Street Railway Journal

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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 Tuesday morning of each week, in order to secure insertion in the current issue.

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Chicago Elevated Traffic During the Strike

The figures on daily traffic on the South Side Elevated Railroad, of Chicago, during the two weeks' strike on the surface lines of the Chicago City Railway, which serves the same territory, are interesting as showing what proportion of daily traffic within reach of the elevated line ordinarily patronizes the surface lines, and also the capacity of the elevated road to handle large traffic. It is true that the elevated road was taxed to its utmost to take care of the business which came to it as a result of the strike, yet it met the emergency when it was presented. The daily average in November, 1902, was 83,299 passengers, and during the strike, from Nov. 12 to Nov. 25, 1903, the average daily traffic was increased to 206,000. This exceeded by 10 per cent any like period during 1893, which was the World's Fair year, when the traffic was very heavy toward the close of the exposition season. On Nov. 14, 1903, which was the date of the heaviest traffic, 229,535 passengers were carried. During the rush hours all trains were not run the full length of the line, but some were turned at Thirty-Ninth Street, Forty-Seventh Street and Sixty-First Street. The possibility of doing this without delaying the traffic and without special terminal facilities at these points calls attention to the flexibility of the multiple-unit system, which enables trains to be switched over to the opposite track at any cross-over without delay. The management was, of course, elated over the splendid showing made, and President Leslie Carter expressed their sentiment correctly when he said: "The figures demonstrate the capacity of the road to do a big passenger business in an emergency, and show, also, what can be done later when we have the additional tracks and power now proposed. The November strike crowd was carried with little complaint, and there would have been less if it had been possible to lengthen the loop platforms." With better station and loop facilities and additional power the South Side "L" will be able to contribute materially to the solution of the transportation problem of Chicago.

Restricting Controller Movement

In another column a synopsis is given of some tests recently made at Madison, Wis., to determine the economies introduced by the use of a certain new but tolerably well-known device for restricting the rate of turning on current at the controller. While these tests were made with the avowed object of determining the advantages to be derived from the use of this one particular device, and for the manufacturing company which is introducing it, the results throw some light on the general question of limiting the attempted rate of acceleration by means of devices connected with the controlling mechanism. That there is value in such devices in the minds of others than those directly interested in their manufacture is shown by the introduction of the automatic throttle or limiting coils in connection with several of the most important multiple-unit systems of control.

The original Sprague multiple-unit system had an automatic throttle which limited the acceleration current to a predetermined value for which value the throttle was set. The controller would not advance from one point to another until the current in one motor fell below the current for which the throttle was adjusted. In the first train control system of the General Electric Company no provision was made for limiting the accelerating current, but a device for this purpose has been introduced for the controllers that company is furnishing for the subway cars in New York, and apparatus having a similar object in view is employed in the Westinghouse electro-pneumatic train control system.

The automotoneer, which is the trade name of the device upon which the Madison tests were made, is a purely mechanical device. The rate of advancement of the controller naturally is independent of the current that may be flowing, and depends entirely upon the rapidity of action of an air dash pot which must release the controller after each advancement of one notch. Although depending simply upon a time element and not upon current flowing, the latter device, in most cases, probably accomplishes about the same results as the former, and its simplicity makes it available for use on many cars where a train control system would not be thought of. The matter of restrictions on the acceleration is, therefore, one of immediate interest to the great majority of electric roads, because the apparatus for that purpose now available covers practically the entire electric railway field.

There is undoubtedly much misconception among electric railway men who have not studied the subject as to the real objects for which such devices should be used on a car, some believing that they have many virtues which they have not, and others failing to appreciate some of the real benefits which they accomplish. This confusion is, perhaps, only natural when we consider the literature which has appeared on the subject of acceleration in the last few years. In the first place, we have the technical society papers of any number of eminent electric railway engineers demonstrating that in any kind of a rapid transit schedule where frequent stops are necessary, the greatest economy in the consumption of electrical energy is secured by accelerating the car or train as rapidly as possible and shutting off current as soon as possible, letting the car drift until it is necessary to apply the brakes. The retardation or rate of braking should be also very rapid. It is not necessary to go into an extended discussion on this principle, which is now well recognized, but it is perhaps somewhat confusing at first when it is learned that the same eminent engineers who expound this principle are responsible in part for the introduction in the controlling mechanism of means for restricting the rate of turning on current. Some will ask why any such restrictions should be introduced when it is desirable to have very rapid acceleration, and this question brings us to the fundamental reasons for the introduction of such devices in any class of electric railway service where the stops are frequent. The simple practical fact is that some such limiting devices as those under discussion are an aid in securing rapid acceleration by acting as a guide to the careful motorman and a check on the careless motorman. A careful motorman of good judgment can, it is true, accelerate a car or train very rapidly and smoothly without any such restricting devices, but their use relieves a careful motorman of responsibility in this direction, and also prevents the careless motorman from spinning the wheels, jerking the passengers and straining the entire equipment by too rapid turning on of current. The spinning of wheels during acceleration, of course, defeats the desired end of rapid acceleration by reducing the available tractive effort of the driving wheels. That the jerking of passengers by careless controller handling is a common evil in most large cities is too well known to need repetition.

There is another field for devices of this kind which is entirely distinct from their use on lines where stops are frequent as they are on city surface and elevated lines. This is in interurban service where it is desired to limit the maximum starting current that can be drawn from a power house or substation by a car, and to limit the heating of motor equipments by heavy starting current. In this case the rate of turning on current should be determined not by the amount of current that can be turned into the motors without slipping the wheels, as in city service, but by the maximum current which it is desired to allow any one car to take from the power house. In service where stops are infrequent and the number of cars are few, the matter of rapid acceleration is of comparatively little importance, and frequently the matter of maximum demand on power house or sub-station and heating of motors is of great importance. These two uses for controller electric devices should not be confused with each other, as they are entirely distinct from each other, as said before.

There have been none too many tests made on the economies possible at the controller handle. While full details as to the methods employed in the tests at Madison are not given, they appear to have been entirely fair, and, if anything, have erred in the direction of comparing test runs under conditions least favorable to the restricting device. None but those who have tried it can appreciate the difficulties to be found at every hand when an attempt is made to make a fair test of the economy to be secured by any device of this kind. Special tests lasting only a short period of time are open to many errors that creep into any test where conditions vary so widely from hour to hour as they do in the operation of an electric car. On the other hand, comparison of the commercial performance of a large number of cars with and without such devices on a given road is also very difficult, because on most roads conditions are changing from month to month and from year to year. The only way to determine these points is to test and keep testing, and the results in the aggregate will show where the correct practice lies. Taken altogether, the Madison tests confirm previous results that have been obtained.

One question upon which these tests throw some light is that of the value of reversal for emergency stops in city service. The curve obtained in the tests, which shows the result obtained by the speed recorder on an emergency stop made by reversing, shows that a stop was made from 20 m. p. h. in 88 ft. This is as good, if not better, than the majority of emergency stops that can be secured with the aid of the brake-shoes, as shown in the braking tests published within the last few years. For example, in the tests recorded by J. D. Keiley, in the transactions of the American Institute Electrical Engineers, Dec. 19, 1902 (see STREET RAILWAY JOURNAL, Dec. 27, 1902), a greater distance than this was usually required to make a stop from about 15 m. p. h. It should be remembered, however, that the emergency stop curve shown in connection with the Madison tests represents favorable conditions, and that a too rapid application of the reverse current by the motorman materially increased the distance required to stop. On the other hand, it can be said that too strong an application of an air brake would skid the wheels and so increase the distance required to stop a car by means of the brake-shoes.

Alternating-Current Traction Motors

For some years past we have persistently harped upon the necessity of alternating-current motors for traction if serious railway work was to be attempted in the future. For large distributions high voltage upon the working conductors is little less than a necessity, and no amount of ingenuity can evade the issue. And to work this high-voltage system effectively, alternating-current motors are highly desirable. Upon this theme we have consistently executed a sort of "vox-clamantis-in-deserto" solo, and it looks now as though time were swiftly bringing us vindication. The account of the Finzi motor, and the still more important announcement of the Westinghouse Electric & Manufacturing Company, which we print elsewhere in this issue, that it is now prepared to take contracts for the equipment of electric railways with the new single-phase system, show that this form of motor meets, at least fairly well, the dynamical requirements of electric traction, and that it must be reckoned with as a competitor at least within certain limitations. Adding to this the really remarkable claims made for the motor of the Union Elektricitäts-Gesellschaft, which has already been described in our columns, and the work of Latour, Schüler and others in Europe and Arnold in America, and one has a mass of evidence in favor of single-phase traction that cannot safely be disregarded.

The interesting feature of all this recent work is that the tendency is toward the adoption of types other than the pure induction motor. In its polyphase form this motor leaves little to be desired in the way of good qualities for ordinary purposes, and the recent success at Zossen shows plainly that it is not to be despised for certain classes of railway work. But, as we have often pointed out, the working conductors of a polyphase line form an exceedingly troublesome system save in special cases, and in ordinary tramway work the polyphase motor is handicapped by troublesome regulation and inability to make up time conveniently. The pure monophase induction motor is in a far worse case in these latter particulars, and has in addition a bad power factor. Hence, this curious simultaneous recurrence to alternating motors with commutators—either series motors with laminated poles and extra low inductance, or repulsion motors of the form devised by Thomson, or some combination of these forms. The series form has been long known and was worked upon a decade since by the late Rudolf Eickemeyer with somewhat promising results. But in spite of careful design and high-resistance commutator leads, such motors have hitherto been afflicted with serious sparking, and both they and the repulsion motors have shown bad power factors, save when running at a fair speed. That these serious objections have been overcome, or at least materially reduced, in the motors now before us, seems beyond question.

In point of efficiency the alternating motors cannot be fairly expected to surpass the present types, or to equal them while retaining the same general constants of design, but it is altogether probable that the difference in practice will be vanishingly small. When, however, the rheostatic control losses with the direct-current motor are taken into consideration, any difference in motor efficiency disappears in the cases of short runs; and when we consider the total losses on the system the advantages of the single-phase motor become still more apparent. Mr. Lincoln, in discussing the Westinghouse single-phase motor, places the point at which the car efficiency of the two systems coincides as being in runs of about a mile in length. Where the average run is shorter, the alternating-current car equipment is more efficient, owing to the practical elimination of controller losses. Where the runs are longer, the direct-current equipment is more efficient. In comparing the total loss, however, in the two systems, the alternating-current efficiency stands out in striking contrast. In the example selected by Mr. Lincoln, it is 81.6 per cent as against 61.5 per cent in the direct-current system.

We are not disposed to get excited over the matter and to predict that the new motors will shortly drive both direct-current and polyphase motors into oblivion, but the time is certainly here when the alternating-current traction motor must be reckoned with as a real competitor, and cannot longer be put aside with contempt. At the time of the Inner Circle litigation, we took occasion to make some predictions on the possibilities of alternating-current motors, which were criticised in some quarters, but the developments of the last year have proved the truth of our contention. We do not mean to claim now, nor did we then, that the alternating-current motor, when developed, will do all that the direct-current motor can do and more, but we do believe that the field which it will fill will be commensurate in size with that of its direct-current counterpart. It is possible that none of the motors now being exploited will take a prominent place in the art, but it is equally certain that the larger requirements of electric traction demand a more rational system of distribution than can be provided by the rotary converter. The latter should be looked upon merely as a useful makeshift. In the very near future there will be hot competition as to what form of alternating-current motor can be used under different conditions, and in some cases what form will best replace the direct-current motor, and the wise thing for American engineers and manufacturers to do is to realize this fact.

Relieving Congestion on Brooklyn Bridge

The opening of the Williamsburg Bridge will be hailed by all who have occasion to cross the East River daily, especially during the rush hours, as this will greatly relieve Brooklyn Bridge. The new bridge connects with a large and important manufacturing district, it has much greater capacity than the present structure, and the arrangements for transportation lines are on a much larger scale than could ever be provided by the first structure. It is 118 ft. in width, as compared with 85 ft., the width of the Brooklyn Bridge. It also has two decks instead of one, two foot walks, each 10½ ft. in width, two bicycle paths, each 7 ft. wide, four trolley tracks, two elevated railway tracks and two roadways, each 20 ft. in width. The old bridge has one promenade 15 ft. wide, two roadways, each 18 ft. wide, and each giving half of its space to the trolley tracks, and two elevated railway lines.

The trolley lines on the new bridge will greatly increase present facilities, as there will be four tracks running in a space especially devoted to their use, thus providing facilities for operating 350 cars an hour, and handling 70,000 persons traveling in both directions, as against 40,000 an hour on the old structure. Moreover, there will be no interference from trucks, wagons or carriages, and the elevated railroad will provide for the carrying of at least 29,000 persons in one direction every hour, or 58,000 persons going and coming across the bridge, thus raising the maximum to 128,000 an hour.

Mr. Wheatley contributed a valuable series of articles on "The Passenger Traffic Problem of Greater New York," to the Street Railway Journal early this year, in which he pointed out the great advantages that would accrue to the city from these added facilities and the relief that would be afforded the increasing congestion of the transportation service of Manhattan, as well as the present facilities of Brooklyn Bridge. His concluding article, which appeared on Feb. 7, 1903, was an able exposition of the relations between Manhattan, Brooklyn and Queens, and the influence which improved transportation facilities would have in building up the boroughs across the East River. It may be read again now with interest.

American Railway Mechanical and Electrical Association Work

The executive committee of the American Railway Mechanical and Electrical Association met at Cleveland this week to lay out general lines of work for the next convention and take such steps as naturally fall on such an organization.

Leaving to another time a fuller consideration of the timeliness and usefulness of the subjects chosen, it can be said that the executive committee has acted wisely in its method of handling the programme. It is a plan that has been followed with much success in similar organizations with which we are acquainted. Various members of the executive committee and other prominent members are each assigned the responsibility for the securing of papers and discussions on a certain subject. It will materially benefit everyone concerned and be very acceptable to the executive committee if those interested will communicate with the members having charge of the various subjects as to men who are especially fitted to discuss the subjects of which they have charge. This new Association certainly has a great work before it, and the earnest manner in which it is going at it shows that its officers and members are equal to the task. Although being new the Association is not, perhaps, as well known and recognized as it will be another year, and the membership and support it is receiving from every quarter assures its continued success and usefulness.

THE METHODS OF HANDLING THE MEN ON THE CAMDEN & SUBURBAN RAILWAY

It is the intention, in the present article, to give in detail the methods followed by the Camden & Suburban Railway Company not only in engaging, instructing and managing the force of men which operates its cars, but also the system followed in preparing the time-tables, assigning the runs, disciplining the men and discharging them if inefficient. In handling its men the company has followed, in many respects, quite novel lines, being the only one, so far as the editors of this paper are aware, which has adopted a regular system of demotion with its employees. This plan has been in use on the Camden & Suburban Railway for two years and a half, with most successful results, being satisfactory to both the officers and to the men themselves.

ENGAGING EMPLOYEES

The company exercises the greatest care in the selection and engagement of its employees. When a man applies for a position he is obliged to fill out the usual blank, in regard to his physical condition, past history and reasons for wishing employment. He is then obliged to give at least three references as to his character. Letters are not sent to the parties whose names are given as reference unless they are some distance away. If they are in Philadelphia or Camden, a representative of the company is sent to them, as experience has shown that a former employer will often give a man a very good testimonial in writing, but if he is interviewed personally he will mention faults in the man's character which he would hesitate to express in black and white. These reports are filed with the application for employment. One question which is always asked every prospective employee and which is not found in the question blank of many roads is whether he has a job at the time of making application for employment, and also his average wages per week during the previous three years. Every employee is also asked personally by the general manager whether he agrees to keep the rules of the company, especially the rule forbidding men to smoke while on duty or while riding as a passenger on the cars, and also the one forbidding them entering saloons while in uniform, and is required to sign a promise to obey these particular rules, as they have been found to be the ones most frequently broken.

EXAMINING APPLICANTS

The prospective employee, if satisfactory to the company up to this point, is then obliged to pass a physical examination. If up to the standard required he is given a note to the chief despatcher, who assigns him to some particular inspector for instruction.

After having served without pay the necessary length of time to become competent on a car in the suburbs and then on a city car with an instructor, the motorman or conductor is given an examination on the rules before being placed in entire control of a car. This examination is conducted by the chief despatcher. If the man passes it successfully his standing is indicated on Form 143, reproduced herewith, which is signed by the employee, by the chief despatcher and by the general manager. The object of having the different topics printed on the examination form is to have all the subjects directly before the examiner and man during the examination, so that the former may not neglect any of them, and the latter will not claim, at a later date, that any portion of the rules was passed over. If the man "passes" he is assigned to work as an "extra."

THE DEMOTION SYSTEM

The discipline of the company is based entirely upon what is known as the "demotion" system, which was originated on this line, and which was adopted on April 1, 1901. Some particulars of the system were given by Mr. Harrington in an article in the Street Railway Journal for Sept. 6, 1902, but it may be well to rehearse its principal features.

Demotion points are applied for tardiness and other petty irregularities and violations of the rules. For instance, for the first failure to report for duty in a month, a regular conductor or motorman is demoted one point; for the second time in the same month, two points; for the third time, three points. For permitting smoking on his car or for starting his car without receiving a signal from the conductor he may be demoted five points. Other violations are punished by demotions of various

Form 143 500-5-22-'03 19613

Application No. ______

EXAMINATION
—OF—
CONDUCTORS AND MOTORMEN

Date ______

Name ______ { Conductor / Motorman

Date of Examination ______ Examination Average ______

Sent out for Instructions ______ Approved ______ Chief Dis

Date Passed ______ Approved ______ Gen. Mgr.

CONDUCTOR AND MOTORMEN'S EXAMINATION

1. Accidents
2. Bell Signals
3. Broadway and Vanhook
4. Broken Trolley wire
5. Car spacing on street
6. City Hall Stop
7. Duty at Ferry Terminal
8. Fenders
9. Freight
10. Fog
11. Gates, Sidebars and steps
12. Haddonfield Terminal
13. Last trips to Barn
14. Light circuit on car,
15. Position at Ferry
16. Power off
17. Passengers on platform
18. Railroad Crossing,
19. Right of way
20. Signs.
21. Street Crossings
22. Smoking on duty
23. Saloons, with uniform
23. Speed by School Houses and Churches

CONDUCTOR'S EXAMINATION

24. Assistance to Passengers.
25. Bicycles
26. Dogs
27. Direction of Trips
28. Division of Fares
29. Delay cards
30. Fares and Tickets
31. Glass
32. Haddon Avenue and Kaighn Avenue
33. Intoxicated and disorderly passengers
34. Lost articles
35. Position of Conductor
36. Passengers, Danger
37. Register strips
38. Spitting on the floor
39. Trolley rope

MOTORMAN'S EXAMINATION

40. Brakes
41. Controller, use of
42. Circuit breakers
43. Gong
44. Headlights
45. Motorman's Cards
46. Passing other cars.
47. Switches and Curves
48. Water

I have carefully read, and understand all the rules and regulations of the Camden and Suburban Railway Co., and will work in strict accordance with same.

______

Remarks—

EXAMINATION SHEET

amounts, but the principal cause of demotion is failure to respond at roll call.

The desirable runs are assigned to the conductors and motormen, not on the basis of seniority of service, but on their standing as determined by the demotion system. The result is that any employee by good conscientious service can advance to the better runs at the sacrifice of the less capable men. It has been found that the men appreciate this reward for faithful service.

RACK FOR INDICATING STANDING OF MEN

The company has the following runs, and they are mentioned in the order in which they are considered as most desirable:

Twenty-three straight day runs.
Twenty straight-from-noon runs.
Nineteen swing runs.
Three night runs.
Sixteen tripper runs.

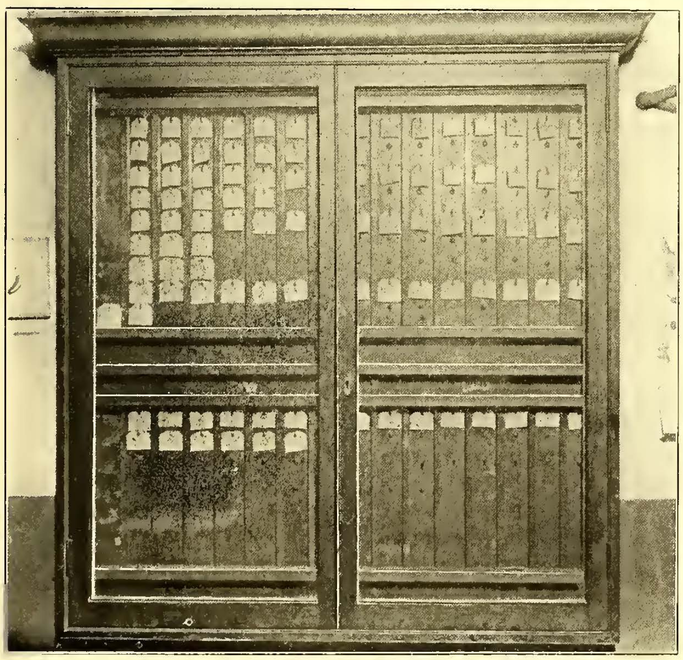
The standing of the men as regards the assignment of these runs is indicated by the position of a series of cards kept in the chief despatcher's office at the car house in two special racks, one for the motormen and the other for the conductors. One of these racks is illustrated herewith. Each rack has about fourteen horizontal rows of fourteen hooks each. There is a small tag corresponding to each motorman and each conductor, upon which is written his name and badge number. The upper two rows in each rack are reserved for the tags of the men holding the "straight-day" runs, the second two rows for those holding the "straight-from-noon" runs, and so on down the scale. The lowest row, that in the lower half of the rack, as shown in the illustration, is for the "extra" men.

When a demotion is decided upon the chief despatcher transfers the tags as called for by the penalty. Thus, if Conductor Doe is to be demoted five points, his tag is taken from its hook and placed on the fifth hook, lower down in the scale, and each of the four intervening tags is moved up one hook. In this way if a man is toward the end of any one of each different kind of run he may be moved back to a run of a less desirable kind, but, of course, always has the chance of regaining his place by conscientious work and attention to duty.

The position of the cards in the rack is changed only by the chief despatcher himself, and a written memorandum is made of it at the time, so that a man will not be demoted twice for the same offense. The rack has glass doors and is kept under lock and key. The chief despatcher holds the only key to it, so that there can be absolutely no tampering with the order of the cards. The order of the cards, however, can be seen through the glass doors, and, as it is open at all times to the inspection of the conductors and motormen, they often consult it as to their standing and that of their comrades.

NOTICES ANNOUNCING THE MEN'S STANDING

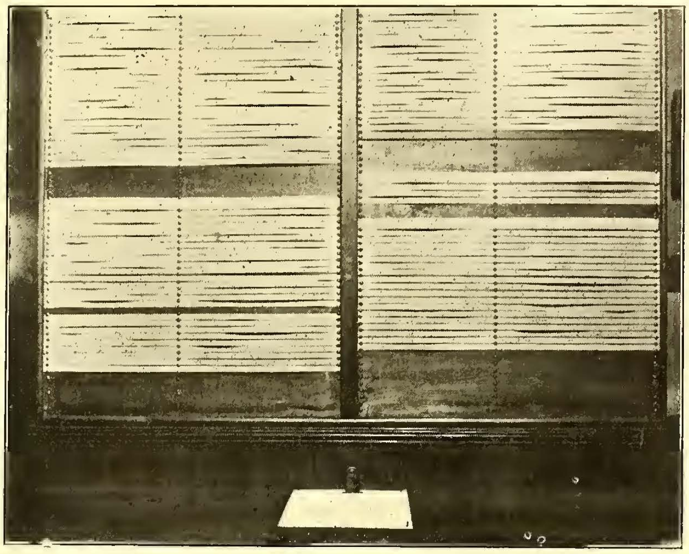
Notice of all demotions made is sent within twenty-four hours to the men interested and also to the general manager. In addition, once a month, a sheet is made up for the general manager showing the standing of all the men, their seniority in service and the runs upon which they are engaged. The seniority is indicated by the order in which these names appear, their standing by the length of a straight line drawn after the name of each man, and the class of run by the color of the line. There is also a numeral at the end of each line showing the relative standing of each man. This record will be referred to



RACK FOR HOLDING CARDS, SHOWING DEMOTION RANK OF MOTORMEN

more particularly in the article next week devoted to the reports made to the general manager by the different heads of departments.

In addition a notice is posted up monthly in the car house, giving the names of the men in alphabetical order, number of days excused, sick, etc., points demoted, and days and hours worked. The latter has been found to be of especial interest to the men, as it encourages the good workers and stimulates others to follow their example. This notice is posted in the



BULLETIN BOARD, SHOWING METHOD OF POSTING RUN NUMBERS AND BLOCK NUMBERS FOR GUIDANCE OF MEN

following form, the names of the regular men being written in black, and those of the extras in red ink:

SUMMARY, AUG., 1903

NAME	Excused	Sick	Times Missed	Points Demoted	Days Not Worked	Days Worked	Hours Worked
Andres, J..........	2	..	1	1	3	28	329½
Apgar, F..........	4	3	..	..	7	24	288¼
Andrews, J.......	..	10	..	..	10	21	246¼
Appleback, C.....	2	10	..	..	12	19	229½
Abbott, W........	4	2	..	..	6	25	319¾
Anderson, W. ...	2		1	1	2	29	342
Arthur, C.........	..	1	1	1	2	29	302¾
Adams, A........		..	..	..	1	30	333¾
Andrews, F......	..	..	2	2	6	25	263½

A copy of this list is also sent monthly to the manager, who finds the record of the number of hours worked by each man, a point on which knowledge is of convenience.

WAGES

The wages paid for motormen and conductors are 17 cents per hour, which is an advance of 2 cents an hour over those paid prior to March, 1902. The runs are arranged for an average day of twelve hours and twenty-five minutes for meals.

PREMIUMS

In addition to the wages a premium of 10 per cent is paid monthly to all conductors and motormen who have gone through the month with a clear record, as far as accidents, good deportment and other parts of their duties are concerned. Tardiness is not punished by a loss of this premium unless a man has been tardy four or more times during the month. This premium is paid on the fifteenth of the following month. The system has been in force for about a year and a half, and the average number of men who participate each month in the division is 55 per cent of the total.

The list of men to whom the premiums are to be paid is made up monthly, in the main office, from the demotion record referred to above, which is sent to the general manager by the chief despatcher. This list contains the names of all the men, but opposite those not entitled to the premium a memorandum appears like this:

Jones—Accidents Nos. 582 and 583.

MOORESTOWN AND MERCHANTVILLE SUNDAY

101

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
					5^{29}
				6^{14}	15
7^{12}	18	49	51		
8^{22}	28	59	9_1		
9^{32}	38			10^{35}	45
11^{42}	48	12^{19}	21		
12^{52}	58	1^{29}	42		
2^{13}	18	49	3_2		
3^{33}	38	4^{9}	22		
4^{53}	58	5^{29}	42		
6^{13}	18	49	7_2		
7^{33}	38	8^{9}	22		
8^{53}	58	9^{29}	42		
10^{13}	18	49	51		
11^{22}	28	59	12_1		

12.25≠

102

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
			5^{35}		
			5^{50}+		
6^{12}	18	49	51		
7^{22}	28	59	8_1		
8^{32}	38			9^{35}	45
10^{42}	48	11^{19}	21		
11^{52}	58	12^{29}	31		
1^{3}	8			2^{4}	7
3^{3}	8			4^{4}	7
5^{3}	8			6^{4}	7
7^{3}	8			8^{4}	7
9^{3}	8			10^{4}	15
11^{12}	18	49	51		
12^{22}	24				

12.35≠

103

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
	7^{20}				
7^{32}	38			8^{35}	45
9^{42}	48	10^{19}	21		
10^{52}	58	11^{29}	31		
12^{2}	8			1^{5}	7
2^{3}	8			3^{4}	7
4^{3}	8			5^{4}	7
6^{3}	8			7^{4}	7
8^{3}	8			9^{4}	7
10^{3}	8			11^{5}	15
12^{12}	14				

12.25≠

104

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
	5^{50}				
6^{6}	8			7^{5}	15
8^{12}	18	49	51		
9^{22}	28	59	10_1		
10^{32}	38			11^{35}	45
12^{42}	48			1^{44}	47
2^{43}	48			3^{44}	47
4^{43}	48			5^{44}	47
6^{43}	48			7^{44}	47
8^{43}	48			9^{44}	47
10^{43}	48	11^{19}	21		
11^{52}	58	12^{29}	30		

12.55≠

105

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
					5^{55}
				6^{44}	45
7^{42}	48	8^{19}	21		
8^{52}	58	9^{29}	31		
10^{2}	8			11^{5}	15
12^{12}	18	49	51		
1^{22}	28			2^{24}	27
3^{23}	28			4^{24}	27
5^{23}	28			6^{24}	27
7^{23}	28			8^{24}	27
9^{23}	28	59	10_2		
10^{33}	38			11^{35}	45
12^{42}	44				

7.≠

106

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
			5^{55}		
		6^{20}	21		
6^{52}	58	7^{29}	31		
8^{2}	8			9^{5}	15
10^{12}	18	49	51		
11^{22}	28	59	12_1		
12^{32}	38	1^{9}	21		
1^{52}	58	2^{29}	42		
3^{13}	18	49	4_2		
4^{33}	38	5^{9}	22		
5^{53}	58	6^{29}	42		
7^{13}	18	49	8_2		
8^{33}	38	9^{9}	22		
9^{53}	58	10^{29}	32		
11^{3}	8			12^{5}	7
1^{4}	8				

NIGHT-CAR-1012

107

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
			5^{55}		
			6.6		
6^{32}	38			7^{35}	45
8^{42}	48	9^{19}	21		
9^{52}	58	10^{29}	31		
11^{2}	8			12^{5}	15
1^{12}	18	49	2_2		
2^{33}	38	3^{9}	22		
3^{53}	58	4^{29}	42		
5^{13}	18	49	6_2		
6^{33}	38	7^{9}	22		
7^{53}	58	8^{29}	42		
9^{13}	18	49	52		

10.15≠

108

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
	6^{50}				
7^{2}	8			8^{5}	15
9^{12}	18	49	51		
10^{22}	28	59	11_1		
11^{32}	38			12^{35}	45
1^{42}	48			2^{44}	47
3^{43}	48			4^{44}	47
5^{43}	48			6^{44}	47
7^{43}	48			8^{44}	47
9^{43}	48	10^{19}	22		
10^{53}	58	11^{29}	31		
12^{2}	8				

NIGHT-CAR-1011.

109

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
	7^{40}				
7^{52}	58	8^{29}	31		
9^{2}	8			10^{5}	15
11^{12}	18	49	51		
12^{22}	28			1^{24}	27
2^{23}	28			3^{24}	27
4^{23}	28			5^{24}	27
6^{23}	28			7^{24}	27
8^{23}	28			9^{24}	27
10^{23}	28	59	11_1		
11^{32}	38			12^{35}	37

1.25≠

1010

FERRY AR	FERRY LV	M'VILLE AR	M'VILLE LV	MOORSTN AR	MOORSTN LV
			12^{30}		
		12^{59}	1_1		
1^{32}	38	2^{9}	22		
2^{53}	58	3^{29}	42		
4^{13}	18	49	5_2		
5^{33}	38	6^{9}	22		
6^{53}	58	7^{29}	42		
8^{13}	18	49	9_2		
9^{33}	38			10^{35}	45
11^{42}	48	12^{19}	20		

12.45≠

TIME-POINTS-TO-FERRY-	70 MIN	120 MIN 30	120 MIN 20
MOORESTOWN-		0	0
MERCHANTVILLE	0	26	25
ROSEDALE-T-GATE	8	34	33
BRIDGE	19	45	44
BROAD AND MARKET	26	52	51
FERRY-	31	57	56
LAY-OVER-AS-SCH			

TIME-POINTS-TO-M'VILE AND MOORTN	70 MIN	120 M-30	120 M-20
FERRY-	0	0	0
BROAD AND MARKET	5	5	5
BRIDGE	12	12	12
ROSEDALE-T-GATE	23	23	23
MERCHANTVILLE	31	31	31
MOORESTOWN		56	57
LAY-OVER-AS-SCEE.			

SCHEDULE

L.V BLK	MOORSTN TO-FERRY
101	6.15
105	6.45
104	7.15
107	7.45
108	8.15
103	8.45
106	9.15
102	9.45
109	10.15
101	10.45
105	11.15
104	11.45
107	12.15
108	12.45
103	1.7
109	1.27
104	1.47
102	2.7
105	2.27
108	2.47
103	3.7
109	3.27
104	3.47
102	4.7
105	4.27
108	4.47
103	5.7
109	5.27
104	5.47
102	6.7
105	6.27
108	6.47
103	7.7
109	7.27
104	7.47
102	8.7
105	8.27
108	8.47
103	9.7
109	9.27
104	9.47
102	10.15
1010	10.45
103	11.15
105	11.45
106	12.7

SCHEDULE

BLK	LV. FERRY M'VILLE	LV. FERRY MOORTN
104		6.8
102	6.18	
103	6.28	
107		6.38
109	6.48	
106	6.58	
108		7.8
101	7.18	
102	7.28	
103		7.38
105	7.48	
109	7.58	
106		8.8
104	8.18	
101	8.28	
102		8.38
107	8.48	
105	8.58	
109		9.8
108	9.18	
104	9.28	
101		9.38
103	9.48	
107	9.58	
105		10.8
106	10.18	
108	10.28	
104		10.38
102	10.48	
103	10.58	
107		11.8
109	11.18	
106	11.28	
108		11.38
101	11.48	
102	11.58	
103		12.8
105	12.18	
109		12.28
106	12.38	
104		12.48
101	12.58	
102		1.8
107	1.18	
105		1.28
1010	1.38	
108		1.48
106	1.58	
103		2.8
101	2.18	
109		2.28
107	2.38	
104		2.48
1010	2.58	
102		3.8
106	3.18	
105		3.28
101	3.38	
108		3.48
107	3.58	
103		4.8
1010	4.18	
109		4.28
106	4.38	
104		4.48
101	4.58	
102		5.8
107	5.18	
105		5.28
1010	5.38	
108		5.48
106	5.58	
103		6.8

BLK	LV. FERRY M'VILLE	LV. FERRY MOORTN
101	6.18	
109		6.28
107	6.38	
104		6.48
1010	6.58	
102		7.8
106	7.18	
103		7.28
101	7.38	
108		7.48
107	7.58	
103		8.8
1010	8.18	
109		8.28
106	8.38	
104		8.48
101	8.58	
102		9.8
107	9.18	
105	9.28	
1010		9.38
108	9.48	
106	9.58	
103		10.8
101	10.18	
109	10.28	
105		10.38
104	10.48	
108	10.58	
106		11.8
102	11.18	
101	11.28	
109		11.38
1010	11.48	
104	11.58	
108		12.8

\- MILEAGE -

BLOCK	M'VILLE	MOORESTOWN	TOTAL
101	112.13	39.30	151.43
102	53.79	123.60	177.39
103	33.60	145.55	179.15
104	36.77	145.55	182.32
105	37.68	134.65	172.33
106	108.33	30.90	139.23
107	89.21	41.20	130.41
108	46.19	123.60	169.79
109	43.02	143.30	186.32
1010	73.54	20.60	94.14
N-CARS		104.35	104.35
TOTAL	634.26	1052.60	1686.86
BARN-TO-FERRY-			1.35M
" " ROSEDALE			2.23 "
" " M'VILLE			3.80 "
" " MOORESTOWN			9.40 "
FERRY- ROSEDALE			3.11 "
" " M'VILLE			4.71 "
" " MOORESTOWN			10.30 "

TIME-OF-RELEIF		
BLK	NOON	NIGHT
101	11.42	6.13
102	11.52	7.03
103	12.02	6.03
104	12.42	6.43
105	12.12	5.23
106	11.22	5.53
107	11.02	5.13
108	11.32	5.43
109	11.12	6.23
1010		5.33

CREWS.

	A.M.	NOON	NIGHT
A	101		107
B	102		105
C	103		1010
D	104		109
E	105	104	
F	106	102	
G	107	108	
H	108	103	
I	109	101	
J		1010	
K		107	103
L		109	102
M		106	104
N		105	101
O		N. CAR	106
P		" "	108

NIGHT-CAR-SCHEDULE-

BLOCK	LV. FERRY FOR MOORESTOWN	L.V. MOORSTN FOR FERRY	L.V. M'VILLE FOR FERRY-
1011		1.7	1.31
1012	1.8	2.2	2.26
1011	2.8	3.2	3.26
1012	3.8	4.2	4.26
1011	4.8	5.2	5.26

CHARGE-DOUBLE-FARE-ON-ALL-TRIPS EXCEPT-5.2 AM-FROM-MOORESTOWN

NOTES-

= LEAVING-TIME-AT-BARN ≠ ARRIVING-TIME-AT-BARN-
\+ " " ROSEDALE-
U.P-TRIP-TO-M'VILLE AND MOORESTOWN-
DOWN " " FERRY
RECORD-REGISTER-ON-EACH-COLLECTION- TURN-REGISTER-BACK-
FIRST-AM-TRIPS-BLOCKS-102-103-107-109 GO-TO-ROSEDALE-FROM-BARN
" " " " 101-105- " " MOORESTOWN " "
" " " " 104 " " FERRY " "
" " " " 106-108-1010 " " MERCHANTVILLE "

10

F. A. Hewitt
10-27-01

C.B.W.

SAMPLE TIME TABLE, SHOWING RUN AND BLOCK NUMBERS, TIMES ON AND OFF, AND OF RELIEF, RUNNING TIMES, ETC.

At the top of the premium list sheet is a digest of the accidents occurring the month in question and prepared in the following form:

Accidents Nos. 500 to 604, inclusive.

Accidents reported	104
Accidents deducted	71
*Accidents not deducted	33

*These are unavoidable or trifling accidents for which the employees are not penalized.

One object of keeping a record of the number of the accidents in this way on the premium list is so as easily to refer to the documents relating to the accident in case an employee should call at the general manager's office to see why he did not get his premium. If he should claim that he did not know about any accident during the month, as is sometimes done, the files are looked up, and if it is found that the employee was in an accident which he did not report he is asked to explain, as the rules call for full reports of all accidents by the employees in charge of the car involved.

OTHER PREMIUMS

In addition, other rewards are given for long service with the company. Thus, at the end of five years he is given one suit of uniform a year and is entitled to wear a stripe of green on his sleeve. A man who has been connected with the company for ten years is given two suits of uniform a year, and is entitled to wear two stripes on his sleeve; and those who have been with the company fifteen years or more are given two suits and an overcoat each year, and are entitled to wear one stripe for each five years which they have been connected with the company.

TIME TABLES

The standard time-table of the company is made out on rather a novel plan, and a reproduction of one of the time-tables is given on the opposite page.

The time-tables are first laid out theoretically, in the usual way, by diagonal lines with the hours of the day as the ordinates and the length of the line as the abscissæ. After the proper spacing of the cars has been determined in this way, the time-table, as shown on the opposite page, is drawn up on a tracing with the proper run numbers and block numbers for the different crews. Blue prints are taken from this tracing and are posted up in the various car houses.

The time-table reproduced is that of the Moorestown & Merchantville line, for a Sunday. The first block number is 101, called 10-1, because the Moorestown line is Division 10. It shows that the first car leaves the car house at 5:20 a. m., arrives at Moorestown 6:14, leaves Moorestown 6:15, arrives at the ferry 7:12, and so on up to one minute past midnight, when it leaves Merchantville to go to the car house, where it arrives at 12:25 a. m. The total mileage of block No. 10-1, as well as that of every other block, is shown in a separate table.

Another table on the tracing shows the times of relief, from which it will be seen that the relief for Block 10-1 at noon is at 11:42 a. m., and at night is at 6:13 p. m. These times are also indicated by the heavy lines in the body of the time-table. Directly under the table showing the times of relief is another, giving the crews; thus, crew A (which has a swing run) takes Block 10-1 from 5:20 a. m. to 11:42 a. m., and Block 10-7 from 5:13 p. m. to 10:15 p. m. On this particular time-table sixteen crews are required; viz., four crews (A to D) who have swing runs, five crews (E to I) who have straight day runs, four crews (K to N) who have straight-from-noon runs, one crew (J) which has a tripper run and is usually combined with a run on another division, and two crews (O and P) who have night runs. The other information given on the time-table is self-explanatory.

It will be noticed that while, as a rule, a crew works on two cars during the day, the block numbers, 10-1, 10-2, etc., remain throughout the day on the same cars. The block numbers are indicated on small wooden signs, which are carried on the hood of the car, and when a crew is assigned to any particular block number the men find the car by this sign. It is, therefore, necessary only to assign the men their proper run numbers, and from the time-table they can find their proper block numbers.

ASSIGNMENT OF RUNS

The assignment of desirable runs, as stated earlier in this article, is dependent on the standing of the men on the demotion system. The assignment must necessarily be posted up daily on the bulletin board, because if a man is excused from working the order may be changed. A regular man who wishes to be excused from duty is obliged to ask the day before, and if he is excused his run is taken by the man at the top of the extra list.

INTERIOR OF DESPATCHER'S ROOM, SHOWING RACK FOR CARDS OF EXTRA MOTORMEN AND CONDUCTORS

The notice showing the names of the men and their run numbers is made up of strips, one for each run, and is tacked up on the bulletin board in the car house, as shown in the upper cut on page 1011. This strip shows for a straight run, the "run number," which is the same throughout the day for the same crew, the "block numbers," "time on and off" and "total hours." This notice is always posted by 4 p. m., to cover the runs of the following day. A duplicate notice is posted at the Market Street terminal, where certain crews take their cars. Owing to this system there is, or should be, no confusion in the crews taking their cars in the morning or at any other time of the day.

EXTRAS

The "extras" who are to take regular runs the following day are also notified on the bulletin board of the time at which they are expected to report. A limited number of "extra" men are also required to report at 4:30 a. m., 5 a. m., 5:20 a. m. and 5:35 a. m., and others at other hours of the day. The noon roll call is at 10:40 a. m., and the night roll call at 4:40 p. m. Upon arrival at the car house all extras report to the car despatcher and the time at which they report is recorded.

The extra men are governed like the regular men, by a demotion system, but the rule for tardiness is not quite so strict as with the regular men. For instance, if an "extra" has a clear record as regards tardiness for two previous months he

Form No. 50—16638—5000—6-16-02. C. & S. RY. CO.

CONDUCTOR'S AND MOTORMAN'S TIME REPORT

Place ________ Date ________

CONDUCTOR	MOTORMAN	SIGNED TO GO OUT				SIGNED COMING IN				REMARKS
		BLOCK	CAR	A. M.	P. M.	BLOCK	CAR	A. M.	P. M.	

MOTORMAN'S SIGNING IN AND OUT SHEET

is relieved from demotion for the first failure to report in the following month.

The chief despatcher has a simple device for keeping track of the order of the extra men and of the names of those who are assigned during the day to runs. This device consists of a rack, shown in the engraving of the despatcher's office on page 1013. This rack has eight upright pieces, with slots, in which

CREW RECORDS

If a man is late, a record is made of the time he actually reports for duty, and notice of it is sent by the assistant despatcher , by whom it is reported to the main despatcher.

The chief despatcher keeps six different records of the men besides those which are kept at the main office. The first is a sheet made out by the day despatcher, showing the extras who take the place of regular men. The day despatcher gets this from the bulletin board at the car house and sends it to the chief despatcher.

The second record is that showing whether each man worked on each day. This is kept in simple form, the men's names being arranged in a book in a vertical column, and the rest of the page being ruled off for the different days of the month. This page is made up from the record first mentioned, received from the day despatcher, and the only symbols used are E, for excused; S, for sick; W. for worked. It was started in 1899 and takes only a very little time to keep up, and shows at a glance the number of days worked and off for each man.

The third record is called the "motormen and conductors' signing in and out sheet." This is a sheet which is kept at the

Inspector's No. ________
Total Hours Worked ________
Total Expenses ________

CAMDEN & SUBURBAN RAILWAY CO.

Report No. ________

________ day ________ 190

BLOCK No.	BADGE No.	CAR No.	TIME ON	STREET ON	TIME OFF	STREET OFF	DIVISION	Total Reg'ist before Ent'ng	Pas'grs before Entr'ing	Passes	Transfers	Total Regist.	Total Pass'grs	Difference	Conductor's Returns	CONDUCTOR'S NAME	Note No.	Run No.
																		1
																		2
																		3
																		4

FORM USED BY INSPECTOR IN MAKING DAILY REPORT

the cards containing the names of the different extra men are placed in the order of their standing. There are four rows of cards, the motormen's cards being on the first and the conductors' on the third.

When an extra man has to be assigned to a run, the man whose name is on the top card is given the run, and his card is lifted out of its place and set in the second or fourth row, depending upon whether he is a motorman or a conductor. In this way the despatcher can see at a glance the proper man to assign to any vacant run and the men who have been so as-

Badge No.		
Car No.	Total Passengers.	
Block No.	" Registered.	
Place on	Notes.	
Place off		
Hour on A. M	P. M	
Hour off		
Date		
Inspector No		

CARD TRIP RECORD OF INSPECTOR

signed. The system, as will be seen, is very simple, and requires no writing.

The morning runs are taken from the car house, while the afternoon runs are taken from the Delaware Avenue ferry to Philadelphia, where there is also a despatcher. At both places the notices as to the runs for each day are posted up by 4 p. m. of the previous day. When this notice is posted the regular men who have asked to be excused for the following day know whether their request has been granted, while the extra men know what runs they are to take.

car house, and is signed by the men themselves, as they come in and go out. The headings across the page are given in the reproduction of this sheet, published herewith.

A carbon copy of this record is sent to the office and filed. If this "signing in and out" sheet is not signed by the man ten minutes before his car is ready to go out the man looses his run.

The fourth record kept is a list of the men who miss their runs, and from this the demotions for tardiness are made.

The chief despatcher also has what he calls his motorman's

DATE	HOURS	EXPENSES	DATE	HOURS	EXPENSES
		$			$
TOTAL			TOTAL		

Car Fares on Inspection ________ Fares at 5 cts ________

Days at ________

TOTAL ________

Form 73-500-8-1-02-16931

Camden, N. J., ________ 190

Received of the Camden & Suburban Railway Company,

________ $\frac{}{100}$ Dollars,

in full for services rendered, and cash fares paid for ________ days

ended ________ 190 , as per annexed statement.

I certify to the correctness of the annexed statement. ________ Inspector No.

Approved for Payment,

____

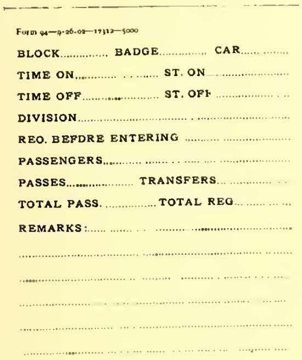
EXPENSE FORM USED BY INSPECTOR

and conductor's record book, which is very similar to that kept on all roads and gives the name of the man, badge number, date of engagement, memorandum of all accidents, suspensions, etc. A page is given to each man. He also keeps a card catalogue of the names of the men, badge numbers and home address. The conductors' cards also bear their punch marks.

The complete record of the relations of the company with each man employed on the system is kept at the main office on a card catalogue. These records are made up from the reports of the secret service department, as described below, which are put in digested form on the card, the original report being filed away for future reference. The cards also show the date of appointment, the number under which the application is filed, record of accidents, demotion, etc. If a man is discharged the date of discharge is entered on his card and they are filed away. If there are several cards relating to one man, as is usually the case, they are kept together by a holder.

INSPECTION SYSTEM

The inspectors belonging to the secret service system work twelve hours a day and make their reports by mail. The inspectators are provided with a pad, shown in form No. 94, on which they make their memoranda of each trip, using a separate sheet for each car taken. This blank contains a place on which the inspector enters the block number, car number and conductor's badge number for each ride which he takes, points at which he got on and off, condition of the register, number of passengers carried, etc. From this memoranda he fills out his regular trip reports, which are of two kinds, one for each trip, as shown in the card herewith marked Inspector's Trip Report, and Form 32, which is simply a summary of the information contained on the individual cards without the remarks, and represents the inspector's work for the day.


Form 94—9-26-02—17312—5000

BLOCK.............. BADGE.............. CAR............

TIME ON.................. ST. ON......................

TIME OFF.................. ST. OFF......................

DIVISION..

REG. BEFORE ENTERING.....................................

PASSENGERS..

PASSES.................. TRANSFERS.......................

TOTAL PASS.............. TOTAL REG.......................

REMARKS:..

PAD USED BY INSPECTOR ON EACH TRIP

When the inspector's reports are received in the main office a clerk first takes each of the cards and compares the block number, badge number and car number, as given on each of the cards with the conductors' records of the previous day, to check up the inspector. After these reports have been checked up in this way the clerk makes a digest of each trip report on a card, under the name of the conductor or motorman referred to, and files it in the card catalogue relating to the employees. The inspector's reports are then filed. At the end of the week or month the inspector sends in a statement on Form 73, showing the number of hours worked, expenses, etc.

The company has found as a result of inspections extending over a number of years that the number of fares collected but not registered has varied all the way from sixty to three and three-fourths for each 1000 passengers carried. The average for some time has been about fourteen fares for each 1000 passengers carried.

EMPLOYEES' RECORDS

A record showing the standing and other particulars about each employee is made up for the use of the general manager. This gives under the name of each employee the following: Application number, date of engagement, how long out of work before coming with the company, trade or business before coming with the company, reasons for leaving former occupation, time lost during the preceding year, maximum wages received per week during the preceding year, average wages received during the year, average wages since his employment by the Camden & Suburban Railway Company. This is made out only for recent employees, and the first part of the information is taken from the application blank.

The general manager also keeps a record of the times each man turns in a car for any fault. This is kept in the following form:

Name	1902		1903		
	Nov.	Dec.	Jan.	Feb.	Mar.
Smith........	....	....	... .	....	....

A record is also kept of each man, by months, of the number of fares collected but not registered, as written up from the inspectors' reports described above. This is based on the number per 1000 passengers and is made up as follows:

Name,
Number of cars inspected,
Fares not registered,
Number of passengers, total,

Total, passengers,	Fares not registered at 5 cents per Fares not registered per 1000 passengers.

BLANKS AND FORMS

In the next article the system of blanks and forms used by the Camden & Suburban Railway Company in keeping its records and accounts, outside of those directly relating to the car crews, will be described.

THE HEATING OF RAILWAY MOTORS

Youngstown, Ohio, Nov. 30, 1903.

Editors Street Railway Journal:

The article of Messrs. Dodd and Canfield, in your issue of Nov. 21, and your previous editorial on the subject of railway motor ventilation are a pleasant new light on a subject discredited in many quarters, particularly by certain manufacturers' engineers who have been and are in the habit of answering any suggestion of ventilation of motors by a wise look and a pitying smile for the ignorance of the inquirer.

A type of ventilated electrical apparatus is in daily use to the extent of several hundred thousand kilowatts, and if one wants to ascertain the true economical value of artificial cooling let him ask a manufacturer to make a guarantee on air-blast transformers used without the air. The answer will throw an interesting side light on the value of ventilation. The comparison between transformers and railway motors is not as far fetched as one might suppose at first glance. Theoretically, of course, we blow only pure, dry air through transformer windings, but practically, however, we blow air charged with atmospheric moisture, engine room sweepings, escaping steam and sulphurous language. Once in a while a transformer burns out, but, on the whole, the arrangement has worked fairly satisfactory for a number of years and at potentials as high as 30,000 volts and above. Now, we are assured that the difficulties of insulation increase very nearly as the square of the voltage, and since 30,000 volts is sixty times the potential used on railway motors it would appear that an air-blast transformer will present a problem of insulation 60^2, or 3600 times as difficult as a railway motor, or vice versa, a railway motor should be 3600 times easier to insulate, provided the same factor of safety is used in both cases. There is something incongruous about a situation like that. It is not to be argued that this represents actually commercial conditions as they exist to-day, but the comparison may help to illustrate the point at issue.

In direct-current motor work we must protect the commutator and bearings against dust and dirt, and it is this feature rather than the protection of windings, which, no doubt, is responsible for the hermetically sealed motor casings of to-day. There must be ways and means to ventilate the interior of railway motors without opening the door for commutator and bearing troubles. Transformer casings are often cast with ribs, both inside and outside, to dissipate the heat, and the same construction is resorted to in almost numberless examples of mechanical appliances. There seems to be no valid reason why a motor casing should not be a ribbed casting, and with the air blast, which is conveniently furnished by the speed of the car, this simple expedient should increase the working capacity of a motor under service conditions very considerably, and this with few, if any, openings in the casing. There are other external means for cooling the motors, such as spoke wheels, which allow a better radiation, and help air circulation by having more or less of a blower effect on the motor casings. There are also one or two patented remedies on the market, which promise to reduce the heating of motors by forcing air from various sources through the casings. It is evident that the subject is a live one and of great economic importance to railways, especially interurban roads, where heating is of greater importance than commutation.

The entire problem is one which should be solved by the operating railway companies rather than by manufacturers, whose interests certainly do not warrant them in making any experiments, the success of which can only result to their commercial disadvantage. On the other hand, it is to be remembered that the average electric railway cannot afford any experiments. It is, therefore, gratifying to learn that at least one manufacturing concern has done something, as indicated by Mr. Dodd and Mr. Canfield, toward reducing the size and cost of railway equipment by introducing ventilated motors. Unfortunately, our railway engineering practice of to-day is very largely canal-bank made, cut and dried and done up in packages, and it seems that once in a while a package contains a nice, shining, gilded brick. There is, therefore, every reason to believe that a thorough and independent investigation of this subject is sure to be of profit to manufacturers and of incalculable benefit to their customers.

Ernest Gonzenbach.

EMERGENCY STOPS AND BRAKING

Boston, Nov. 30, 1903.

Editors Street Railway Journal:

I am much pleased to see in your last issue a note on emergency stops by M. C. Richards. I fear that he did not quite catch the purport of my comment in the issue of Oct. 31. The thing to which I wished especially to direct attention was the fact that in the instance cited the two cars did not have sufficient braking capacity, considering the topography of the road. If an interurban line is to be operated at such speeds that two cars being in sight of each other cannot avert a head-end collision, it seems to me that it is clearly up to the road to furnish better brakes, or so to modify its grades and curves that two cars cannot come into dangerous proximity without seeing each other or to reduce its speed.

The long and short of the matter is that interurban cars are frequently so run that the cars are not under proper control, considering the brakes, schedule and track, and it is small wonder that accidents result. Of course, a block system can be arranged to prevent cars getting into dangerous proximity, but such a system is a rather costly and troublesome safeguard, and most roads try to get along without it. They run as steam railroads ran on single track years ago, trusting in the care of the train despatcher and the presence of mind of the engineer, and they are reaping just the harvest of accidents that long experience on railroads has shown to be likely when trains are not kept under proper control. I have nothing to say against cutting off the current as a safety measure, but it is an expedient which does not relieve the roads of the responsibility of keeping the cars under control at all times.

As to emergency stops by reversal with the trolley current, its effectiveness is merely a qestion of fact, as to which data ought to be gathered. Skidding with the wheels in reversal is by no means the same thing as skidding with them fixed, either in theory or in practice, particularly on slippery tracks, and its characteristics ought to be determined. Apparently Mr. Richards regards it as between hand brakes and air brakes in efficiency, but does anybody really know the facts? As to "plugging". the motors, I should hardly expect it to give results equal to air brakes, and I hope, as Mr. Richards suggests, that some interurban road will start experiments on the subject.

A. P. Johnson.

AN INTERURBAN MAP OF INDIANA

The map of Indiana interurban railways changes so rapidly these days, because of the great amount of construction going on in that State, that although an interurban map of Indiana was published in these columns Aug. 30, 1902, a revised map is here presented, which contains many lines not given on the previous map, and affords an opportunity for comparison of the district and the progress that has been made in this work. The map is in the main self explanatory. Roads in operation are indicated by heavy solid lines; those under construction by heavy crossed lines, and those projected by light dotted lines. It is not claimed that this map shows all the projected lines. If it did the network of such lines would cover the entire State.

Only the more important projected lines have been included, such as those for which the right of way is being actively secured by strong companies already in the field, or which are far enough along so that there seems to be a reasonable prospect that they will be built soon.

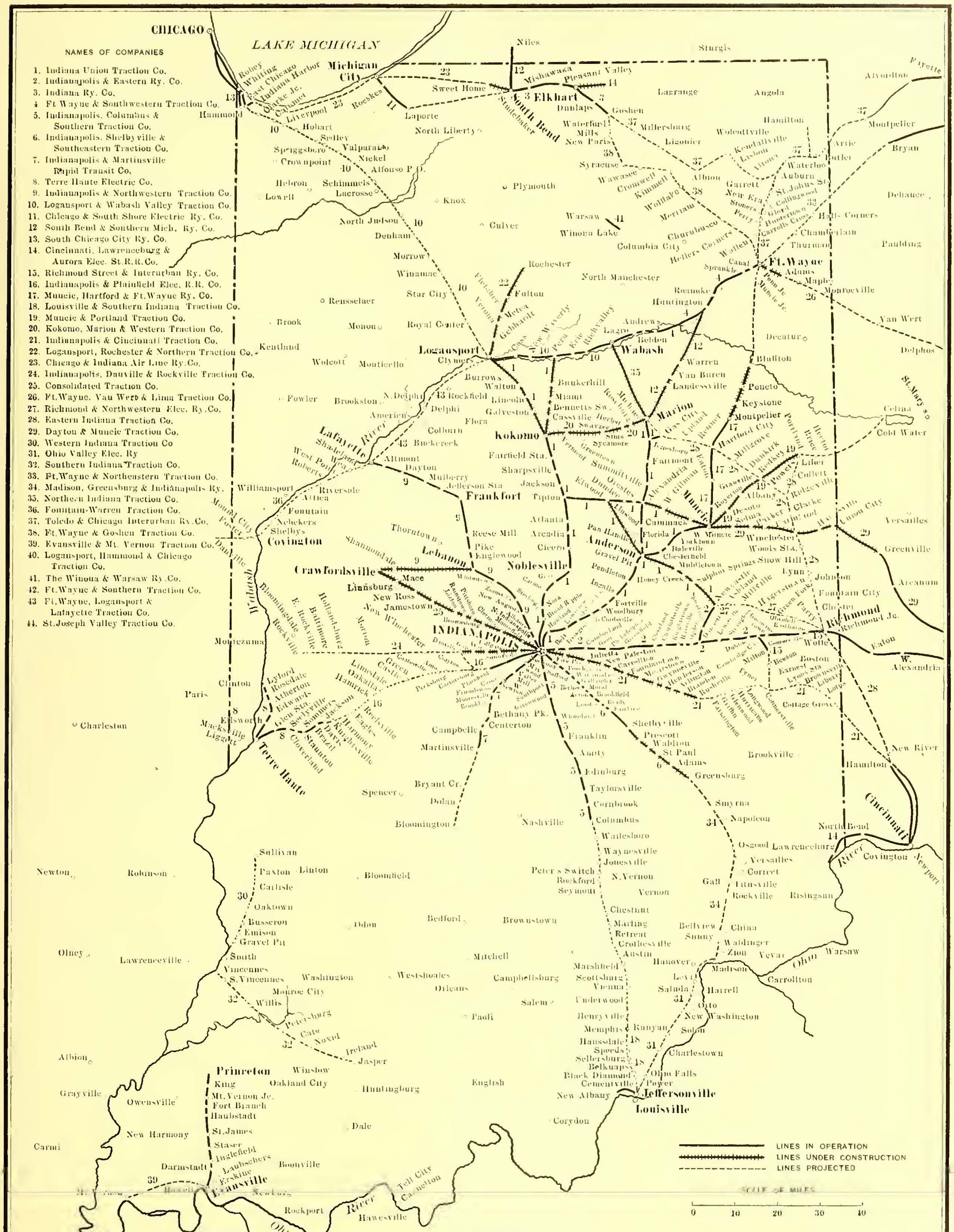
The most important company in Indiana is, of course, the Indiana Union Traction Company, which operates by far the greatest mileage of any interurban system in the State. Besides the mileage indicated as belonging to the Indiana Union Traction Company there is a considerable mileage in addition to this which is owned by companies closely allied with that company. All the lines between Fort Wayne and Logansport and the lines indicated as running north and west from Logansport are controlled by these allied companies, and include the Fort Wayne & Southwestern Traction Company, the Fort Wayne & Southern Traction Company, the Logansport & Wabash Valley Traction Company, the Logansport, Rochester & Northern Traction Company, the Logansport, Hammond & Chicago Traction Company, and the Fort Wayne, Logansport & Lafayette Traction Company.

The Indianapolis & Eastern Railway, running almost due east from Indianapolis, forms part of the through line between Indianapolis and Columbus, Ohio. Those interested in the Indianapolis & Eastern are also actively at work on a line due west from Indianapolis, called the Indianapolis, Danville & Rockville Traction Company, which is said to aim at a Terre Haute connection.

Several companies have projected through lines from Indianapolis to Cincinnati. The Indianapolis, Shelbyville & Southeastern was at one time thought to be the most likely link in the Indianapolis-Cincinnati chain. At the present time, however, it seems almost certain that the Indianapolis & Cincinnati Traction Company, which expects to reach Cincinnati by way of Rushville, Connersville and Hamilton, Ohio, will be the through line, as the Indianapolis, Shelbyville & Southeastern has been purchased by those interested in the Indianapolis & Cincinnati Traction Company, and it is thus no longer a possible competitor of the Rushville route to Cincinnati.

An important system now rapidly nearing completion is that of the Indianapolis & Northwestern Traction Company, which will soon be giving service from Indianapolis to Lafayette. It is now completed as far as Frankfort.

Across the northern end of the State there has been very little building, but a great deal of "projecting." The Indiana Railway Company has operated with success the interurban system between Goshen and South Bend for a number of years, and is completing an extension to Niles, Mich., under the name of the South Bend & Southern Michigan Railway Company. At least four companies have been working on various routes between South Bend and Hammond. The Chicago & Indiana Air Line Railway Company has constructed some track and secured a number of franchises, hence it is a line put down on the map, although other companies have done strong work in the same territory over somewhat different routes.



MAP OF INTERURBAN ELECTRIC LINES IN INDIANA

EUROPEAN SINGLE-PHASE RAILWAY MOTOR

BY GUIDO SEMENZA

The writer had an opportunity to assist at some experiments with a single-phase railway motor, which he feels are of sufficient importance and interest to warrant him in presenting

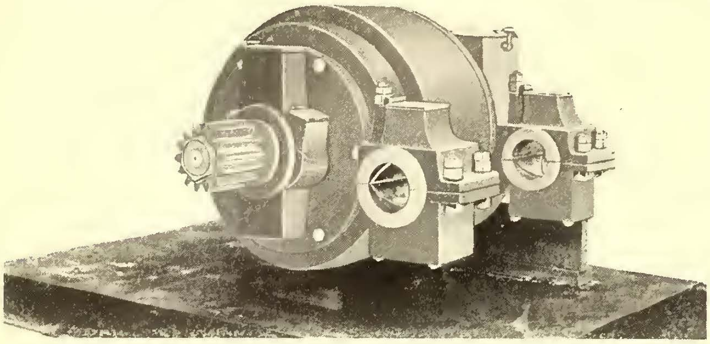


FIG. 1.—FINZI SINGLE-PHASE MOTOR FOR RAILWAY SERVICE

a somewhat extensive account at this time. The motor was designed by Dr. Giorgio Finzi, of Milan, Italy, and is simply a modification of the series direct-current motor having a laminated multipolar field core with longtudinally divided poles, a

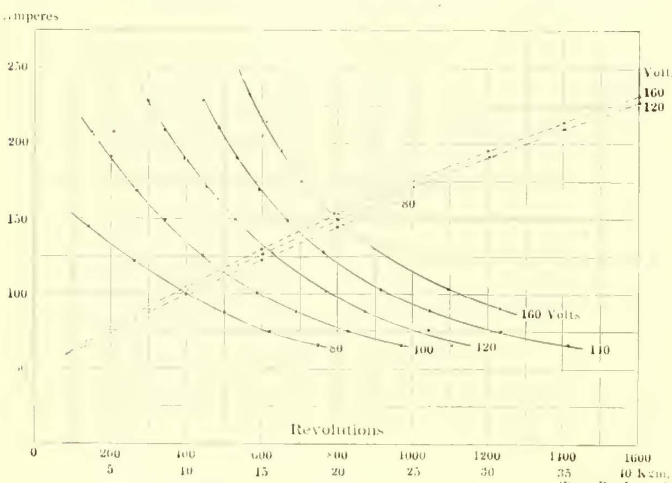


FIG. 2.—CURRENT SPEED CURVES IN FULL LINES, AND CURRENT TORQUE CURVES IN DOTTED LINES.

small air gap, low speed and a set of resistances connecting the armature coils to the commutator sections.

The longitudinal division of the poles, often suggested and sometimes adopted for continuous-current dynamos, is quite as important for alternating current as the laminating of the field core, and it is the simplest method of destroying the reaction flux of the armature. Other and less satisfactory means of accomplishing this result depend upon highly saturating the portion of the poles which is near the air gap, as in the Lamme single-phase motor, where a number of holes are made in the poles, or by short-circuited windings in the poles, as developed by Steinmetz, Stanley and Lamme, or by the use of a symmetrically distributed field winding, supplied from opposite points, and short-circuited at 90 degs. from the points of supply, as advocated by Latour. But these are all subsidiary means, which dissipate energy, and, through leakage, are prevented from completely attaining their end.

Although the transverse flux is prevented there is still a greater difficulty in the sparking, due to the short-circuiting (under the brushes) of the armature sections, acting as secondaries of a transformer under the influence of field poles supplied by alternating current. The german silver resistances, connecting the coils to the commutator, are introduced in the circuit one at a time, and bring down the maximum short-circuit current to a much lower figure. These resistances do not appreciably lower the efficiency. By adopting a design, giving a low reactance voltage in the armature sections, and with an appropriate shape of the poles, Dr. Finzi secured a series motor well adapted to traction use for frequencies of 15 to 20 and more and for 100 volts to 300 volts.

The appearance of one of these motors is shown in Fig. 1, which closely resembles an ordinary railway motor. Its weight is 1760 lbs., and it is designed to run at a frequency of 18 cycles.

This motor was thoroughly tested at the Gadda-Brioschi-Finzi works in Milan, and from this study produced the characteristic curves recorded. Fig. 2 shows, for each voltage applied, the amperes and the angular speed in full lines and the torque in dotted lines. It may be observed that the current is slightly higher with a higher voltage for the same torque, and this is more clearly shown when the torque is greater.

Fig. 3 shows the efficiency and the power factor for this particular motor for various voltages in function of the speed. It is interesting to note that in the efficiency curves the higher segment corresponds to lower speeds when the voltage is lower, consequently the motor tends always to work under favorable conditions, its speed being generally lower when the voltage is kept low.

This motor was then geared to one of the ordinary cars of

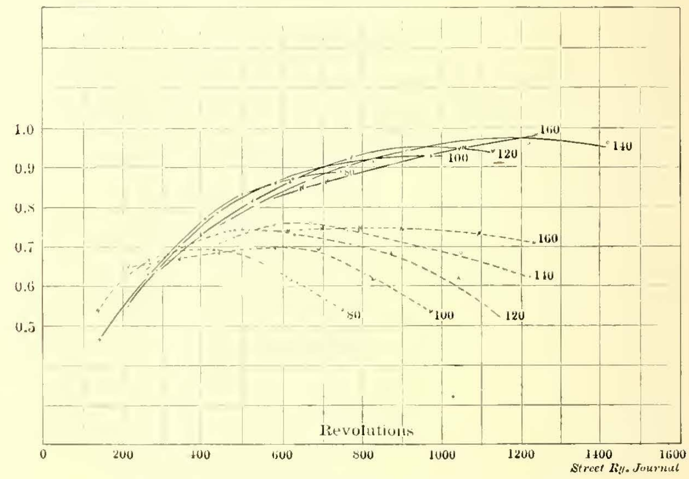


FIG. 3.—EFFICIENCY AND POWER FACTOR

the Edison Company, used for the service on the Milan lines, thus replacing the continuous-current motor. The controller and the rheostats were also taken off and replaced with the controlling transformer. The weight of the car so equipped was slightly above 7 tons.

The circuits on the car are shown in Fig. 4. The line from

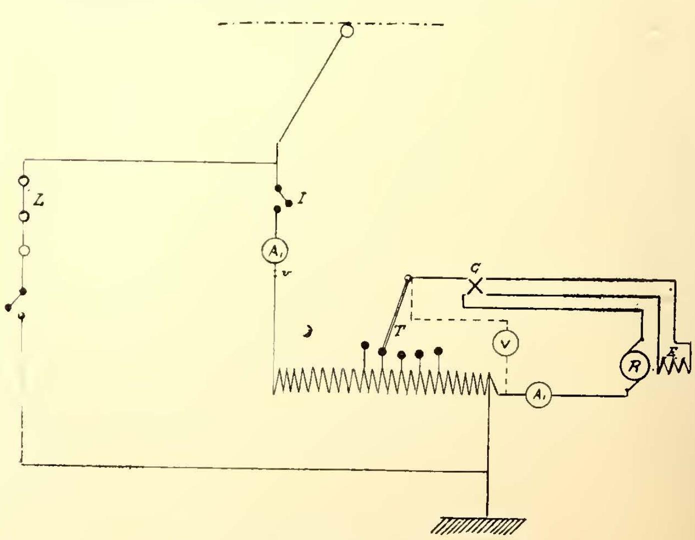


FIG. 4.—CAR WIRING DIAGRAM

the trolley has a switch I on one platform, it passes to the other platform where the controller is placed, then to the ammeter, the snap-fuse V, and finally to the auto-transformer; the other end of this is grounded, and so is one brush of the motor. The other brush goes to the field E'', and then to the handle of the controller, which takes current from different points of the transformer windings. These points go to five sections, corresponding to 80-100-120-140 volts. With a 500-volt supply the passing of the five points was made absolutely non-sparking. As can be seen, the five points were running points, and the stoppage was performed by opening switch I. This was a temporary arrangement. Through a commutator, C, the fields were inverted, to change the direction; an ammeter, A'', showed the current going through the motor, and a voltmeter the voltage.

The usual method of gearing the motor was adopted. A

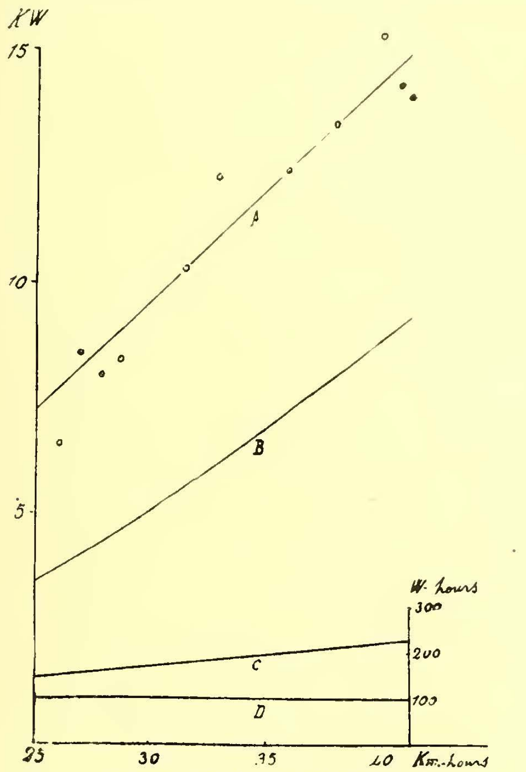


FIG. 5.—ENERGY CURVES

standard pinion of fourteen teeth was geared to a wheel of sixty-seven teeth (1 to 4.78 ratio). The diameter of the car wheels was 77 cm, or 30 1-16 in. A Kapp accelerimeter was fastened to the car; for measuring the speed several methods were used, but that ultimately adopted as the most exact was to deduct it indirectly from current and voltage through the curves of the motor itself.

The generating station was near the laboratory of the Edison Company in the works at Porta Volta, and it contained a 60-hp, 3600-volt, three-phase induction motor, belted to an old eight-pole alternator, with rotating armature, giving a frequency of 18 at 270 r. p. m.

The exciter was an old Edison dynamo, with thin upright fields, kept as an historical object in the Edison laboratory.

The voltage in the alternator was raised from 90 volts to about 550 volts by an auto-transformer, feeding the trolley line, the other wire being connected to the rails. The instruments in the station were: a hot-wire ammeter, a Thomson integrating wattmeter and an Olivetti's recording wattmeter, specially arranged for the tests. A voltmeter showed the line voltage, which varied from 575 volts with open circuit to about 520 volts when the car was running.

The greatest number of runs was made during the night, on the municipal line connecting the Milan Monumental Cemetery with the new Musocco Cemetery. The track had Vignole rails over the whole length, of about 5 km, with a considerable number of switches and several curves of small radius. At a crossing over a railway there was an average grade of 25 per cent on each side for a length of 225 m. The grade of the whole line from Musocco to the Monumental Cemetery is 2 per cent.

The test runs were begun on June 29, 1903, and continued for ten nights, the two last nights being made through the whole town of Milan over the tramcar lines of Phœnix rails with a trailer.

The first tests showed very smooth speeding up and absence of sparking at the commutator, and the writer, who has followed some of the runs very closely, can testify that the satisfactory commutation was chiefly remarkable in starting, the motor behaving better than the corresponding continuous-current motor. Some little sparking was observed now and then when the full voltage was delivered, but not more than is usually noticed with a good standard railway motor. These sparks did not show the color or the light of an arc, resembling mere carbon particles from the brushes. As a matter of fact,

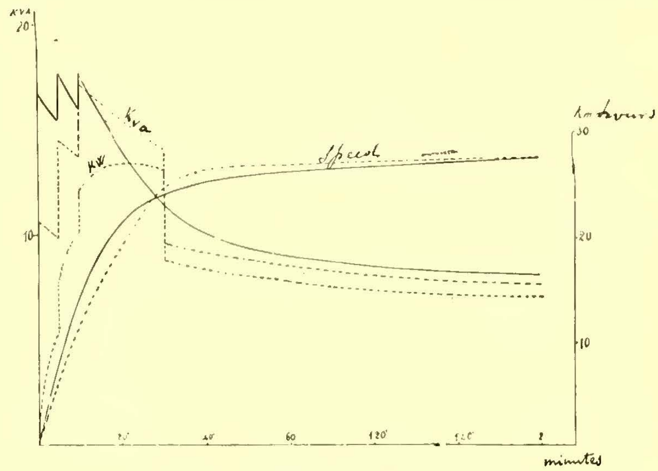


FIG. 6.—ACCELERATION CURVES

after a run of 200 km the commutator was as clean and smooth as when the runs were started, and the brushes suffered no measurable wear.

The objects of the tests were: first, to determine the general working of the motor in respect to its specific qualities for traction use; and, secondly, to measure how much power the startings and runnings absorbed, compared with standard continuous-current equipments. With these two objects in view two different classes of runs were made. During the first, instantaneous readings of the instruments were taken, besides records from Olivetti's wattmeters, by which the power necessary to keep up the various speeds, when once attained, was determined. The startings in this case were very few, in fact, only those which were necessary. Other runs were full of successive speeding up and stopping, thus it was possible to form a correct idea of what a standard starting was, while the figures of the integrating wattmeter, at the end of the run, showed the difference due to a given number of startings compared with the energy absorbed by a run without startings. The same course was carefully followed, using another car equipped with a standard General Electric 52-motor.

In Fig. 5 the line A shows the power at the generating station necessary for a 10-ton single-phase car, running on a level, straight track, at speeds from 25 km to 40 km per hour. This curve represents the average curves of all the experiments. The B curve shows the power delivered by the motor, and it is obtained from line A, taking into account the line and transformer losses and the efficiency of the motor (voltage and speed given). The line C gives the energy in watt-hours per car-kilometer given by the motor. The line D gives the energy dissipated per car-kilometer in mechanical friction; that is, after deducting the air resistance, which was computed by considering the shape of the car and taking advantage of the coefficients found in some recent experiments by Finzi and Soldati on air resistance.

Thus we find that mechanical friction absorbs 10 watt-hours per ton-kilometer, of which about 1.5 is gear-friction. This leads to a traction coefficient of 3.48 kg per ton; a very normal figure for a level, straight track and for Vignole rails.

Fig. 6 institutes a comparison between single-phase motor acceleration and continuous current. The data here given does not depend upon one individual acceleration, but is the average of several experiments. The speed reached was 22 km per hour, with an average acceleration of 0.25 m per second motor, 10.6 watt-hours per ton, and for the General Electric 52, 14.85 watt-hours per ton; while, if we calculate from these figures down to 22-km speed, we find for the single-phase motor 9.35 watt-hours per ton, and for the General Electric 13.10 watt-hours per ton. The theoretical amount of energy for starting at a 22-km speed would be 6.6 watt-hours per ton.

These figures show 25 per cent economy in favor of the single-phase motor, which is a matter of great importance when we consider that the power absorbed in starting on a city thoroughfare is 50 per cent, and sometime as much as 65 per cent of the whole consumption of current.

Figs. 7 and 8 are reproductions of the registering kilowatt-meter records at the generating station. They must be read

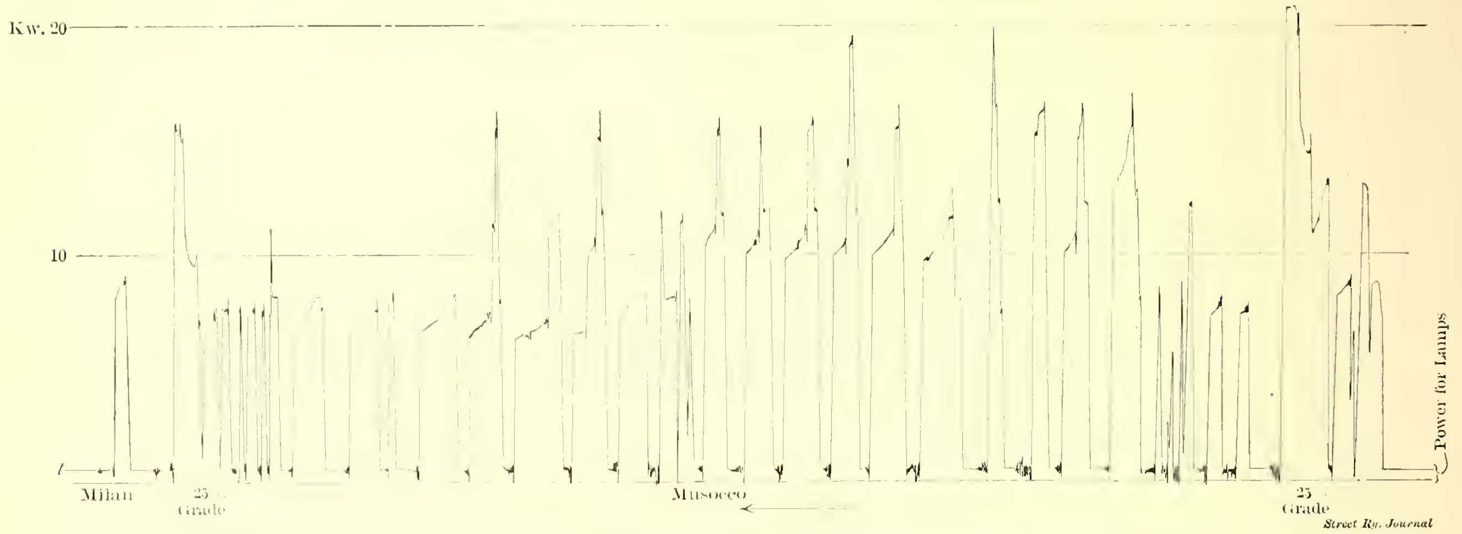


FIG. 7.—KILOWATT-METER RECORDS AT GENERATING STATION FOR FINZI SINGLE-PHASE MOTOR; WEIGHT OF CAR 9.45 TONS

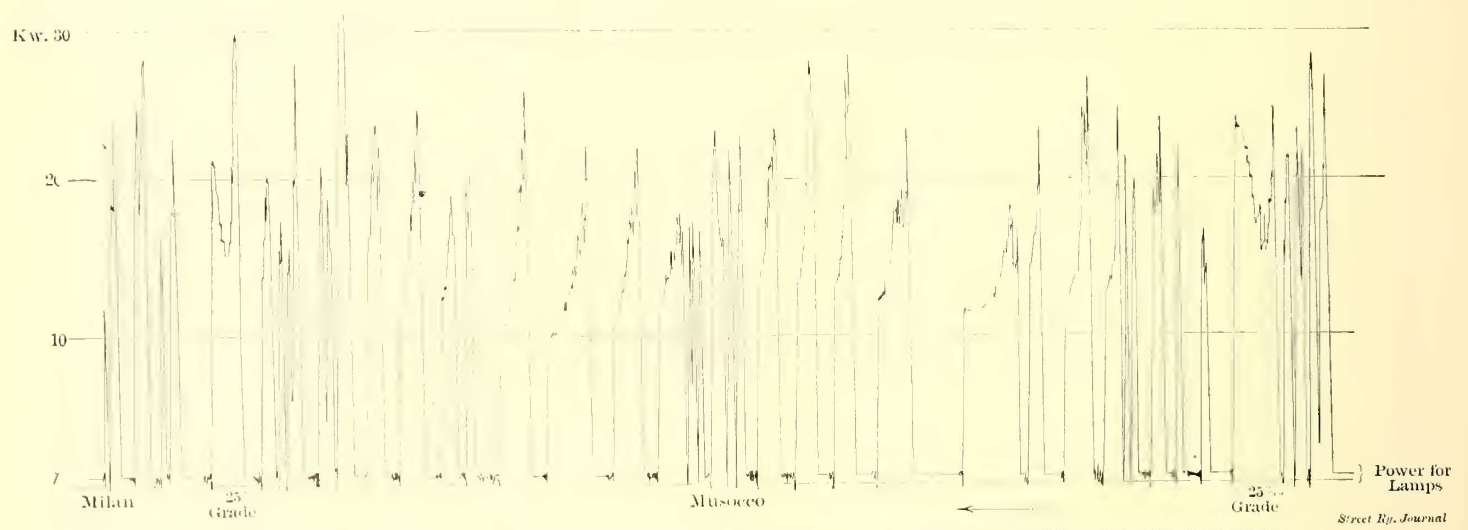


FIG. 8.—KILOWATT-METER RECORDS AT GENERATING STATION FOR G. E. 52 MOTOR; WEIGHT OF CAR 9.65 TONS

per second with the single-phase motor, and of 0.28 m per second per second with the General Electric 52. The full lines in Fig. 6 refer to the latter, the dotted lines to the former; while the power absorbed and the speeds are represented in function of the time. For the single-phase motor the higher line indicates the kilometer-volt-amperes at the motor while the lower line indicates the actual kilowatts. Even after starting we find the single-phase motor absorbing less power (its efficiency though being a trifle lower), on account of the resistances the General Electric 52 had still in series.

Integrating the power curves for each motor to a 22-km speed we find, for the single-phase motor, 9.4 watt-hours per ton, and for the General Electric motor, 12.35 watt-hours per ton. If we integrate at a speed of 23.5 km, which both motors reached in the same time, but at a little greater distance in the case of the General Electric 52, we have, for the single-phase

from right to left, and they all refer to one 10-km run between Milan and Musocco and back, on the same track, at the same average speed of 17.3 km to 17.8 km per hour, and the same number of starts, about 2.25 per kilometers. Note should be made that the scale of ordinates is different in the two diagrams.

The integration of the diagrams gives: (Fig. 7), single-phase, 9.45 tons, 425 watt-hours, 45 per ton-kilometer; (Fig. 8), General Electric 52, 9.65 tons, 775 watt-hours, 70 per ton-kilometer.

It should be observed that this difference is due, partially, to the fact that in order to remain within the limits which were established to correspond to those of a city traffic, the continuous-current motor had to work almost all the time with resistances in series. But even this shows the advantage, in similar conditions, presented by the single-phase motor, which would allow a very wide range of velocities without lowering the efficiency at normal speed.

As to the power factor, it varies between rather wide limits, according to speed and voltage, which is shown by the characteristic curves of the motor. These curves, computed in the case of Fig. 6 for acceleration, give, during starting, an average power factor of 0.7. On the other hand, if we compare the wattmeter diagrams with the instantaneous current and voltage figures, at the station during the run, we find an average power factor, including line, transformer and motor, of 0.8.

Some of the most important objections made to the single-phase motor are the following:

(1) The commutation is unsatisfactory.

(2) The wattless current is always pretty high.

(3) The power is developed in that element of the machine, on which a commutator is attached, making direct high-tension working impossible.

(4) The heating of the stator is different in different points.

On the first point the writer can attest that commutation was satisfactory at all speeds, that runs on the same conditions, with continuous current on a General Electric 52-motor, did not show better behavior at the brushes, and that the commutator did not require the smallest care throughout all the experiments.

Moreover, it is a remarkable fact that such results have been attained with the simplest means and without having recourse to any roundabout devices. They are entirely due to proper design, to suitable shape of the magnetic circuit, to the resistances between the windings and commutator, to the suppressed transverse reaction, accomplished by simply dividing the magnetic circuit, and not through special windings or by short-circuiting two symmetrical points of the main stator's windings. This does away with an ohmic loss and any non-symmetrical heating, which was one of the points criticised by Mr. Latour about series motors.

As to the wattless current, the curves of Dr. Finzi's motor are the best answer to any such objection. A motor which shows a power factor of 0.85 to 0.98 through a range of speeds and voltages from 550 revolutions to 1400 revolutions, and from 80 volts to 160 volts, cannot be condemned on account of the low power factor.

The third objection touches a point which is yet under discussion. The supporters of low-tension motors contend that where even the high-voltage central station generator itself is on many sides objected to, because of the small margin of safety, the same feeling is *a fortiori* justified, when it is the question of a motor working under a car on the road, and they conclude that the best railway practice is to allow, with the simplest controlling mechanism, the use of the highest voltage on the line together with a low-tension motor. This position is constantly winning adherents.

Summing up, Dr. Finzi's single-phase motor, at a constant voltage, automatically regulates its speed according to the load, the speed being at high load inversely proportional to it; besides, it allows a voltage control with negligible losses and the widest speed limit. As against these advantages it cannot use high voltage directly, and it is for the present restricted to comparatively low frequencies.

The writer's impression is that Dr. Finzi has solved the problem of single-phase traction motor, and that it is now only a question of how such motors will work on the every-day service and fulfill the conditions and requirements of an interurban or a heavy railway traffic, and to compare, for different conditions of traffic, line and speeds, their advantages and disadvantages, with those of other systems which are already working to be exploited. The tests here described are significant, and the work accomplished is of great practical value.

ECONOMIES INTRODUCED BY THE USE OF THE AUTOMOTONEER

A report has recently been submitted to the Garton-Daniels Company by D. C. & W. B. Jackson, of Madison, Wis., on the results of tests carried on by that firm of consulting engineers on the lines of the Madison Traction Company to determine some of the economies introduced by the use of the automotoneer on the car controllers. The automotoneer, as is probably well known, is a device for limiting the rate at which current can be turned on at the controller. A description of the latest form of the device appeared in the STREET RAILWAY JOURNAL of Aug. 23, 1902, page 262. It is a purely mechanical device, the time element, or interval between notches being determined by the rapidity of action of a piston in an air dash pot. It thus accomplishes mechanically about the same results as are secured electrically by the electric throttles and limiting coils on the most recent types of multiple-unit controllers for elevated and heavy rapid transit work. The results of these tests, as they apply broadly to the question of limiting the attempted rate of acceleration, should be of general interest to the electric railway engineer at the present time, and a tolerably complete abstract of the report is, therefore, given here.

The tests were carried out on the lines of the Madison Traction Company on a run of a little over 6 miles in length, including many sharp curves, grades and switches. The schedule requires an average running time of approximately 9 m. p. h. The car used is one of the single-truck open cars in the regular service of the Madison Traction Company. It is 30 ft. over all, weighs about 8 tons, and was equipped with two General Electric 800-motors and K-2 controllers. The car was on its regular service runs during the time that the tests were being made. These tests were carried on during two successive days. The track was dry and clean during the tests. The car was fitted with the following instruments: Weston indicating ammeter, Weston indicating voltmeter, Thomson integrating wattmeter, all mounted for car testing, special Boyer speed recorder and a special device for indicating distances. The indicating instruments were read at 5-second intervals throughout the test runs, and the current curves were plotted from the results of these readings. The integrating wattmeter was read at the terminii of the line, and the record of the speed recorded was used in checking the distance record and in comparing the maximum speeds attained.

Tests were first made of the performance of the car without automotoneers attached to the controllers, and tests of the same car on the same run were made on the succeeding day with the automotoneers applied.

The motormen on this road are closely supervised and exhibit unusual care in handling the controllers, and the road men knew that a test was under way. It may, therefore, be accepted that the data of the tests show the improvement in the performance of the equipment produced by the effect of the automotoneer as compared with the performance of the same equipment when handled in an unusually careful manner.

Observations of the handling of the controller by the motorman during the test before the automotoneers were applied entirely confirmed the above view. Only at one interval was the controller handled in the manner of the usual raw motorman, and this was done to test the effect.

The automotoneer was adjusted throughout these tests to permit the movement of the controller from the "off position" to the full "current on" position in 4½ seconds. This permitted more rapid acceleration than is necessary for the service, and reduced the relative economy produced by the "automotoneers."

Several diagrams are presented with the report, showing the current consumption at various parts of the line, with the object of showing the effect of the automotoneer in reducing the starting current peaks. One set of curves shows the current from 5-second readings on a car equipped with the automotoneer, and the other set shows the current taken by the same car over the same portions of the route without the automotoneer but with careful handling of the controller. These curves are not reproduced here because of the great number that would be required to make an intelligent comparison, but the peak currents are generally lower with the automotoneers in service, and the ampere-hours are stated to be 28 per cent lower. Fig. 1, however, is given to show a comparison of the conditions with the automotoneer in use and with a careless handling of the controller. In this latter case the highest peak currents are respectively 160 amps. and 110 amps. The former is over 45 per cent larger than the latter, and the advantage thus resulting from the use of the automotoneer is gained without interfering with the car's operating schedule. The ampere-hours represented by those two curves are respectively 0.4 amp.-hour and slightly over 1 amp.-hour, and the automotoneer, therefore, reduced the power consumption for this

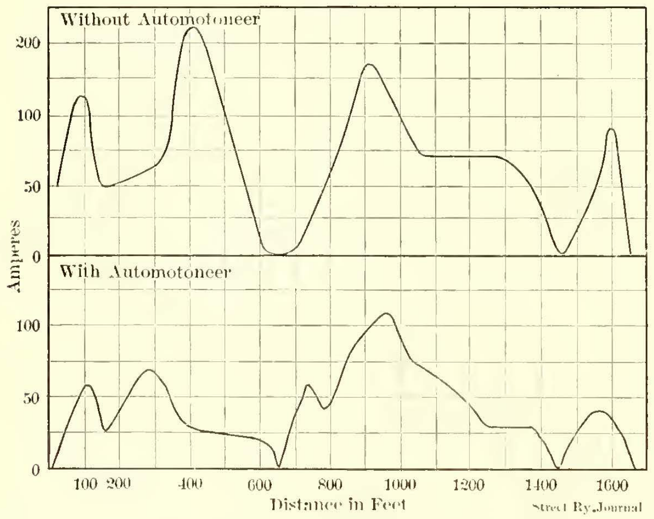


FIG. 1.—CURRENT CONSUMPTION WITH CARELESS HANDLING OF CONTROLLER, AND WITH AUTOMOTONEER

particular 1600 ft. of track by more than 60 per cent. This portion of the track was on somewhat of an adverse grade, and the number of stops was the same in the two runs. The time consumed in the two cases is not stated in the report. The records made by the Thomson integrating wattmeter differ for the different runs as might be expected, but the average power consumed by the car with and without the automotoneers shows an advantage of a little over 7½ per cent for the automotoneer. Without the automotoneer, and while in charge of an unusually careful motorman, as explained before, the car equipment absorbed almost exactly 1000 watts per car-mile. After the automotoneers were applied the power consumption averaged approximately 925 watts per car-mile. This shows a difference of slightly over 7.5 per cent in favor of the automotoneer. In one of the runs the difference was as high as 10 per cent. These results make the comparison with the plain controllers handled with unusual care. The margin in favor of the automotoneer by the recording wattmeter records, in that portion of the run shown in Fig. 1, is over 60 per cent. Messrs. Jackson believe that this latter represents the condition existing on many electric railroads, and also believe that a more retarded adjustment in the automotoneer would increase the saving in power, and that 15 per cent or more saving in power may be effected on a large proportion of roads by the employment of the automotoneer.

Special tests were made of the effect of the automotoneer on the time required for accelerating the car and upon emergency stops made by reversing the motors. With the automotoneers adjusted to 4½ seconds as a minimum time in passing the controller from the "off" to the full "on" position it may ordinarily be expected that between 5 seconds and 6 seconds will be consumed by the motorman in starting. This time is divided fairly uniformly between the several points of the controller, and the result conduces to a smooth acceleration and an economical start. The tests indicate that the car gets under way so promptly and so quickly comes to a full speed, that the automotoneers cause no loss of schedule-keeping power. A materially slower operation of the automotoneers would still give satisfaction in this respect under the traffic conditions in Madison.

Fig. 2 exhibits a curve showing a start and emergency stop with automotoneers in use. It is to be noted that the car came to a speed of over 15 m. p. h. in the space of 100 ft., or a little over three car lengths. The car came to a speed of 20 m. p. h. in 16 seconds in a distance of 290 ft., and to 18¾ m. p. h. in 12 seconds and 170 ft. This was effected with a smooth acceleration and minimum peak current.

While making emergency stop tests by reversing the motors, it was clearly seen that the maximum braking effect was obtained by allowing the controller to rest upon the first and second notches. The automotoneer is here of service in pre-

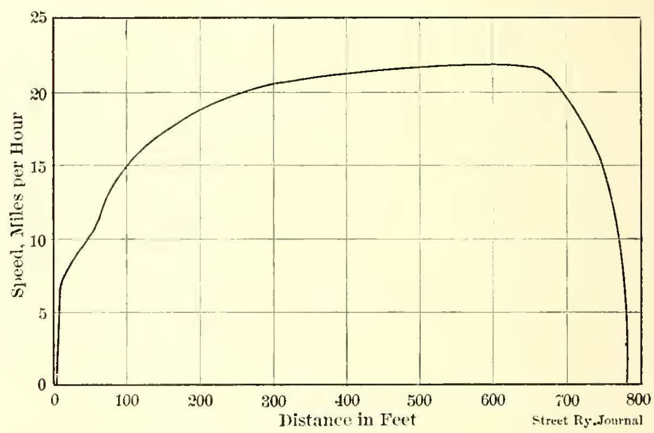


FIG. 2.—ACCELERATION AND EMERGENCY STOP BY REVERSAL

venting the controller from being carried around quickly to the last notch by an excited motorman, which slips the wheels and reduces the retarding effect, besides causing serious danger of opening the safety devices or injuring the motors.

Fig. 2 also illustrates an emergency stop, the reverse switch being thrown and the controller then being operated as rapidly as the automotoneer would permit. It was found that a stop could be made from a speed of 20 m. p. h. to standstill in 88 ft., or two and one-half car lengths. When an effort was made to stop by throwing the motors at once into parallel, as would be done by an excited motorman unchecked by the automotoneer, the distance required for the stop was considerably longer and sometimes exceeding five car lengths.

The adjustment of the automotoneers, as used on this test, is considered a trifle fast for the best results, and in small cities, such as Madison, a slower rate is permissible, and a 5-second adjustment would probably not interfere with schedule keeping even in dense thoroughfares with crowded crossings, after motormen became accustomed to the most effective way of handling the controllers.

The saving in operating expense which these tests show may be brought about by using the automotoneers, relate to: Repairs on the equipment, which are reduced through the reduction of starting currents. Cost of power for propelling the cars, which is reduced through the reduction in the amount of power consumed. Increase of operating capacity of the plant through reduction in the maximum of current which is required.

Besides this, the report shows that the automotoneer, when properly adjusted, imposes upon the motorman a reasonable rate for accelerating the car, and thereby conduces to the comfort and safety of the passengers and the safety of the motors. The tests also show that it is perfectly easy to maintain the schedule of the Madison Traction Company, with the automotoneers set for $4\frac{1}{2}$ seconds or longer, leaving a proper margin for making up time if the car becomes delayed for any reason. The automotoneers, however, will not permit the motorman to throw the controller on with a "jump," and thus impair the equipment, reduce the efficiency of operation, and produce discomfort for the passengers. The tests also indicate that the device will not interfere with picking a way in dense traffic and at crowded crossings.

It is clearly proved by the tests that the automotoneer is of value in emergency stops where reversing the motor is resorted to, by preventing the motorman from too quickly operating the controller.

A NEW FARE REGISTER

Will I. Ohmer, of Dayton, Ohio, is the inventor of a device for registering and recording fares which comprises many new ideas. The invention is the outgrowth of about twelve years experience in designing and manufacturing automatic recording and registering machines of various kinds.

The new device will be known as the Dayton Fare Recorder, and will be manufactured and placed on the market by the Ohmer Automatic Recorder Company, of Dayton, Ohio. The company already has its factory fully equipped and will have the recorders ready for the market at an early date. The invention comprises a fare indicator, fare register and recorder, a cash and fare computer and total adder. With all it is surprising simple, and is operated by one operation of a rod.

Fig. 1 is a front and side view of the recorder. The upper openings show the direction and trip passengers independent of the amount paid. The trip passenger register is reset at the end of each trip by a knurled hand grip, which also sets the direction indicator.

Through the lower group of sight openings in the case are seen the fare indicators, which show at each operation of the recorder the kind or amount of fare that has been registered. The automatic display of one of these fare indicators every time the recorder is operated is a check on every fare registered. The register can be operated in two ways, either by several independent rods or by one rod. In both cases the rope or cord is dispensed with. Where the fares are limited there is, possibly, a slight advantage gained by using independent rods, each rod providing means for registering two classes of fares. Thus, in practice, when the conductor has collected a fare, say a 5-cent cash fare, he registers the fare by a forward or rearward movement of the operating lever or handle. The fare indicator exhibited remains in full view of the passengers until another fare is registered, when it is released and another indicator is brought to view. At the extreme end of the movement, which is necessary to make the registration, a bell rings within the recorder as a signal that the registration has been complete.

The most important feature of the invention is the very complete and fully itemized record which is produced within the recorder. For this purpose two groups of duplicate record printing counters have been provided, also automatic mechanism for recording the various classifications of the fares. The recorder is also provided with a roll of blank paper and suitable mechanism for taking a printed impression of the record made by the record printing counters.

In operation when the car leaves the car house on the first trip out the recorder is locked and cannot be operated until the conductor who is in charge of the car inserts a key into the mechanism and unlocks it, the key remaining in the mechanism as long as the conductor has charge of the car. Engraved on the key is the conductor's name or number, which will be printed upon that part of the record for which he is responsible. At the end of each trip the conductor operates the printing mechanism of the recorder and prints a record from the group of record printing counters which pertains to the record of the fare collections on that trip. The record will show the direction the car was running on the trip, the consecutive number of the trip, the total amount of cash collected, the number of each class of fares collected, the total number of passengers carried, the number of the car and the name or number of the conductor. The conductor then resets the group of record

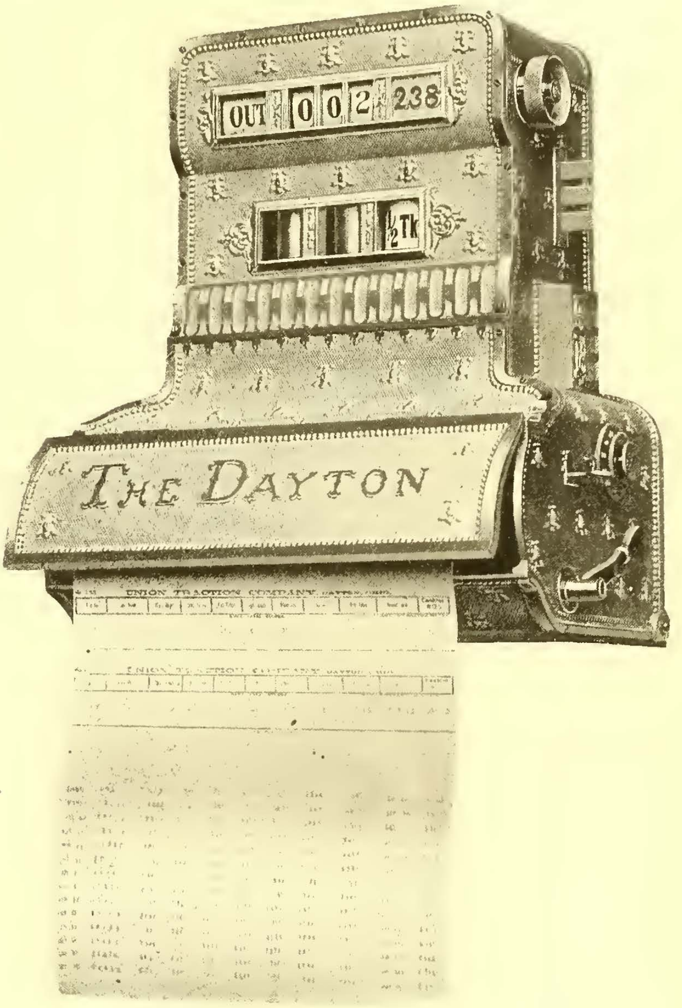


FIG. 1.—FARE RECORDER OPEN, WITH DAILY RECORD AS IT ISSUES FROM MACHINE

printing counters from which a record has been taken with the same movement and simultaneously with the trip passenger register. The operation described is repeated at the end of each trip; the record of the fare collections for each trip showing separate and complete in itself. The conductor in no case removes the record from the recorder, and has no means of knowing the result of the registrations, except when sight openings in the recorder are provided, which is optional with the company as well as with the conductors.

When the car is returned to the car houses at the end of the day's work the conductor removes the key from the mechanism, and the recorder again locks automatically and becomes inoperative as before. A duly authorized person, such as an inspector or cashier, then inserts another key into the mechanism and unlocks that part of the printing mechanism which permits of a record being printed from that group of record printing counters which pertain to the daily total record. In this case the key used to unlock the mechanism bears the name or number of the inspector or cashier, and identifies him with that part of the record for which he is responsible. The mechanism pertaining to the registering of fares, however, remains locked and cannot be operated. The printing mechanism is then operated and a printed record is produced from the last-named group of record printing counters, which is a record showing the result of the fare collections and operations of the car for the entire day, viz., total number of trips made by the car, total amount of cash collected, total number of each class of fares collected, total number of passengers carried during the day, total number of passengers carried since the beginning of the car run or month or year, the month and date, name or number of the inspector or cashier, name of the company, place of operation, number of the recorder, etc. Suitable headings are also printed to the respective cassifications of the record.

Fig. 2 is a fac simile copy of a record taken from the recorder. It will be noted that the record is fully computed and that it shows complete information in every respect. Not a single mathematical calculation is required to show the result of the fare collections on any trip made during the day, nor to arrive at the total classified result of the fare collections and operations of the car for the entire day. The work is all done mechanically, which insures its accuracy.

The result of the fare collections on the first trip made by the car is shown in the bottom line of figures beginning with "Out 1," which shows the direction of the car for that run and the consecutive number of the trip. The record for the trip shows the following result of the fare collections: One dollar and seventy-five cents in cash, 26 5-cent fares, 15 3-cent fares, 14 half tickets, 10 full tickets, 28 transfers and 2 passes. The total number of passengers carried was 95. The record also shows that the trip was made with car No. 356, and that conductor No. 165 was in charge. The record of each trip made during the day shows the same fully itemized results. A change of conductors took place at the end of the sixth trip. This is indicated on the record by the change in the conductor's number. Conductor No. 165 is responsible for that part of the record which bears his number. Before leaving the car he removed his key from the recorder and the mechanism locked automatically against further operations until the relief conductor inserted his key which made him responsible for that part of the record identified with the number "C-142."

As has already been stated the conductor has no means of knowing the result of the registrations he has made, except where special provision is made for that purpose. He simply turns into the office what he has collected, and his returns are then checked from the record by the cashier or clerk assigned to that duty. Thus, referring again to the record shown in Fig. 2, when the twelve trips had been made and the car was returned to the car house at the end of the day's work, conductor C-142, who was then in charge of the car, removed his key from the recorder, leaving it locked against the further registering of fares or manipulation of any kind. Cashier No. 126 then went to the recorder and inserted a key bearing his number and unlocked that part of the printing mechanism which governs the printing of the daily total record, but did not unlock that part of the mechanism which pertains to the registering of fares by the conductors. He then printed the part of the record which shows the result of the fare collections and operations of the car for the entire day, making as many duplicate copies as may have been required, and at the same time printed the headings to the respective classifications of the record and other matter, such as the name of the company, place of operation, number of the recorder, etc., and his own number, which identified him with the record. He then unlocked and opened the lid, as shown in Fig. 1, and removed the record by tearing off the strip of paper along a straight-edge knife provided for the purpose. The cashier then reset the group of record printing counters pertaining to the daily total record by means of a resetting key, shown in Fig. 1. This left the record in its normal condition and ready for the next day's operations.

The result of the fare collections for the day, as shown in the line of figures under the heading, "Daily Total Record," is as follows: Sixty-five dollars and ninety-eight cents in cash, 908 5-cent fares, 686 3-cent fares, 492 half tickets, 326 full tickets, 754 transfers and 26 passes. The record also shows that twelve trips were made in all, and that 3172 passengers were carried during the day, and that a total number of 232,654 passengers had been carried since the beginning of the year. The date of the record is June 12.

No. 238 **UNION TRACTION COMPANY,** DAYTON, OHIO.

Trip No.	Cash Total	5c. Fares	3c. Fares	Half Ticket	Full Ticket	Transfers	Passes	Trip Total	Grand Total	Cashier #126
DAILY TOTAL RECORD.										
12	065.98	0908	0686	0492	0326	0734	0026	3172	232654	June-12
CONSECUTIVE TRIP RECORD.										
In 12	011.09	0145	0128	0C86	0067	0095	0002	0523	Car 356	C-142
Out 11	005.22	0072	0054	C045	0024	0068	0004	0267	Car 356	C-142
In 10	006.98	0094	0076	0053	0037	0078	0006	0344	Car 356	C-142
Out 9	007.83	0105	0086	0074	0043	0092	0002	0402	Car 356	C-142
In 8	006.10	0086	0060	0042	0026	0058	0000	0272	Car 356	C-142
Out 7	005.09	0070	0053	0027	0018	0042	0001	0211	Car 356	C-142
In 6	004.40	0064	0040	0021	0018	0038	0003	0184	Car 356	C-165
Out 6	005.91	0081	0062	0049	0028	0073	0000	0293	Car 366	C-166
In 4	003.58	0060	0036	0027	0016	0062	0002	0193	Car 356	C-165
Out 3	006.28	0076	0061	0032	0026	0055	0003	0242	Car 356	C-165
In 2	002.76	0040	0026	0022	0013	0045	0001	0146	Car 366	C-166
Out 1	001.75	0026	0015	0014	0010	0028	0002	0096	Car 356	C-166

The Ohmer Automatic Recorder Company, Dayton, Ohio U. S. A.

COPY OF RECORD (HALF SIZE) TAKEN FROM RECORDER

The returns made by the two conductors in charge of car No. 356 for that day are then checked from the record. If found correct the record is then filed for possible future reference. If any discrepancy exists between the returns and the record sufficient to warrant an investigation, the company will, of course, be governed by its own rules and regulations in such cases. However, when conductors use due care when registering the fares their returns will invariably be found to tally with the record. The duplicate records are sent to such departments or heads of departments as may require them. The record may also be printed in two colors of ink so that the totals will be prominently distinguished.

The advantages to be derived from this register will be apparent. The conductor is relieved of all clerical work while in charge of his car. He has more time to attend to the collecting of the fares and to look after the welfare of his passengers. The record produced by the recorder is indisputable evidence that places every conductor upon his own merits. The advantages to the office from the fully itemized record of the fare collections will also be appreciated by those who are familiar with the rather complex system of counting and checking the fares which is now a part of the office work.

A number of sizes of the recorders will be manufactured. For city use two sizes will be made. One having capacity for four different classes of fares, and the other for from six to eight different classes of fares. In each case the recorder will have all the features that have been described. Slight changes, of course, in the record will be necessary in order that it may conform with the fares in use.

For interurban lines the recorder is modified so as to have greater capacity as to the number of the different kinds of fares that may be independently recorded. At least two sizes will be made. These will accommodate from ten to twenty different classes of fares, permitting of each class to be recorded separately. However, instead of showing a consecutive trip record an independent station record showing the number of passengers taken aboard at each station and the amount of fare paid by each will be shown. The time when each stop was made will also be shown when desired. The independent station record corresponds to the consecutive trip record described in this article. At the end of a trip another record is made, corresponding to the "Daily Total Record" described, which shows the result of the fares collected and the operations of the car for the entire trip. At the end of the day's work a final record is made, which shows the result for the entire day. Instead of the direction-indicating wheel, shown and described in connection with Fig. 1, a station-indicating wheel, which shows the name of the approaching station, is used. The station-indicating wheel works automatically with the operations of the recorder. The fares are classified and registered with a single rod method.

ELECTRICAL HEATING OF THIRD RAILS FOR SLEET REMOVAL

The plan of melting sleet from a third rail by means of electricity has been proposed a number of times, and a patent covering special apparatus for accomplishing this result was issued about a month ago to E. E. Ries, the well-known electrical inventor. The favorable execution of this plan depends upon the theory that when sleet forms upon the rail the latter is seldom more than 1 deg. or 2 degs. below the freezing point, that only a slight increase in its temperature is necessary to melt the sleet, and that a comparatively small amount of power is required to maintain the rail, when once heated, at a temperature at which no sleet will form upon it.

Mr. Ries has estimated that the electrical energy required, in still air, to heat 1000 ft. of 100-lb. rail, such as used on the Manhattan Elevated Railway, and which has a cross-section of 9.8 sq. ins. and perimeter of about 25 ins., would amount to 1.5 hp per 1 deg. F. This figure is based upon a loss from radiation and convection of 1.33 B. T. U. per hour, per degree Fahrenheit

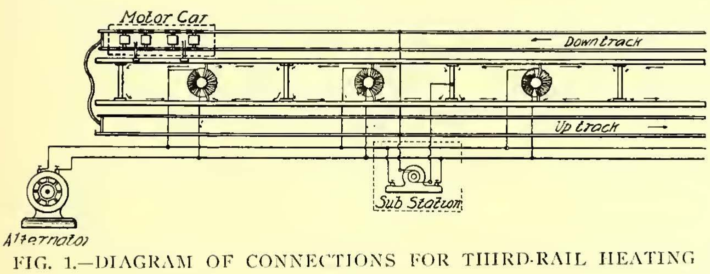


FIG. 1.—DIAGRAM OF CONNECTIONS FOR THIRD-RAIL HEATING

per square foot of surface, divided into 0.64 B. T. U. loss due to radiation and 0.69 B. T. U. due to convection. A high wind against a bare rail would abstract heat perhaps twice as rapidly, but this condition does not usually exist with a wet rail surface, which is a requisite to the formation of sleet.

It obviously requires considerably less energy to maintain the rail at a given temperature elevation in still air than is needed initially to bring it up to this temperature. For initial heating purposes a current strength of not less than 500 amps. per square inch of section is considered necessary, whereas, less than one-tenth of this amount will be required to maintain it at, say, 34 degs or 35 degs. in a surrounding temperature of 4 degs to 5 degs. lower.

According to the plan proposed, the most important sections, which are at the same time the shortest, such as at stations, on curves and cross-overs, are heated first. After the sleet on these sections has been removed the current is cut down and the sections on ascending grades are cleared. Finally, the level sections and those on descending grades are supplied with current. The term "section" is not used in this connection in

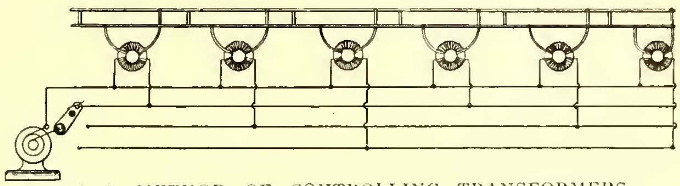


FIG. 2.—METHOD OF CONTROLLING TRANSFORMERS

its electrical sense, as in the system of heating proposed it is not necessary to divide the rail electrically into sections. Direct or alternating current can be used for heating, but alternating current is preferred, as it is not only much more convenient of application but the skin effect produced is useful. The effect of skin heating is that the heat is first developed on the surface of the rail where it is most needed, and a portion of it is then conducted into the body of the rail. This makes it unnecessary to heat the entire mass before melting can commence. Twenty-five-cycle current has been found very suitable to produce the requisite skin heating.

The apparatus and connections proposed are shown in Fig. 1, which illustrates a double-track third-rail road with the third rails between the tracks, as is the practice in New York. Heavy bonds connecting the third rails are placed every 500 ft., and midway between them is a transformer, whose secondary is designed to give a maximum of 5000 amps. at 25 volts. These transformers are located permanently between the ties, but as they are to be used only a few days during the year they can be of the cheapest construction. Owing to the low voltage the secondary need not be insulated except by air, which will allow the transformer to run at considerably over its rated capacity or to develop for the initial heating 20 kw from a 10-kw transformer. Owing to their simple construction it is thought that these transformers can be easily manufactured for $5 per kilowatt, making the cost of the transformers about $1,000 a mile. The circuits of the heating currents would be, as shown in the diagram, through each third rail and cross connection back to the transformer. As will also be seen, the plan does not make it necessary to sectionalize the third rail or to discontinue its use for car movement while it is being heated, as the alternating-current circuit is entirely distinct from the car circuit and the latter will assist in heating.

The primary winding of the transformer is preferably in two parts, capable of multiple or series connection, and is fed from an intermediate tension cable extending from the various sub-stations along that portion of the line supplied by them. The transformers are controlled from the sub-stations, according to the prearranged schedule already referred to, in which the third rail of the important sections of the road are first heated up, after which the series connection is used to maintain the rails at the requisite temperature. Assuming the additional cost of feeder cables, switches, etc., at $1,500 a mile, the entire cost of equipping a third-rail road with this system is estimated at not to exceed $2,500 a mile. As opposed to this, there will be no wear on the third rail from scrapers as in the present system.

The Canton-Akron Railway Company has issued a ruling requiring passengers to purchase round-trip ticket at offices, instead of selling such tickets on the cars as heretofore. The policy of selling round-trip tickets only at ticket offices is becoming the general rule with Ohio interurban roads.

INTERURBAN ELECTRIC TRACTION SYSTEMS—ALTERNATING CURRENT VS. DIRECT CURRENT*

BY P. M. LINCOLN

Electric traction is peculiarly an American institution; that is, it has found its widest application in American communities and has been developed chiefly by American engineers. In America practically every town of over 5000 inhabitants is provided with an electric traction system. In other parts of the world it is only larger centers of population that are so provided.

Practically, all the traction work in America has been done by direct current. The alternating-current traction system, although it has received considerable attention from American engineers, has not until recently been favorably considered by them. In Europe, on the other hand, the alternating-current traction problem has received a large amount of attention. The polyphase induction motor has been developed by European engineers for traction purposes, and a number of installations have been made in Europe with apparatus of this character. American engineers have consistently refused to adopt the polyphase induction motor for traction purposes, on the ground that it is not suitable for that purpose. The principal reasons for this stand are two in number.

(1) That the polyphase induction motor is inherently a constant speed motor, and, therefore, not adapted to traction purposes. Continual change of speed is one of the characteristics of traction work. The direct-current series motor is peculiarly adapted to this class of work, because it is inherently a variable speed motor. At one definite speed the polyphase motor is an efficient machine, while at all other speeds the efficiency cannot be greater than the ratio of the actual speed to the synchronous speed. For instance, if the actual speed at which a given induction motor is working is 10 per cent of its synchronous speed, the power utilized is at most only 10 per cent of the power put in. In traction work a large part of the work done is necessarily at speeds below the maximum attained, and at these lower speeds the maximum economy that can be obtained from induction motors is necessarily small.

One expedient used by European engineers to reduce this source of loss is the use of motors in concatenation or in tandem; that is, the secondary of one motor is fed into the primary of another on the same car. If both motors thus concatenated are wound for the same number of poles this expedient has the effect of making the synchronous speed of each of the pair of concatenated motors one-half that which it is when not in concatenation. It is equivalent in direct-current practice to throwing two shunt motors in series. Up to the half-speed point, therefore, there is a gain of economy by this arrangement. By winding the two concatenated motors for different numbers of poles, more than one point of maximum economy can be secured between zero speed and full speed, but this arrangement has the disadvantage of being able to use but one-half the total motor capacity above half speed, while the greatest expenditure of energy takes place above half speed. In order to secure the advantages of concatenation, however, it is necessary to add largely to the weight of the electrical apparatus. European practice has been to equip cars with four motors, two main motors and the other two being used only while the car is below half speed. Above half speed the motors are running idle and are doing no useful work. The energy required to take care of the additional weight is an offset against the energy which is saved by concatenating the motors. For long runs this expedient would probably be detrimental, since the energy taken up to transport the extra weight would be more than equivalent to the energy saved at the start.

*Read before the electrical section of the Canadian Engineers' Society, Montreal, Nov. 19, 1903.

(2) The second reason against the use of polyphase induction motors for traction purposes is the necessity for providing at least two overhead conductors. If the track is not used as one of the conductors, then the necessity arises of using at least three overhead conductors. Maintenance of insulation on such overhead conductors when they are at high voltage is naturally a difficult problem, much more difficult than to maintain the insulation between a single conductor and ground, as would be the case in the single-phase system.

American engineers, instead of endeavoring to adapt the unsuitable induction motor to traction purposes, have devoted their energies to the development of a suitable alternating-current motor. The idea of using a series motor operated by alternating current is not new. The only alternating-current single-phase motors which have a characteristic suitable for electric traction purposes are those of the commutator type. In no other type of motor are the speed and torque characteristics such as to be suitable for traction purposes. In the commutator-type alternating-current motor the speed and torque characteristics are practically identical with these characteristics in the direct-current series motor. As early as 1893 extensive experiments were made by the Westinghouse Electric & Manufacturing Company on this class of motors. In fact, the experiments went so far as to equip a car with two motors of this type, and the car was put into actual operation. Moreover, the frequency and voltage for which the motors were designed was practically the same as those for which the more recent motors were designed. These early motors were considerably smaller in capacity, however, and the trolley voltage was less. Further, the method of controlling the speed was by control of voltage. Although the early motors were successful as motors, the alternating-current system, as a system, was not thought at the time of sufficient importance to continue the developments along this line. In other words, the time was not yet ripe for the development of this system. Interurban electric traction work, such as exists to-day, was not at that time thought of, and this is, in my opinion, the peculiar field for the alternating-current traction system.

In considering the general problem of electric traction, the question naturally arises—what is gained by the use of alternating current over direct current? and the converse of this question also naturally arises—what is it necessary to sacrifice in order to obtain the benefit of alternating-current traction? An analysis of the advantages and disadvantages of these two systems may be of interest. Although many of the following points have been treated in previous papers, particularly that of Mr. Lamme, before the American Institute of Electrical Engineers, in September, 1902, it is hoped the reader will bear with a repetition of some of the points mentioned.

The principal advantages of the alternating-current electric traction over the direct current are as follows:

(1) Limits to trolley voltage are removed.

(2) Avoidance of rheostatic losses.

(3) The necessity for rotary converter sub-stations abolished.

(4) Manual attendance at the sub-stations done away with.

(5) Danger of electrolysis by return current avoided.

To take up these points more in detail:

(1) VOLTAGE LIMIT REMOVED

The greatest item of cost in the electrical equipment of interurban traction systems, as they exist to-day, is that of secondary distribution. This item of cost usually carries somewhere between 25 per cent and 50 per cent of the total for electrical equipment, and is usually much nearer the latter figure than the former. Six hundred volts at the motor in a direct-current traction system is practically the limit at which present designers and manufacturers are willing to guarantee their operation except in some special cases. This necessarily limits the voltage fed into the secondary distribution system to, say, 700 as a maximum. The consequence of this comparatively low voltage is naturally a high cost for conductors of this secondary distribution. The alternating-current system, providing, as it does, the possibility of greatly increasing the voltage of the distributing system, thus cuts down largely the cost of this distributing system.

Another point which militates against the use of direct current is the fact that when large units are used it is difficult to collect the large amount of current for their operation. For this reason, as well as an advantage in cost, trolley construction has been largely replaced by the third rail for interurban work. By raising the voltage of the secondary system the current taken by a locomotive may be reduced, and consequently the difficulty with collecting devices may be made to disappear.

(2) RHEOSTATIC LOSSES AVOIDED

In the direct-current system the voltage at the car is practically constant, and while the counter e. m. f. of the motors is building up, the excessive voltage must be taken up by resistance. At the start, therefore, a comparatively large rheostatic loss occurs. With the alternating-current system, on the other hand, the voltage at the car may be controlled by suitable means and the rheostatic loss thus avoided. When stops are few, and, consequently, runs are long, the rheostatic loss in the direct-current system is a small proportion of the total, and, therefore, under these conditions this advantage of the alternating-current system is not so greatly marked. With short runs, on the other hand, and consequently frequent starts, the rheostatic loss with the direct-current system amounts to a considerably greater proportion of the total loss, and the alternating-current system, therefore, can have the greater advantage.

Figs. 1 and 2 show kilowatt curves for a car equipped in one case with direct-current motors and in the other with alternating-current motors. The weight of the direct-current car is 35 tons, and of the alternating-current car about 18 per cent greater. The length of run is 2 miles in each case, and the schedule speed 30 m. p. h. Were it not for the saving of rheostatic loss, one would expect that the alternating-current equipment, being 18 per cent heavier, would take 18 per cent more power. The actual difference in the areas under the curves, however, shows about 10 per cent more power in the alternating current than the direct current on account of avoiding rheostatic loss in the alternating-current equipment. If the run were for about 1 mile instead of 2 miles the consumption of power would be about equal, and for runs of less than 1 mile the alternating-current power consumption would be less.

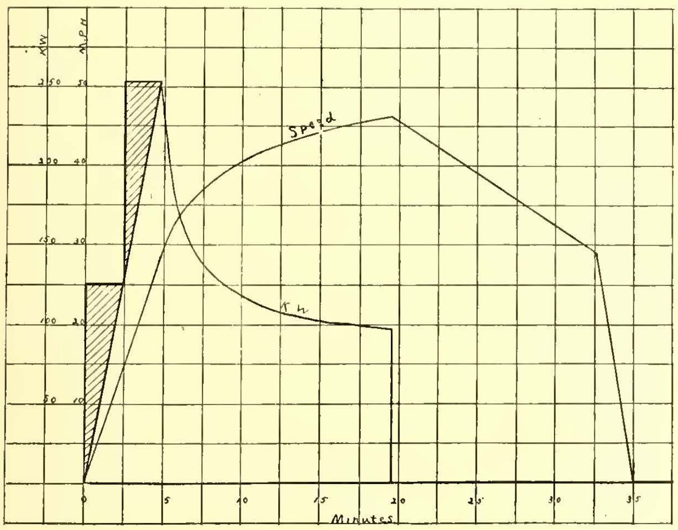


FIG. 1.—TYPICAL RUN CURVE WITH DIRECT-CURRENT MOTORS

Weight of car, 35 tons.
Equipment, two No. 50-C Ry. motors.
Schedule speed, 30 m. p. h.
Average volts at motors, 550
Braking accel., 2 m. p. h. p. s.
Average kw., 67.2.
√Mean² curent per motor, 105 amp.
Accel., 1.0 m. p. h. p. s.
Gear ratio, 21:50.
Wheels, 36 in.
Run, 2 miles.
Stop, 30 seconds.

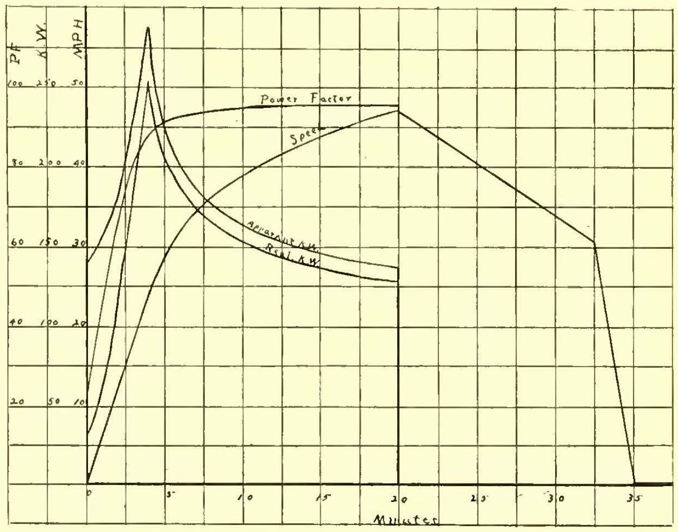


FIG. 2.—TYPICAL RUN CURVE WITH ALTERNATING-CURRENT MOTORS

Weight of car, 41.3 tons.
Equipment, two 175-hp ac. motors.
Gear ratio, 17:53.
Schedule speed, 30 m. p. h.
Stop, 30 seconds.
Braking accel., 2 m. p. h. p. s.
Average kw, 73.9 real; 84.7 apparent.
Accel., 1.0 m. p. h. p. s.
Wheels, 36 ins.
Run, 2 miles.
Average volts at motor, 200.

(3) NECESSITY FOR ROTARY CONVERTERS AVOIDED

The cost of sub-station equipment constitutes one of the large items in the cost of the electrical equipment of an interurban road. In this sub-station equipment by far the largest item of cost is the rotary converters. In the alternating-current equipment the rotary converter has no place, thus avoiding not only a large item of cost but also one of the largest items of the loss of power.

(4) ATTENDANCE AT SUB-STATIONS DONE AWAY WITH

The direct-current rotary being a piece of revolving machinery, of course, requires manual attendance at the various sub-stations. Alternating-current sub-stations consist of static transformers only, and, therefore, require attendance only for the purpose of operating the switches. Making the switching devices entirely automatic in their operation avoids the necessity of attendance for this purpose. A still further refinement is the use of distant-controlled switches operated from a central point, say the main power house. Electrically-operated switches have already been developed to be operated from a distance of several hundred feet, and no reason exists why this distance of operation cannot be extended to 20 miles to 30 miles by proper design. By including in such a switch operating mechanism, also a signaling device, by which the position of the switch is made known at the central point, the switch-operating system becomes complete and no necessity exists for attendance at the alternating-current sub-stations for any purpose except occasional inspection. There is, of course, an expense in connection with installing such a system of operating switches electrically, but it bears no comparison to the expense of manual attendance.

(5) ELECTROLYSIS

Electrolysis of parallel conducting systems is generally recognized as one of the most serious dangers in connection with present direct-current trolley systems, and the fact that an alternating-current system avoids this danger entirely need only be mentioned in order to be recognized as a marked advantage.

So much for the advantages which accrue to the alternating-current system. Now the question arises—what points must be sacrificed in order to obtain these advantages. The disadvantages which necessarily accompany the use of the alternating-current traction system are as follows:

(1) Additional weight.
(2) Difficulty of operating on existing lines.
(3) Increased rail loss.
(4) The fact that an active e. m. f. exists between field turns.
(5) Possible interference with telephones.

Now suppose we take up the above points in detail.

(1) ADDITIONAL WEIGHT

An alternating-current motor of a given capacity is necessarily somewhat heavier and somewhat more expensive than a direct-current motor for the same capacity. This difference in the motor, however, does not constitute the total difference in weights of equipment. In order to make use of the advantages of high trolley voltage the alternating-current equipment should preferably be provided with a step-down transformer on the car. Also, in order to obtain the advantages of avoiding the rheostatic losses some provision must be made for controlling the voltage on the car. The transformer, the voltage control apparatus, and the greater weight of motors make the alternating-current equipment necessarily heavier than the direct current. Although this difference need not, and in many cases will not, be as great, the example cited later in this paper (18 per cent), still a difference in weight will always exist detrimental to the alternating-current equipment. This greater weight of the alternating-current equipment is one of the items on the debit side of the ledger.

One of the most attractive methods for controlling the voltage on the motors is the use of an induction regulator. The principal advantage over other forms is that it does not require the interruption of the current, and is, therefore, of particular advantage in large equipments. It is this problem of breaking the current that forms not only the greatest difficulty with direct-current equipments of large capacity but also one of the largest items in the deterioration account. The induction regulator has the disadvantage of adding considerably to the weight, and in equipments of comparatively small size where the difficulty of current interruption is not great will probably be replaced by some other method of voltage control, such as loops or commutated coils on the step-down car transformers.

(2) DIFFICULTY OF OPERATING ON EXISTING LINES

Practically all interurban roads run in and through cities on existing tracks, and, therefore, must use the existing sources of direct-current power. In order to meet this condition the equipment for an alternating-current interurban road must be so arranged as to operate an alternating current outside the city and on direct current inside. Although this is entirely possible, it must necessarily prove to be a matter of considerable complication. It means, in the first place, the use of motors which can be operated from both direct current and alternating current. This is entirely possible with the series alternating-current motor. It means in the second place that another system of control must be added to the car. This objection might, in part, be avoided by using rheostatic control for both the alternating-current and direct-current conditions, but the objection obtains that this method will deprive the alternating-current system of its advantage of saving rheostatic losses. Further means will have to be provided for disconnecting all transformers when running from direct-current system and reconnecting them when running from alternating-current system. All these matters, although they mean a considerable amount of complication, are entirely possible. The most important part of the equipment—the motors—can be operated from direct current as well as alternating current.

(3) INCREASED RAIL LOSS

Experiments have shown that with alternating current from 2000 alternations to 3000 alternations the actual loss which takes place with a given current through the iron rails is from three to five times that which the same direct current would give. The higher ratio of loss holds for the higher frequencies. At first thought this seems to be an important objection to the alternating-current system. But when it is considered that in order to utilize the main benefit of the alternating current a higher trolley voltage is used, and, therefore, smaller currents in the return conductor, the element of rail loss in an alternating current proposition may be made even a smaller proportion of the total than in the direct current, in spite of this apparently large handicap. The rail loss with direct current is usually a small proportion of the total, and this, with alternating current at the trolley voltages, which are usually considered, viz.: 2000 to 5000, becomes a much smaller proportion.

(4) ACTIVE E. M. F. BETWEEN FIELD TURNS

The space that can be assigned to the motor for operating a car is necessarily limited. It is this limitation of space, in fact, which often forces the use of a four-motor equipment instead of a two-motor equipment, the available space not being large enough to allow the installation of motors, two of which are sufficient for the work. When we consider the alternating current motor, the question of space available becomes still more exacting; first, because the alternating-current motor is necessarily heavier, and, therefore, occupies more space than an equivalent direct-current motor; and, secondly, because of the active e. m. f. that exists between the field turns in the alternating-current motor, and which, other things being equal, again requires additional space for installation. In the matter of e. m. f. between field turns, the alternating-current and direct-current motors are quite different. The e. m. f. between the field turns of a direct-current motor is due simply to ohmic resistance, and a short circuit between turns simply throws out of action the turns so short circuited, and if not too severe, does not interfere seriously with the motor's operation. Between field turns of the alternating-current motor, on the other hand, there is an active e. m. f. similar to that between the turns of a transformer winding. A short circuit between field turns in an alternating-current motor, therefore, means a destructive short circuit and an immediate interruption of service from that motor. In other words, the effect of a short circuit between field turns in an alternating-current motor has the same effect that short circuit between armature turns would have in either the alternating-current or direct-current motors. Roasting out of field coils is one of the most frequent causes of trouble in direct-current motor equipments, and it is readily realized that this matter of active e. m. f. between field turns in the alternating-current motor is a serious one. As an offset against this disadvantage of an active e. m. f. between field turns, the alternating-current motor possesses the advantage of being capable of operation at low voltage, thereby reducing the number of turns on the series field and increasing the proportionate space for insulation. The use of a step-down transformer on the car makes available any desired voltage at the motor. This existence of an active e. m. f. between field turns is the most serious obstacle to the use of high voltage on the motor. Even with low voltage the alternating-current motor is laboring against the handicap of occupying more space than an equivalent direct-current motor, and the use of high voltage still further increases this handicap. The limitations of space do not apply to the transformer in anything like the same degree that they do to the motor, and no particular difficulty is anticipated in building a transformer for this work.

This limitation of available space for the motor and the existence of an active e. m. f. between field turns makes it seem probable to the writer that the alternating-current railway motor of the future will be operated at low voltage, and will receive its current from a transformer carried on the car.

(5) INTERFERENCE WITH TELEPHONES

It is a question whether alternating current in the rails will interfere with telephones and similar instruments more than the direct current, which they have to contend with at present. In any event, the amount of current in the rails can be reduced by the use of higher voltages, so that this source of interference can be made less than it is with the present direct-current system. Further means have been proposed whereby the current can be confined entirely to separate conductors provided for the purpose and not allowed to wander at will through any return circuit that may exist, as is the case with the direct-current system. This can be done, of course, only at the expense of erecting a separate system for the return currents and a system of series transformers whereby these currents can be confined to this return system. The alternating-current system, therefore, possesses the advantage of being able to use the rails for contact and still not allowing the alternating currents to escape at will through the earth. As a matter of fact, interference with other circuits by the alternating-current system is expected to be less than with the present direct-current system.

COMPARISON OF ALTERNATING AND DIRECT-CURRENT SYSTEMS

The engineer has been defined as a man who could do for \$1.00 what any fool could do for \$2.00. The engineer, in other words, stands for efficiency. It is he who accomplishes a given result with a minimum expenditure of effort and money. Suppose we apply this criterion to the comparison between the alternating-current and direct-current systems. By which of these systems can a given service be rendered most economically? In order to answer this question we shall assume a certain typical interurban road, ascertain the first cost by both systems and the cost of operating by both systems and compare the results. Suppose the typical road which we will assume to be as follows:

Length, 60 miles.

Schedule speed, 30 m. p. h.

Cars running half-hour apart.

Number of stops thirty, that is, typical run, 2 miles long.

Weight of direct-current car, complete, 35 tons.

Weight of alternating-current car, complete, 41.3 tons.

It may be noted here that the difference in weight is not the minimum that can be obtained. A large part of the difference in weight comes, as previously mentioned, in the induction regulator, with which it is assumed the alternating-current car is equipped. Other methods of voltage control can be applied which would be considerably lighter, but the induction regulator is selected on account of the advantages previously mentioned. The alternating-current system is, therefore, working under a handicap which is greater than would be the case if some other method of control were assumed.

Fig. 1 shows the speed-time and kilowatt-hours curve of a direct-current car of 35 tons over the typical run. The equipment, gear ratio, acceleration, etc., are given on the curve.

Fig. 2 shows the same for an alternating current typical run, and in addition gives also the apparent kilowatt and power factor. It will be noted that the difference in power at the car is only 10 per cent in favor of the direct-current equipment, in spite of the fact that the difference in weight is 18 per cent in favor of the direct current.

The location of the power house is assumed in both cases to be on the line of the road midway between the termini, therefore, 30 miles from each terminus.

In each case, also, one of the sub-stations is located in the power house. In the alternating-current proposition the generators are wound for trolley voltage (3000 volts) and feed directly into the trolley.

In each case, also, there are supposed to be four feeding points beside the power house, thus making the sub-stations 12 miles apart in both cases.

Further, in both cases the secondary system is a single network, thus gaining the advantage of two feeding points except beyond the end sub-stations. In neither system are secondary feeders figured on, the alternating-current being simply a No. 0000 trolley wire throughout, and the direct current a 60-lb. conductor rail. In the direct-current system the high-tension line is supposed to be along the right of way of the road, and the high-tension poles are utilized for supporting the trolley wire with a bracket construction.

Recognition of the fact that the alternating-current car is the heavier and requires more energy is made, and larger motors than on the direct-current car estimated on.

In the direct-current proposition the generators, transmission line, etc., are supposed to be three-phase, naturally making necessary smaller transformers than in the single-phase system.

The following parallel columns give complete comparison of the power consumption, the losses in the various transmissions and transformations, the first cost of the apparatus used and an estimate of the operating expenses. The conditions are taken as nearly as possible to those in the typical road. Location will, of course, make differences in many of the items considered, but especial care has been used in estimating those items in which the two systems present a difference:

DIRECT-CURRENT RAILWAY SYSTEM POWER REQUIREMENTS		ALTERNATING-CURRENT RAILWAY SYSTEM POWER REQUIREMENTS	
Average kilowatt at car in typical 2-mile run (Fig. 1)	67.2	Average real kilowatt at car in typical 2-mile run (Fig. 2)	73.9
Number of cars running at one time	8	Number cars running at one time	8
Number sub-stations...	5	Number sub-stations..	5
Average number cars per sub-station	1.6	Average number cars per sub-station	1.6
		$\sqrt{\text{Mean}^2}$ apparent kilowatt per car	129.0
$\sqrt{\text{Mean}^2}$ amps. per car.	185.3	$\sqrt{\text{Mean}^2}$ amps. per car (3000 volts)	43.0
$\sqrt{\text{Mean}^2}$ amps. per sub-station = m	279.0	$\sqrt{\text{Mean}^2}$ amps. per sub-station = m	68.8
With sub-stations 12 miles apart. 80-lb. track rail and 60-lb. third rail. resistance between adjacent sub-stations is = r......	0.9 ohms	With sub-stations 12 miles apart, 80-lb. track rail and No. 0000 trolley, resistance between sub-stations, allowing for increased rail resistance	4.2 ohms
Direct-current line loss per sub-station $\frac{r\,m^2}{6}$ =	16.1 kw	Trolley and rail loss per .... sub-station = $\frac{r\,m^2}{6}$ =	3.32 kw
Average kilowatt per sub-station at cars = 67.2 × 1.6 =......	107.5	Average real kilowatt per sub-station at cars = 73.9 × 1.6 = ...	118.0
Average kilowatt per sub-station at sub-station	123.6	Average real kilowatt per sub-station at sub-station	121.32
		Per cent loss in regulator and car transformer	5.0
Per cent loss in third rail	15.5	Per cent loss in trolley and rails	2.8
Per cent loss in step-down transformers...	3.5	Per cent loss in step-down transformers ..	3.5
Per cent loss in rotaries	10.0		
Per cent loss in high-tension line	2.5	Per cent loss in high-tension line	2.5
Per cent loss in step-up transformers	3.5	Per cent loss in step-up transformers	3.5
Total per cent loss from cars to P. H.........	39.5	Total per cent loss.....	18.4
Average kilowatt consumed by eight cars at the cars	537	Average real kilowatt consumed by eight cars at the cars......	591
Average kilowatt at power house for eight cars	750	Average real kilowatt at power house for eight cars	700

Max. load per sub-station—worst condition, two cars starting.... 560

One 400-kw rotary will take care of this 40 per cent over load.

Average load on rotary 30%

Rotary sub-stations are of sufficient size so that one can be cut out temporarily.

Max. load on P. H., say 1200 kw

Can be taken care of with three 400-kw generators—one for spare.

STEP-UP TRANSFORMERS

Seven 150-kw transformers—1 for spare.

HIGH-TENSION LINE

One No. 6 B. & S. gage line each way from P. H., 20,000 volt, three-phase.

Max. loss, about....... 8.25%

Average loss, about... 2.50%

SUB-STATION EQUIPMENT

Five sub-stations in all—one in P. H.

Each of four sub-stations to contain:

Three 135-kw step-down transformers.

One 400-kw rotary converter.

Switchboard.

Step-down transformers omitted in power house sub-station.

LOW-TENSION DISTRIBUTING SYSTEM

Entire length of track equipped with 60-lb. conductor rail.

CAR EQUIPMENTS

Each car equipped with two 150-hp direct-connected railway motors and multiple control apparatus complete.

ESTIMATED FIRST COSTS OF ELECTRICAL EQUIPMENT

POWER STATION

Three 400-kw, 25-cycle, 360-volt, three-phase, A. C. generators, at $6,500 each	$19,500
Seven 150-kw, 350-volt to 20,000-volt, self-cooling, oil-insulated trans., 25-cycle, at $1,225	8,575
Switchboard	4,500
	$32,575

HIGH-TENSION LINE

48 miles of 20,000-volt, three-phase transmission line—No. 6 B. & S. gage conductors, at $900 per mile........	$43,200
Lightning protection...	2,500
	$45,700

Average apparent kilowatt at power house, about 825

Max. load per sub-station—worst condition, two cars starting (say 275 apparent kw each)......... 550

One 350-kw transformer will take care of this with 50 per cent overload.

Average load on sub-station, about 40%

These transformers are sufficiently large to take care of road if one is cut out.

Max. load on P. H. in apparent kilowatt, say 1400 kw

Can be taken care of with three 450-kw generators—one for spare.

STEP-UP TRANSFORMERS

Three 400-kw transformers—load can be carried by two in case of emergency.

HIGH-TENSION LINE

One No. 3 B. & S. gage line each way from P. H., 20,000-volt, one-phase.

Max. loss, about....... 8.2%

Average loss, about ... 2.7%

SUB-STATION EQUIPMENT

Four sub-stations—P. H. feeds directly into 3000-volt trolley.

Each sub-station to contain:

One 350-kw transformer.

Switchboard.

LOW-TENSION DISTRIBUTING SYSTEM

Entire length equipped with No. 0000 B. & S. gage trolley.

CAR EQUIPMENTS

Each car equipped with two 165-hp alternating-current railway motors, with multiple-control apparatus complete.

ESTIMATED FIRST COSTS OF ELECTRICAL EQUIPMENT

POWER STATION

Three 450-kw, 25-cycle, 3,000-volt, one-phase, 2,000 alt. generators, $7000 each	$21,000
Three 400-kw, 17-cycle, 3000 to 20,000-volt, O. I. S. C., trans., at $2,500	7,500
Switchboard	3,800
	$32,300

HIGH-TENSION LINE

48 miles of 20,000-volt, one-phase transmission line—No. 3 B. & S. gage conductors, at $1200 per mile	$57,600
Lightning protection...	2,000
	$59,600

SUB-STATIONS

Twelve 135-kw, 20,000 and 360-volt, 25-cycle, O. I. S. C. transformers, at $1,175 each..	$14,100
Five 400-kw, 600-volt, 25-cycle rotary converters, at $5,200 each	26,000
Five switchboards, at $2,800 each	14,000
	$54,100

LOW-TENSION DISTRIBUTION SYSTEM

63 miles of 60-lb. conducting rail, at $2,500 per mile, installed....	$157,500
Bonding main track—63 miles, at $400 per mile	25,200
	$182,700

CAR EQUIPMENT

Twelve D. C. car equipments complete, consisting of two No. 50-C motors, with multiple-control outfit, heaters and contact shoes, at $5,217 each.	$62,604
Total first cost electrical equipment...	$377,179

ESTIMATE OF YEARLY OPERATING EXPENSES

DIRECT-CURRENT SYSTEM.

Five men, at P. H., two shifts, average wage $900 per year........	$9,000
One man at each of four sub-stations, two shifts, at $900 per year each	7,200
Fuel, water, oil, etc., at one-half cent per kw-hour—4,890,000 kw-hours	24,450
Repairs and maintenance of P. H. (3 per cent of cost per year)	971
Repairs and maintenance of H. T. line (5 per cent of cost per year)	2,285
Repairs and maintenance of sub-stations (4 per cent of cost per year)	2,064
Repairs and maintenance of third rail (1 per cent of cost per year)	1,822
Repairs and maintenance of car equipments (12 per cent of cost per year).......	7,512
Total yearly operating expenses	55,404

SUB-STATIONS

Four 350-kw, 2000-alt., 2000-volt to 3000-volt, O. I. S. C. transformers, at $2200 each....	$8,800
Five switchboards, at $1,500 each	7,500
Auxiliary signaling lines for operating sub-station switches..	7,500
	$23,800

LOW-TENSION DISTRIBUTION SYSTEM

63 miles of No. 0000 trolley wire in place, at $900 per mile....	$56,700
Bonding main track 63 miles, at $400 per mile	25,200
15 miles of pole construction not included in H. P. lines, at $630 per mile	9,400
	$71,300

CAR EQUIPMENT

Twelve A. C. car equipments complete, consisting of two 165-hp motors, with multiple-control outfit, heaters and trolley, at $8,482 each	$101,774
Total first cost electrical equipment....	$308,774

ESTIMATE OF YEARLY OPERATING EXPENSES

ALTERNATING CURRENT SYSTEM

Five men at P. H., two shifts, average wage $900 per year each...	$9,000
Fuel, water, oil, etc., at one-half cent per kw-hour	23,050
Repairs and maintenance of P. H. (3 per cent of cost)	969
Repairs and maintenance of H. T. lines (5 per cent per year)	2,980
Repairs, maintenance and inspection of sub-stations (6 per cent)	1,428
Repairs and maintenance of trolley (4 cent per year)	3,652
Repairs and maintenance of car equipments (10 per cent).	10,177
Total yearly operating expenses	51,256

NOTES ON THE FOREGOING COMPARISON

In the first cost of the two systems thus compared no allowance is made for the fact that the alternating-current system requires less energy at the power house, and, therefore, will economize to a considerable extent in both engines and boilers. On account of the greater apparent kilowatts for the alternating-current system, generators and transformers will be larger in capacity, but the engines and boilers need not be so great in capacity. So far as transformers are concerned, the alternating-current system has the advantage, because it allows the use of considerably larger units than the direct-current, where three-phase transmission is necessary instead of single-phase, as is the case in alternating-current system. The alternating-current switchboards also have the advantage in that two switches per panel are required instead of three.

To render a given service over high-tension line, more copper is required for a single-phase line than for a three-phase line, and this makes the copper for the alternating-current system somewhat more expensive than for the direct-current system. The largest difference, however, in the high-tension line items comes from the fact that the poles of the high-tension line are spaced sufficiently close to allow the trolley brackets to be supported from the same poles. In the direct-current system, the spacing need be only sufficient for the requirements of the high-tension line alone.

So far as sub-station transformers are concerned the alternating-current system has the advantage of single-phase over three-phase in that larger units are used. By far the largest item of saving in sub-station equipment between the two systems is, of course, in the omission of rotary converters in the alternating-current system.

The greatest difference in first cost of the two systems is, of course, the great difference in the cost of the secondary network. A glance at the comparative values will show that this difference in the case we have considered amounts to nearly $100,000, and is, therefore, nearly 30 per cent of the total cost of the direct-current system.

In first cost the alternating-current car equipments are, of course, considerably higher than the direct current. I would call attention to the fact, however, that the costs of the alternating-current car equipment include an induction regulator. If some other style of regulator, such as, for instance, loops on the car transformers, has been figured upon, the cost of the alternating-current car equipments might be diminished by something like 6 per cent; that is, something over $6,000. The saving in weight by the same change and the consequent saving of power in the alternating-current system would amount to nearly 4 per cent of that which have been figured upon. In the item of maintenance of the control apparatus, however, it is believed that the induction regulator has the advantage, in that it is not necessary to break the current in going from step to step.

The alternating-current system throughout is figured on the basis of using a frequency of 2000 alternations per minute. This frequency could be increased to, say, 3000 alternations per minute at the expense of, first, a considerably decreased power factor, and, consequently, increased apparent kilowatts; second, increased generator and transformer capacity; third, increased line and rail loss; and, fourth, increased cost of motors. This difference might run the cost of the alternating-current car equipment some 5 per cent higher than figured on. It will be noted that the great saving comes in changing from direct current to alternating current, and that a change in frequency within moderate limits affects a change by no means comparable with that which is effected by going to alternating current.

Operating Expenses.—In the labor item it will be noted that the main saving comes in that sub-station attendance is avoided by the use of the alternating-current system. In other respects the labor items will be the same.

The fuel item for the alternating-current system is somewhat smaller than for the direct-current system, as the actual energy at the power house is less in the former case than in the latter.

Besides labor and power the main operating expense for any interurban railway system comes in the items of repairs and maintenance. It will be noted that this item of repairs and maintenance has been included in the above comparison by assuming that it is a certain percentage of the first cost in each case. There may be some difference of opinion as to the percentage that should be assumed in the various cases of this item of repairs and maintenance, but I have endeavored to make the comparison between the two systems as fair as possible. It is not intended to include any item of depreciation in these repairs and maintenance figures. It will be noted that a marked difference is made between the maintenance of a third rail and trolley by allowing 1 per cent in the one case and 4 per cent in the other. The apparent discrepancy in allowing 5 per cent for the maintenance and repairs on the high-tension line and only 4 per cent for that of the trolley is explained by the fact that the 5 per cent on the high-tension line includes the repairs and maintenance and the supporting structure for the trolleys.

The matter of inspection of the alternating-current sub-stations is taken care of by allowing 6 per cent in the case of the alternating-current sub-stations instead of 4 per cent, as in the direct-current sub-stations.

In the matter of repairs and maintenance of the car equipments it will be noted that 12 per cent is allowed in the direct-current system and only 10 per cent in the alternating-current system. Even this difference in percentage allows $10,000 per year for the maintenance of the alternating-current equipments in the place of $7,500 for the direct current, or 25 per cent more for the alternating current than for the direct current. The alternating-current motors being lower in voltage and being protected by direct lightning discharges by the intervention of a transformer, ought to have at least a no higher maintenance bill than the direct-current motors. The number of motors in each case is the same. The alternating-current system, however, will require a certain amount of attention for the transformers and regulators. This item, though necessarily not based on experience, is estimated to represent the comparative conditions as closely as is possible at this time.

EXECUTIVE COMMITTEE MEETING OF THE AMERICAN RAILWAY MECHANICAL AND ELECTRICAL ASSOCIATION

A meeting of the executive committee of the American Railway Mechanical and Electrical Association was held at the Hollenden Hotel, Cleveland, on Dec. 7, to make preliminary arrangements for the next convention of that Association, which will be held two days in advance of the next American Street Railway Association convention and at the same place. Those present at this executive committee meeting were President E. W. Olds, of the Milwaukee Electric Railway & Light Company; Secretary Walter Mower, of the Detroit United Railway; W. O. Mundy, of the St. Louis Transit Company; Alfred Green, of the Rochester Railway; H. H. Adams, of the United Railways & Electric Company, of Baltimore, and T. J. Mullen, of the Scranton Railway Company. It was decided to have papers on a number of subjects, and in order to facilitate the work of securing the best men from the various members of the Association to discuss these subjects, one member of the executive committee was assigned the task of securing an author and men to lead in the discussion of each subject.

As one very important subject that was suggested to the committee was the keeping of shop records, mileage of parts, etc., in some uniform method so that records of various companies could be compared to advantage, H. H. Adams, of Baltimore, was appointed a committee chairman, with power to appoint assistants, if he sees fit, to insure the proper presentation of this subject at the next convention.

Wheels and wheel mileage is another topic which drew out considerable informal discussion at the committee meeting, and Alfred Green, of Rochester, is the committee chairman to look after the papers and discussion on that subject.

Maintenance of electrical equipments was another subject decided upon, T. J. Mullen, of Scranton, being given charge of this topic.

A paper and discussion on power stations is planned, and Ex-

President Thomas Farmer, of Cleveland, was requested to secure an author for this topic and look after the discussion, Mr. Farmer being present at one of the committee sessions.

As it was felt that a discussion of shop design and centralizing of repairs should have considerable attention, as suggested in a communication from Mr. Beggs, of Milwaukee, President Olds was appointed a committee to see that some one present the designs of a number of modern shops, with an analysis of their strong and weak points.

It was brought to the attention of the committee that there are many unnecessary and unreasonable variations in the specifications of car bodies, and that it should be the work of the Association to collect the car specifications of various companies with reasons for all changes from the most usual practice. By weeding out unnecessary clauses in these specifications a comparatively standard practice could be brought about by the Association in certain respects. W. W. Annable, of the Grand Rapids (Mich.) Railway Company, was appointed to start such a work, which it was felt would probably last many years.

It was decided to have a question box at the next convention for the benefit of members wishing light on certain troublesome points. This question box will be in charge of the secretary. In appointing these various gentlemen, each to look after a certain topic, it is not to be understood that they will, themselves, prepare the papers, but that they will see that their subjects are properly discussed by the best available members, and, hence, will act as chairmen of committees. Suggestions addressed to any of these committee chairmen as to men desirable for papers and discussions on their respective topics will, therefore, be in order and welcome.

The membership in this new association is steadily increasing, and its work certainly is so important that no company and its staff can afford to be without the proceedings to which membership entitles it, to say nothing of the benefit derived from attendance at the conventions.

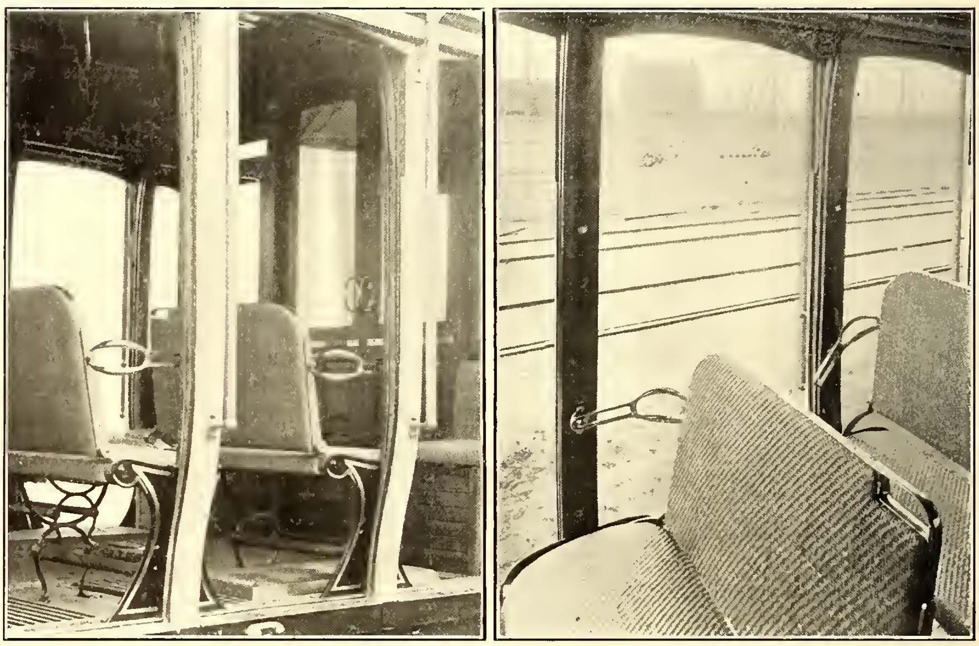
The Association has issued a little book, which will be sent upon application to the secretary. It gives information about the Association and the endorsement its work is receiving.

After the committee adjourned a dinner was given at the Hollenden to the members, by H. N. Ransom, Cleveland representative of the National Electric Company.

NEW FORM OF SEAT ARM

The J. G. Brill Company has recently added a small but important attachment to the seats of its convertible cars, consisting of a metal arm pivoted to the back of the seat and connected with the side post by a button, on which the arm slides and makes part of a revolution. The operation of this arm is shown in the illustration taken from the interior of the car. The back of the rear seat, it will be noticed, is raised, showing the position of the arm during reversal. The arm has three purposes; one being the strengthening of the back. This is necessary on account of having the back supported at unusually low points by the reversing levers. A pair of levers is used at the aisle end of the seat and a single lever at the post end. The double levers are amply strong for any weight that may be brought against the back of the seat at that end, but the lever at the post end is single and curved, and although strong enough for persons of average weight, requires extra support for heavy passengers, and this is met by the arm. At the same time the arm is useful for filling the gap between the back and the post. The arm is also to be used as a handle for passengers getting in and out, and is well situated for that purpose, especially for passengers leaving the car, inasmuch as it prompts them to face in the right direction when stepping down. The J. G. Brill Company owns the patents now pending on this device, has installed seats with this arrangement in a number of convertible cars, and intends using it regularly hereafter. This device is equally applicable to various types of seats now in use other than those of the Brill Company.

NON-CHILLED BRAKE-SHOE



SEAT ARM AS SEEN FROM EXTERIOR AND INTERIOR OF CAR

NON-CHILLED BRAKE-SHOE

Among the numerous other supplies now being manufactured by the St. Louis Car Company, in addition to its car and truck building business, is the Diamond "K" brake-shoe. This shoe, which is illustrated herewith, has a hard iron insert around which is cast the body of the shoe in gray iron. The gray iron is not permitted to chill, which is claimed to be a peculiarity of this shoe as compared to others of the kind. The hard iron is made of very high-grade malleable iron. The secret processes of casting gray iron about the insert without chilling are said to give toughness to the body of the shoe and a better friction coefficient than a chilled shoe.

FINANCIAL INTELLIGENCE

Wall Street, Dec. 9, 1903

The Money Market

An extremely low rate for sterling exchange persisting in face of heavy gold exports continues to be the most striking phenomenon in the money market. We have now taken, all told, upwards of $15,000,000 gold from London, and yet demand sterling bills have sold during the past week not only at the lowest figures of the season, but below any previous record for the last ten years. In fact, the recent quotations have been lower than anything ever known, except in times of great financial disturbance. With the explanation for this extraordinary situation the average observer of current financial events is quite familiar. The enormous exports of cotton at almost unprecedented prices are chiefly responsible for the great pressure to which the exchange market has been subjected during the last month and a half. Nor are there any signs that this pressure is about to diminish. European spinners, having so entirely underestimated the size of this autumn's cotton crop, find themselves in a position where they must pay whatever prices the American speculator demands. So long as this necessity continues the present influences in favor of low exchange rates will remain, and gold will continue to be shipped across the ocean in settlement of international credit balances. This is the strongest assurance that conditions now afford that money will gradually work easier. Shipments of currency for our own interior needs have not yet ceased, but the movement to the South in connection with the financing of the cotton harvest has begun to be offset by return of funds sent out earlier in the autumn to the grain country. During the next few weeks we shall undoubtedly witness the customary turn of the interior exchanges in favor of New York, which will be followed, after the first of the year, by a rapid accumulation of local bank cash holdings. Already the money market has begun to discount these events. The high call money rates of the latter part of November are no longer present, and the tendency in the time money market is distinctly toward relaxation. As high as 7 per cent is occasionally paid even now for the use of call loans, but 5 and 5½ per cent are the ordinary quotations on all renewals. Time money is quoted at 5½ per cent for all periods both long and short.

The Stock Market

Wall Street has witnessed, during the last two weeks, something very like a return to a genuine bull market. Prices have advanced sharply all along the line and dealings have very often aggregated upwards of a million shares a day. Examining the causes of this movement, the main thing that must be concluded is that the majority of the standard securities were driven down far below their real values during last summer's forced liquidation. This being the case, a sharp recoil was bound to occur as soon as it was clearly established that the selling pressure had ceased. There are certainly no great incentives to investment or speculation in the present situation. The decline in general business may have proceeded as far as it is going to for the time being, but it is still a question in men's minds whether the wave will not recede farther at a later period. At all events, the resumption of the forward movement is quite out of the question. Railroad earnings, if they succeed in holding their own during the next twelve months, will be doing as much as may reasonably be expected. Any further increase in dividends is highly improbable. Consequently, the great motives which are usually found at the beginning of an extensive rise in prices are not present now. The upward movement of the past month seems plainly to be a recovery rather than a fresh advance. The distinction is an important one, because a recovery under the present circumstances can scarcely be anything but limited both in extent and duration. It must simply proceed on the theory that the recent decline was excessive and that a rebound was necessary in order to restore a normal level of prices. The fact that railroad stocks of the better grade have been selling on a basis where they yield 5 per cent and over to the investor, while the money interest rate is working toward a 4½ per cent level, has undoubtedly been a powerful inducement to the buying of securities. Besides this, the conviction has now become general that too much has been made of the argument of industrial reaction, and that so long as railroad earnings hold up as well as they are now doing this argument has no great practical force. In well informed quarters the prevailing view seems to be that the upward movement is likely to continue for a while longer, at least, subject to the normal reactions of a speculative market. The stage has not been reached, however, where the public has found courage to take a hand in the proceedings.

A 10-point advance in Brooklyn Rapid Transit has been the spectacular incident in the local traction group. A variety of explanations—new and old—have attached to the movement. But so far the truth seems to be nothing more startling than that the supply of the stock in the market is extremely narrow, that a short interest has been outstanding, and that two or three pools have been using this favorable technical condition to make a good turn for themselves on the long side. The advance in Manhattan and Metropolitan has been more or less sympathetic with the strength of the Brooklyn stock. Insiders appear to have been doing nothing in Manhattan, the rise in the price being quite evidently the work of professional speculators. People who bought Metropolitan Securities low down, on good information, have been taking their profits during the past week.

Philadelphia

All the active street railway specialties on the Philadelphia Exchange have taken part in the general market advance of the last two weeks. Philadelphia Electric is up a quarter point from 5 15/16 to 6 3/16, Union Traction has gained a point and a half from 44 to 45⅝, and Philadelphia Traction a half point from 95 to 95½. American Railways has been particularly strong. The stock sold ex-dividend a week ago, and rising to 43 has more than regained the whole amount of the dividend. Consolidated Traction of New Jersey has been another feature, advancing to 64 on sales of about 1000 shares. This is 5 points higher than the low figure for the stock two months ago. Fairmount Park Transportation advanced from 19 to 20, then reacted to 19¾. Philadelphia Rapid Transit, on the report that another assessment call will be made by the end of January, declined from 11¾ to 11. Philadelphia Company common rather hung behind the rest of the list, advancing only a point to 37½. The preferred was a trifle higher at 43¼. Thirty shares of Reading Traction changed hands at 30.

Chicago

The interesting episode recently in Chicago traction matters is the effort made by the receivers of the Union Traction Company for permission to substitute trolley lines where the cable is now in use. Judge Grosscup has announced that he will postpone action in answer to the petition of the company made for the purpose of effecting this change in motive power. The city will make a vigorous fight against the application of the company, and it may be that while this matter is before the courts, opportunity will be taken to test the whole question of the constitutionality of the ninety-nine year franchise grant. Many people believe that this is the real end that Union Traction officials have in view. Dealings in the common shares have been light, most of the sales occurring around 6. City Railway, on the settlement of the strike, advanced from 170 to 171, but later 10 shares of the stock sold at 167½. South Side Elevated has been strong at an advance to 95 on the excellent showing made by the company during November. The large increase in the earnings of this period was directly due to the diversion of traffic from the surface roads on account of the strike. The Northwestern Elevated reported a gain of over 6 per cent in the earnings for the month. This road is suffering much less than the Metropolitan from the effect of the recent adoption of the transfer system on the West and North Side surface lines. A few sales were reported in Metropolitan common at 17 and the preferred at 54. Lake Street sold at a new low record of 1¾, rallying later to 2. North Chicago made a new low record at 89, but later recovered to 90.

Other Traction Securities

The publication of the annual statement of the Massachusetts Electric Company showed, as expected, a very large increase in operating expenses for the year, due principally, as was explained, to the higher cost of fuel. Altogether the showing was not a flattering one, but the speculative market took the view that the heavy decline in the stocks had discounted the unfavorable news. The common, on active trading, moved up from 19 to 21⅞ and later eased off to 20. The preferred gained 3 points, from 77 to 80, and then fell back to 79. In both instances the improvement in the general market had obviously more connection with the rise than any special considerations in regard to the property. The other Boston stocks underwent no particular change during the fortnight. Boston Elevated sold as high as 141½ at one time but later reacted to 140¾. West End common sold at 89⅞ and 90 and the preferred at 110 and 110½. In Baltimore the general mortgage bonds of the United Railways Company were the feature of that group, selling up to 92, which is the highest price reached for a considerable while. The income bonds, ex-interest of 2 per cent, rose as high as 57½ then declined to 57. The stock was dull and featureless around 9. Atlanta Street Railways 5s were in good demand, advancing from 105¾ to 106½; later sales were made at 106. Norfolk Street Railway 5s sold at 108. On the New York Curb sales of the traction securities have been as usual rather limited during the last two weeks. Following the advance in the street railway group on the Stock Exhange, Interborough Rapid Transit rose 3 points, from 90 to 93, but sales amounted to less than 1000 shares. New Orleans securities were rather notably strong, the preferred stock gaining a point and a half to 29¾, 300 shares changing hands, and the common selling up to 11. The 4½ per cent bonds were firm at 80, but only a few lots sold at that figure. Brooklyn Rapid Transit 4s were bought and sold at 76½ to 76¾, Washington Traction 4s at 71¼, odd lots of St. Louis Transit at 14, and Brooklyn City Railroad at 232½.

Toledo Railways & Light featured in Cincinnati last week as well as in Toledo, where there seems to be a strong local demand. Over 600 shares changed hands in Cincinnati, starting at 24⅜ and advancing steadily to 26. Detroit United was very active and about 385 shares sold; all in lots of less than 50 shares. The price was almost stationary at 68½, although one lot brought 70. Cincinnati, Newport & Covington preferred was active, the range being from 81¼ to 82¼. Cincinnati Street Railway was inactive, a few shares selling at 132. Cincinnati, Dayton & Toledo 5s sold at 81½.

About 500 shares of Cleveland Electric sold in Cleveland, a considerable portion of this being at a premium over ruling market prices for 90-day delivery. The range during the week was from 68¾ to 70¾, the latter being the price paid for the future delivery. Northern Ohio Traction was firm at 12½ to 12⅝, with sales of 200 shares. Toledo Railways & Light attracted some attention, caused by the activity in Cincinnati, and 200 shares sold at 24⅞ to 25.

The new Columbus Railway & Light was very active in Columbus and the price advanced from 25 to 30 during the week. The old Columbus Railway common advanced from 82 to 85 on several sales.

Security Quotations

The following table shows the present bid quotations for the leading traction stock, and the active bonds, as compared with two weeks ago:

	Closing Bid Nov. 24	Closing Bid Dec. 8
American Railways	41	42
Aurora, Elgin & Chicago (preferred)	a68	a57½
Boston Elevated	140	140
Brooklyn Rapid Transit	38⅝	46⅞
Chicago City	164	160
Chicago Union Traction (common)	5	5¼
Chicago Union Traction (preferred)	27	28
Cleveland Electric	67½	68
Consolidated Traction of New Jersey	60	63½
Consolidated Traction of New Jersey 5s	106½	105½
Detroit United	64	69
Elgin, Aurora & Southern	—	—
Lake Shore Electric	a14⅞	—
Lake Street Elevated	1½	1½
Manhattan Railway	138⅞	141¼
Massachusetts Electric Cos. (common)	17¼	20
Massachusetts Electric Cos. (preferred)	76	75
Metropolitan Elevated, Chicago (common)	17	17
Metropolitan Elevated, Chicago (preferred)	50	51
Metropolitan Street	115⅝	120½
New Orleans Railways (common)	8¼	10½
New Orleans Railways (preferred)	28¼	30¼
North American	71½	75
Northern Ohio Traction & Light	12⅛	12⅝
Philadelphia Rapid Transit	11½	11
Philadelphia Traction	95	95½
St. Louis Transit (common)	13½	13
South Side Elevated (Chicago)	95	93¼
Third Avenue	107	115
Twin City, Minneapolis (common)	89¼	94
Union Traction (Philadelphia)	43⅞	45⅝
United Railways, St. Louis (preferred)	57½	59

a Asked.

Iron and Steel

Although a decidedly better feeling is evinced in the iron market, and although there has unquestionably been some real improvement during the last few weeks, there is still a great deal of uncertainty regarding the immediate position. In the case of pig iron, while it is known that output has been greatly reduced and that the reduction is still in progress, it is by no means clear that the process has been carried far enough to suit the full decrease in consumptive requirements. In view of this uncertainty, purchasers of pig iron are confining themselves to buying from hand to mouth and are covering only such contracts as are due in the immediate future. It is reported that Southern makers, who have all along taken the lead in the price cutting, have at length been encouraged to advance their schedules a trifle. In the finished branches of the trade the situation is that the recent concessions on the part of sellers have brought in enough new orders to render any further lowering of prices unnecessary for the time being. Nevertheless, opinion is divided as to whether further reduction will not be necessary later on. Quotations are as follows: Bessemer pig iron, $14.85; Bessemer steel, $23, and steel rails, $28.

Metals

Quotations for the leading metals are as follows: Copper, 12 to 12¼ cents; tin, 26 cents; lead, 4⅛ cents, and spelter, 4½ cents.

ANNUAL REPORT OF THE ALLGEMEINE ELEKTRICITATS GESELLSCHAFT

The statement of the Allgemeine Elektricitäts-Gesellschaft which has just been issued for the fiscal period July 1, 1902, to June 30, 1903, shows that despite the industrial depression which has for some time existed in Germany, this company has more than held its own, the net profits for the year being 5,624,385 marks ($1,338,603.63), and the dividend proposed by the directors 8 per cent.

One of the noteworthy features of this report is the approval with which the directors look upon the recent consolidations of German electrical companies, not only because such action has tended to eliminate ruinous competition but is also helping to standardize apparatus. It is interesting to note that the company has made arrangements to build steam turbines on a large scale for both stationary and marine service.

On July 1, 1903, the Allgemeine Elektricitäts-Gesellschaft was consolidated with the Union Elektricitäts-Gesellschaft. The Allgemeine Elektricitäts-Gesellschaft is developing the Slaby-Arco and Braun wireless telegraph systems in conjunction with the Siemens & Halske Company, and is also co-operating with the latter company in the construction of a complete lighting, power and railway system for Valparaiso, Chile.

The directors report a slight improvement in electric railway business, the most important foreign contracts being the reconstruction of the Metropolitan Tramways of Buenos Ayres and Valparaiso tramways in South America. The consolidation with the Union Elektricitäts-Gesellschaft has relieved the works of the Allgemeine Company to such an extent that the latter company will hereafter manufacture railway signals, using the Köslin patents. Brief reference is also made to the Marienfelde-Zossen tests, reports of which have been published in these columns.

STORAGE AIR BRAKES FOR DETROIT UNITED SYSTEM

The cars of the Detroit United Railway Company are all to be equipped with storage air-brakes. The National Electric Company has the contract. This is the second large system to adopt storage air-brakes for its entire equipment within the past year, the St. Louis Transit Company having decided upon the National Company's system last spring.

PRIVATE RIGHT OF WAY AND COMPETITION IN STREET RAILWAYS DENIED IN MASSACHUSETTS

An important order has just been issued by the Board of Railroad Commissioners upon the petition of the Suburban Street Railway Company, of Springfield, for approval of locations in the city of Springfield, and the towns of Ludlow and Wilbraham. The order is as follows:

"The agreement of association published by the Springfield Suburban Street Railway Company refers to the 'provisions of chapter 113 of the Public Statutes and all general laws in addition thereto or amendment thereof' as the body of laws under which the company is to be organized. The Public Statutes had then been repealed and the Revised Laws were in force in their stead. We are asked to rule that this mistake in naming the statutes has rendered all subsequent proceedings void. We decline to make this ruling. It was not necessary that the agreement of association should name the statutes under which the company was to be organized. The provision of law to which reference was made were actually in force, though under a different title, and there is no proof or likelihood that the misnomer misled anybody who had any interest in the matter.

"The Springfield location provides that a violation of any one of the many conditions imposed upon the company shall work the immediate forfeiture of all rights in the street. This is contrary to the general law, which provides an effective and at the same time a just method for revoking street railway locations whenever the public good requires it. No location which controverts a State policy wisely established by the Legislature for the protection of public rights can be said to be consistent with the public interests.

"Again, the plan for constructing so large a part of the railway upon private lands raises a serious legal question. The company has no special statute authority to construct its railway upon private lands such as was given, for instance, to the Boston & Worcester Street Railway Company. It is, therefore, subject to section 9, chapter 112, Revised Laws. However unrestricted the right to build and operate street railways apart from the highway may have been prior to the passage of the above statute, street railways organized under the general law can now be constructed over private lands only for the purpose of avoiding grades and curves, or for other purposes 'incidental to the use of the highway.'

"The proposed railway passes for 2½ miles over private lands in Springfield, admittedly not to avoid grades or curves, but to secure a direct route for quick service and high speed. It takes to the highway only as it approaches populous centers. This departure for long distances from the highway would seem to be for railroad rather than street railway purposes. Apparently the highway and private lands have been used in furthering this enterprise whenever either best served the purposes of the promoters, the use of neither being 'incidental' to the use of the other.

"We do not intimate that railways ought not to be built over private lands between town and city centers and upon the streets when such centers are reached. On the contrary, much is to be said in favor of such construction. High speed is surely more appropriate over private lands than upon the highway. We only suggest that there is as yet no general law for such construction, and that therefore the petitioner, having no authority by special statute, cannot lawfully construct its railway as proposed.

"The foregoing views dispose of the location in Springfield, but we deem it only fair to interested parties to call attention to certain general principles which, under other circumstances, might have played an important part in the discussion of the facts here presented.

"There is no doubt about the need of additional street railway accommodations for those now without them, nor about the need of improvement in the accommodations now furnished certain patrons of existing lines.

"The Springfield Company was asked to extend its railway across the bridge into Ludlow. If it did not refuse to do this, it certainly pursued a short-sighted policy in paying scant attention to the needs of the community which desired the extension. There is also abundant evidence that passengers who desire to leave Springfield for Palmer and towns beyond have had difficulty in obtaining seats in the cars that go through to these points; and it would further appear that there is frequent annoyance from poor connections made between the Springfield and the Springfield & Eastern Railways.

"The new company seeks to furnish the needful additional facilities for Ludlow and to provide a remedy for the other grievances named, while the old company offers to do the same by extending its lines and improving its service.

"In Springfield we have a long established company with a railway reaching into almost every part of the city, well equipped, and, notwithstanding the exception noted, efficiently managed, affording convenient transportation in all directions and for long distances for a single five-cent fare; a company to which prosperity has brought financial strength and abundant resources. Can it be said upon business principles that the public interests would not be best served by giving this company an opportunity to build and equip an extension of its railway to Ludlow? A grant which secures economy in capitalization, and efficacy in operation, is certainly desirable.

"It is urged that the competition which would result from admitting another company into the city would be a public benefit. This is a theory which, in spite of the multiplied lessons of experience, is still more or less popular. History has repeatedly proved that such competition, after a fitful existence, always gives way under the compelling force of business principles to the consolidation of competing companies, leaving behind evils which are lasting in their effect. A monopoly in local street railway service under proper supervision would give the public a better service than the efforts of contending companies, not infrequently struggling to keep alive enterprises which ought never to have been undertaken. Under our laws such a monopoly is founded upon statutes which protect the public interests by making street railway locations not only subject to supervision, but subject to revocation for cause; practically, therefore, dependent upon the good behavior of the company receiving them. To deny recognition and protection to a company which renders good service kills ambition to please and accommodate and encourages rather a disposition to thwart the public. It weakens confidence in the stability of the tenure by which the company holds its property, and so impairs its credit and consequent ability to comply with the public demands.

"The operation of street railways in the larger municipalities has shown that the traffic within city limits can be handled with greater success and greater safety by one than by several companies. It will not do, however, for a company which receives the privileges of a monopoly to forget the obligations which go with them. The public in such case can look to the one company only for needful extensions and additional accommodations. In response such company should be quick to meet all reasonable demands. When it undertakes to perform the entire public service it must carry out the task.

"The petitioner contends that the question of the public convenience and necessity is not open in a proceeding of this sort. In our opinion it would be impossible to issue a certificate that locations are consistent with the public interests without full consideration of all matters affecting capitalization and safety and convenience in operation. We deem these questions of more than mere local concern.

"In declining to certify that the Springfield location is consistent with the public interests, we indirectly pass upon the locations of the Suburban Company in Ludlow and Wilbraham, as those grants were obviously made in connection with the Springfield location and are dependent upon it. The Selectmen of these towns very naturally and properly availed themselves of the opportunity to obtain street railway facilities at the hands of the Suburban Company. Their failure to obtain them in this way need not prevent the ultimate realization of the desires of these communities in respect to street railway accommodation."

OUTLAY OF $5,000,000 FOR TEMPORARY WORK IN CHICAGO

If the receivers of the Chicago Union Traction Company secure the right from the court to make improvements which they think are needful at once, the sum of $5,000,000 will be spent before the extension ordinances have been considered by the Council. The plans for the new work to be done include the construction of a number of underground lines, the relaying of rails, the purchase of new cars and the readjustment of loops. In addition to the 100 new cars which are expected to be delivered early next year, an order will soon be placed for 500 cars. The money for these improvements is to be raised by issuing receivers' certificates or bonds. The hearing on the application to make the expenditure just referred was begun by Judge Grosscup on Tuesday, Dec. 8, in the Federal Court, and it is understood that if the court rulings are favorable to the receivers, application will be made to expend even more than the original $5,000,000.

THE JOLIET, PLAINFIELD & AURORA RAILWAY

The Joliet, Plainfield & Aurora Railroad has recently been placed in regular operation between Joliet and Plainfield, 10 miles, with a forty-five minute headway, and the reports of the earnings for the first few days show that the receipts are exceeding the estimates made by the promoters. The road is a connecting link between the Chicago & Joliet Electric Railway, extending from Chicago to Joliet, a distance of 35 miles, and the Aurora, Elgin & Chicago Railway, extending from Chicago to Aurora, a distance of about 35 miles. The distance from Joliet to Aurora, between which points the road is built, is about 20 miles, and the populations of the terminal towns are 40,000 for Joliet and 35,000 for Aurora. Plainfield, to which the road is now in operation from Joliet, is about midway between Aurora and Joliet, and has a population of 1500. The average population per mile of line is 4000, and from the standpoint usually adopted in figuring tributary population the road will enjoy the proud distinction of 200,000 population to the mile, since the completion of the triangle above described makes Chicago directly tributary. The road is being built by the Fisher Construction Company, of Joliet. The standard specifications of the American Railways Company, which owns the Chicago & Joliet Electric Railway, are being followed. Use of the terminals of the Chicago & Joliet Company, at Joliet, have been secured under a long-time contract, and arrangements have also been made with this company for power. At Aurora the road will enter the city over the tracks of the Aurora, Elgin & Chicago Company.

FOURTH ANNUAL REPORT OF THE MASSACHUSETTS ELECTRIC COMPANIES

The fourth annual report of the Massachusetts Electric Companies, covering the year ending Sept. 30, 1903, has just been issued. During the year the policy of consolidating the constituent companies has been continued until there are to-day but two operating companies, not including the Hyde Park Electric Light Company, which cannot, under existing laws, be consolidated with the Old Colony Street Railway Company, to which it furnishes a large amount of power.

As a result of the considerable amount of new construction done in 1902 for the purpose of connecting various existing lines, little work of that kind has been done during the past year, but very important improvements have been carried out both to the equipment and to the power houses. Thus during the fiscal year the following amounts have been expended:

Cars and electrical equipment	$906,000
Reconstruction of track	468,000
Power stations (including Newport and transmission lines)	910,000
Reconstruction of cars	93,000
Land, building and engineering	193,000
Total	$2,570,000
While for new roadway and new tracks there was spent only	$460,000

With the above outlay 164 new cars were purchased, of which 132 were equipped, 25.552 miles of track were reconstructed with new and heavy rail, 44.858 miles of new feed-wire, and 2½ miles of underground feeder were built, and 8500 hp in new machinery installed. Besides this, the new station at Newport, with 2100 hp of turbo-generators, was practically completed, and the new station at Quincy Point, with room for 15,000 hp of turbo-generators, with a sub-station at Brockton, was pushed forward rapidly, so that it may be expected to be ready for its electrical equipment by Feb. 1. In addition to this, advantageous sites have been secured for new stations at Fall River and Danversport, although work on the buildings has not yet been begun.

The records show that during the period of four and one-half years the properties have been in charge of the trustee, and leaving out of account all new construction, 75 miles of track have been reconstructed with either 75-lb T or 90-lb girder rails; that 267 miles of new feeder-wire have been strung; that 123 cars have been reconstructed and increased in size; that 621 new cars and snow-plows have been added, and that 1064 new motors and equipments have been purchased.

The general increase in price of all supplies and the increase in wages all combined to swell expenses, while the gross earnings showed a serious falling off in the best months of the year, owing to the cold, wet summer. Gross earnings increased only 5 per cent for the year, but, compared with the results of other suburban companies, these figures show a very great stability of business, and it is interesting to note that in July and September (the only pleasant months of the summer) the gross increased 11 per cent, While October of the new fiscal year shows an average gain of 6 per cent in gross over the same month of last year, when much of the new mileage was in operation.

The operating expenses were very materially swelled during the year, owing to an increase of substantially 12½ per cent in rate of wages of conductors and motormen.

The consolidated income account shows earnings as follows:

FOR THE YEAR ENDING SEPT. 30, 1903

Earnings	$6,333,910
Expenses	4,155,908
Net earnings	$2,178,002
Interest, rentals and taxes	1,331,147
Net divisible income	$846,855
Dividends	840,233
Surplus for the year	$6,622

The profit and loss statement for the year ending Sept. 30, 1903, follows:

INCOME		
Dividends on stocks owned	$840,738	
Interest on notes and bank balances	85,371	
Total income		$926,109
EXPENSES		
Salaries—general officers	$9,000	
Printing and stationery	1,123	
Legal expenses	775	
Miscellaneous expense	3,988	
Total expense		$14,887
Net income for the year		$911,222
CHARGES AND DIVIDENDS		
Interest on coupon notes		$121,500
Net divisible income		$789,722
Dividends (4 per cent on preferred shares)	$809,646	
Less accrued on preferred shares sold	27,430	
		782,215
Surplus for the year		$7,507
Surplus Sept. 30, 1902		204,160
Surplus Sept. 30, 1903		$211,667

The consolidated balance sheet as of Sept. 30 shows:

ASSETS		
Property, Sept. 30, 1902	$31,152,269	
Net additions to Sept. 30, 1903	2,658,366	
Property, Sept. 30, 1903		$33,810,635
Cash		815,965
Accounts receivable and open accounts		338,843
Newport & Fall River and Nashua Street Railway lease accounts		222,480
Coupon deposits		86,542
Sinking and redemption funds		50,883
Prepaid taxes, insurance and rentals		134,730
Material and supplies		933,157
Total assets		$36,393,235
LIABILITIES		
Capital stock		$16,760,100
Capital stock subscription		400,000
Funded debt		13,174,500
Notes payable		2,014,500
Notes and accounts with the Massachusetts Electric Companies and Massachusetts Street Railway Accident Association		1,683,638
Vouchers and accounts payable		580,261
State, local and excise taxes		367,064
Coupons outstanding		86,543
Dividends declared, unpaid		429,118
Accrued interest and rentals		185,795
Renewal funds		10,000
Surplus		701,716
Total liabilities		$36,393,235

CHICAGO ELEVATED TRAFFIC FIGURES

The most interesting feature of the passenger traffic reports of the South Side, Metropolitan and Northwestern Elevated Railroads, of Chicago, for the month of November, is the increase in passengers carried by the South Side Company, due to the strike of the employees of the Chicago City Company. The South Side Company during the month broke all records for the number of passengers carried by the Chicago elevated railroad in a single month since the World's Fair. The daily average number of passengers carried was 143,398, compared with 83,299 in November, 1902, an increase of 72.15 per cent. From Nov. 2 to Nov. 25, inclusive, the average traffic was 206,000 passengers per day. This exceeded by 10 per cent any like period during the World's Fair in 1893. The largest day's traffic was 229,535, on Nov. 14. President Leslie Carter of the company said:

"The capacity of the road to carry passengers in an emergency was amply demonstrated, as well as what can be done when we have the additional tracks, cars, and power now proposed. The passengers were very good humored and kindly gave us credit for doing our best. If the loop platforms had been lengthened, as we desire, much of the crowding and discomfort on the Union loop would have been avoided. We went to the limit of the present power of our power house in our effort to accommodate the public."

Northwestern Elevated and Metropolitan Elevated had fair months. Following is the record of elevated traffic this year:

	1903	1902	Gain	Per cent gain
	SOUTH SIDE			
January	86,637	79,154	7,483	9.45
February	88,516	79,386	9,130	11.50
March	87,989	80,318	7,671	9.56
April	87,553	81,009	6,544	8.07
May	82,884	76,063	6,821	8.96
June	85,262	76,449	8,813	11.52
July	76,236	70,767	5,469	7.72
August	72,646	68,334	4,312	6.31
September	81,887	76,572	5,315	6.94
October	85,788	83,112	2,676	3.02
November	143,398	83,299	60,299	72.15
	METROPOLITAN			
January	112,771	98,029	14,742	15.03
February	116,090	100,466	15,624	15.55
March	116,716	105,512	11,204	10.61
April	117,597	109,246	8,351	7.64
May	109,330	105,798	3,531	3.34
June	111,613	101,743	9,870	9.70
July	102,057	97,929	4,128	4.21
August	102,971	100,099	2,872	2.87
September	112,993	109,751	3,242	2.95
October	117,387	115,980	1,407	1.21
November	114,148	110,289	3,859	3.50
	NORTHWESTERN			
January	68,266	62,010	6,256	10.80
February	69,885	64,760	5,125	7.91
March	70,070	65,362	4,708	7.22
April	71,340	65,430	5,910	9.03
May	66,990	63,199	3,781	5.98
June	66,571	60,813	5,758	9.46
July	59,393	56,110	3,283	5.85
August	60,693	57,911	2,182	3.76
September	68,107	63,950	4,157	6.50
October	71,617	69,562	2,055	2.96
November	71,422	67,236	4,186	6.23

UNION BUTTONS CAUSE TROUBLE IN CHICAGO

An official button has been issued by the Cook County division of the Amalgamated Association of Street & Electric Railway Employees of America. "Union Principles and Immediate Municipal Ownership" is the slogan it carries. The wearing of these buttons brands at once a man as non-union or union. As a result of this the non-union employees remaining in the employ of the Chicago City Railway Company after the strike have been abused in a number of instances. On Dec. 5 three non-union conductors of the company were attacked by passengers who refused to pay their fares to non-union men. A fracas followed, in which two non-union conductors were injured and a union man shot in the leg. On Wednesday, Dec. 9, a most serious riot was precipitated by union sympathizers. Cars manned by non-union crews were stoned, windows were broken and several passengers hurt at the hands of mobs that congregated at Root Street and Wentworth Avenue to make a demonstration against the non-union employees. Police from the Stock Yards Station arrived shortly after the demonstration, but no arrests were made. A new book of rules which has just been issued by the company prohibits the employees from wearing any badge or sign other than that provided by the company.

CHICAGO UNION TRACTION MATTERS

The hearing of arguments on the validity of the claims of the Chicago Union Traction Company under the ninety-nine year act, which was to have been held before Judge Grosscup Dec. 3, was postponed one week. In his response to the petition for permits to install the overhead trolley and make other extensive improvements, Corporation Counsel Tolman makes a sweeping denial of the constitutionality of the ninety-nine year act and declines to admit the jurisdiction of the Federal Court over any of the important questions at issue. He puts aside as irrelevant all questions as to whether the improvements will be of benefit to the public or value to the estate in the custody of the court. He claims the only question properly involved in the matter is whether, under existing and valid ordinances, the receivers are entitled to the privilege asked for.

There seems at present no likelihood that the Chicago Union Traction Company will obtain any franchises or attempt to obtain any from the City Council until the litigation that has been started has been decided.

W. K. Vanderbilt, Jr., was in Chicago inspecting the Union Traction lines Dec. 4. It was rumored that his mission had something to do with the financing of the Chicago Railways Company which was recently organized, with the idea of taking over the properties now operated by the Chicago Union Traction Company.

CHICAGO CITY RAILWAY FRANCHISE MATTERS

The ordinance proposed to extend the Chicago City Railway Company's franchises twenty years, recently outlined in these columns, is being discussed at a series of public readings held by the local transportation committee in Chicago.

The Council has extended the franchises of this company ninety days from Nov. 30, as a temporary measure to provide for time in which to get action on the twenty-year ordinance.

THE DEVELOPMENT OF TRAFFORD CITY, PA.

Those who have visited the works of the Westinghouse interests near Pittsburg know that they extend along the line of the Pennsylvania Railroad for several miles, and that, with the exception of the works of the Union Switch & Signal Company, they are connected by a private railroad known as the Westinghouse Inter-Works Railway. Of the shops on the line of this road, those of the Westinghouse Machine Company and of the Westinghouse Electrical & Manufacturing Company are at East Pittsburg, those of the Westinghouse Air-Brake Company are at Wilmerding, and the new foundry is at Trafford City. The property at the latter point available for industrial development comprises some 130 acres, on which have been erected a large foundry, pattern shop, power house, machine shop, brass foundry and sand house. The foundry is 184 ft. x 612 ft., and is served by three Sellers cranes of 80-ft. span, one of 100 tons capacity and two of 60 tons. Also running below them are four traveling cranes, two on each side. The cranes and most of the machinery used in the foundry and department buildings are operated by induction motors supplied with current from the power station, which contains both steam and gas engines of Westinghouse make.

One of the most interesting features of the installation at Trafford City is the provision made for residences for the employees. For this purpose some 470 acres have been acquired by the company and set aside for the erection of model buildings. The individual residences are on a hill above the foundry, and are of brick with slate roofs, and contain five rooms and a bath, besides an attic and a cement cellar. Employees are encouraged to rent these houses or purchase property on easy terms. The streets are laid out in a generous manner, and are paved, with flagstone sidewalks, while the entire town has a water supply and gas for illuminating and heating.

In addition to these individual houses, the Westinghouse interests have erected a block of flat houses two stories in height. These rent for somewhat less than the individual houses, and each apartment contains four rooms and a bath, and has separate entrances. For unmarried men a well-appointed hotel has also been erected. It is tastefully furnished, and is planned to give accommodations at cost.

CHICAGO CAR HOUSE HOLD-UP SOLVED

The mystery surrounding the hold-up of the receiver at one of the car houses of the Chicago City Railway last August, during which two of the employees were shot and killed without warning, has been cleared up by the confession of one Gustave Marks, under arrest for the murder of a detective. Marks has named two accomplices in the car house murders. He says that he and the other two men went to the office of the company for the purpose of robbery, and that when he ordered the men to throw up their hands they obeyed. One of his accomplices, he says, burst in the window of the office and commenced shooting. The door was then broken down with a sledge hammer and the office was rifled. In all, $2,250 was secured, and Marks says the money was evenly divided among the three men. The next day Marks and his companions went to Denver, where they remained but a short time. From Denver they went to Cripple Creek, and in a week they came back to Chicago.

FENDERS ADOPTED IN LINCOLN, NEB.

The Lincoln Traction Company recently made an extended test of a number of car fenders, to determine the type to be adopted on its cars. The tests were conducted before the members of the City Council and the officers of the company, and resulted in the selection of the Providence fender. In consequence, the order has been placed with the Consolidated Car Fender Company to equip all of the electric cars in Lincoln with this fender.

PLANS FOR THE CRUSADE AGAINST NEW YORK TRANSPORTATION COMPANIES

According to the officers of the Committee of One Hundred and the Merchants' Association, the crusade against the surface and elevated roads throughout New York is to be resumed at once, and a plan of preventing overcrowding, which has been tried abroad, is now under consideration. The London authorities, finding the arrest and fining of conductors insufficient, have now resorted to the arrest of passengers, whom the magistrates fine for "aiding and abetting" conductors in contravening the anti-crowding law. An officer of the Merchants' Association, who is supposed to know all about transportation matters, although he never owned any vehicle other than a truck, delivered himself of the following profound thoughts:

"This London plan is an indirect means of getting at the officials of the companies. After a certain number of passengers have been arrested and fined, a public sentiment will be aroused, sufficiently strong to force the companies to better their carrying facilities. The plan is a good one, but is decidedly English; and, while it could be used successfully in clearing the open cars in summer of standing passengers, it is not the most practicable way of gaining the desired end in this country."

A strict enforcement of such a regulation, if it were possible, would require the entire police force of the city, and while it would doubtless put an end to overcrowding, or at least greatly modify the evil as it exists to-day, it would at the same time effectually cripple the transportation business of the city, and by restricting the carrying capacity of the city lines practically bring all business to a standstill.

Another suggestion, made by an eminent reformer, is to the effect that if an association were formed by the indignant passengers of any particular road, and action were brought by individuals against the conductors of cars, that the companies would soon be brought to time. "Certain police rights are vested in transit companies and their servants, and if they do not perform certain duties they may be haled before the nearest magistrate and fined. At present the weapons to combat the evils complained of lie in the hands of the public and need only be used to be made effective. There is power in numbers. If several such organizations are formed and the individuals of each carry overcrowding and other grievances into the city courts, the result will be immediate and satisfactory. Rather than be compelled to send half a dozen lawyers to the different municipal courts every day, and ultimately pay fines, the companies will do exactly what we want them to do. These cases must be brought before the city courts, for the higher courts are too slow and cumbersome to suit the purposes of this attack. It must be quick, rapid and constant."

THE QUESTION OF A STRIKE AT PITTSBURG

At a conference at Pittsburg on Monday, Dec. 7, of the special committee of organized motormen and conductors, with J. D. Callery, president of the Pittsburg Railways Company, it was planned to settle the difference between the company and its employees. Meantime the company is conducting an investigation of its schedules, with an idea of making changes that will benefit the workingmen, and not interfere with a satisfactory operation of cars, and the employees are expressing their sentiment by ballot regarding their course if the peace conference fails of result.

TROLLEY COMPETITION HURTS—RATE WAR

Numerous changes in running time are being made by the steam railways entering Indianapolis. The schedules show that a number of accommodation trains have recently been dispensed with, and the announcement is made that further reductions in train service are to go into effect Jan. 1. While no cause is given for the taking off of trains other than that "business does not warrant their continuance," it is known that the reduced service is due to the competition of the electric railways. In the future the steam roads will pay more attention to through traffic, having, it is believed, fully realized how futile it is to try to compete with the electrics. What purport to be authentic figures show that railway stations that sold about $250 or $300 worth of tickets per week to Indianapolis before the electrics entered the field now sell about $50 or $75 worth a week.

In this connection it is interesting to note the announcement that the Monon, the Lake Erie & Western and the Big Four Railroads are to establish a one-cent a mile rate for passengers between Lafayette, Frankfort, Lebanon and Indianapolis. This, of course, means a cut in the regular rates on these lines. The establishment of the new rate is ascribed to the competition of the Indianapolis & Northwestern Traction Company, which company even charges higher rates of fare than most of the other interurban companies. Between certain points the average fare amounts to more than 2 cents per mile. The regular mileage rate is 1¼ cents per mile. There has been no announcement by the Indianapolis & Western Company as to whether it will attempt to meet the cut of the steam companies.

QUARTERLY REPORT OF THE INTERURBAN COMPANY

The consolidated statement of earnings and expenses for the quarter ended Sept. 30, 1903, of the Interurban Street Railway Company (including Third Avenue Railroad and all leased and controlled lines) compares as follows:

	1903	1902
Gross receipts	$5,570,212	$5,371,690
Operating expenses	2,761,600	2,736,022
Net earnings	$2,808,612	$2,635,668
Other income	370,224	425,926
Total income	$3,178,836	$3,061,594
Deductions	3,015,459	2,915,224
Surplus	$163,377	$146,370

THE BACKERS OF THE ELEVATED AND SUBWAY ORDINANCES IN ST. LOUIS

Official confirmation is received of the statement made in the STREET RAILWAY JOURNAL of Oct. 31, 1903, that the Western Electrical Supply Company, of St. Louis, is behind the applicants for combined subway and elevated railway franchises in that city. As previously stated, the road will run from Third Avenue and Washington Avenue, underground to a point between Seventeenth and Nineteenth Streets, where it will come to the surface and then proceed by an elevated line west to the city limits, terminating on the Watson Road. The route of the present franchise asked, will be from Third Avenue and Washington Avenue under St. Charles Street, to a point between Seventeenth Street and Nineteenth Street, to St. Charles Street, Bell Avenue, Fairfax Avenue, west to Taylor Avenue and south over Taylor Avenue to Manchester Avenue, thence west over Manchester, Clayton, Berthold, Billon and McCausland Avenues to the city limits on the Watson Road.

TRACTION DEVELOPMENTS IN PITTSBURG

Interests identified with a number of companies incorporated at Harrisburg during the year have just applied to the Common Council of Pittsburg for franchises to build street railway lines which will be approximately 40 miles long and in the construction of which about $10,000,000 will be spent, if the franchises are granted. The lines will be built mostly in the east end of Oakland, Lawrenceville, Hazlewood and in the lower section of the city. Provision is made for a downtown loop connecting with lines that run through Bloomfield and Garfield Parks to Highland Park, with a branch to East Liberty, Homestead and Brushton. The applications for franchises have been made in the names of seven different companies, namely, Pittsburg Rapid Transit Company, Ferry Street Railway Company, Iron City Street Railway Company, Bankers Street Railway Company, Squirrel Hill & Wilkinsburg Street Railway Company, Webster Avenue Street Railway Company and Atlantic Street Railway Company. The routes as detailed in the ordinance are of interest only to residents of the city. In an official announcement made immediately after the application had been filed it was stated that the financial stringency of the past summer has somewhat delayed the plans of the company, and that the original intention was to apply for franchises immediately after the charter had been granted at Harrisburg. At one time the names of T. S. Bigelow, E. M. Bigelow and Murry A. Verner were connected with the enterprise. Mr. Bigelow, for himself and the other two gentlemen, has denied any connection with the company. An announcement of the company that is official gives the following organization: R. C. Hall, president; S. S. Leslie, secretary; James W. Clark, treasurer; R. C. Hall, James W. Clark, John Sloan, William Kaufmann and S. S. Leslie, Jr., directors. The engineers will be Harry Mulholland, former City Engineer W. M. Brown, and Lippincott & McNeil.

BETTER SERVICE PROMISED IN MANHATTAN

The Board of Railroad Commissioners had a conference last week with E. P. Bryan, vice-president and general manager of the Interborough system, and made a critical examination of the measures adopted by the company to provide accommodations for the great increase in traffic that must be expected during the holiday shopping season. The phenomenal increase that has been experienced during the last few months over the corresponding periods of last year has taxed the facilities of the company to the utmost, and the management fully appreciates the problem it must now face in handling the crowds of the shopping district during the next few weeks. The Commissioners, it is said, are satisfied with the improvement that has been made thus far, and they realize that the management will do all in its power to relieve the crush and give satisfactory service during the holidays. It was suggested that the company run extra trains in the rush hours on Sixth Avenue by using a switch at Waverley Place, and keeping the cars of those trains empty as far as Fourteenth Street. Mr. Bryan submitted a statement to the Commissioners, containing the following interesting data:

Contracts were made with four different car companies for 500 cars for the subway. The contracts provided that these cars be delivered by November, 1903. Realizing in the summer that there would be no need for these cars in the subway, owing to the delays occasioned by the numerous strikes, it was planned to use them on the Manhattan division, supplying the entire equipment of Second Avenue—about 250 cars—from subway equipment. This would relieve the Second Avenue cars for distribution on other lines of the Manhattan division. It was fully expected that these 250 cars would be delivered in ample time for service as indicated. Up to the present date we have received about 175, of which 160 are now in use on the Second Avenue line. All the cars from the Second Avenue line have been put in service on the other lines, a large part of them on Sixth Avenue. In addition to this we have taken all of the cars some sixty, out of the shop which were there for painting, and put them into service, necessitating the closing of the paint shops.

A cable or tie has been laid between the Fifty-Ninth Street power house and the Manhattan power house, at Seventy-Fourth Street, at a cost of $125,000, in order to be ready to make use of any power which may be generated in the Fifty-Ninth Street power house on the Manhattan division.

It has been planned to run from Franklin Street certain trains, making first stop at Fourteenth Street, and we had hoped before now to have increased our Franklin Street service, but as before stated, we have not been able to do so on account of lack of rolling stock. The cars are being wired at the rate of three a day, and we will by Monday next be in a position to run at least four trains from Franklin Street, making no stops until they reach Fourteenth Street. It is not practicable to operate trains from the switch below Eighth Street during the rush hours.

The increase in passengers carried in the month of October was 3,000,000 over October, 1902, and the car mileage increase was 1,146,716. For November the increase in passengers was 2,972,000, and the increase in car mileage was 1,052,470.

NEW CARS FOR BROOKLYN SURFACE LINES

The State Board of Railroad Commissioners has recommended to the Brooklyn Heights Railroad Company that it add fifty cars to those at present in use, to be operated between the hours of 9 o'clock in the morning and 4 o'clock in the afternoon and 7 o'clock and midnight and to be run on the lines on which there is the greatest overloading of cars at present. This recommendation is based upon a thorough examination of the transportation conditions of the company's system. The board in its recommendation to the company says:

"As a result of our investigation the conclusion has been reached that little, if any, improvement can be made at present in existing conditions during the rush hours of the morning and evening. This statement is made after a careful consideration of all the conditions as they exist, including the amount of power which the company has available for operation. Under the present conditions the company is unable to operate more cars than are now in use during the rush hours and is only able to partly heat them with all of the power apparatus working on overload. Any injury to or breakdown of the power units will compel the company to reduce the number of cars or lessen the amount of heat furnished. Because of this the consideration of the improvement in the transportation facilities was confined to other than the rush hours."

The board conducted a systematic investigation and formulated a series of tables showing the necessities of certain days of the week, which demonstrate that the average number of additional cars required on these lines for Sunday is 104; Monday, 52; Tuesday, 96, and Saturday, 82. The conclusion is reached: "If they were added to the present operation, while they would not furnish seats for all passengers, it would greatly relieve the overcrowded conditions on the lines mentioned."

The recommendations conclude: "The maximum number of cars which will be operated during the rush hours the coming winter on the surface lines, including surface cars, will be about 1200. The average number of cars operated during the non-rush hours will be about 545. The natural query is, 'If the company can operate 1200 cars during the rush hours, why can it not operate more than an average of 545 during the non-rush hours?'

"The reason for this large difference in the number of cars operated during different portions of the day is that in order as nearly as possible to accommodate the traffic during rush hours the power apparatus is worked to a point far beyond its normal capacity. In the case of electric generating apparatus this can be done for short consecutive intervals, but after the rush hours the load must be reduced and the machines allowed to regain their normal temperature, and during the non-rush hours some of the units must be shut down each day for repairs, hence the necessity for reducing the number of cars operated during these hours.

"The board, after a careful consideration of all the existing conditions and the danger involved in any impairment of the service during the rush hours, whether in the number of cars operated or the heating of them, has arrived at the conclusion that the company can at present safely operate fifty more cars during the non-rush hours, and makes that recommendation, with which it expects the company to comply immediately, and the board will take the proper means to inform itself as to such compliance."

J. F. Calderwood, vice-president and general manager of the Brooklyn Rapid Transit Company, when notified of the State Railroad Commission's recommendations, is reported to have said: "If the State Railroad Commission makes such a recommendation we shall most assuredly comply with it. We have fifty new trolley cars, and they were to have been put out within a few days anyway."

The Harlan & Hollingsworth Company, of Wilmington, Del., has completed the electric sleeping car, Theodor, and it has been shipped to Indianapolis. The car was built for the Holland Palace Car Company, of Indianapolis, and was described in the STREET RAILWAY JOURNAL of Aug. 15, 1903.

PROPOSED MIXED SYSTEM FOR NEW YORK

Elias E. Ries, of New York City, has addressed a letter to Dock Commissioner Hawkes recommending a modified mixed system of storage battery and direct supply for the proposed electric line on West Street, which, he claims, will obviate the necessity for overhead wires on that route. According to Mr. Ries, the plan differs from the mixed storage battery and direct supply system which has been tried extensively and abandoned in Germany, from the fact that current would be taken from the storage batteries for only very short periods of time, hence the battery, which receives its charge from the channel rails while the car is traveling over the regular underground trolley route, would have to be of only one-eighth to one-quarter the weight and capacity heretofore found necessary for regular storage battery operation. The plan is to build an underground conduit of the usual type and which would be used in the ordinary way except in times of high water. Even then the higher portions of the conduit would be available. The conductors in this conduit would be divided into sections and those in the flooded sections would be automatically cut out by the action of the rising water itself when the same reaches a predetermined travel. This Mr. Ries accomplishes in one of several ways, preferably by causing the water to establish electrical connection between a pair of terminal plates in the lower part of the conduit, or in a side chamber connected therewith, which action operates a suitable electromagnetic cut-out to break the circuit to the channel rails, which latter thereupon become temporarily "dead." By a corresponding automatic apparatus within the car the motor connections, at the same time, would be switched from the plow to the storage battery carried on the car. When the water receded the current would be automatically restored to the conduit conductors and the batteries would be automatically cut out. In this manner, it is claimed the necessity for equipping the cars with removable or folding plows would be avoided.

An additional advantage claimed is that cars equipped in this way would be independent of a direct source of supply, and in case of blockades or short circuit they could run for a short distance over another line by their batteries, also that there would be no flickering or going out of the lights, or danger of stalling of the motors, as at present, when the cars pass over a crossing.

AN OMNIBUS LINE IN ST. LOUIS

The Imperial Transit Company, of St. Louis, recently organized, announces that by April 1, 1904, an automobile omnibus service will be in operation between the downtown district in St. Louis and the Louisiana Purchase Exposition grounds. Contracts for the coaches have already been placed by the company with the American Car Company, of St. Louis, and for the electrical equipment with the Western Electric Company, of Chicago. The cars will be double-deck affairs, and will vary in capacity from twenty-four to forty persons. While the service will be inaugurated as a feature of the exposition, it will not strictly be an exposition venture, as the plan is to continue the operation of the cars permanently. When the regular carrying capacity is reached by a car, it is planned to display a red flag and to stop only to discharge passengers. The schedule of fares has not been decided for the exposition period, but the statement is made that a straight 5-cent fare will prevail over the regular routes after the exposition period. Thomas M. Jenkins, formerly general manager of the St. Louis & Suburban Railway Company, has been elected president and general manager of the company. Among those associated with Mr. Jenkins in the new enterprise are: Ernst Kastor, Edward Weston, John D. Johnson, who will be the legal counselor for the company; J. L. Williams, president of the Commercial National Bank, of Detroit, and John D. Baker.

STREET RAILWAY MEN PROMOTE BASE-BALL LEAGUE

Indiana is to have an interurban baseball league. Representatives of the eight interurban roads centering in Indianapolis held a meeting a few days ago and formed an organization. The cities composing the league and where baseball will be played are: Greenfield, Rushville, Shelbyville, Richmond, Frankfort, New Castle, Connersville and Indianapolis. W. R. McKown, of Greenfield, is president of the league and Harry Sielken, secretary. The season will begin May 1, and end Sept. 15. The organization will seek protection of the national association of minor leagues. The electric railways will give the league loyal support for the increased patronage they will get.

BOSTON ELEVATED REPORT FOR THE YEAR

The income account of the Boston Elevated Railway Company for the year ended Sept. 30 is issued. A comparison with 1902 follows:

	1903	1902
Gross	$11,959,511	$11,321,030
Operating expenses	8,259,860	7,862,571
Net earnings	$3,699,654	$3,458,458
Other income	59,856	.....
Gross income	$3,759,510	$3,458,458
All charges	2,932,556	2,836,560
Balance	$826,954	$621,898
Dividends	798,000	600,000
Surplus	$28,954	$21,898

The balance sheet as of date Sept. 30 compares as follows:

ASSETS

	1903	1902
Cost of roadway	$6,747,692	$6,047,089
Cost of land	5,104,898	4,679,548
Cash	4,019,431	2,112,974
Bills receivable	855,963	963,409
Current assets	208,010	212,010
Deposited with State	500,000	500,000
Material and supplies	1,045,011	748,451
Somerville Railroad	102,851	102,851
West End property account	1,613,856	2,609,866
Subway	160,343	158,268
Total	$20,358,058	$18,134,470

LIABILITIES

	1903	1902
Capital stock	$13,300,000	$12,383,310
Vouchers and account	293,784	332,904
Salaries and wages	124,051	125,615
Dividends not called for	7,697	9,481
Matured coupons	31,337	39,550
Rent due	333,873	317,975
Outstanding tickets	24,407	21,041
Notes payable	.....	500,000
Accrued interest	113,651	150,051
Accrued taxes	904,351	840,909
Accrued rentals	131,825	131,825
West End ls account	1,207,201	1,227,207
West End bond account	171	12,849
Damage fund	598,015	598,015
Insurance fund	360,000	360,000
Depreciation fund	600,000	600,000
Surplus	2,327,687	483,733
Total	$20,358,058	$18,134,470

PASSENGER TRAFFIC STATISTICS COMPARE

	1902-3	1901-2
Revenue miles	47,476,702	45,772,836
Revenue passengers	233,563,578	222,484,811

THE THREE-CENT FARE SITUATION AT CLEVELAND

The fight between the Cleveland Electric Railway and the People's Street Railway, the so-called 3-cent fare line, has assumed a very peculiar phase. The old company has secured an injunction against the 3-cent fare line, temporarily restraining it from building on Denison Avenue on the ground that the consents of some of the property owners are invalid because they are not given by the true owners of the property. Heretofore, in obtaining consents, it has been considered necessary only to secure the consents of the parties paying taxes on a piece of property. The attorneys for the Cleveland Electric Railway Company have delved into the records and developed a number of flaws in the titles of the present owners, and they claim that these parties are not competent to grant consents. The 3-cent fare company, in seeking to retaliate, is attacking the validity of the franchise granted the Cleveland Electric Railway for a line on Doan Street, Glenville. The result is that when the cases come up for trial the opposing attorneys will have to argue one way in one case and the other way in the other case. Whichever way the Denison Avenue case is decided, it would seem that the Doan Street case must be decided the same way; hence the 3-cent fare company would seem bound to win one case.

STREET RAILWAY PATENTS

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

UNITED STATES PATENTS ISSUED NOV. 24, 1903

744,770. Trolley; Levi L. Leathers, St. Albans, Maine. App. filed April 22, 1903. Guard arms extending above the wheels are adapted to yield when a cross wire is encountered and afterwards return to normal position.

744,780. Street Car; William P. Michel, New York, N. Y. App. filed Sept. 4, 1903. A street car in which the handles on one side alternate with those on the other side, to prevent stepping from the car while facing backwards.

744,913. Car Fender; Thomas J. Glynn, Coal Center, Pa. App. filed May 2, 1903. Consists of a rotary, spring-mounted brush, disposed at an angle to the transverse axis of the car and provided with belts and pulleys whereby motion is conveyed from the car axle.

744,926. Electric Conductor; Albert E. Lytle, Chicago, Ill. App. filed April 20, 1901. A trolley-wire connector consisting of a tube having internally threaded ends and a lateral, threaded external lug.

744,973. Hand Strap; Uriah McClinchie, Brooklyn, N. Y. App. filed Sept. 20, 1903. The strap has an integral widened portion at a point above the hand-loop, which serves as a holder for advertisements.

744,975. Suspension of Dynamo Electric Machines; James F. McElroy, Albany, N. Y. App. filed Sept. 2, 1903. The motor is so constructed and mounted that parts subject to vibration have such a relation to the center of oscillation that the vibration will be neutralized.

744,983. Car Truck; George J. Smith, St. Louis, Mo. App. filed April 6, 1903. An anti-friction journal-bearing for the reception of the truck axles, straps fitting over the housing of the anti-friction bearings and spring bolts connecting said straps to the truck frame, the housing having downwardly extending ears or projections.

745,020. Trolley Controller; Walter B. Leecraft, Denison, Tex. App. filed Jan. 31, 1903. Fluid under pressure is used in connection with automatic means operating to pull the pole down when the trolley jumps from the wire.

745,033. Underground Conduit System for Electric Railways; Andrew H. Angle, Philadelphia, Pa. App. filed July 3, 1902. The conductor sections are removable, the shoe forcing them downward to make connection with the feeder.

745,065. Track Sander; Charles E. M. Knight, Huntington, Ind. App. filed June 10, 1903. Details of a pneumatic sander.

745,096. Automatic Switch Operating Mechanism; Henry T. Dumas, South Hadley Falls, Mass. App. filed April 1, 1903. A system of levers operated from the car platform to move a tappet, mounted on the car truck, to engage the switch point.

745,127. Trolley; Harry M. Williams and John W. Woomer, Pittsburg, Pa. App. filed Sept. 5, 1903. Curved guard arms carry auxiliary wheels to receive the wire in case it leaves the main wheel.

745,161. Means for Driving Traction Vehicles; Crowell M. Dissosway, New York, N. Y. App. filed Sept. 2, 1902. A motor vehicle provided with flanged wheels to keep it on the track and with a traction driving wheel adapted to bear sidewise on some part of the crown of the rail, the plane of the face which bears on the rail being perpendicular to the axis about which the wheel rotates.

745,285. Electric Railroad Brake; John S. Lockwood, Kansas City, Mo. App. filed April 21, 1903. A magnetic brake in which the rail and wheel shoes are simultaneously actuated by the same electromagnetic force.

UNITED STATES PATENTS ISSUED DEC. 1, 1903

745,359. Removable Brake-Shoe; Carl W. Larson, Schenectady, N. Y. App. filed June 30, 1901. Relates to means whereby the brake-shoe may be easily removed and replaced.

745,382. Electric Railway; William B. Potter, Schenectady, N. Y. App. filed Aug. 2, 1901. Details of a sectional conductor system.

745,383. Sectional Third-Rail System; William B. Potter, Schenectady, N. Y. App. filed April 23, 1902. A sectional conductor system in which the switches for directing main current into the sections of the third-rail are actuated by current carried on a light overhead conductor.

745,386. Friction Brake; Aldo E. Reynolds, Peoria, Ill. App. filed July 27, 1903. Comprises a friction wheel secured to the car axle to revolve therewith, a chain drum carried on the axle but free to revolve thereon, a longitudinally-shiftable friction device carried on the hub of the drum and secured against rotating on the hub, said hub being secured against movement along the axle and means carried on the hub for shifting the friction device into engagement with the friction wheel.

745,436. Electric Railway System; Frederic W. Hild, Schenectady, N. Y. App. filed April 28, 1900. The current to the sectional conductor is controlled by switches which are arranged in groups and means are provided so that when a switch is closed, its coil is open-circuited and the switch remains closed independently of its coil.

745,502. Combined Trolley and Air Brake Controller; James Kynoch, Toronto, Canada. App. filed April 20, 1903. Air brakes are automatically applied when the trolley wheel leaves the wire.

745,614. Trolley; Henry Holland, Detroit, Mich. App. filed Nov. 11, 1902. A spring plate between the wheel and harp, to carry the current.

745,650. Car Wheel; Grant Newland, Linden, Ia. App. filed Aug. 4, 1903. Rollers are journaled in recesses in the flange of the car wheel, the recesses extending longitudinally relative to the flange.

745,708. Third-Railway System; William E. Wray, New York, N. Y. App. filed March 26, 1903. A gear wheel and brush adapted to engage the third-rail and remove the snow and ice therefrom.

745,778. Contact Box for Electric Railways; William M. Brown, Johnstown, Pa. App. filed Dec. 6, 1902. The electrodes are in a cup and an arc-guard is arranged to prevent a deposit of a conducting coating on the adjoining surfaces.

745,848. Car Brake; William W. Hopkins, St. Louis, Mo. App. filed May 26, 1902. A combined service and emergency brake, means being provided in connection with the emergency brake whereby the power is automatically shut off and sand applied to the rails when said brake is applied.

745,849. Car Brake; William W. Hopkins, St. Louis, Mo. App. filed Dec. 29, 1902. Details of construction of a friction brake.

745,916. Car Step; Carl Sellergren, Chicago, Ill. App. filed Sept. 9, 1903. The hinged steps of an open car are so connected that when one step is down the other is folded into an upright position against the side of the car.

PERSONAL MENTION

MR. A. A. ANDERSON has accepted the position of general superintendent of the Indianapolis-Cincinnati Traction Company, with headquarters at Indianapolis.

MR. WILLIAM C. ANDREWS, of New York, has just accepted the position of engineer of the sales department of the Stanley Instrument Company, of Great Barrington, Mass.

MR. CHARLES REMELIUS, who recently resigned as chief engineer and master mechanic of the Indianapolis Traction & Terminal Company, has accepted a position with the St. Louis Transit Company.

MR. HARRY BULLEN, formerly assistant general superintendent of the Detroit United Railway Company, has been promoted to the general superintendency, to fill the vacancy left when Mr. Albert H. Stanley went to the Public Service Corporation, of New Jersey.

MR. H. C. REAGAN has been appointed chief engineer of the Cleveland, Painesville & Ashtabula Railwy, of Painesville, Ohio, and Mr. J. H. Lahrmar has been appointed chief dispatcher for the same company. Mr. Reagan and Mr. Lahrmar held the same relative positions with the Columbus, London & Springfield Railway, of Columbus, recently.

MR. JAMES W. CROSBY, chief electrician of the Halifax Electric Tramway Company, of Halifax, N. S., has been appointed general manager of the company to succeed Mr. F. A. Huntress, who resigned from the company to become general manager of the Worcester Consolidated Street Railway Company, of Worcester, Mass.

MR. H. A. DAVIS, who has been in charge of the improvements to the system of the Nashville Railways & Light Company, of Nashville, Tenn., has been appointed superintendent of the railway department of that company. Mr. Davis was formerly connected with the New Orleans & Carrollton Railroad, of New Orleans, La., and has also been prominently identified with other street railway companies in the South.

MR. THOMAS M. JENKINS, formerly general manager of the St. Louis & Suburban Railway Company, has been elected president and general manager of the Imperial Transit Company, of St. Louis, which plans to operate an omnibus service between the downtown district and the Louisiana Purchase Exposition grounds at St. Louis during the exposition. After the exposition, the plan is to inaugurate a regular city service with a probable uniform fare of 5 cents.

MR. JOSEPH STEHLIN has been appointed mechanical engineer in the engineering department of the New York Central & Hudson River Railroad, vice Mr. A. J. Slade, resigned. Mr. Stehlin will report to Mr. E. B. Katte, electrical engineer, on designing and construction of power stations except those in the electric traction system, and to Mr. Olaf Hoff, engineer of structures, on designing and installation of heating and lighting plants, water and coaling stations.

MR. ROBERT B. CATHERWOOD, of Brooklyn, N. Y., an old-time street railway man, is dead, at the age of eighty-four years. Mr. Catherwood built the DeKalb Avenue Railroad in, Brooklyn, now part of the prosperous Coney Island & Brooklyn Railroad system, and operated the line for two years before a company was organized to take it over. Mr. Catherwood was also connected with prominent municipal undertakings in Brooklyn. In the street railway field he was also prominently identified with early street railway work at Indianapolis, Ind.

MR. H. F. J. PORTER, who has been associated with Westinghouse interests since the first of the year and has held the position of assistant manager of the publishing department, with offices in East Pittsburg and 10 Bridge Street, New York, has been made second vice-president of the Nernst Lamp Company, of which enterprise Mr. George Westinghouse is president, with the duties of general manager and headquarters at Pittsburg. He assumed charge on Dec. 1. This appointment does not affect Mr. Porter's relations with the publishing department at the present time.

MR. EUGENIO DAVERI, who has been constructing superintendent of the Italian Edison Company at Milan for the last ten years, has resigned that position, and on Jan. 1 will act as representative for foreign manufacturers of vehicles of all kinds, such as cars for steam and street railways, automobiles, etc., and also for car supplies. The Italian Edison Company, with which Mr. Daveri has been connected, operates all of the electric street railway lines in Milan, so that he is well posted on all subjects relating to cars and car appliances. He would like to enter into communication with manufacturers who wish to extend their business in Italy.

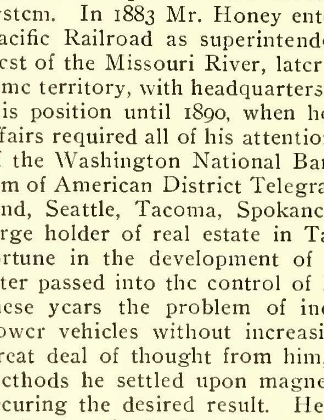
COL. JAMES H. BAILEY, vice-president and part owner of the "Railroad Gazette," of New York, retired from active business several weeks ago. Col. Bailey has been one of the best known and most popular among technical newspaper men in New York City and has the highest respect of all who are acquainted with him. He took an active part in the Civil War, enlisting in the Union army in 1861, when he was only fifteen years of age. He served through the entire war, participating in a good many battles and being held a prisoner of war for part of the time. After his service in the army ended he went West, where he was engaged in railroad construction for a short time, then came to New York, where he engaged in newspaper work. He has been connected with the "Railroad Gazette" since 1884 and had charge of the business management of the paper. In his retirement he will have the best wishes of his many newspaper friends that he will live long to enjoy the leisure which he has so richly earned.

MR. RICHARD T. LAFFIN'S retirement as general manager of the Worcester Consolidated Street Railway Company, of Worcester, Mass., in order to become general manager of the Manila Railway & Light Company, of Manila, P. I., was considered at the annual meeting of the Worcester Company, held a few days ago, and resolutions were adopted paying the following tribute to Mr. Laffin as an executive: "Many things which cannot be enumerated have been accomplished under Mr. Laffin's care and supervision. He has shown an untiring devotion to the interests of the company, and a faithful and close attention to details and to the duties that have devolved upon him. His thoughtfulness for others, and his spirit of fairness, have won for him the confidence of those with whom he has come in contact, and by his uniform courtesy in dealing with the employees and by his treatment of the public, he has created and retained a friendly feeling for the company. His work has been well done. He leaves the road and other property in first-class condition, and he takes with him the best wishes of every one for his success in the new and larger field to which he goes."

MR. LOUIS J. MAGEE, who is a director of the Allegemeine Elektricitäts-Gesellschaft and also of the Union Elektricitäts-Gesellschaft, both of Berlin, is in this country, and has offices at 25 Broad Street, New York. Mr. Magee is an American, and before his departure to Europe, some fifteen years ago, was prominently connected with the Thomson-Houston Electric Company. He was one of the organizers in Berlin of the Union Elektricitäts-Gesellschaft, which has developed in Germany the patents of the General Electric Company, of this country. It was therefore recognized in that country as the exponent of the "American" electric railway system, and has constructed a large proportion of the electric railways now in Germany. About a year ago, at the time of the consolidation of the interests of the Allgemeine Elektricitäts-Gesellschaft with the Union Elektricitäts-Gesellschaft, Mr. Magee was elected a director in both companies. No announcement has been made that these companies are to have a permanent New York office, but Mr. Magee is planning to remain for some time at least in this country, and it has been a pleasure to his former friends in the electrical business to meet him, as his previous visits to this country at occasional intervals have been of the briefest character.

MR. ALBERT A. HONEY, inventor of an underground trolley system, and more recently of a magnetic traction increasing device, died from paralysis at the Chicago Union Hospital, Dec. 4. Mr. Honey was born at Two Rivers, Wis., in 1849, and at the age of twelve years entered the service of the old Illinois Telegraph Company. In the late 60's he was employed as one of the first three Associated Press operators stationed in Chicago. Later he was engaged with the Union Pacific road and played a prominent part in the development of the transcontinental system. In 1883 Mr. Honey entered the service of the Northern Pacific Railroad as superintendent of construction of the lines west of the Missouri River, later acting as superintendent for the same territory, with headquarters at Tacoma, Wash. He occupied this position until 1890, when he resigned, because his personal affairs required all of his attention. At that time he was president of the Washington National Bank and the organizer of the system of American District Telegraph companies operating in Portland, Seattle, Tacoma, Spokane, Butte and Helena, and was a large holder of real estate in Tacoma. Mr. Honey expended a fortune in the development of the underground trolley, which later passed into the control of Eastern capitalists. Through all these years the problem of increasing the traction of motive power vehicles without increasing dead weight had received a great deal of thought from him, and after many trials by other methods he settled upon magnetism as the important factor in securing the desired result. He commenced experimental work in 1890, and in the face of repeated failures he tirelessly continued his research and finally evolved an application which is now being exploited. In 1902 the Magnetic Equipment Company was organized to handle this system, and until within the last six months, when his health necessitated his resignation, he occupied the position of president of the company.

MR. JOHN B. McCLARY has resigned as manager of the street railway department of the Birmingham Railway, Light & Power Company, of Birmingham, Ala., his resignation to take effect Jan. 1. Mr. McClary thus will terminate on the date just mentioned connections with the street railway systems of the city after a service of sixteen years and five months, surviving various changes in ownership. For seven years previous to his connection with railway work at Birmingham, Mr. McClary was associated with the Pratt Coal & Iron Company and the Tennessee Coal, Iron & Railway Company. Later he was secretary of the Woodward Iron Company. In 1887 he was general manager of the Birmingham Railway & Electric Company, then including the East Lake, Ensley and Bessemer lines. In 1890, on the formation of the Birmingham Railway Company, he was made superintendent of the Bessemer line, and later of the East Lake line. With the organization of the Birmingham Railway, Light & Power Company, in 1900, Mr. McClary was elected manager of the entire system, and on the consolidation of the gas and electric companies of the city, in August, 1901, under the title of the old company, the Birmingham Railway, Light & Power Company, he was made general manager of the street railway department, which position he has held until the present time. For thirteen years Mr. McClary has been a member of the American Street Railway Association. He has always taken an active interest in the affairs of the association and was third vice-president of the body in 1900-1901. Mr. McClary has announced that he will go into business for himself. It is announced that his successor will be Mr. Geo. H. Harris, the present traffic manager of the company.



JOHN B. McCLARY