electric motors, and when the plant is shut down charged batteries in the pit are thrown in at the switchboard and used for this purpose. A single motor, geared to one of the axles, moves the car up and down the pit. There are two hoists, each operated by a separate motor, geared to a grooved drum, which holds the four chains used in hoisting. A framework of I-beams carries the hoisting pulleys, and serves as a guide for the hoist platforms. The operating platform with the motor controlling lever, is in the center of the transfer car, and the hoists at the ends.

The batteries while on the hoisting platform and on the stands rest upon a series of flat-faced pulleys, which are connected together by their shafts with level gearing. A small motor under each hoist platform rotates the pulleys, and thus rolls the batteries to the charging stands. When the battery is opposite a stand, a clutch on the power shaft of the hoisting platform engages with

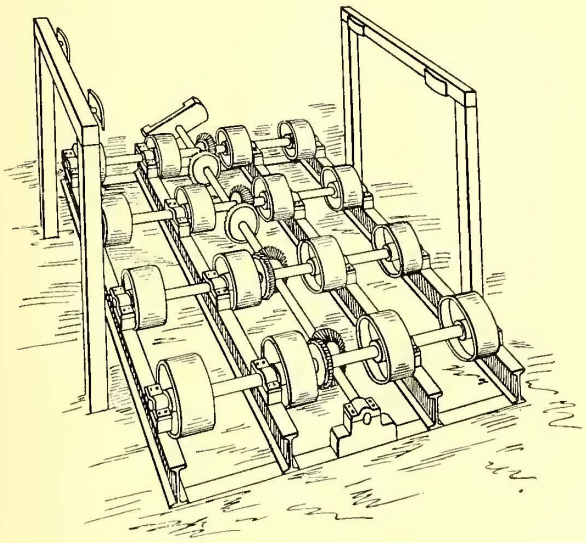
LOADING BATTERY ON TO CAR

the extended end of a shaft from the charging stand, and all the pulleys are revolved, rolling the battery to its place.

The leads to the hoist transfer motor are connected to contact clips in the bottom of the car, and the motor is in circuit only when the hoist is fully down. It is thus impossible when the hoist is down to move the batteries transversely to the level of the charging stands.

Wooden uprights at the side of each charging stand hold the spring contacts, which automatically connect with the battery contact plates when the battery is put in position. There are two contact plates on the side of each upright, one pair being

connected together by a suitable cable, and each of the others on the opposite side being connected to the charging lines, as the batteries are charged with seventy-two cells in series. There are corresponding contact plates on each side of the battery.



GEAR FOR MOVING BATTERY FROM CHARGING STAND TO HOIST

The charging stands consist simply of a framework of I-beams, which provide a solid foundation, and also a rigid alignment for the transfer shafts and pulleys.

The battery for each car consists of seventy-two cells, of special make from the Electric Storage Battery Company, of Philadelphia. The cells are of hard rubber, and are arranged six cells one way by twelve the other way. They are held by a heavy wooden tray, alternate rows being separated by sheets of glass, while the sections into which the battery is divided electrically are separated by a substantial wooden partition. The cells are connected in series in two sets of thirty-six each, the end cells of each set being connected to the contact plates before mentioned by heavy iron straps, which pass along the bottom and up at each end, where they terminate in flat hooks, by which the battery is suspended from the car truck. Along the bottom of each strap is a rib extension on each side, thus forming a channel or guide for the transfer pulleys, which effectually prevents any lateral motion of the batteries.

Each cell consists of nine plates, five negative and four positive, separated by hard rubber spreaders. At the bottom of the cells the plates rest upon two ribs, which keep them well off the bottom, allowing any lead particles that may appear to fall, or be pushed down out of the way, and thus not short-circuit the plates at the bottom.

The negative plates are of the well-known chloride type, with square pellets of prepared lead, held in corresponding spaces in the supporting lead plate. The positives are made up of spirals of prepared lead ribbon, crimped, held in corresponding spaces in the supporting lead plate. The plates have been specially designed for this class of work.

The batteries are inspected as to appearance, manner of gassing and energy input in determining their charged condition.

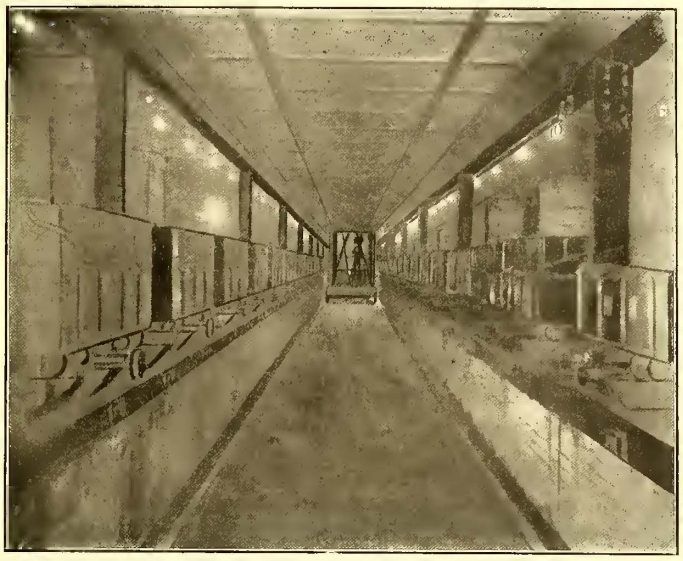
The batteries are divided in halves electrically for the purpose of getting the proper voltage and motor connections used in the controller, as will be shown later. When the batteries are hoisted into the car, electrical connection is made with the car circuit by means of four spring contact plates corresponding to those on the battery trays. These automatically make contact as the battery is placed in position. The battery while in the car is held by the hooks before mentioned, from two substantial bars, which are fastened to the truck by stiff springs.

One point should be noted in regard to the arrangement to prevent wave motion and splashing of the battery liquid. The plates in the cells are arranged at right angles to the direction of motion of the car, and thus serve as admirable dampers to any decided movement of the liquid.

The controller used on the cars is known as the S 7, and is of the same general type as the 500-volt controller of the General Electric Company. The current passing through it is, of course, larger than that for 500-volt apparatus, and is in about inverse proportion to the applied voltages of the two cases.

The controller is of the series-parallel type, and the battery and motor combination are as shown below:

1. Halves of battery in multiple; motors in series; full field.
2. Same as above, except fields are shunted.



VIEW IN CHARGING ROOM, SHOWING HOIST IN BACKGROUND

3. Halves of battery in series; motors in series; full field.
4. Same as above, except fields are shunted.

(Transition steps.)

5. Halves of battery in series; motors in multiple; full field.

SWITCHBOARD IN CHARGING STATION

6. Same as above, except fields are shunted.

2, 4 and 6. Are running points.

1, 3 and 5. Are accelerating points.

There are intermediate points between 4 and 5, which are preliminary to changing the motors from series to multiple. These

change steps are similar to the change steps used for the same purpose on the 500-volt series-parallel controller of General Electric make, viz.: First one motor is short-circuited at one end, and almost at the same instant its circuit is opened at the other end, as shown by the diagram. This motor is then thrown in multiple with the other motor across the battery mains.

These transition steps are not indicated on the controller face, and as the controller is snapped rapidly from step 4 to step 5 the change takes place very rapidly.

Assuming two volts per cell, we have the following voltage on the motors for the various steps:

(1 and 2.) (36 cells $\times$ 2) = 72 volts, 72 $\div$ 2 motors in series = 36 volts per motor.

(3 and 4.) (72 cells $\times$ 2) = 144 volts, motors in series. We have 144 $\div$ 2 = 72 volts per motor.

(5 and 6.) (72 cells $\times$ 2) = 144 volts. Motors in multiple gives 144 volts per motor.

In starting, therefore, the motors have only *one-quarter* of the full voltage applied to their terminals. In each case of change of voltage, although the impressed voltage is doubled in each instance, it should be observed that wherever (in any case) the motor is running with voltage (V) it has a weakened field, and speeds up quickly.

It is under this increased speed condition that voltage ($2V$) is thrown on; but the field is then of full strength, so that the back e. m. f. is greatly increased, and the actual jump in conditions is not nearly as great as might appear at first sight. As a matter of fact, the cars have a very smooth acceleration, and run easily throughout. It is well known also that a sudden draft of current from a storage battery is to some little extent counteracted by a fall in voltage, due to its internal resistance.

With the three generating units it is possible to have all three at different voltages for charging the batteries. The lower voltage can be applied to the battery as it first comes in, while a higher one is put on when it charged sufficiently to prevent a too heavy flow of current. Both two and three steps in the charging voltage have been used.

Starting in the fall of 1900 with one pit and a few batteries and cars, the service has been gradually increased, until at the present time, with two pits in use, about forty-six cars are operated during the rush hours.

The heavy cars accelerate very smoothly, and are exceptionally easy and stable when in motion.

Electric Railway Apparatus*

BY ERNEST J. BERG

With the extended application of electricity to heavy railroad work within the last few years, a number of interesting features have been brought out, the most important being what system to adopt and what apparatus to use in each particular case.

The object of this paper is to discuss the characteristics of the various apparatus, and, to a certain extent, their limitations, which, indeed, have almost entirely the deciding influence on the choice of system. The discussion of storage batteries is purposely omitted, since their characteristics are well known and have been written up very fully within the last few years.

Continuous-Current Generators.—By far the greater number of these are of the direct-connected type. Their frequency varies from 6 cycles to 15 cycles or 18 cycles, and in some cases as high as 25 cycles. This latter frequency is adopted when, in addition to commutator, the generator is supplied with collector rings intended to take off more or less of the power as alternating current; that is, when the machines are "double-current generators." With the exception of more extended use of direct-connected units and double-current generators, which are able to supply alternating as well as direct-current power, very little if any radical modification in design or characteristics has been made during the last few years, but the progress has rather consisted in a steady and gradual improvement of design, especially in regard to sparkless commutator and overload capacity. Although the standard machines are over-compounded, in actual operation, as a rule, the direct-current potential is kept constant at all loads, the over-compounding being used only to compensate for drop in speed with the load. When used as double-current generator, the compounding on the direct-current side is taken care of in the same way as when used as direct-current machine; that is, by series winding, and the compounding for the alternating-current load made by phase control; that is, the load, which usually is rotary converters, is made to take leading or lagging currents which react on the machine and thereby raise or lower the voltage as the demand may be. In order to accomplish this satisfactorily, the double-current generators should have fairly high-armature reaction, which means not too close regulation. This high-armature reaction, usually less than standard direct-current practice, is not objectionable from the direct-current generator point of view, since the regulation of potential is taken care of by the series field. Nevertheless it has been customary to ask for a regulation as close as 6 per cent on the alternating-current side, the intention being not to attempt any phase control, but permit the voltage to drop slightly with the load. Under these conditions, obviously, the closer the regulation the better. The limit is reached when, due to the necessarily low-armature reaction and the many armautre circuits in multiple, the cross current, caused by slight inequality in pole shape or gap, becomes excessive.

Alternating-Current Generators.—These are in almost every case directly connected to the steam engine and operated at a frequency of 25 cycles per second. If, however, a considerable portion of the power must be used for lighting, a higher frequency may be used. It must, however, be borne in mind that satisfactory parallel operation depends largely upon the frequency, and that the tendency to hunt, and in general, the difficulties of operating any installation satisfactory, increase as the frequency increases. Twenty-five cycles has the disadvantage that it is too low for indoor and for efficient outdoor incandescent lighting, and entirely too low for arc lighting, therefore it is hardly advisable to use it for any kind of lighting, but when such has to be done, it is accomplished by rotary converters or motor-generator sets or frequency converters. Twenty-five cycles has, however, so many advantages for railway work that it must be recommended, at least in all cases where induction motor direct-current generator sets are not advisable. The generators are usually designed for a regulation of about 6 per cent to 10 per cent. In view of the fact that usually a great many are operated in multiple in the same station, and, therefore, the load on individual feeders does not seriously affect one machine, it is preferable to go to rather high-armature reaction, since this limits the maximum flow of current and power in case of short-circuit, and suppresses large cross current when operated in multiple from generators of not too close speed control. The European practice is to design these generators with polar windings for securing satisfactory parallel operation, but this has not been found necessary in America, where strict demands have been made upon steam-engine builders, who thereby not only proportion their machines with great care, but pay particular attention to the fly-wheel and governor construction. These generators are always of the revolving-field type, and usually installed in connection with independent fly-wheel; whereas the practice in Europe is to make the armature of such a great fly-wheel capacity as to combine the fly-wheel and armature in one structure. One reason for the universal adoption of the fly-wheel type in Europe is that in most cases 50 cycles are used. With 50 cycles or 60 cycles, and particularly with high-voltage machines, the diameter of the revolving field is, as a rule, enough to render it available as a fly-wheel, whereas with 25 cycles, with relatively low peripheral speed, the cost of an unnecessarily heavy revolving field is often greater than that of an additional fly-wheel. Almost without exception they are designed for three-phase current and voltages ranging between 2000 and 13,000, depending upon the distance of transmission, etc. When used for voltages less than 6000, they have, as a rule, three slots per pole and phase, and for higher voltages two slots per pole and phase. The poles and the slots are shaped so as to give as nearly a sine wave as can be obtained by using machine-wound coils. (The use of machine-wound coils and entirely open slots is contrary to the European practice, at least until very recently, the practice being to use hand-wound coils in almost entirely closed slots.)

Although smaller alternating-current generators are made with automatic compounding, in no case is such compounding used with large direct-connected machines for railway work, but the control is done by hand, and the fields have only one winding.

Inverted Converters.—These are in their constants essentially direct-current machines operating at 25 cycles, and are used to transform from direct current as obtained from the station bus-bars to alternating current, which, after being transformed to higher potential, is transmitted to sub-stations a considerable distance from the main station. The use of inverted converters is decidedly more efficient than the use of boosters, and is being introduced considerably. Although an inverted converter and a straight converter—that is, a machine transforming from alternating to direct current—to all appearances are identical, it is not always advisable to use one or the other indiscriminately. An inverted converter should preferably have lower armature reaction than a straight converter, and consequently is, as a rule, a larger and more expensive machine. The object of the lower

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armature reaction is to obtain closer speed control and to prevent, as much as possible, the tendency of the inverted converter to run away, in case suddenly an alternating-current load of considerable magnitude or of very low power factor is thrown on. But even with inverted converters of such design it is not advisable to omit speed-limiting devices, which may consist of a circuit breaker in the direct-current leads in connection with a centrifugal device, or the inverted converter is excited by a special exciter directly connected or belted thereto. Indeed, such exciter, or "a compensated exciter," is very essential for the frequency control. The plain exciter may be shunt or compound wound, whereby it is easily seen that, as the rotary begins to speed up, the exciter also speeds up and its voltage rises, causing more current to flow through the shunt fields, which has a tendency to prevent acceleration. The compensated exciter, which is also a direct-driven exciter, changes its voltage not only with the speed, but with the phase relation of current, increasing the voltage with lagging current going from the converter and lowering it when leading current is taken, which obviously is just what is wanted for close speed control. The ratio between the alternating-current voltage and the direct-current voltage depends upon the system, characteristics of the machine, etc., and is discussed later in connection with converters proper. It suffices here to state that it is a fraction, or, in other words, the alternating-current voltage is always less than the direct-current voltage. It is, therefore, obvious that the alternating current delivered from an inverted converter is always of too low a potential to be used directly, and step-up transformers have to be used. In its potential control an inverted converter has not the feature of a direct converter of compounding for the load if required, but the voltage will drop with the load unless made up entirely of converters, which, by taking leading or lagging current, can react upon the inverted converter; but even with such load only a very low compounding can be obtained. Therefore, as, a rule, the voltage of an inverted converter will drop with the load. In order to obtain constant potential at the receiving end of the system it is necessary that the converter proper should be compound wound, and that reactances should be inserted in the leads so that the rise in voltage can be obtained across these reactances instead of at the inverted converter. Frequently inverted converters are operated in parallel with alternators on the alternating-current side, and it is then as important to investigate the speed regulation of the prime mover driving the alternator as when contemplating running such alternators in multiple, since the inverted converter naturally runs at a uniform rate of rotation, and, therefore, if the alternators to be run in parallel therewith are not run at a uniform rate of rotation, cross currents will be caused and serious difficulties might arise.

Rotary Converters.—Although converters of a higher frequency than 25 cycles occasionally are used, in most cases, and particularly when the plant is intended for railway work, 25 cycles is chosen, and the discussion will, therefore, apply to them. Were it not that rotary converters sometimes cause trouble by hunting, there is hardly any doubt they would be used universally, even with the limitations in voltage control imposed by their use, instead of synchronous motor or induction motor direct-current generator sets. The question of hunting, however, is so serious that frequently it is good policy to introduce the complication of running two or three machines instead of one, even at the lower efficiency, to insure satisfactory service. Hunting is caused by many circumstances, one being that the rate of rotation of the prime mover is not uniform; another that converters are operated in the same network, but interlinked by lines of relatively high resistance; another that the converter has sluggish magnetic circuit, so that it can not quickly respond to variations in impressed voltage; still another that the impressed voltage on the converter, for some outside reason, tends to fluctuate suddenly. The remedy for the first case of hunting is obviously to get the rate of rotation of the prime mover more uniform, which often is very difficult, particularly if the machines are already installed. (With the stipulations imposed upon the engine builders, this case of hunting is not now so serious, and does not exist when the generators are driven by turbines.) Another remedy which occasionally gives satisfactory results is to use one or more induction motors of considerable size on the same circuit, or even a small induction motor with large fly-wheel, the tendency of the induction motor being essentially to steady the frequency by its momentum. The other cause, that of considerable resistance losses between converters or generators and converters, has a tendency to set up hunting also, since, with a slight fluctuation in current, due to various causes, the voltages fluctuate also. This fluctuation in impressed voltage will react in the rotary converter, and, if the magnetic circuit is not very sensitive, causes a state of unstable equilibrium which leads to hunting. It is obvious that, if the e. m. f. supplied to the armature varies suddenly, the flux also must vary at the same rate to insure the same relative position of the armature and the field. If the magnetism lags behind, the armature must take a different position from what it would have otherwise, and thereby a pulsation in speed is set up and the rotary "hunts." It is, therefore, evident that the magnetic circuit should be as responsive as possible; in other words, all causes delaying change of magnetism should be eliminated. As a consequence it is not best to use magnetic material of low ohmic resistance, such as steel; but a considerable part of the magnetic circuit is made of cast iron which has high ohmic resistance, and damping devices are inserted not in the path of the main flux—that is, in the poles—but midway between the poles. This damping device is only effective when the rotary hunts—that is, when there is an appreciable armature reaction which sets up currents to the circuit formed by the bridge. The last cases of hunting can be explained and remedied in much the same way as in the previous case, and sometimes preclude the use of converters in places where the rate of rotation might be uniform and where the ohmic losses between generators and converters might be small, the disturbing element being a fluctuating load placed near to the converter, and therefore inducing periodic pulsations in voltage on the converter circuit.

Summarizing the hunting situation, we find that, although there are a number of causes for this trouble, the phenomenon is fairly well understood, and no great difficulties need be expected in well-planned 25-cycle systems. The other limitation of rotaries is the difficulty of obtaining wide range of voltage, as compared with direct-current generators, and providing for automatic compounding over a wide range.

Although it is possible to compound rotary converters to some extent by merely using a series field similar to that on direct-current generators, the amount of compounding is very slight, indeed, and is obtained by leading or lagging currents taken by the converter and passing over the very low reactance of the converter armature proper. In order to compound to any considerable extent, it is necessary to have some reactance in the circuit between converter and generator, and to permit the converter to take wattless currents at almost all loads. The proportion of wattless current and reactance can be varied considerably, and still the same results obtained, so, for instance, roughly speaking, 10 per cent compounding can be obtained by 50 per cent leading current and 20 per cent of reactance; or by 20 per cent leading current and 50 per cent reactance, etc. The more reactance over a certain limit, the more liability of an unstable operation and the more wattless current, the poorer the power factor at light loads, and the greater the armature heating; indeed, with quarter-phase or six-phase converters the saving in armature copper is not great over that in three-phase converters if too large a percentage of wattless current is used in phase control. A fair average is to insert about 15 per cent reactance. With such reactance in a circuit of 6 per cent resistance, it is possible to obtain constant potential at all loads with a power factor of 60 per cent at one-quarter load, 91.5 at three-quarter load, 100 per cent at full load, 99.5 per cent at 50 per cent overload, and 96.5 per cent at double load, or even higher if the series field is so adjusted that the converter runs non-inductive at three-quarter load, then a power factor of 73.5 per cent at one-quarter load, 97.5 per cent at one-half load, 100 per cent at three-quarter load, 99.5 per cent at full load, 98 per cent at 50 per cent overload, and 96 per cent at double load. Under these conditions the voltage not only is approximately constant over the whole range of loads, but is still within a fraction of 1 per cent up to 50 per cent overload.

With several rotary converters operated in the same station, it is advisable to use independent transformers, or at least independent secondaries for each transformer, since, if this is not the case, considerable cross-currents are likely to flow if the direct-current brushes on each individual converter are not placed identically the same.

The transformers themselves should preferably be designed with the greatest amount of self-induction, since, as stated above, in almost every converter installation some reactance is advisable. Thus, the essential difference between a transformer used for lighting and a transformer used for converter is that transformers for rotary converters have more self-induction and higher efficiency than lighting transformers, or at least that in the design of these transformers this condition has been looked for.

The great advantage of rotary converters over motor-generator sets is the higher efficiency, due to the small copper and iron losses, and the facts that only one machine is used instead of two or more; that the power factor can be 100 per cent at all loads; that they can act as condensers, and therefore compensate for lagging currents introduced by other apparatus on the system; that, in case of a very heavy load, they can give almost unlimited

power, and that, even as such shunt machines, the voltage does not materially change with the load, but that it will, at the most, vary a few per cent between no load and full load, whereas the direct-current machine probably will vary perhaps 10 per cent or more under the same conditions.

The ratio between alternating and direct-current e. m. f. of a converter or inverted converter depends upon the system used, upon the ratio of maximum to square root of mean square value of impressed e. m. f. (that is, the e. m. f. given by the generating apparatus), upon the load of the machine, upon the ohmic losses in the machine, upon the position of the direct-current brushes on the commutator, upon the excitation, upon the ratio of pole arc to pole pitch, and upon the operating conditions; that is, whether the machine is used to convert alternating to direct-current power, or vice versa. Sixty-cycle converters, which usually have shorter pole arc and higher commutator losses than 25-cycle converters, have, as a dule, higher ratios, and when used as inverted converters, lower ratios than 25-cycle machines.

At no load, with an average wave shape, such as given by standard generating apparatus, the average ratios are:

Percentage pole arc	67%	74%	80%
Three-phase and six-phase double delta	62	61	60.5
Six-phase, diam. and two-phase	72.5	71.5	71

With the average losses at brushes and armature winding, this will give the following ratios at full load of a 550-volt converter:

Percentage pole are	67%	74%	80%
Three-phase and six-phase double delta	63	62	61.5
Six-phase, diam. and two-phase	73.5	72.5	72

INVERTED CONVERTER

Percentage pole arc	67%	74%	80%
Three-phase and six-phase double delta	61	60	59.5
Six-phase, diam. and two-phase	71.5	70.5	70

The values apply when the direct-current brushes are placed on the exact neutral point. If the brushes, for some reason or other, are placed either leading or trailing, these ratios are increased; that is, the direct-current voltage for a given impressed alternating-current voltage is less. This variation may amount to several per cent, therefore moving the brushes makes it possible to lower the direct-current voltage, and thereby change the ratio to some extent without changing the transformer connections. It is, however, impossible to increase the direct-current voltage, no matter in what position the direct-current brushes are placed.

Changing the exictation will also change the ratio. With reduced excitation, that is, with lagging current, the ratio may increase a couple of per cent, and, with over-excitation, it may drop a couple of per cent, depending upon the electrical constants of the machine.

Synchronous Motor-Driven Direct-Current Generators.—These have the advantage over the rotary converters that they can be run on circuits of high voltage directly, without the use of step-down transformers; that the direct-current voltage is independent of fluctuations in voltage on the alternating-current side, and dependent only upon the speed control, and that by a mere change of field excitation the direct-current voltage can be varied over a very wide range. Their limitation, however, is their tendency to hunt, which is quite as marked as with rotary converters. In other words, the limitations inherent to rotary converters exist also with synchronous motors, and even to a greater extent, at least, with synchronous motors wound for high voltages with relatively few slots, with which type it is decidedly more difficult to apply anti-hunting devices than with rotary converters, which, by their more distributed winding and large number of small slots, are less likely to have excessive eddy losses, in the anti-hunting devices. It is, therefore, questionable whether it is advisable to substitute such sets for converters under any conditions, the more so as frequently the cost of a synchronous motor wound for very high voltage is not much less than the step-down transformers and a low-voltage motor.

Induction Motor-Driven Direct-Current Generators.—This combination has decided advantages over the first-mentioned types by its stability, and may, therefore, find considerable field of application in systems of unstable frequency and fluctuating voltage, or installations which already have a number of synchronous apparatus. As stated regarding rotary converters, it is sometimes possible to obtain good results with hunting converters by installing induction motors of considerable inertia on the same circuit, and such a set naturally lends itself very well for this purpose. At moderate voltages, up to, say, 2000 to 3000, induction motors can be built with good constants at a reasonable cost, and do not, therefore, involve the use of step-down transformers. At higher voltages, however, and particularly up around 10,000 volts, it is found that the use of step-down transformers not only introduces much better constants, but frequently makes a cheaper installation. Under these conditions it is decidedly questionable whether it does not pay to install more line copper, remedy the speed control of the generators, or, in general, remove the causes prohibiting the use of rotary converters, since the cost of such motor-generator sets is much higher and the contents much lower than when converters are used.

Direct-Current Railway Motors.—The characteristics of this type of motor are so well known that it is not worth while to discuss them further than to say that in general the tendency seems to have been during the last few years to design the motors for a given train weight and maximum speed, disregarding the number of stops, provided the car is accelerated and retarded at a comfortable rate, which involves, of course, the schedule speed changing with the number of stops.

To accomplish this, the motors are so designed and particularly the ventilating conditions are such that the temperature of the fields will not rise more than a safe number of degrees if subjected to the accelerating current at the rate of, say, ten times per mile, and the armature has such a low core loss that it can run for a considerable time at the maximum speed. Such condition is made possible with the modern mechanical design which readily conducts the heat from the inside to the outside, and

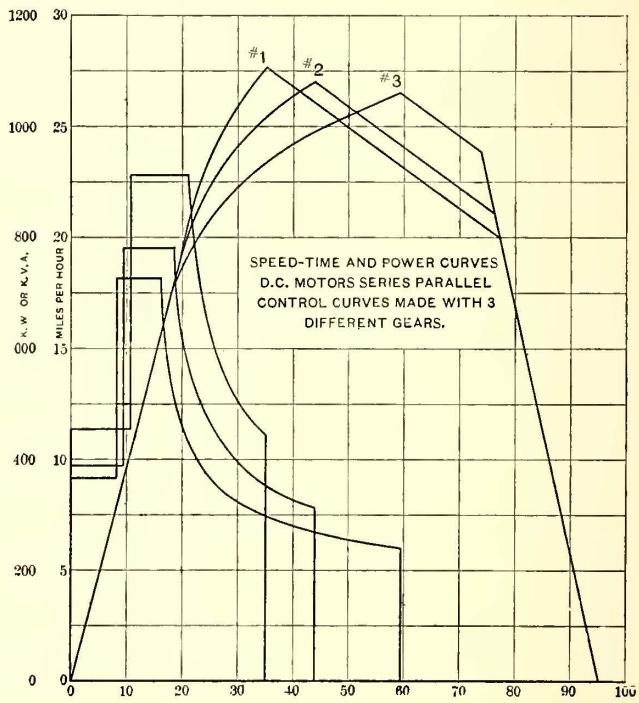


FIG. 1

thereby obviates great differences in temperature. The main difference in electrical design is that much more precaution has to be taken to have low self-induction in commutation. This is necessary since, as stated above, the field winding has to stand the full current of acceleration for a much longer time than formerly was the practice, and, therefore, a less number of turns and a weaker field in general is used in modern motors, this condition causing sparking unless the armature reaction is reduced and the number of commutator segments increased. We therefore find now, as a rule, higher flux and a greater number of commutator segments than in older types of motors.

Alternating-Current Railway Motors.—A very superficial study will show that, whenever this type of motor has been adopted, the reason lies, not with the motors themselves, but in the fact that a lesser amount of feeder copper, and possibly fewer attendants, are required with an alternating-current railway system than with a direct-current system involving rotary converters. It is, however, only in cases of relatively long runs with few stops, or in mountainous roads where power can be returned by induction motors, that economy can be shown with this system as compared with the direct-current system. It is very doubtful whether in many cases where alternating motors have been installed, direct-current motors would not have been better engineering.

The alternating-current railway motors are of the polyphase induction type, and therefore their characteristics are essentially those of direct-current shunt motors; that is, they run efficiently only at one speed, whereas the direct-current series motor will operate at high efficiency over a considerable range of speed. It is, therefore, obvious that in railway service where the speed for

many reasons has to vary during the run, and where cars are stopped and started at rather short intervals, the actual power taken by the induction motor will be greater than that taken by the direct-current motor. Since, furthermore, any induction motor must take a certain amount of wattless current, the apparent power input of the motor must be greater than with direct current. With the same mechanical clearance in the two types of motors, the amount of wattless current taken by the induction motor would be quite prohibitive; therefore these must be made with decidedly smaller air-gap than direct-current motors, which necessitates more careful adjustment, and involves more repair work. The wattless current is also dependent upon the voltage

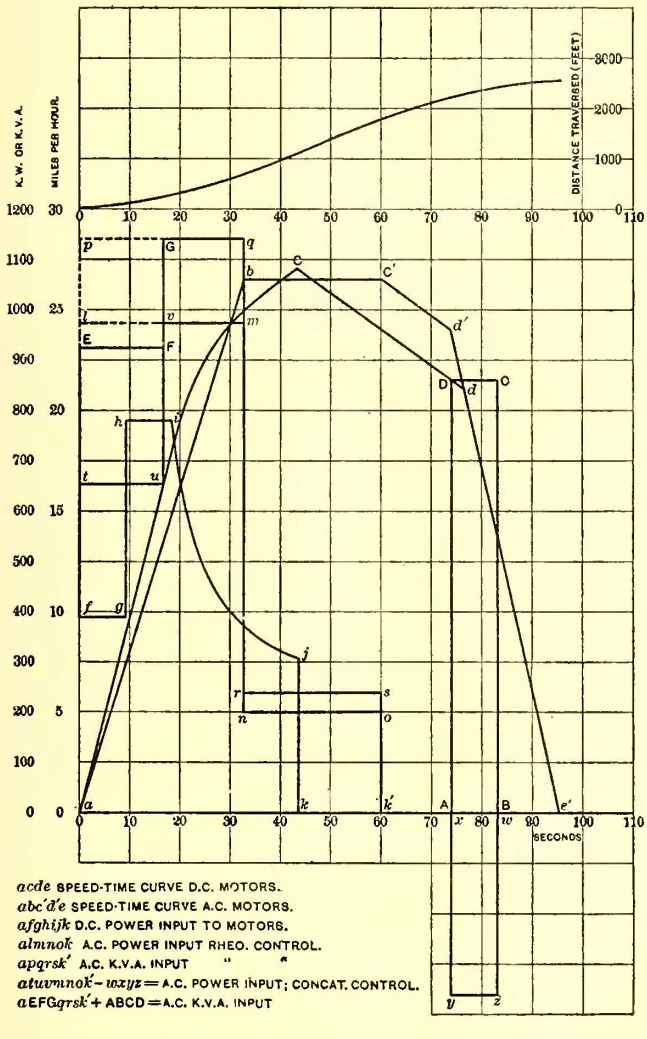


FIG. 2

at which the motors are operated and increases as the voltage increases. With the known methods of insulation and with the limited space available for railway motors, it seems that it is almost out of the question to consider a design at higher potential than 3000 volts. Even with the smallest safe air-gap this will give a power factor of at the most 85 per cent, or 88 per cent at full load under the best conditions, which, with an efficiency of, say, 86 per cent, including gear loss, gives an apparent efficiency of at the most 77 per cent; in other words, the kva input of the motor would be about 30 per cent greater than that corresponding to the work done. Whereas, with the direct-current motor, the power input would probably not be more than 12 per cent or 15 per cent greater than that corresponding to the work done. Therefore, and in view of the laws governing the design of such induction motors, it is to be expected that the copper losses in an alternating-current motor will be decidedly greater than in a direct-current motor. The core loss in the field of the induction motor is also greater than the core loss in the armature of the direct-current motor at maximum speed, so that this gives another source of increased heating of the motor. This increased heating is decidedly objectionable, as it involves the use of a much larger machine than the direct-current motor, which increases the cost and weight of the equipment. To illustrate this somewhat more concisely, consider the losses occurring in a couple of motors of direct and alternating-current type while accelerating from standstill up to full speed. The core loss and eddy losses in the direct-current motor are zero at standstill, and increase to a certain maximum at full speed. In the alternating-current motor at standstill, even under favorable conditions, the core loss in the field is the same as the maximum core loss in the armature of the direct-current machine, and the core loss in the armature at standstill about the same as in the field. At full speed the core loss in the field still remains the same, but the core loss in the armature is zero, and, therefore, roughly speaking, the core loss of the direct-current motor is in the neighborhood of half of the core loss at maximum speed, while accelerating, and is one and a half times as much in the alternating-current motor. In other words, during acceleration the alternating-current motors have three times as much core loss as the direct current. Adding to this loss the greater copper loss, due to the larger power input of the motor, we find, from actual calculations, that the alternating-current motors of good design will have in the neighborhood of four times as much loss as the direct-current motors when operating over

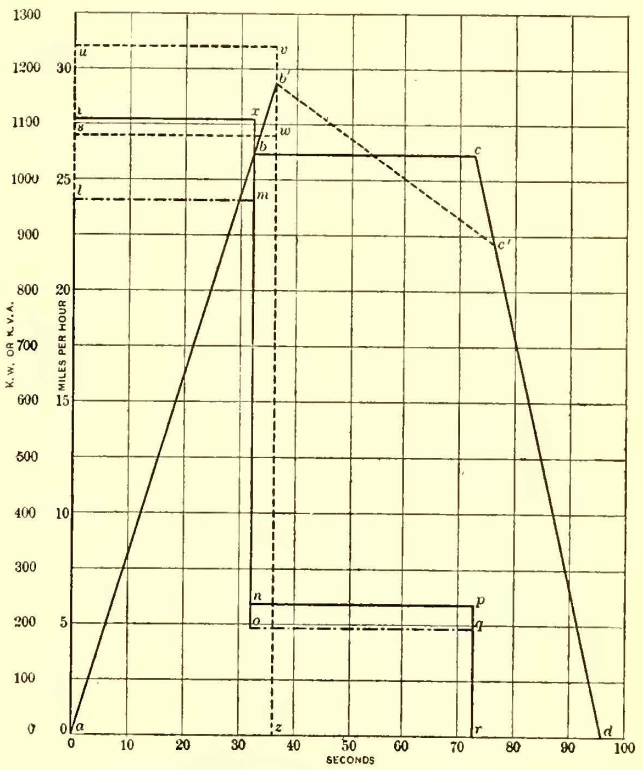


FIG. 3.

relatively short lines, as would be the case in rapid-transit systems. To dissipate four times as much energy means that the volume of the motor has to be very much greater, and its heating facilities decidedly better. This does not mean that the actual heating will be as much more, since, at least in long-distance runs, the time of accelerating is short compared with the total time of the run; nevertheless, the loss will be decidedly more, and consequently it would seem as if the actual cost of the induction-motor equipment per car would be from 50 per cent to double that of direct equipments, depending upon the service. Since the cost of the motor equipment is a very large factor in the installation of a plant, and since the direct-current equipment is so standardized and brought down to the least possible cost here in the United States, this is probably one of the main reasons why, upon careful examination, it has been found not only a saving of power, but great economy in the first cost to install direct-current rotary converters instead of alternating current systems. In places, however, where the direct-current railway system is not so fully developed, the difference in cost between the two systems might not be so much, and that accounts for some European concerns installing alternating-current motors.

To illustrate more fully the characteristics of the two types of motors, the following instance is considered, although it necessarily introduces some questions slightly outside of the scope of the paper.

A double-track road with twenty-seven stations is supplied power

from a station located a distance from the tracks. Eight trains are running in each direction, which cover the entire distance in 52 minutes.

Weight of loaded train, including locomotive = 180 tons (2000 lbs.).

Weight on driving wheels = 50 tons.

Thus maximum draw-bar pull at 25 per cent of weight = 25,000 lbs.

Which corresponds to a maximum acceleration of 2 ft. per second, per second.

Distance of run is 2560 ft.

Schedule speed, 15 miles per hour.

Maximum speed, 27 miles per hour.

Total distance is covered in 95.5 seconds, 20 seconds allowed for stops at each station.

No appreciable grades exist and effect of curves is negligible.

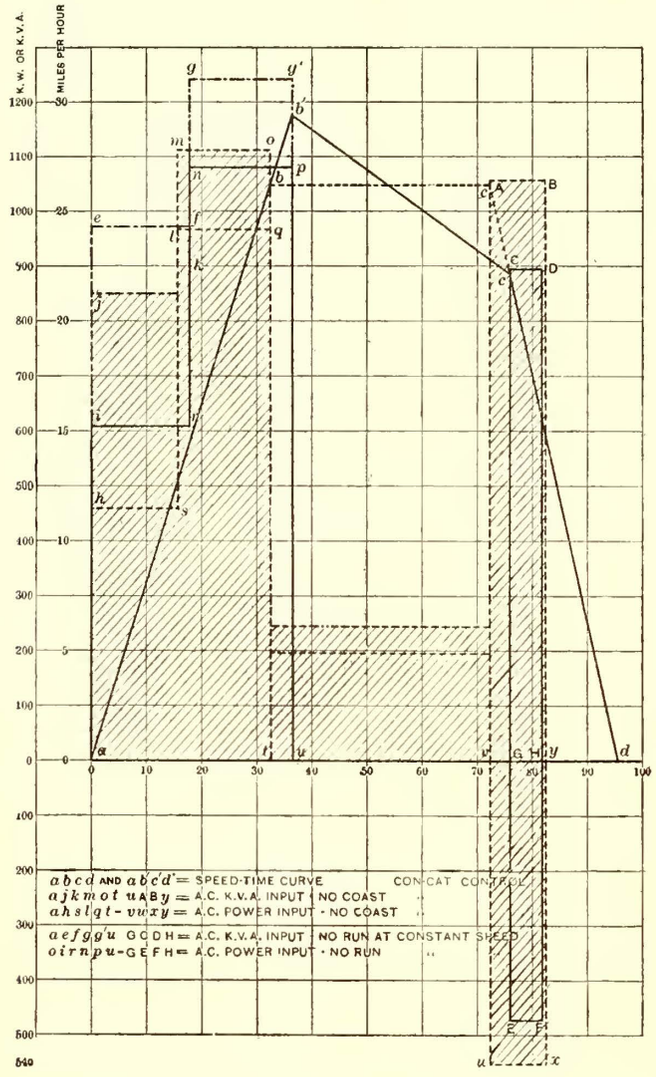


FIG. 4

The three systems considered are:

A. The standard direct-current railway system with series-parallel control of the motors.

B. Three-phase induction motor system with rheostatic control.

C. Three-phase induction system with concatenated control in accelerating as well as braking.

Obviously when running at uniform and maximum speed one system offers no advantage over any other in energy consumption, assuming same efficiency of the motors (which is very nearly the case), while the volt-amperes taken by the motors are about 20 per cent greater with the alternating-current system (running at relatively light load).

While braking, the use of either of the first-mentioned systems is immaterial, since no return of power can take place, but the third, that with concatenated control, offers some advantage in returning power, which, however, is practically offset by the large current taken, and the complication of control and design of motor.

While accelerating, however, marked differences exist in the three systems; therefore the choice of one or the other is largely dependent upon the relative time of accelerating, running at uniform speed and braking. Since, furthermore, the power required with any particular system depends upon the method of accomplishing the run, a number of schedules have been worked out.

So, for instance, in Fig. 1 are given three runs with direct-current motors. Of these, Nos. 1 and 3 require more power than No. 2, therefore No. 2 run is referred to as the direct-current motor run in the discussion following:

In Fig. 2 are given what is considered the best alternating-current runs. One curve shows the conditions with rheostatic control, and the other with concatenated control in accelerating as well as braking. These two curves will be referred to as the alternating-current runs in the discussion following.

In Fig. 3 are given two runs with rheostatic control, both of which take more power than the corresponding run in Fig. 2, and are given merely to show that with widely different methods of running, the power does not vary more than 5 per cent.

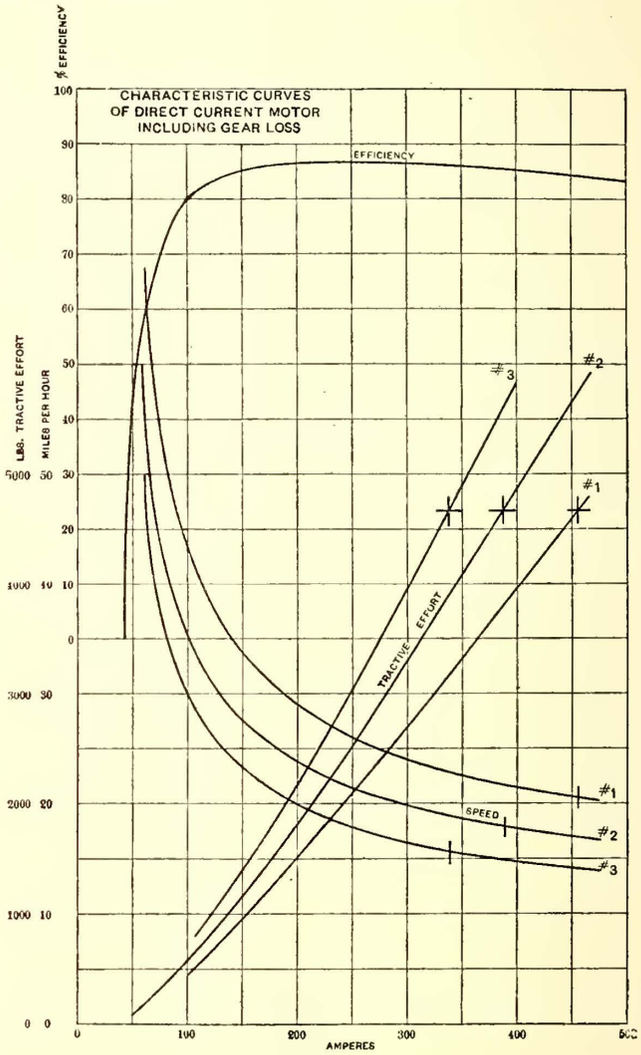


FIG. 5

In Fig. 4 are given two different runs in which concatenated control is used. These seem not so favorable as those in Fig. 2, therefore they are not referred to later except in the general table given below. The chief object of including them is to show the merits of coasting with concatenated motors. As should be expected, if the motors are connected in concatenation, when accelerating only, it is advisable to go up to as high speed as possible, and then coast without running at constant speed, whereas, if power is returned by concatenation, it is advisable to maintain the maximum speed until time of braking.

So, for instance, the least average power taken per run is found if the cars are not permitted to coast, but accelerated and retarded in concatenation, which power is only 15 per cent more than the least direct-current power. The apparent power is, however, 2.4 times as great. In view of this very large apparent power, this method is not the most favorable, but that given in Fig. 2 is preferable.

The important results of the various runs are shown in the table given below, which undoubtedly is more comprehensive than the diagrams for a superficial investigation:

Columns A, B and C are most important, and show the condi-

tions of the best runs. Upon the constants given there and the corresponding curves the rest of the investigation is based.

Columns D and E show two direct-current runs at different gear ratios.

Columns F and G show two runs with rheostatic control only.

Columns H, I and J show three runs with concatenated control in accelerating only.

Columns K and L show two runs with concatenated control in braking as well as in accelerating.

In going over the matter in more detail, are considered the direct-current run, as shown in heavy lines in Fig. 1, and in column A, and the alternating-current runs with rheostatic and concatenated control, as shown in Fig. 2 and columns B and C.

The characteristic curves of the motors are shown in Figs. 5, 6 and 7. Fig. 5 gives the direct-current motor curves, Fig. 6 the alternating-current motor curves, and Fig. 7 curves of the same motors in concatenation. No special curves are given for this latter motor when used as generator to return power, since it is essentially the same as when used as motor.

To sum up the results, it is found, from the various methods of running trains, first, that under apparently the most favorable as well as average conditions, the most economical alternating-current system will take 26 per cent more power and 2.2 times as many volt-amperes as the direct-current system. Second, that the concatenated control takes 26 per cent less power but only 10 per cent more apparent power than the alternating-current system with rheostatic control. It must, however, be borne in mind that these values refer to power input at the motors, not the relations at the sub-stations and power house, as will be seen later.

Power is supplied to four sub-stations located, respectively, 16,600 ft., 17,400 ft., 22,800 ft. and 35,000 ft. from the generating station. The transmission potential is 11,500 volts.

Capacity of Power House, Electrical Machinery, Lines, Etc.—Since the supply of power is located at some distance from the receiving circuit, high-potential three-phase generators are proposed in all three cases.

A. Direct-current motors with series-parallel control.

Installation.—The roadbed has double tracks of 85-lb. rails, and the combined cross section of feeders and trolleys for two tracks is 1 sq. in. of copper. In the calculations all tracks and feeders are assumed inter-connected and the feeder copper strung all around the track.

The resistance of steel rails is assumed as twelve times that of the corresponding copper, and that of bonds as 50 per cent of rails. This gives the ohmic resistance of four rails in multiple between two sub-stations (average 17,100 ft.) as .09 ohms and the corresponding resistance of copper as .159 ohms, or a total resistance of .25 ohms.

Each sub-station has three 650-kw converters (one as spare) and ten 240-kw transformers. The high-potential lines consist of two cables No. 0 B. & S. (one of which is spare) for each of the two distant stations and two cables No. 3 B. & S. for the two nearer stations.

Distance between sub-stations = 17,100 feet.

The transformers have 2 per cent *I. R.* loss and 1 per cent core loss. The converter has 94 per cent efficiency over considerable range of loads. The generating station has four 1600-kw generators (one as spare) and engines.

Referring to Fig. 8 we find that neglecting losses

	kw
Average load in kilowatts on one sub-station is	760
Maximum load on one sub-station is	1,600
Average load on the generating station is	3,040
Maximum load on the generating station is	4,400

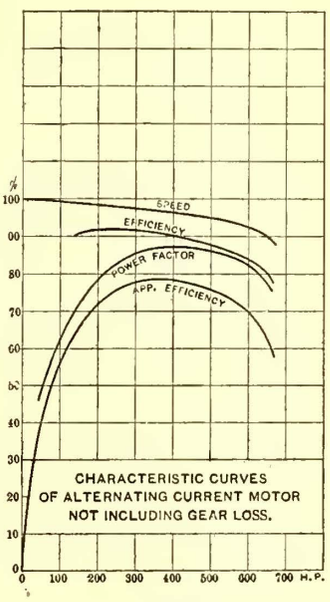


FIG. 6

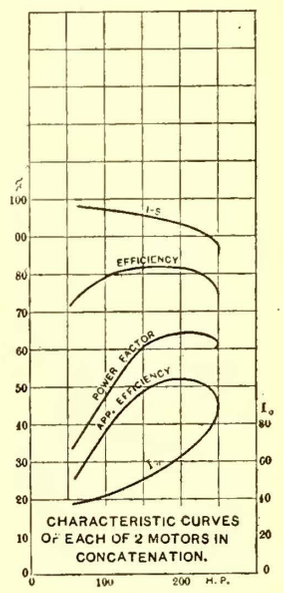


FIG. 7

This brings the average actual load on a rotary converter to 832 kw.

Maximum load on rotary converter	1,910
Average load on generating station	3,650
Maximum load on generating station	5,650

The converters run at 64% load at average load;
" " 146% load at maximum load.
The generators run at 76% load at average load;
" " 118% load at maximum load.

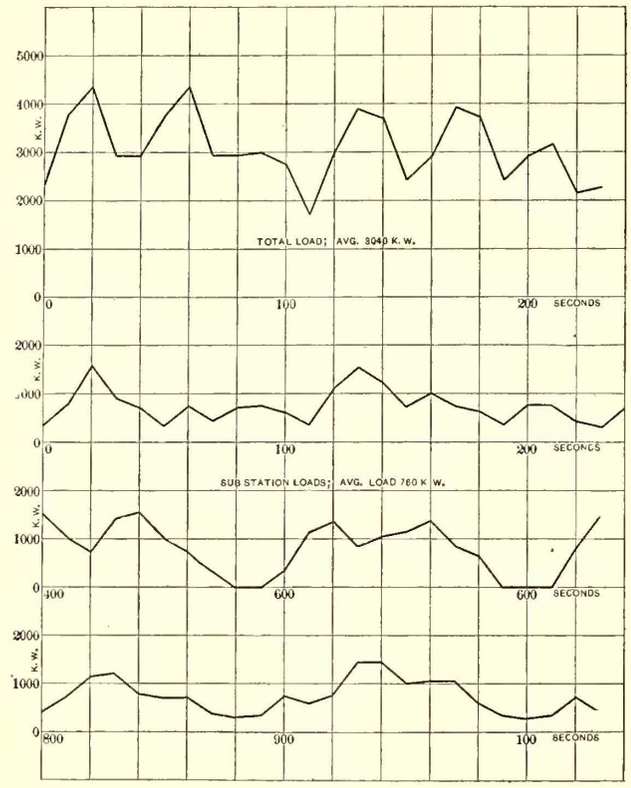
B. Alternating-Current Motors with Rheostatic Control.—The motors are supplied power from four sub-stations at an average potential of 3000 volts over two sets of three-trolley wires, No. 00 B. & S. (inter-connected). Each sub-station has four 700-kw transformers (one to spare). The high-potential lines are two sets of No. 00 B. & S. and No. 2 B. & S., respectively, for the longer and shorter distances.

The generating station has five 1800-kw three-phase 11,500-volt generators and five 1700-kw steam engines.

	D.C. Series Paral. 33 Seconds Coast	A.C. Rheostat 14 Seconds Coast	A.C. Concat. 14 Seconds Coast	D.C. Motors 42.5 Seconds Coast	D.C. Motors 14.5 Seconds Coast	A.C. Rheostat 40 Seconds Coast	A.C. Rheostat No Coast	A.C.—Concat. only when Accel. 40 Seconds Coast	A.C.—Concat. only when Accel. 14 Seconds Coast	A.C.—Concat. only when Accel. No Coast	A.C. Concat. Brake and Accel. 40 Seconds Coast	A.C. Concat. Brake and Accel. No Coast
	A	B	C	D	E	F	G	H	I	J	K	L
KW seconds accelerating	21800	31700	25100	22700	23000	39100	31100	30900	25100	22700	30900	22700
KW seconds uniform speed		5400	5400				7800		5400	7800		7800
KW seconds braking			—3230								—2800	—5400
Total KW seconds	21800	37100	27270	22700	23000	39100	38900	30900	30500	30500	28100	25100
Average KW per run	196	322	237	197	200	340	338	268	265	265	244	218
KVA seconds accelerating	21800	37000	33600	22700	23000	44900	35800	40000	33600	32100	40000	32100
KVA seconds uniform speed		6600	6600				9500		6600	9500		9500
KVA seconds braking			7730								5400	10600
Total KVA seconds	21800	43000	47900	22700	23000	44900	45300	40000	40200	41600	45400	52200
Average KVA per run	190	379	416	197	200	390	394	348	350	362	394	454
Maximum KW per run	780	977	977	912	725	1080	965	1080	977	965	1080	965
Maximum KVA per run	780	1140	1140	912	725	1240	1110	1240	1140	1110	1240	1110
Watt hours per ton-mile	70	120	88	73	74	126	125	99	98	98	91	81
VA hours per ton-mile	70	138	154	73	74	145	146	129	129.5	134	146	168
Ratio $\frac{\text{Average a-c KW}}{\text{Average d-c KW}}$		1.72	1.26			1.80	1.79	1.41	1.40	1.40	1.30	1.16
Ratio $\frac{\text{Average a-c KVA}}{\text{Average d-c KVA}}$		1.97	2.20			2.07	2.09	1.85	1.85	1.92	2.09	2.40
Average P F	1	87	57	1	1	87	86	77	75.5	73	62	48

From the load diagrams, Figs. 9 and 10, is found that, neglecting losses,

	kw
Average power on sub-station is	1,290
Average kva "	1,515
Maximum power "	2,300
Maximum kva "	2,800



LOAD DIAGRAM
D.C. MOTOR; 6ER-PARALLEL CONTROL.
LOSSES NOT INCLUDED.

FIG. 8

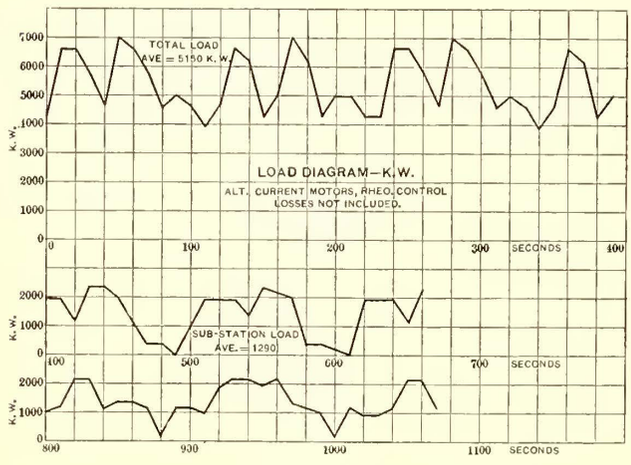


FIG. 9

Average power generating station is			5,150
Average kva	"	"	6,060
Maximum power	"	"	7,100
Maximum kva	"	"	8,300
This gives an average kw output of power station			5,600
" " kva	"	"	6,500
" maximum kw	"	"	7,780
" " kva	"	"	8,880

The generators will run at 90% load at average load;
" " 123% load at maximum load.
The engines will run at 92% load at average load;
" " 126% load at maximum load.

C. Alternating-Current Motors, Concatenated Control.—The secondary net work is laid out as in previous case, but the high-potential lines are duplicate sets of No. 000 B. & S. and two No. 000 B. & S. cables in multiple for the shorter and longer distances, respectively.

Each of the four sub-stations has four 800-kw transformers. The power station has five 2000-kw generators and five 1700-kw engines.

From the load diagram, Figs. 11 and 12, is found that, neglecting all losses,

	kw
Average power on sub-station is	948
" kva "	1,660

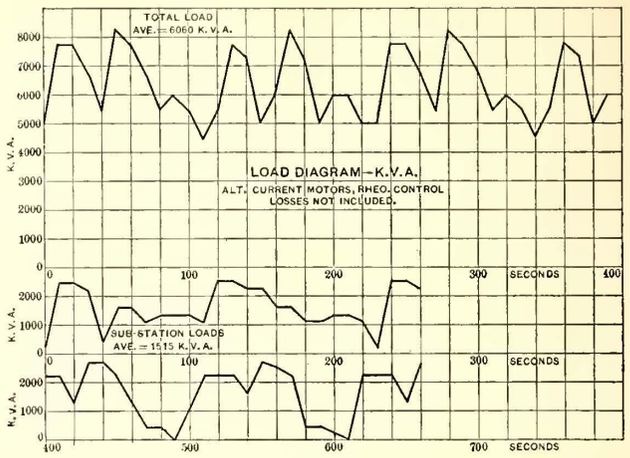


FIG. 10

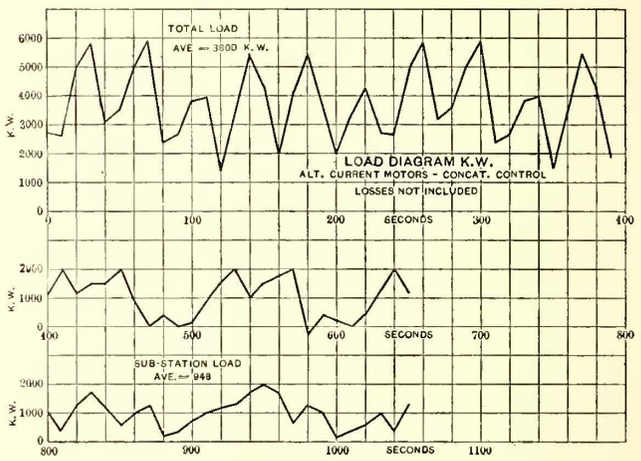


FIG. 11

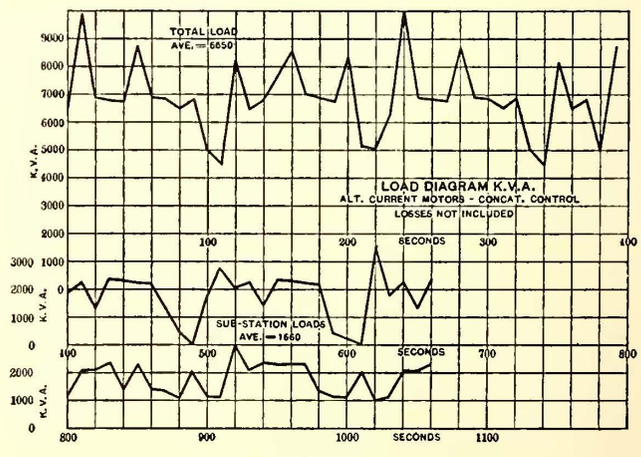


FIG. 12

Maximum power	"		2,000
" kva	"		3,500
Average power on generating station is			3,800
" kva	"	"	6,650
Maximum power	"	"	6,000
" kva	"	"	10,000
This gives an average kw output of power station			4,170
" " kva	"	"	6,850
" maximum kw	"	"	6,000
" " kva	"	"	10,000

The generators will run at 85% load at average load;
" " 125% load at maximum load.
The engines will run at 75% load at average load;
" " 107% load at maximum load.

The selling prices of the various items referred to are assumed as follows:

Complete steam equipment, including installation	$75.00 kw
High potential generators, switchboards and instruments	26.00 "
Rotary converter sub-stations and apparatus	40.00 "
Transformers (700 kw)	4.50 "
Direct-current electric locomotive complete	$15,000.00
Alternating-current electric locomotive complete	19,000.00
Passenger coaches (70 seats)	4,500.00
High-potential cables (10,000-v.) No. 000 B. & S.	1,060.00 per M. ft.
High-potential cables (10,000-v.) No. 00 B. & S.	930.00 "
High-potential cables (10,000-v.) No. 0 B. & S.	840.00 "
High-potential cables (10,000-v.) No. 1 B. & S.	710.00 "
High-potential cables (10,000-v.) No. 2 B. & S.	650.00 "
High-potential cables (10,000-v.) No. 3 B. & S.	600.00 "
Copper	.186 per lb.
Direct-current trolley construction	900.00 per mile
Alternating-current trolley construction	1,200.00 "
85-lb. rails, per ton	26.00
Track construction	500.00 per mile

EXPENSES OF INSTALLATION AND AMOUNT POWER REQUIRED

A. Continuous-current motors with series-parallel control.
B. Alternating-current motors with rheostatic current.
C. Alternating-current motors with concatenated control.

	A	B	C
Power house steam equipment	$480,000	$600,000	$525,000
Power house electrical equipment	166,000	234,000	260,000
	$646,000	$834,000	$785,000
Rotary converter station	312,000	.....	.....
Transformers	.....	50,500	57,500
	$312,000	$50,500	$57,500
17 locomotives, complete	225,000	322,000	322,000
68 passenger coaches	306,000	306,000	306,000
	$531,000	$628,000	$628,000
Cables, duplicate	157,000	172,000	366,000
Trolley and feeder copper	49,000	31,000	31,000
	$206,000	$203,000	$397,000
Track construction	109,000	109,000	109,000
Trolley construction	23,400	31,200	31,200
	$132,400	$140,200	$140,200
Total cost	$1,857,000	$1,856,000	$2,008,000
Average kw power required	3,650	5,600	4,170
Kw average loss	600	440	380
Percentage loss	16.4	7.8	9.1
Percentage of d. c. power	100	153	114
Percentage cost of d. c. installation	100	100	107

It is thus apparent in this particular instance, which is fairly representative for heavy urban work, that the direct-current system offers decided advantages in economy if installed at the same price as the alternating-current system, and that the same economy can not be obtained with alternating current, no matter at which cost; furthermore, that the alternating-current system with concatenated control is preferable to that with rheostatic control. It must, however, be borne in mind that for an actual installation, practical conditions might warrant different amount of machinery and different units, and that allowances must be made for sharp turns, grades, etc., and that the prices given are somewhat arbitrary. The three systems are, however, placed on as nearly as possible the same footing, so that the comparison should be fair, even if the actual cost of the installation is considerably different.

To conclude, it might be stated that due to the favorable characteristics of the direct-current railway motor and the rotary converters, compared with the alternative-current motor for this class of work, very few propositions warrant the use of the alternating current throughout. Indeed, there is no question that the stand taken by the American engineers in this matter in recommending rotary-converter systems almost exclusively, is correct and warranted by considerations of economy and first cost, no matter what the adverse criticisms have been of late. There is undoubtedly a field for alternating-current motors, but it is strictly limited to long-distance schemes with very few stops, or to mountain roads.

Street Railway Companies Do Not Possess Right of Eminent Domain in Ohio

A decision of considerable importance to Ohio electric railways was made last week by Judge Porterfield of the Probate Court of Delaware County, in a suit brought by the Columbus, Delaware & Northern Traction Company, to condemn a private right of way where property owners had declined to sell. The court held that, except in an unusual case where it is necessary to deviate from the highway because of physical obstructions, or because of failure to secure a grant from the County Commissioners, a company chartered as a street railway has not the right to condemn private right of way. It was shown that in the case of the company mentioned no attempt had been made to secure a franchise along the highway. This decision seems likely to affect the plans of companies chartered as street railways. Many of the Ohio roads are chartered as railroads, and, as such, have right to condemn right of way. The decision follows:

OPINIONS

The petitioner in this case, the Columbus, Delaware & Northern Traction Company, seeks to condemn the lands of the defendants for the purpose of its electric railway, and its right to do so is here in controversy.

The plaintiff's petition alleges that it is a corporation, duly and legally organized under the laws of the State of Ohio for the purpose of constructing, operating and maintaining an electric street railway, and that, as such, it has full power to construct, maintain and operate an electric street railway from a point at or near the city of Columbus, through the counties of Franklin, Delaware and Marion, and for such purpose it has the right to appropriate private property for its right of way. And the plaintiff further alleges that it has been unable to agree with each of the defendants as to compensation to be paid them for such right of way.

In the separate answer of each of the defendants it is admitted that an agreement as to the price of the property sought to be appropriated could not be made, but they deny all other allegations in the plaintiff's petition, and by their separate motions, after the introduction of evidence, both by plaintiff and defendants, ask the court to dismiss the plaintiff's petition on the grounds that it has no right to condemn the property sought, and that there is no necessity for its being done, holding that a street railway has only the right to appropriate private property under extraordinary conditions; that is, when some physical obstruction makes it impossible to construct it on the highway without great disadvantage to the traveling public, or when those who have power to grant a right of way over said highway refuse to do so.

It has been argued and submitted to the court that the laws of the State of Ohio allowing the appropriation of private property for constructing, maintaining and operating street railway systems for the conveyance of persons and property are general and are not specific as to kinds of transporting systems; that is to say, a corporation duly incorporated under the laws of this State for the purpose of transporting persons and property has the right to appropriate private property, though that right may not have been specifically delegated to such corporation.

If that be true, we should find continually corporations formed for private interests only, seeking to appropriate private property under the disguise of the right to exercise the power of eminent domain, and individual rights would be trampled upon with impunity, contrary to the spirit and intention of the constitution of the State. Individual rights, the most sacred of all rights, and made so by the constitution of Ohio, are not to be placed in jeopardy because there is a doubt as to the intention of the statute, if there is a doubt. If the statute is not specific in warranting an encroachment upon individual rights, leave must be refused, and individual rights held inviolate. Implied powers will not warrant the taking of private property for public use. It must be expressly stated in the statute, and the statute must be strictly construed, and corporations having a right to condemn must show that right by statute.

These facts have been well settled by the courts. In the case of Atkinson et al. vs. The Marietta & Cin. Ry. Co. (150 St. P., 21) we find these words: "The right to exercise the power of eminent domain can only be derived from legislative enactment, and before a company can demand a judgment of condemnation it

must show that that right has been conferred upon it by a valid law." And in the case of Currier vs. The Marietta & Cin. Ry. Co. we find this language: "There is no rule more familiar or better settled than this, 'The grants of corporate power, being in derogation of common rights, are to be strictly construed, and this is especially the case when the power applied is a delegation of the right of eminent domain, one of the highest powers of sovereignty pertaining to the State itself, and interfering most seriously and often vexatiously with the ordinary rights of property.'" (110 St. P., 222.) And again in the 16th O. S., p. 396, the court states that grants are given to corporation being in derogation of private rights and must be strictly construed.

It has been claimed that in this case, Section 3437 of the Revised Statutes of Ohio, authorizing the erection of street railways, within or without, or partly within and partly without any municipal corporation, gives the right to street railways to appropriate private property to street railway purposes; that the Legislature recognized at this time that street railways would necessarily take on the nature of steam railroads to some extent, and that this section of the statute implies the right of such companies to appropriate private property for the purposes designated in that section. There is no power to condemn stated in Section 343, and we believe there is none implied. It authorizes the creation of what are known as street railways and interurban street railways. We do not think this statute confers upon the street railways any of the powers given to railroads, and that the laws governing railroads are not applicable to street railways, unless specifically made so by the statute, and that street railways can not usurp the power granted by Legislature to railroads and appropriate private property under the statute any more than railroads could usurp the power granted to the street railways and take the public highways for their use. Railroads and street railways are two distinctive systems; are made so by statute, and though by recent legislation steam railroads are permitted to use power other than steam, yet the distinctive character of the two systems remains—the one to make rapid transit from place to place at the shortest distance possible, and the other for the accommodation of the public along the highway and for facilitating travel along such highway.

As has been said by another court, if it is desirable to introduce a new kind of railroad transportation, it should be provided for by suitable laws, so that all parties interested may be able to understand their rights and adjust themselves to the situation, but this is a matter for legislation and not for the court.

To confound the legislation governing the two systems is to encroach upon the rights of individuals guaranteed by all our laws.

A reference to the distinction between the two systems we find in 87 Mich. Reporter, p. 361, in case of Nichols vs. Railway Co. The court says: "A street railway is a railway laid in the street to facilitate its use by the public." In the Federal Reporter 88, p. 588, in the case of Mass. Loan & Trust Co. vs. Hamilton, and in the case of Louisville & Portland R. R. Co. vs. Railway Co., 2 duv., 175, we find that a railroad and a street railway are distinct and different things. Also in O. C. D., vol. 10, p. 212, in the case of the State of Ohio vs. Dayton Traction Company et al., we find these words: "The distinction between two kinds of railways is in the manner of construction and in the mode of operation," and that a "street railway is constructed upon the streets or a highway, and for the purpose of facilitating the use thereof in the transportation of persons and property."

That the court may be well understood at this time, we may recapitulate by saying that the right given corporations to condemn and appropriate private property must be defined by statute, and that the statute must be strictly construed, and that there is a difference in railroads and street railways, and that the laws governing one are not applicable to the other, unless specifically made so by statute, and are not applicable by implication.

Our conclusion this far is, that the Columbus, Delaware & Northern Traction Company is a street railway, as alleged in the petition and as shown by the character of the corporation, and, as such, must be governed by the laws regulating street railways.

Section 3437 R. S. reads as follows: "Street railways, with single or double tracks, side tracks and turnouts, may be constructed or extended, within or without, or partly within or partly without, any municipal corporation, or any unincorporated village; and offices, depots and other necessary buildings for such railways may be constructed."

This is the section giving street railways the right to construct their roads, and under this section the Columbus, Delaware & Northern Traction Company claims its right to build such a railway as has been submitted in its brief. In this section we find nothing authorizing the appropriation of private property by such corporation.

Section 3438 R. S. empowers the Council of a municipal corporation or the County Commissioners with authority to grant a right of way to a street railway company over a public highway within the jurisdiction of such Council or Commissioners. In this section we find no delegated power to condemn private property, and if such right of way has been granted by the County Commissioners, it must be made by order on their journal. At this time we may say that no evidence was introduced to show that the Columbus, Delaware & Northern Traction Company ever obtained the right to construct a street railway over any public highway in Delaware County, and, further, that it is not shown that said company is constructing or intends to construct a street railway over any public highway.

Under Section 3440 R. S. we find that a street railway company may appropriate any property necessary for the construction of its railway, if not expressly waived by owners, providing that a grant had been given to the railway company by the Council of a municipality or a Board of County Commissioners. In this case this has not been done. The plaintiff company has not complied with the requirements of this section, and, therefore, would have no right to seek to condemn private property under this section. The section gives the right, but it is conditional.

Section 3443-8 reads as follows: "Companies incorporated under Section 3226 of the Revised Statutes of Ohio for such purpose may construct, maintain and operate electric street railroads, or street railroads urging (using) other than animal power as a motive power, for the transportation of passengers, packages, express matter, United States mail, baggage and freight upon the highways of this State outside of municipalities."

This section authorizes corporations incorporated under Section 3236 R. S. to construct, maintain and operate electric street railroads, or street railroads, upon the highways of this State, outside of municipalities. As before stated, the general corporation law does not delegate the right to exercise the power of eminent domain, but it is only the authority for creating corporations, and the corporations must get such right from another statute. Neither does Section 3443 R. S. delegate this right. And this statute specifically provides for the construction of such railways upon the highways.

Section 3443-9 gives the right to street railways to occupy and use the public highway for their railway, providing the written consents of a majority, measured by front foot, of the property owners abutting on each of such highways has been secured. Section 3443-8 authorizing corporations to build and operate street railroads upon the public highway necessitated the passage of Section 3443-9 in order that such right of way might be obtained.

Section 3443-10 is as follows: "When necessary to enter upon and use private property the construction and operation of such roads, such companies shall have the same power of appropriation that railroad companies have."

In reading this section we find the words "such roads." To what do they refer? They must refer to such roads as are designated and authorized to be built on the public highway by Section 3443-8 R. S. The general law provides for the construction of street railways upon highways, but the Legislature, anticipating that obstacles would be met with, passed Section 3443-10 R. S., in order that such public improvement might not be frustrated, and that when necessary to appropriate private property it might be done. But we construe and hold that "necessary" here means that it must be shown necessary to deviate from the highway. This the company has failed to do, and has failed to show that it was ever refused a right of way over the public highway in this county by the commissioners of the county. The plaintiff relied upon the right to appropriate given to railroad companies. The court thinks that the plaintiff should show the necessity of deviating from the highway, or as a street railway company, it has no right to appropriate private property. Section 3443-10 is supplementary to Sections 3443-8 and 3443-9.

The motions are sustained, the application refused, and the costs adjudged against the plaintiff.

It is said that the transfer ticket record in Seattle was recently broken, 30,000 transfers having been issued in one day by the Seattle Electric Company. The daily average number of transfers said to be issued in Seattle is 14,000, but it is not out of keeping with the progress of the city that so many transfers are issued. Seattle is at present experiencing a building boom. In fact, the number of buildings actually under construction is larger than in any other city in the United States, but the total cost of these buildings is, of course, exceeded by the larger cities, where more spacious and costly dwellings are being erected. The report recently issued by the Seattle Electric Company bears evidence of the prosperity of the city, and there is certainly a most promising future for this company.

Electrical Developments in Greece

F. W. Jackson, United States Consul at Patras, Greece, writing to the State Department, under date of July 10, 1901, says, in regard to electrical developments in Greece:

"The progress of communication within Greece at present is marked, and promises in the near future to bring conveniences of travel to a level with those of any country in Europe. The Greek Electric Company, otherwise known as the Thomson-Houston Company, established in 1898, with a capital stock of about $1,250,000, of which one-half is paid up, is now completing in Patras the first electric street railway in Greece, and, in fact, in the East. The same company operates the gas company of Patras, the electric light plants of Athens and Piræus, and of four or more other cities, and is now negotiating with the Athens-Piræus Street Railway Company to supply motive power from a central electric station at Phalerum, near Athens. This proposed power station, if constructed, will be on a scale sufficiently large to supply power for manufacturing purposes, as well as for the lighting of Athens, Piræus and Phalerum. It is also current rumor that the Franco-English company, already organized to construct a broad-gage railroad through the north of Greece to Athens, will soon begin operations. The completion of this road will connect Greece with the north of Europe by rail, and trains will be run from Paris to Athens direct via Constantinople.

"Speaking more particularly of the street railway in Patras, the system will be similar to that found in general use in France and Italy. The road has been constructed entirely of iron and with considerable despatch. The motive power will be furnished by gas motors of German construction. The steel rails are from Belgium, while from the United States there will come—from the General Electric Company, of New York—the material for the aerial line, insulators, circuit brakes and car motors; and—from the J. G. Brill Company—the trucks for the cars. The main stem of the road is constructed the length of the city, parallel with the sea, and extends some distance beyond the city limits, to a point suitable for coffee houses and baths. Business men generally believe the road will prove of great benefit to the city, but are skeptical as to the results to the company. It will probably be some time before the road will become a paying investment."

Detail Report of the Twin City Company

Through the courtesy of J. F. Caldewood, auditor of the Twin City Rapid Transit Company, the following comparative statement of earnings and expenses of the company, both fixed and operating, for month of July, 1901, and year to date, is presented. As will be seen, the averages are made up on the basis of the "Motor Hour," or motor car hour. Very few trailers are run, but if a trailer is attached to a motor car it does not, of course, affect the number of motor hours.

The report of the Twin City Rapid Transit Company, published in the last issue, was a special report issued to present certain information to the stockholders, and not an annual report. The regular annual report was issued some time ago.

The Yerkes and Westinghouse London Interests Harmonious

George Westinghouse returned last week from England, where he has been since May 1 on business in connection with the development of the British Westinghouse Company. In view of the rumors of a clash of interests between himself and Mr. Yerkes about the electrical equipment of the District Underground Railway in London, of which road Mr. Yerkes has the control, Mr. Westinghouse authorized a denial of the story.

"At first," said Mr. Westinghouse, "I did not intend to make any statement upon this matter, as I thought the public would not be interested in what I might say. But on account of certain erroneous published statements I may as well straighten out the matter.

"There are absolutely no differences between Mr. Yerkes and myself. As a matter of fact, he has awarded to the British Westinghouse Company the contract for engines of 30,000 hp and generators for his Metropolitan District Railway. He will require much more apparatus, the manufacture of which in England will be advantageous to his interests. It may, therefore, be said that his interests and mine are in harmony, with the probability that these operations, respectively, will be mutually helpful."

On the question of a spirit of hostility which, according to London despatches, is said to have developed in that city against the American control of the Metropolitan District road, and against the improvements on the same by American companies, Mr. Westinghouse said:

"While it is true that some hostility has been displayed, it really does not amount to much. The public want the improvements that are now under way, and while they might prefer to have them as the result of British enterprise, they are glad to have them regardless of the source. Nine-tenths of what has been cabled to America on that subject is exaggerated. I believe such mischievous statements, made by disappointed or scheming people to the London representatives of American newspapers, do great harm to the development of American interests."

A butter and egg dealer of Cincinnati is being prosecuted by the Cincinnati Traction Company for selling and trafficking in transfers. It is said that the man operated the transfer ticket scheme in conjunction with his legitimate business, offering customers, or prospective customers, transfers as an inducement to have them make purchases at his store. The man is said to have had a small army of people supplying him with transfers.

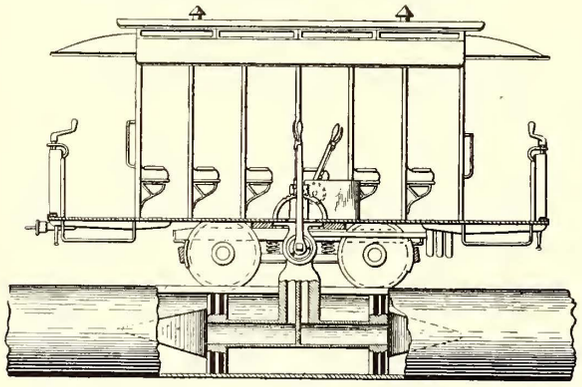
Classification	Current Month.								January 1st to Date—Seven Months							
	1901	1900	Percentages				Amount per Motor Hour		1901	1900	Percentages				Amount for Motor Hour	
	Amount	Amount	Increase	Decrease	Per Cent of Earnings		1901	1900	Amount	Amount	Increase	Decrease	Per Cent of Earnings		1901	1900
					1901	1900							1901	1900		
Passenger earnings	$238,336.00	$247,658.50	16.42	----	99.20	99.12	2.32	1.97	$1,734,234.40	$1,558,744.95	11.26	----	99.20	98.93	2.18	1.93
Miscellaneous	2,312.72	2,163.35	05.96	----	00.80	00.88	.02	.02	13,947.66	16,896.16	----	17.45	00.80	01 07	.02	.02
Total earnings	290,648.72	249,841.85	16.33	----	100.00	100.00	2.34	1.99	1,748,182.06	1,575,641.11	10.95	----	100.00	100.00	2.20	1.95
Maintenance of way and structure.	14,566.33	11,400.31	27.70	----	05 01	04.56	.12	.09	46,914.07	40,067.48	17.09	----	02.68	02.54	.06	.05
" " equipment	14,030.91	10,679.91	31.38	----	04.83	04.28	.11	.09	107,821.49	89,638.11	20.28	----	06.17	05.69	.14	.11
Operation of power plants	19,998.95	14,621.67	36.77	----	06.88	05.85	.16	.12	117,264.46	96,891.41	21.03	----	06.71	06.15	.15	.12
Car service	54,791 51	54,016.82	01.43	----	18.85	21.62	.44	.43	378,967.05	377,460.93	00.40	----	21.68	23.95	.47	.47
General expense	18,152.37	17,932.64	01.22	----	06.25	07.18	.15	.14	93,749.21	95,420.12	----	01.75	05.36	06.06	.12	.12
Legal expense	1,916.66	1,999.99	----	04.15	00.66	00.80	.02	.02	13,416.70	12,999.96	03.21	----	00.77	00.83	.02	.02
Injuries and damages	10,650.08	9,060.95	17.53	----	03.66	03.62	.08	.07	56,830.18	50,240.75	13.11	----	03 25	03.19	.07	.06
Insurance	1,243.00	798.11	55.76	----	00.43	00.32	.01	.00	8,717.17	5,489.51	58.81	----	00.50	00.34	.01	----
Total operating expense	135,349.81	120,510.40	12.31	----	46.57	48.22	1.09	.96	823,680.33	768,208 27	07.22	----	47.12	48.75	1.04	.95
Net earnings	155,298,91	129,331.45	20.08	----	53.43	51 77	1.25	1.03	924,501.73	807,432.84	14 49	----	52.88	51.25	1.16	1.00
Taxes, apportioned	11,000.00	7,656.30	43 68	----	03.78	03.07	.09	.06	74,000.00	53,019.10	89.57	----	04.23	03.36	.09	.07
Interest on funded debt, "	46,575 00	42,566.66	09.41	----	16.03	17.04	.38	.34	308,291.62	317,983.32	----	03 05	17.64	20.19	.39	.39
Dividends 7 p.c. pref. stock, "	17,500.00	17,500.00	----	----	06 02	07.00	.14	.14	122,500.00	117,250.00	04.48	----	07.01	07.44	.15	.14
Interest, premium and discount	245.56	2.80	----	----	00.08	00.00	.00	.00	5,256.44	1,688.38	211.4	----	00.30	00.11	.01	.01
Investment real estate, deficit	--------	75.00	----	----	----	00.03	----	----	--------	525,00	----	----	----	00.03	----	----
Total deductions from net earnings.	75,320.56	67,800.76	11.09	----	25.91	27.14	.61	.54	510,048.06	490,465.80	03.99	----	29.18	31.13	.64	.61
Net income	79,978.35	61,530.69	29.98	----	27 52	24.63	.64	.49	414,453.67	316 967.04	30.76	----	23.70	20.12	.52	.39
Total deductions from net income	--------	--------	----	----	----	----	----	----	--------	--------	----	----	----	----	----	----
Surplus	79,978.35	61,530.69	29.98	----	27.52	24.63	.64	.49	414,453 67	316,967.04	30.76	----	23.70	20.12	.52	.39

Street Railway Patents

[This department is conducted by W. A. Rosenbaum, patent attorney, 177 Times Building, New York.]

UNITED STATES PATENTS ISSUED AUG. 20, 1901

680,704. Electric Traction Road; L. Dion, Boston, Mass. App. filed Nov. 24, 1900. In a stud contact system, the stud contains a quantity of spherical bodies, which are lifted into contact with the head of the stud by magnet on the vehicle to close the circuit between the feeder and the head of the stud.



PATENT NO. 680,843

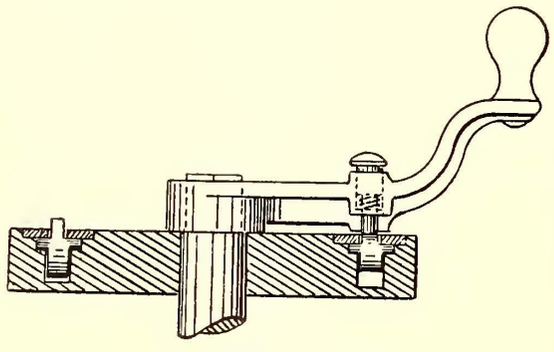
680,768. Brake Mechanism for Railway or Other Wagons; J. K. Ewart, Glasgow, Scotland. App. filed June 3, 1901. A locking device in conjunction with the brake lever for locking the brake after it is applied, so constructed that when the lever is raised to release the brake the lock is automatically released.

680,843. Pneumatic Railway System; C. Comstock, Richmond, Va. App. filed March 13, 1898. A piston connected with the vehicle moves through a tube in the roadbed by reason of air pressure in the tube; a pump on the vehicle exhausts the air on one side of the piston, allowing the pressure on the other side to move it.

680,901. Signaling Device for Cars; W. W. Ward and J. Kean, Fairmont, Minn. App. filed May 15, 1901. Details.

680,919. Trolley Guide; G. F. Heusner, Portland, Ore. App. filed Dec. 13, 1900. Outwardly flaring arms are arranged to be thrown into position to guide the wire on to the wheel.

681,025. Safety Device for Automotor Vehicles; V. Huberti, Berlin, Germany. App. filed March 29, 1901. An elastic roller receives the obstacle and tosses it into a safety net in the rear of the roller.



PATENT NO. 681,167

681,039. Electric Railway; W. Chapman, Washington, D. C. App. filed May 29, 1896. A motor generator takes current from the feeder circuit and supplies it at lower tension directly to the circuit containing the pick-up magnet.

681,103. Brake Lever System for Railway Cars; N. A. Christensen, Milwaukee, Wis. App. filed Dec. 3, 1898. The object is to insure the operation of both power and hand connections on the brake of either truck in case the connections between the lever system and the brake of the other truck is broken.

681,119. Trolley Switch; W. P. Hines, Portsmouth, Va. App. filed Oct. 20, 1900. Details.

681,167. Electrical Controller Attachment; G. L. Fairbrother and A. H. Mathewson, Thompsonville, Conn. App. filed April 19, 1901. The attachment is a circular plate adjusted beneath the controller handle and containing pivoted lugs, which normally stand in the path of the handle; the handle is provided with a plunger arranged to depress the lug out of the path of the handle after they have stopped its movement.

PERSONAL MENTION

MR. F. C. ARMSTRONG, of Dick, Kerr & Company, of London, reached New York from London Aug. 22. Mr. Armstrong will remain in this country about two weeks.

MR. GEORGE H. GIBSON, assistant editor of *Engineering News*, has resigned to accept a position in the Westinghouse Companies' publication department, at East Pittsburgh, Pa.

MR. M. G. STARRETT, chief engineer of the Metropolitan Street Railway Company, returned to New York Aug. 22, after a trip abroad, extending between six and seven weeks. Mr. Starrett's trip was for recreation entirely.

MR. FRANK J. SPRAGUE, of the Sprague Electric Company, of New York, has just returned from a prolonged sojourn in Europe, where, it is understood, he devoted his attention to traction matters, principally in England.

PROF. SIDNEY H. SHORT, technical director of the English Electrical Manufacturing Company, expects to visit this country during October, and will arrive in time to attend the convention of the American Street Railway Association in New York. This will be the first visit of Prof. Short to this country since he took up his residence abroad, and his many friends will be glad to meet him.

MR. A. J. J. PFEIFFER, formerly with the General Electric Company at Schenectady, and for the past three years with the Compagnie Thomson-Houston della Mediterranea, at Milan, Italy, to which place he came principally to study and execute the third-rail, high-speed, electric-traction scheme on the old steam road, Milan-Gallarate-Varese-Porto-Corsico, upon completion of his work severed his connection with this company, and now enters the London office of the J. G. White Company.

MR. S. W. CHILDS, formerly of the Perth, Australia, Electric Tramway Company, and recently constructing engineer for J. G. White & Company, of the Toledo & Detroit Electric Railway, left Aug. 29 on the "Fuerst Bismarck" for London, on his way to Kalgoorie, Western Australia. Mr. Childs is going in the interest of J. G. White & Company to install a large tramway system in that city, to be operated in conjunction with a large electric power plant now under construction, and which will supply power to the gold mines in that district. The machinery for the tramway will be ordered in America, and about 11 miles of track will be installed at present.

MR. RICHARD EMORY, who recently resigned as superintendent and general manager of the Nashville Railway & Cumberland Electric Light Company to accept an important position with the Milwaukee Electric Railway & Light Company, was, just previous to his departure for Milwaukee a few days ago, presented with a handsome gold watch by the employees of the company, as a token of their esteem and appreciation of his valuable service and liberal treatment of them as individuals. Mr. Emory was connected with the Nashville companies for two years, entering their employ as superintendent; and his appointment as general manager of the properties and the improvement he made in the face of adverse conditions are fitting testimonials of his ability. The interest manifested by Mr. Emory in the affairs of the city also won for him the highest respect of the community at large, and resolutions adopted by a committee of the Retail Merchants' Association of Nashville show the high esteem in which Mr. Emory was held.

RICHARD EMORY

FINANCIAL INTELLIGENCE

THE MARKETS

The Money Market

Wall Street, Aug. 28, 1901.

An increasing tendency has developed during the week toward higher rates for money. The call loan department has been influenced by the returning speculative activity on the Stock Exchange, and the enlarged demands from this quarter have raised the average rate to 2¾ and 3 per cent, as against 2½ per cent a week ago. These demands also served to prevent any further reduction of bank loans, the account increasing in Saturday's statement some $3,000,000. Otherwise the leading features in the local money market have undergone little change. There are some indications, notably in the falling rate of New York exchange at the Western centers, that the withdrawals of currency for crop moving are on the increase, but as yet they have not grown enough to offset the gain which the banks are enjoying from out-of-town centers nearer by. Banking authorities are of the opinion, however, that by the end of another fortnight the movement to the West and South will have begun in earnest, and that reserves of the local banks will steadily diminish. The payments against gold arriving from the Klondike and from Australia continue at the rate of between a half million and a million weekly, but they are overbalanced in the Sub-Treasury operations by the collections of the heavy customs revenue, which, owing to the decline in government expenditures, leave the Treasury with a constantly large surplus in their ordinary receipts. This surplus has already amounted to upward of $3,000,000 since the first of July. It now appears that the officials of the Treasury have awakened to the impossibility of altering this condition, without some fresh legislation further reducing the internal revenue taxes. As no such action is possible before the reassembling of Congress in the winter, and as the absorption of funds in the meantime by the Treasury threatens to be an embarrassing factor in the money market, the Secretary has sought to stimulate the offerings of bonds for redemption by agreeing to purchase them in New York as well as in Washington. How far this new order will accomplish the end which it aims at remains to be seen. Bond purchases as a factor of relief are apt to be more effective at a time of high-money rates than they are when rates are low, because there is more temptation to holders of the bonds to sell. But offerings will have to increase greatly from what they have been during the last few months if the disbursements on this account are to make much of an impression upon the current heavy excess of the federal revenue. The probabilities are that from now on surplus reserve of the local banks will steadily decrease, and that money rates will steadily harden. It will then be a leading question whether the higher rates will start a fresh decline in the foreign exchanges and bring gold here from Europe. The sterling quotation has recovered fractionally during the present week, on a slackening in the foreign demand for wheat. The firmer tendency, however, can hardly be more than temporary.

Time loans generally command a higher figure than they did a week ago. For sixty-day loans the rate continues at 4 per cent, but 4½ is asked for ninety days and 4½ to 5 for periods from three to six months.

The Stock Market

The improvement in the stock market, which began a fortnight ago, has continued this week, with sharp advances throughout the entire list and a decided increase in speculative activity, which has reflected a growing public interest. It is obvious that the movement is no longer merely a recovery from the excessive decline of a month ago, but is more in the nature of a fresh advance based on new developments in the general situation. Of these developments the most important is the revelation of the shortage in the foreign wheat harvest, and the consequent appreciation that the whole of the exceptional surplus of the domestic crop will be in active demand at prices which will yield an unusually large profit to the Western farmers. The chief significance of this disclosure lies in its application as an offset to the losses from this season's corn crop. If the amount of corn destroyed by the July drought be taken at 600,000,000 bushels and the price which would have been received under ordinary conditions be taken at 30 cents per bushel, the apparent total loss would be $180,000,000. This year's wheat production will reach somewhere about 700,000,000 bushels, and there has already been an advance of 12 cents per bushel since the combined effect of the corn damage and the prospective foreign demand began to be felt upon the market. Expert opinion in the grain trade would undoubtedly allow that an advance of 20 cents in the average price for the whole yield would be well within the bounds of conservatism. At this estimate there would be a total addition to the value of the wheat crop of $140,000,000. No provision is made in this computation for the effect of the advance in corn prices as a partial compensation for the reduced production; but it will be seen that the contention that the increased profits from wheat will go far toward offsetting the losses from corn is based on a pretty solid foundation. Realization of this fact has contributed, more than anything else, perhaps, to the remarkable demonstration of strength in this week's security market. The Western railroad shares have been bought confidently in the belief that there is little probability now of a reaction from the present prosperity of the agricultural regions and of a decrease in the volume of traffic and the earnings of the roads. More consideration, also, has been given to the plans for combination and for reorganization among the various individual properties. Announcement is looked for before long of the scheme for the financing of the immense Northern Pacific stock purchases of last spring, and it is expected that this will give the holders of Union Pacific valuable rights for subscription to a new share issue. The much-talked-of combination among the Gould roads in the Southwest is also expected to mature in the near future. Were it not for the uncertainty regarding the money outlook, which always makes the speculative public cautious at this season, there is little doubt that the upward movement would continue on the lines indicated for some time further. There are no other disturbing features in the situation, now that the collapse of the steel strike is so plainly foreshadowed. But, with the chances of tight money in the fall, the time is evidently one for the exercise of conservatism in making fresh speculative ventures.

The local traction issues, while undergoing some sympathetic improvement during the week, have not kept pace with the rest of the list either in the volume of business or in the extent of the advance. The reason for this is that no special efforts to put up prices have been made in this group as in other quarters of the list. Some intimation has been given that a new movement would shortly be begun in Manhattan, but apart from the fact that the stock is known to be more closely held than it ever has been before, there is no incentive apparent for the rise. It still looks as if the traction issues would keep in near touch with the fluctuations in the general list.

Chicago

With a few noteworthy exceptions, the shares of the Chicago traction companies have improved during the week. Light dealings have been the rule, except in Union Traction, where the renewal of rumors that control of the property is about to change hands caused some fairly heavy buying, especially in the common shares. Northwestern Elevated sold "ex" the rights to subscribe to the new bonds, and in consequence the market quotation of the common was brought down 3 points. No transactions are reported in the preferred, the holders of which do not seem disposed to sell around current figures. This stock is more closely held than that of any other road in Chicago, the number of shareholders not exceeding 300. The rise in Lake Street and Metropolitan issues is partly due to the publication of large traffic increases for July and to the expectation that equally good results will be recorded both for August and September. It is taken for granted that the next quarterly dividend on City Railway will be reduced, but no one seems to know how much. Nevertheless the stock has sold considerably higher during the week.

Philadelphia

The chief feature of the Philadelphia market during the last week has been the rise in Pittsburgh securities, owing to the rumored deal between the Philadelphia Company and the Consolidated Traction Company. It was currently stated that the political and other obstacles which, up to this time, have prevented a consummation of this project, have now been removed, and that the consolidation plan will now be carried through successfully not later than October. Consolidated Traction rose rapidly from 12 to 24¼, though lost a fractional part of its total rise. The preferred also showed a rise and closed at 60, and Philadelphia Company closed about 52. Union Traction scored a substantial rise during the week of 3 points. The rest of the list followed in general the trend of the New York market.

Iron and Steel

The iron and steel conditions show little change from last week, the market being in abeyance pending the settlement of the strike. Prices show little change except in the affected branches, in which

sellers can secure almost any price demanded if they guarantee deliveries. At the same time there is a general feeling that the worst of the strike has past and the end is expected soon. Quotations are: $15.75 to $16 for Bessemer pig, $24.50 to $25 for steel billets, and $28 for steel rails.

Stock Quotations

The following table shows present bid quotations for the leading traction stocks, and the active bonds, as compared with a week ago; also the high and low since Jan. 1, 1900:

	Jan. 1, 1900 To Date		1901 Closing Bid	
	High	Low	Aug. 20	Aug. 27
American Railways Co.	48¼	27	40	40
Boston Elevated	192	b95	178	178
Brooklyn R. T.	88⅞	47⅛	74⅞	75¼
Chicago City	†285	200	201	209½
Chicago Union Tr. (common)	..	..	15½	17⅜
Chicago Union Tr. (preferred)	..	..	58½	60
Columbus (common)	48	20	46½	47
Columbus (preferred)	103	80	102	102
Consolidated Traction of N. J.	69½	57	67	66
Consolidated Traction of N. J. 5s	110	..	108½	108¾
Consolidated Trac. of Pittsburgh (common).	30¼	20¼	20¾	23¾
Indianapolis Street Railway	48¾	15	46½	46
Lake Street Elevated	16¼	6½	13⅛	13
Manhattan Ry	131¾	84	118⅛	119¾
Massachusetts Elec. Cos. (common)	43¼	15	38½	38¾
Massachusetts Elec. Cos. (preferred)	96	70	92½	93
Metropolitan Elevated Chicago (common)..	37½	24½	36	36
Metropolitan Elevated, Chicago	98½	70	92½	91
Metropolitan Street	182	143¾	166½	167¼
Nassau Electric 4s	97½	..	97½	97½
New Orleans (common)	33½	18¼	28	30
New Orleans (preferred)	108	90	100	101
North American	*106	*74	98	101¼
North Jersey	36	21	22½	22½
Northwestern Elevated, Chicago (common).	52	..	45	38
Northwestern Elevated, Chicago (preferred).	97½	..	85	85
Rochester	31½	12	25	26
St. Louis Transit Co. (common)	35	16½	26¾	27¼
South Side Elevated (Chicago)	119	93	108	108
Syracuse (common)	b23	10½	23	23
Syracuse (preferred)	b65	25	62	62
Third Ave.	135⅛	45¼	121	122
Twin City, Minneapolis (common)	100⅞	58½	97¼	100⅞
United Railways, St. Louis (preferred)	82	..	81¼	80½
United Railways, St. Louis 4s	91½	..	89	89
Union Traction (Philadelphia)	40⅛	24¼	27½	30
United Traction (Providence)	110	107	109	109

a Asked. b Bid. * Quotation of new stock. † High quotation previous to the issue of new stock.

Metals

Quotations for the week are as follows: Copper 16½ cents; lead, 4⅜ cents; tin, 25¾ cents; spelter, 4 cents.

BIRMINGHAM, ALA.—A mortgage and deed of trust from the Birmingham Railway, Light & Power Company to the Old Colony Trust Company, of Baltimore, has been filed in the office of the Probate Judge. It calls for $6,000,000, protecting an issue of that amount of bonds. The bonds are to run fifty years and bear interest at 5 per cent. They are first mortgage gold bonds, and will be used as follows: Bonds in the amount of $1,250,000 are to be set aside to redeem first mortgage bonds of the Birmingham Railway & Electric Company now against a portion of the property of the consolidated company. The amount of $2,000,000 is to be placed in the treasury for future sale. The amount of $2,750,000 is to be sold for immediate use. Of this sum $1,000,000 is to be sold for not less than 77½, and is to be sold for the general purposes of the consolidation; while $1,000,000 is to be used for the purpose of construction to the extent of 75 per cent of the value.

MARION, IND.—It is generally reported that the Union Traction Company, of Anderson, is about to close a deal for the purchase of the Marion Transit Company. It is said that a proposition offering $70,000 for the property has been made.

LOUISVILLE, KY.—The Louisville, Anchorage & Pewee Valley Electric Railway Company has filed a mortgage in favor of the Cincinnati Trust Company, trustee, to secure $350,000 of 5 per cent thirty-year gold bonds. The mortgage covers the franchise, right of way, 14 miles of track and other property. The line to Anchorage is designed to be the beginning of a network of electric interurban lines to cover the whole Blue Grass region. A syndicate is said to be prepared to underwrite $18,000,000 of bonds as the work progresses.

COVINGTON, KY.—It is reported that a proposition has been made by the North American Company for purchasing the Cincinnati, Newport & Covington Railway. It will be remembered that the Cincinnati Traction Company recently made strenuous efforts to secure control of the line. The following is said to be the plan under which the property is to be taken over. The North American Company proposes to form a new company, with a capital of $2,000,000, which shall take over the Union Light, Heat & Power Company, that now owns the gas and electric plants and franchises in Covington, Newport, Bellevue and other villages, and the Cincinnati, Newport & Covington Railway, that controls all of the street railway lines on the other (Kentucky) side of the river. The North American Company now owns all of the stock of the Union Light, Heat & Power Company, the capital of which is $3,000,000. On this there is a bond issue of $1,000,000 4 per cents, which are largely held outside. The stockholders of the Cincinnati, Newport & Covington Railway Company will be taken into the consolidation on a basis of one hundred shares of 4 per cent preferred stock of the new company and fifty shares of common for every one hundred shares of the present stock of the Cincinnati, Newport & Covington Railway Company. This will be equivalent to giving the stockholders of the Cincinnati, Newport & Covington Railway Company one share of 4 per cent stock for one share of the present 3 per cent stock and one share of new common stock for every two shares of the present Cincinnati, Newport & Covington Railway Company stock held.

WORCESTER, MASS.—The Railroad Commissioners have received a petition from the Worcester Consolidated Railroad Company for a further increase of capital stock by the amount of $500,000. The petition states that the sum named is required for the purchase of new equipment and real estate and the further extension of the line. No date has yet been set for a hearing.

STOUGHTON, MASS.—Judge Colt, of the United States Circuit Court, has appointed William Odlin, of Andover, as receiver of the Stoughton & Randolph Street Railway Company, on application of Domonic Guicola, a creditor to the extent of $3,073. The latter alleges that the stated indebtedness of the company exceeds $130,000.

DETROIT, MICH.—A first consolidated mortgage, given by the Detroit & Pontiac Railway Company to the Washington Trust Company, of New York, to secure the payment of $1,100,000 of the twenty-five-year 4½ per cent bonds to be issued for the purpose of providing further double track, power and equipment, was filed for record Aug. 10. The mortgage is dated June 1, 1901, and the bonds are guaranteed by the Detroit United Railways Company.

EXETER, N. H.—At a special meeting of the stockholders of the Seabrook & Hampton Beach Street Railway Company, held at Exeter Aug. 13, it was voted to authorize a lease of the railway to the Exeter, Hampton & Amesbury Street Railway Company for ninety-nine years. The capital stock was increased from $50,000 to $55,000 and an issue of 5 per cent bonds authorized. A special meeting of the stockholders of the Haverhill, Plaistow & Newton Street Railway was also held, and the company authorized an increase of $10,000 in stock, making the total capital $160,000. Portsmouth & Exeter stockholders authorized an increase of $15,000 in stock, making the total $165,000.

JERSEY CITY, N. J.—The stockholders of the Jersey City, Hoboken and Paterson Street Railway Company have voted to guarantee $1,000,000 bonds of the Bergen Turnpike Company.

NEW YORK, N. Y.—Vermilye & Company offer, subject to sale, or advance in price, 15,125 shares, being the unsold balance of an issue of 60,000 shares, of the Worcester Railways & Investment Company, at a price of $100 per share and accrued dividends at the rate of $4.50 per share per annum from Aug. 1, 1901. Vermilye & Company say: "The Worcester Railways & Investment Company is a voluntary association managed by a board of trustees, in whom is vested the ownership of the entire capital stocks (except only qualification shares held by officers of the corporations) of the Worcester Consolidated Street Railway Company, and of certain other corporations, holding charters under Massachusetts laws, which are engaged in enterprises closely identified with that of street railway transportation. The company also controls other securities of the corporations referred to, and other valuable property rights. The corporations controlled by the company have a total bonded and mortgage indebtedness of $1,519,000. The Worcester Consolidated Street Railway Company, as now constituted, is the result of a consolidation of the following Massachusetts street railways, completed March 1, 1901: Worcester Consolidated Street Railway Company, Worcester & Suburban Street Railway Company, Worcester & Marlborough Street Railway Company, Worcester & Clinton Street Railway Company, Clinton & Hudson Street Railway Company, Leominster & Clinton Street Railway Company, Fitchburg & Suburban Street Railway Company. Prior to the consolidation, the companies named had been operated independently. Under separate management and operation, the gross receipts of the old Worcester Consolidated Street Railway Company, which was practically operated only in the city of Worcester, increased 69 per cent from 1895 to 1900. The extent of this increase may be realized when it is stated that the gross receipts of the West End Street Railway system, now controlled by the Boston Elevated Railway Company, increased only 31 per cent during the corresponding period. The present consolidated company has a total mileage of 135.85 miles, and includes not only the entire and only street railway system of the city of Worcester, but also connects that city by numerous suburban lines with the following fifteen flourishing cities and towns in which its railway is also operated: Fitchburg, Leominster, Lancaster, Hudson, Boylston, Berlin, Clinton, Westboro, Marlborough, Northborough, Shrewsbury, Grafton, Milbury, Leicester, Spencer."

BROOKLYN, N. Y.—Notice has been given in pursuance of the terms of the lease of the Brooklyn Union Elevated Railroad to the Brooklyn Heights Railroad Company for 999 years, from July 1, 1901, that the guarantee will be printed on all Brooklyn Union Elevated and Kings County Elevated bonds that are presented at the general office of the Brooklyn Heights Railroad Company, between the hours of 9 a. m. and 12 noon, on Tuesday, Wednesday and Thursday of each week during August and September. The guarantee is in the following form: "For value received the Brooklyn Heights Railroad Company, having been thereunto duly authorized, hereby guarantees the payment of the principal and interest of the within bond, according to the tenor thereof."

SYRACUSE, N. Y.—The Syracuse Rapid Transit Railway Company reports earnings as follows:

Quarter ending June 30	1901	1900
Gross receipts	$159,795	$139,976
Operating expenses	88,394	79,548
Earnings from operation	$71,401	$60,428
Receipts from other sources	1,531	1,299
Gross income	$72,932	$61,727
Fixed charges	56,313	54,444
Net earnings	$16,619	$7,283

CANANDAIGUA, N. Y.—The Ontario & Wayne Traction Company was incorporated Aug. 28 with a capital of $500,000, to construct an electric railway from Main Street Canandaigua, to Pultneyville. The directors of the company are: Senator John Raines, State Commissioner in Lunacy William L. Parkhurst, Assemblyman J. L. Burnett, Walter H. Knapp and J. H. Pardee, of Canandaigua; Deputy State Treasurer B. H. Davis, F. W. Griffith, of Palmyra; J. M. Stoddard, of Shortsville, and L. S. Cuyler, of Pultneyville.

CLEVELAND, OHIO.—The Southern Ohio Traction Company will hold its annual meeting at Hamilton on Sept. 3. Officers will be elected, but it is probable that no changes will be made. The company has declared a dividend of ¾ per cent payable Sept. 1.

TOLEDO, OHIO.—The Toledo Railways & Light Company makes the folowing exhibit of earnings:

1901	Gross Earnings	Net Earnings	Surplus for stock
January	$100,937	$52,288	$26,619
February	88,804	46,037	20,160
March	97,611	53,622	27,841
April	95,913	42,717	17,131
May	99,566	48,604	22,831
June	111,333	59,545	33,761
Six months ending June 30, 1901	594,167	302,815	148,345
Year ending June 30,			
1899	1,006,384	479,386	.....
1900	1,125,187	531,427	.....
1901	1,223,696	628,809	.....

ALLENTOWN, PA.—The negotiations for the sale of the Quakertown & Philadelphia Electric Railway to the Lehigh Valley Traction Company have been successfully closed. The purchase of the Quakertown & Philadelphia Electric Railway, which has under construction an electric railway from Allentown to Quakertown, gives the Lehigh Valley Traction Company a through line from Allentown to North Wales, with the exception of a few miles between Hellertown and Quakertown, which will be built.

PITTSBURGH, PA.—It was rumored Aug. 26 that the Mellons had offered to buy control of the Consolidated Traction system on the basis of $30 a share for the common stock and $60 a share for the preferred. The rumor was amplified by combining all the Mellon suburban lines with the Consolidated, and adding these to the lines to be constructed on the North Side, charters for which have been obtained and franchises granted. This would give the Mellons control of all the traction lines of the two cities and suburbs, with the exception of the Southern Traction and the United Traction, which are controlled by the Philadelphia Company.

PHILADELPHIA, PA.—No official information has yet been given out respecting the sale of the Michigan Traction Company to the Boland syndicate, which is now building a line between Chicago and Detroit, although it is reported that the Railways Company General obtained $60 a share for its 3300 shares of the total 5000 shares of Michigan Traction Company stock, amounting to $198,000. It is generally believed that at the Railways Company General meeting next month a dividend disbursement at the rate of 5 per cent per annum will be authorized, payable on the reduced capitalization of $1,200,000.

PHILADELPHIA, PA.—The Philadelphia News Bureau has the following to say regarding the exhibit of the Union Traction Company for the year ending June 30: "The Union Traction accounts for the year ended June 30, 1901, have now been made up, and will show in the stockholders' report surplus earnings for the year $861,000 over charges of all kinds. The statement, however, will show that there were charged up against earnings two items, namely, fire insurance and paving accounts, aggregating $179,000, that have not appeared as charges in previous accounts. The results were:

Year ending June 30, 1901	
Surplus over interest, rentals, taxes, etc	$1,040,000
Fire insurance and paving funds	179,000
Surplus	$861,000

"In previous years, while these funds were maintained, the sums set aside were not deducted from profits, and while the money has not been spent this year it was deemed best by the management to charge these items up against income, because, it is understood, of the recent agitation of the labor question. The company, therefore, really earned $1,040,000 over interest, rentals, taxes and fixed charges, as against $938,000 in 1900, $617,073 in 1899, $24,620 in 1898, and a deficit of $901,175 in 1877. The comparative increase for the year 1901 over 1900 is $102,000. Operating expenses were increased by the advance in wages about $27,000 per month, or $342,000 per annum, while gross earnings increased something like $450,000, so the increase in the labor item would account for an increase of about $126,000 in net earnings. The average receipts per passenger were about 4.38 cents as against 4.44 cents in 1900. The fire insurance fund payments have been increased from $7,400 to $10,000 per annum, and that fund now stands at between $740,000 and $750,000. Current earnings are stated to be running $2,000 a day ahead of last year."

Tables of Recent Traction Earnings

NAME	Latest Gross Earnings			Latest Net Earnings	
	Week or Month	1901	1900	1901	1900
American Rys. Co.	July	$89,657	$83,718	$.....	$.....
Binghamton Ry. Co.	July	22,480	19,875	12,328	11,351
Brooklyn R. T. Co.	June	1,181,023	1,105,006	*e*448,283	*e*447,126
Chicago & Mil.El.Ry.Co.	July	23,459	18,378	15,770	13,232
Cincinnati, Newport & Covington Ry. Co.	June	72,201	73,965	42,452	42,700
City Elec. (Rome, Ga).	July	3,873	.....	*e* 260	.....
Cleveland El. Ry. Co.	July	210,329	181,856	101,210	87,977
Cleveland, Painesville & Eastern	July	19,143	16,605	11,393	11,057
Consolidated Tr. (Pittsburgh)	July	304,388	282,986	169,299	160,113
Denver City Tramway	July	143,223	119,910	64,320	59,026
Detroit United Ry.	July	291,388	231,247	148,427	110,615
Duluth Superior Tr.	July	45,983	.....	23,866	.....
Herkimer, Mohawk, Ilion & Frankfort Ry. Co.	May	4,508	4,146	1,935	908
International Tr.	May	283,403	203,389	120,993	87,903
London St. Ry.	July	15,303	11,159	6,531	3,818
Montreal Street Ry.	June	180,371	168,244	.....	.....
Northern Ohio Traction.	July	66,898	54,468	33,414	21,587
Olean St. Ry. Co.	Apr.	3,749	3,505	1,741	1,100
Richmond Traction Co.	July	23,543	20,979	8,569	11,434
Rochester Ry. Co	May	80,401	75,749	32,9 0	26,011
Scranton Ry. Co.	July	64,195	59,196	32,299	27,794
Southern Ohio Trac. Co.	July	35,866	31,215	18,855	18,154
Syracuse R. T. Ry. Co.	June	56,952	48,211	26,010	21,305
Twin City Rapid Transit.	July	290,649	249,842	155,299	129,331
United Tr. Co. (Albany).	July	134,370	126,121	54,732	47,466
United Tr.Co.(Pittsburgh)	Mar.	157,792	148,009	70,741	65,511

NAME	Gross from July 1 to Latest Date			Net from July 1 to Latest Date	
	Period Ending	1901	1900	1901	1900
American Rys. Co.	June 30	$844,297	$778,042	$	$.....
Binghamton St. Ry	June 30	190,910	176,210	86,835	79,108
Brooklyn R. T. Co.	June 30	12101 198	11751595	*e*4130,563	*e*3,758,369
Chicago & Milwaukee El. Ry. Co.	*a* July 31	88,920	71,565	46,829	40,828
Cincinnati, Newport & Covington Ry. Co	*a*June 30	384,638	369,938	223,546	220,145
City El. (Rome, Ga.)	*a* July 31	24,138	.....	*e* 2,970	.....
Cleveland El. Ry. Co	*a* July 31	1,264,620	1,147,653	565,227	511,572
Cleveland, Painesville & Eastern	*a* July 31	84,592	74,854	40,614	35,715
Denver City Tramway	*a* July 31	838,502	722,301	378,268	304,849
Detroit United Ry.	*a* July 31	1,554,934	1,381,976	717,462	603,864
Herkimer, Mohawk, Ilion & Frankfort Ry. Co	May 31	48,895	47,026	20,247	21,063
International Tr.	May 31	2,698,332	2,331,632	1,303,216	1,085,748
London St. Ry.	*a* July 31	75,416	60,629	26,698	13,475
Milwaukee El. Ry. & Lt. Co	*d*June 30	918,104	830,674	426,071	389,333
Montreal Street Ry.	*June 30	1349,214	1,256,116	.....	.....
Olean St. Ry. Co.	Apr .30	43,019	39,322	21,735	18,475
Richmond Trac. Co	*c*July 31	175,594	164,197	66,948	77,064
Rochester Ry	May 31	898,156	835,543	337,248	328,021
Scranton Ry. Co.	July 31	374,723	345,044	175,982	144,013
Seattle Elec. Co.	*d*May 31	514,386	412,705	193,192	97,253
Southern Ohio Tr.	*a* July 31	178,821	157,855	74,792	74,172
Syracuse R. T. Ry. Co	June 30	621,299	552,403	280,469	233,268
Twin City R. T. Co.	*a* July 31	1,748,182	1,575,641	924,502	807,433
United Tr. Co. (Albany)	June 30	1,340,356	.....	186,131	.....
United Tr. Co. (Pittsburgh)	Mar. 31	1,434,145	1,321,158	634,423	604,154

* Nine months. † Caused by strike of employees. *a* From Jan. 1.
b Three months. *c* Ten months. *d* Five months. *e* Excluding taxes.

NEWS OF THE WEEK

CONSTRUCTION NOTES

PRATT CITY, ALA.—The Board of Revenue has granted the Steel Cities Railroad Company permission to construct an electric railway through specified sections of the county. It is to traverse the towns of Adamsville, Pratt City, Sandusky, Ensley, Graysville, Brookside, Bessemer and Pinckney City. The incorporators of the company are: E. J. Hudnall, J. B. Stagg, W. H. Barnard, W. J. Outlaw, R. R. Zell, James Regan, George C. Harrison and J S. Kennedy. The following board of directors was elected: J. W. Minor, J. B. Stagg, J. S. Kennedy, I. N. Poe and N. M. Barber. The capital stock of the company is $500,000.

LOS ANGELES, CAL.—The Los Angeles Railway Company is planning to build many important suburban lines, and it is said that the company is now perfecting its plans for the construction of the lines. Lines will be built to Monrovia, 17 miles; to Whittier, 21 miles; to San Gabriel, 9 miles; to Long Beach, 24 miles; to Anaheim, 28 miles.

LOS ANGELES, CAL.—Serious opposition has developed to the plan of Capt. John Cross to build an electric railway on Los Angeles Street. Capt. Cross now has a franchise application pending before the Council.

WILMINGTON, DEL.—The Peoples Railway Company is considering the advisability of issuing a workman's ticket, good between 5 and 7 a. m. and 5 and 7 p. m., for 3 cents. No definite decision has yet been reached.

WASHINGTON, D. C.—It is stated that the City & Suburban Railway is to be extended from Berwyn, Md., now its terminus, to Ellicott City, thus connecting the City & Suburban with the Baltimore, Catonsville & Ellicott City road through to Baltimore. Work is to be begun Sept. 15, continued to Laurel as speedily as possible, and extended to Ellicott City before Jan. 1.

OTTAWA, ILL.—Application has been made to the Secretary of State for a charter for the Illinois River Railway Company. The capital stock of the company will be $150,000, with headquarters in Ottawa; and its purpose is to build an electric railway from Ottawa to Marseilles and possibly Seneca. L. W. Hess, J. I. Warner and Henry A. Sherman are interested in the company.

INDIANAPOLIS, IND.—The Commissioners of Marion County have granted a right of way to the Indianapolis, Morristown & Rushville Traction Company from the corporation line, south, in Sherman Drive, to the Brookville Road, and thence south to the county line.

RICHMOND, IND.—W. D. Riddell, chief engineer of the Cincinnati, Hamilton, Richmond & Muncie Electric Railway, is now making the preliminary surveys for the construction of that line. The preliminary survey starts from Hamilton, coming by way of Seven Mile, Winchester, Ohio, Easton, Ohio, and Boston.

UNION CITY, IND.—The Richmond, Union City & Portland Interurban Railway Company has been incorporated with a capital stock of $50,000. The purpose of the company is to construct an electric railway to connect Richmond, Union City and Portland, passing through the counties of Wayne, Randolph and Jay. The officers of the company are: Clarence S. Pierce, president; Simeon H. Dunn, vice-president; Don P. Shockney, secretary; William Kerr, treasurer; Louis C. Henshann, general manager.

OLATHE, KAN.—The Interstate Traction Company, through its attorneys, Reed & Reed, has made application to the Board of County Commissioners in Kansas City, Kan., for a franchise for an electric railway from the city limits of Rosedale to the Johnson County line. A franchise application covering the same route has also been applied for by William Lakeman. The object of both applicants is to build an interurban electric railway from Olathe to Kansas City.

LOUISVILLE, KY.—The Kentucky Railroad Commission has decided that an electric railway is a railroad within the meaning of the law, and as such is entitled to all the privileges and rights accorded to railroads. This decision was rendered at a special meeting of the Commission to pass upon this question in reference to an electric railway running out of Ashland. This much-mooted question, which arose in the condemnation suits instituted by the Louisville, Anchorage & Pewee Valley Electric Railway, has been argued at great length before County Judge Gregory, who has not yet rendered his opinion.

DONALDSVILLE, LA.—A franchise has been granted for the construction of an electric railway between Donaldsville and the Gulf. The franchise is to run ninety-nine years. A rate of five cents for every mile traveled may be charged passengers, and cars must be run at least every half hour. The promoters of the enterprise are: T. A. Badeaux, L. H. Lancaster and H. S. Smith, of Lafourche, La.; C. P. Young, of New Orleans.

ELKTON, MD.—At the annual meeting of the stockholders of the Cherry Hill, Elkton & Chesapeake City Electric Railroad Company, held in Elkton, Aug. 12, the following board of new directors was elected: M. P. O'Brien, John F. Cahill; W. J. McGregy, of Philadelphia; James F. Powers, John T. Wilson and Ricketts Nelson, of Elkton. M. P. O'Brien was elected president of the company.

PITTSFIELD, MASS.—The Berkshire Street Railway Company has awarded the contract for the electrical equipment for the new road of the Westinghouse Electric Company and Thayer & Company, of Boston. The contract calls for two 750-kw generators, the necessary equipment for the two sub-stations at Lee and Great Barrington, and forty-eight motors for the cars. There will be four double-battery boilers of 1500 hp, costing about $20,000. The contracts for the engines and the building of the power house have not yet been awarded.

WORCESTER, MASS.—The Uxbridge & Blackstone Street Railway Company has begun work on its line which will he the connecting link between Worcester and Providence. The length of the line will be 9 miles, and it is proposed to have it in running order before snow flies. The road will begin at the town line in Linwood. From here it parallels the Milford & Uxbridge Railway, across the flats, and then goes through the villages of Hecla and Elmdale and through private land to where it meets the State road at the road crossing under the New York, New Haven & Hartford Railroad. From here it goes on the west side of the country road until connection is made with the Woonsocket Railway at Millville. The company was formed in March, and at a recent meeting of the directors, Col. T. S. Johnson was elected president of the company; Col. E. B. Stoddard, vice-president, and Frank H. Viele, secretary and treasurer. Taylor & Tylee, of Worcester, have the contract for building and equipping the road.

DETROIT, MICH.—The attention of the Everett-Moore syndicate, of Cleveland, is now turned to the problem of procuring electric power as cheaply as possible, and the syndicate is said to have decided to establish an immense plant in the River Rouge District, several miles below this city, on the river front, for the manufacture of coke and a large number of by-products.

GRAND RAPIDS, MICH.—The Grand Rapids, Kalamazoo & South Haven Traction Company has been incorporated to build an electric railway from Grand Rapids, through Kalamazoo to South Haven, a distance of about 100 miles. The capital stock of the company is $800,000 and the directors are: John J. Patterson, Martin Van Harlingen and J. R. Fell, of Philadelphia; J. Gust Zook, of Lancaster, Pa., and William H. Patterson, of Grand Rapids.

JACKSON, MICH.—Application has been made to the Common Council of Jackson, by the Detroit, Ann Arbor, Ypsilanti & Jackson Railway Company for a franchise to operate an electric railway in this city. This is what is known as the Hawks-Angus Company and the granting of the franchise is being opposed by the Boland Company, so-called.

DETROIT, MICH.—The Rapid Railway Company will build a new line from Anchorville, at the head of Lake St. Clair, to a connection with its present line at Marine City, shortening the distance between Detroit and Port Huron about 9 miles. The company will also build a large car house north of Mt. Clemens, being very much in need of additional facilities of this nature.

LANSING, MICH.—The Lansing, St. Johns & St. Louis Railway Company has made arrangements for the use of power from the Piatt Electric Light Works, and for the use of the tracks of the Lansing Electric Street Railway Company from North Lansing to Lansing. The company has also adopted the final plans for its proposed steel girder bridge over the Pere Marquette Railroad on Center Street, Lansing.

DETROIT, MICH.—Work is progressing rapidly on the Detroit & Chicago Traction Company's line. Work westward, it is said, will at once be commenced at Jackson. The entire line has been marked out, and 22 miles of rails have been laid eastward, connecting Jackson with Chelsea and intervening points. The roadbed is graded for 30 miles, from Jackson to Dexter, and rails are being laid in the 45-mile lap to Detroit. It is estimated that the road will be completed west to Battle Creek by Dec. 1, which will give Kalamazoo electric road connection with the Michigan metropolis. When the line reaches Battle Creek it will connect with the Michigan Traction Company's line for Kalamazoo, and later will be laid to Kalamazoo, Dowagiac, Niles, Michigan City, and other points before it reaches Chicago.

TRAVERSE CITY, MICH.—A proposition has been submitted to the people of Peninsula Township, Grand Traverse County, to bond the township for $20,000 to aid in building an electric railway around the peninsula, touching at Old Mission and a number of other resorts. The Westinghouse Electric Company has looked over the ground and will build the line if the bonds are voted. The citizens of Traverse City are also raising money to aid the enterprise, and there seems little doubt that the line will he built in time to be put into operation next spring.

GRAND RAPIDS, MICH.—The Grand Rapids, Grand Haven & Muskegon Railway Company has its grading practically completed, a large number of ties are laid, pole-setting and wire-stringing is nearly done, work has been begun on laying the iron, and the line will undoubtedly be in operation by Nov. 1, between Grand Rapids and Muskegon. The company is building a telephone line of its own, and booths will be erected along its line, making a complete telephone system. Work on the power house at Fruitport is progressing rapidly. The dynamos and engines are being installed.

MINNEAPOLIS, MINN.—The Twin City Rapid Transit Company has appeared before the City Board of Equalization and made protest against the increase in the assessment of its property. The company is represented by Judge M. B. Koon, its general counsel, and John F. Calderwood, its auditor. Judge Koon declared that the assessment both for last year and this was far in excess of what was equitable. In 1897 the company's assessment was $725,000. The next year it was $1,500,000. Last year the State Board of Equalization arbitrarily placed the assessment at $2,400,000 and the company protested and carried its protest to the courts, where the matter is still pending. This year the company made a voluntary return of $1,900,000 and City Assessor Fort raised the figures to an even $3,000,000.

ELIZABETH, N. J.—The Essex Cross Railway Company, which is planning to operate an electric railway between Elizabeth and Bloomfield, has made application for a franchise in Clinton.

STATEN ISLAND, N. Y.—The Southfield Beach Railroad Company, having had dissolved the injunctions that prevented the operation of the road, is now running cars. The road connects South Beach and Midland Beach.