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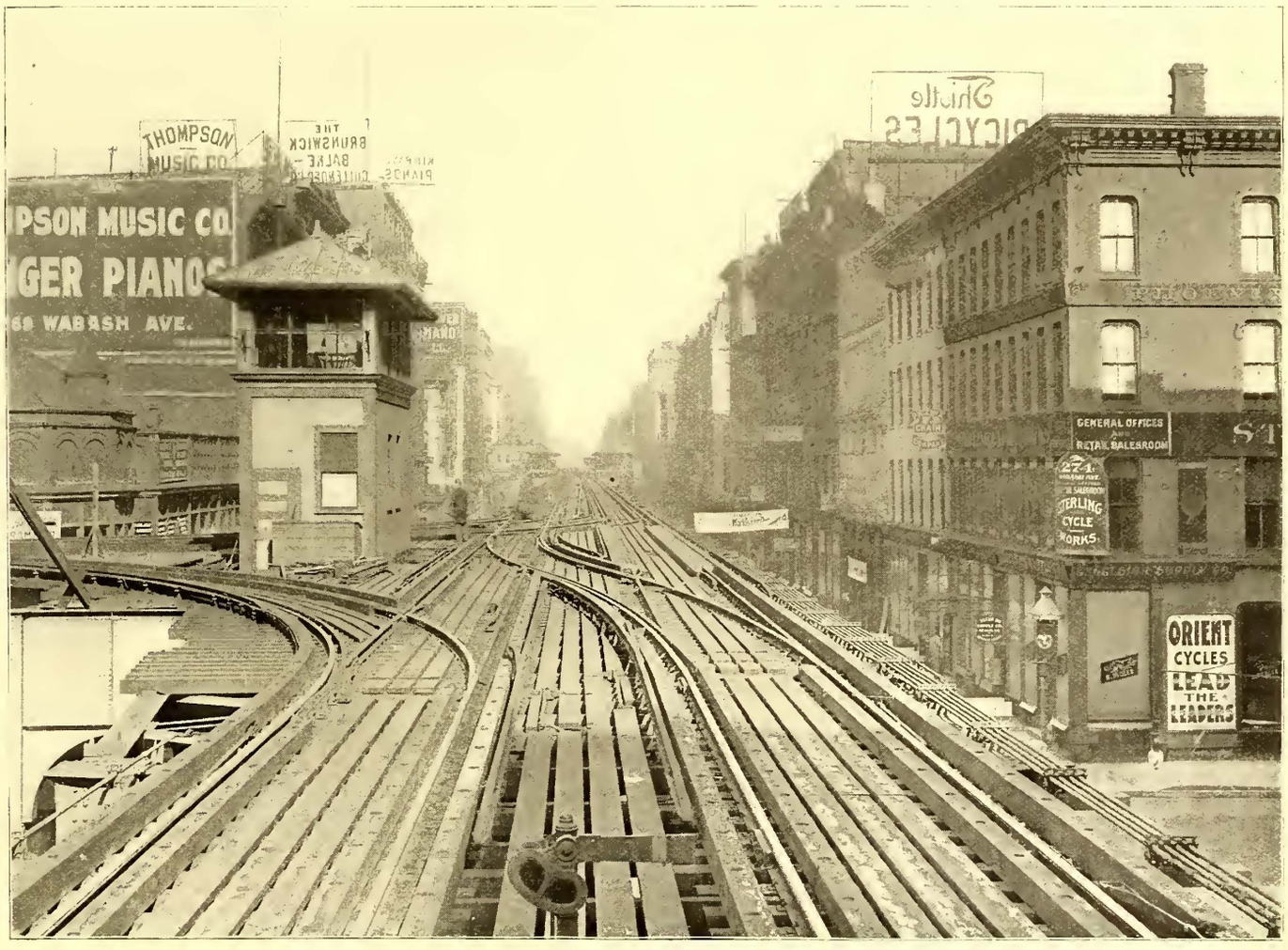
SOME ELEVATED RAILWAY PROBLEMS AND RESULTS

All railway transportation agencies serving cities and suburbs may be divided into two classes, the one operating cars which stop at extremely short intervals, such as street corners or at the pleasure of the passengers; and the other operating cars which stop at definitely established stations at longer intervals and which attempt to save time to passengers at some expense in convenience. To the former belong city and most suburban street railways, and to the latter elevated, underground and suburban steam or electric surface railroads operating on private right of way.



SOUTH SIDE ENTRANCE TO ELEVATED RAILWAY LOOP - CHICAGO

The sharpest kind of competition exists between these two classes of railroads. Until electricity displaced horses on street railways, the elevated and steam suburban railroads obtained enormous patronage, the time saved by them being sufficient to overcome the disadvantages to the traveler of a walk at both ends of the journey. It is needless to point out the change which electricity has made in the competitive conditions, for it is a matter of common knowledge that the patronage of the "station class" of railroads has dropped off greatly with the increased speeds and greatly extended facilities of the "convenience class." What is not so clear, however, is what are the possibilities of the future. It is not to be supposed that the present losers in the race will sit quietly by and suffer their properties to depreciate in value without making a supreme effort to regain patronage and earning power. The daily carriage of a city's workers between their homes and business places is far too profitable to be yielded up carelessly as a thing of no account. Each side has advantages and disadvantages of position, and the sooner that each correctly measures the strength of the other and faces the problem of making the most of its own elements of strength, the more quickly will the traffic in any given community settle down to a permanent basis.

The object of this article being chiefly to set forth the conditions which confront the "station class" of railways, those of the "convenience class" may be dismissed with a few general statements. Street railways in America will always obtain, in competition with any other agency, that

profitable class of business known as "short distance riding." They cannot be disturbed in this monopoly. They will also obtain the major part of the patronage of the nearby suburbs of a large city, no matter how good the steam railroad service can be made, for their facilities for distribution within the city proper are, and always must be, better than those of suburban or elevated roads. The real test of strength will come, of course, in the distance traffic, both in suburbs and in cities proper, and here street railways must always be seriously handicapped by their passage through more or less crowded streets and the multitude of stops necessary to take on and let off individual passengers. The principal way, so far as can at present be foretold, in which street railways can improve their present position in the competitive struggle is by introducing power brakes and other safety appliances so as to

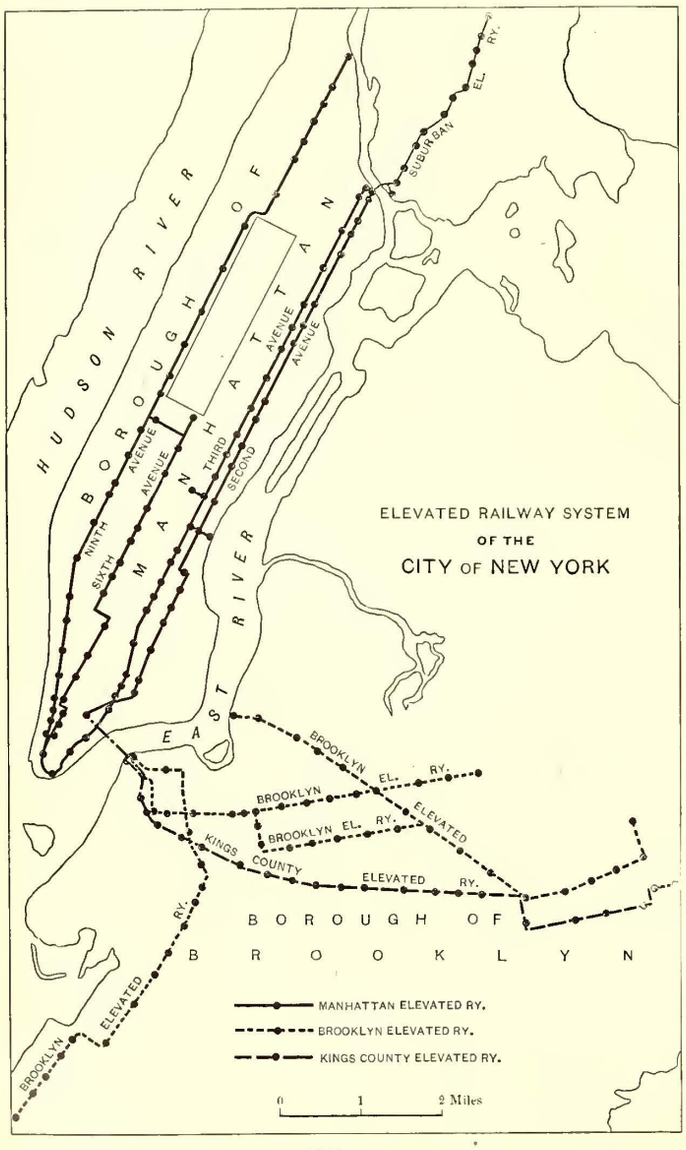


FIG. 1

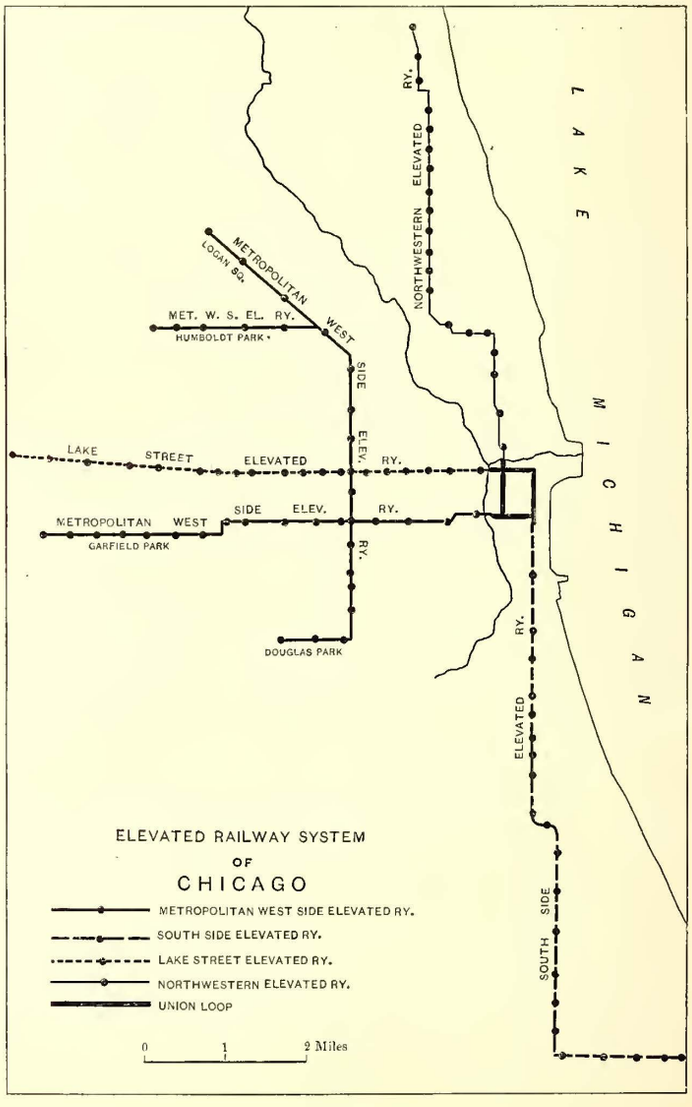


FIG. 2

permit of increased speeds through the streets without greater danger to street traffic and by giving additional comforts and convenience to their patrons.

The elevated railroads of New York and Brooklyn have been losing business during the last two or three years so rapidly that the financial condition of the Brooklyn system is most serious, and the accustomed rate of return on investment of the New York system has been much reduced, and is still on a declining scale. The elevated railroads of Chicago have been not inaptly termed "gift enterprises to the public," in that they have never been able to earn a satisfactory return upon their investment. The general introduction of electricity in the Chicago system and the completion of the new terminal "Loop" has greatly improved the Chicago situation, in spite of the constantly increasing competition of the surface trolley lines, which parallel the elevated lines in most cases, and which have also introduced electricity and much more rapid schedules. History is yet being made in New York, Brooklyn and Chicago, and it is believed by many that the competitive resources of their elevated railroads are by no means exhausted, but that profits can be regained by proper engineering and financial decisions.

There are two good reasons why a citizen of New York or Chicago may be induced to ascend and descend elevated railway stairs. The first and best is found when he will save considerable time in his journey, and the second is that he will be riding above the street and with less confusion, noise and danger of accident. Conversely, there are two good reasons why a citizen should not use a *steam* elevated road when he can get a surface electric car, the first being that he must ride, even in the summer, in closed cars, or else suffer greatly from the cinders and sulphurous gases of the locomotive, and the second being found when he cannot save sufficient time to warrant the combined disadvantages of stairs and other disagreeable concomitants of his journey. It follows that, in order to preserve or regain gross receipts, steam must be done away

with for elevated and underground railroad service, that speeds must be great in order to save time in actual transit, and that stations must be frequent in order that the time saving may not be too much reduced by necessary walking to and from stations.

Passing over the first deduction as being self-evident, and, in fact, admitted, the elevated railroad problem is resolved into a discussion of speeds, station frequencies and relative costs of service. There is no escape from this

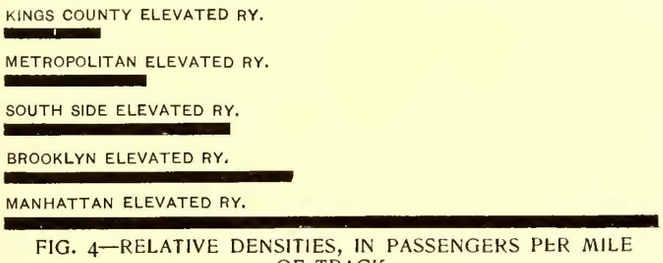


FIG. 4—RELATIVE DENSITIES, IN PASSENGERS PER MILE OF TRACK

conclusion. The dilemma is forced upon elevated railroad managers by the loss of earnings gross and net.

In any railroad, elevated, underground, or surface, where stops are frequent, the average schedule speed over the entire line is chiefly dependent on the rate of acceleration possible to obtain with the motive power used, and upon the braking effort possible to exert. The greater part of the distance between stations must be covered in the periods of acceleration and retardation, and the time for free, clear running at high speed is extremely short. It is true, therefore, that any railroad of this class which aims to maintain a high schedule must choose a motive power in which the possibilities of rapid acceleration are intrinsically at a maximum, and—all other conditions being equal—should choose that particular adaptation of the motive power selected which will bring about the quickest acceleration consistent with due economy.

Electricity has a great intrinsic advantage over all forms of motive power employing reciprocating motion in that its effort is rotary and its torque constant, while with reciprocating motion the effort varies from maximum to minimum several times per revolution. This feature has a direct bearing upon traction on grades and upon acceleration, and is almost sufficient in itself to lead to the adoption of electricity for this character or service. Besides this, however, there are collateral advantages of electricity over other motive powers which confirm a predisposition in its favor.

In the application of electricity, and, in fact, of any motive power, to transportation service, there are three systems possible to employ, the "individual unit" plan, common in street railway practice; the "locomotive" plan, where the motive power is contained in one only of several units composing a train; and the "multiple unit" plan, where two or more units in the train carry motive power and assist in propelling the train. Of the last two systems, the locomotive system has the advantage of smaller initial cost where moderate speeds and accelerations only are required, possibly a slight advantage in maintenance expenses owing to concentration of equipment and a less number of appliances per train, and one or two other advantages. It has the serious disadvantage of using a small fraction only (ordinarily from 15 to 35 per cent in elevated railroad service) of the train weight for purposes of traction, whereas, by the multiple unit system, 100 per cent of the train weight may be used if desired. This means, of course, that it is utterly impossible for a train drawn by locomotive to obtain a maximum rate of acceleration anywhere near as great as that possible to the multiple unit system. It does not follow, however, that the locomotive system under given speed conditions cannot attain a rate of acceleration sufficient to satisfy those conditions, this being an engineering question which must be determined by experiment or by the application of well-known principles and data.

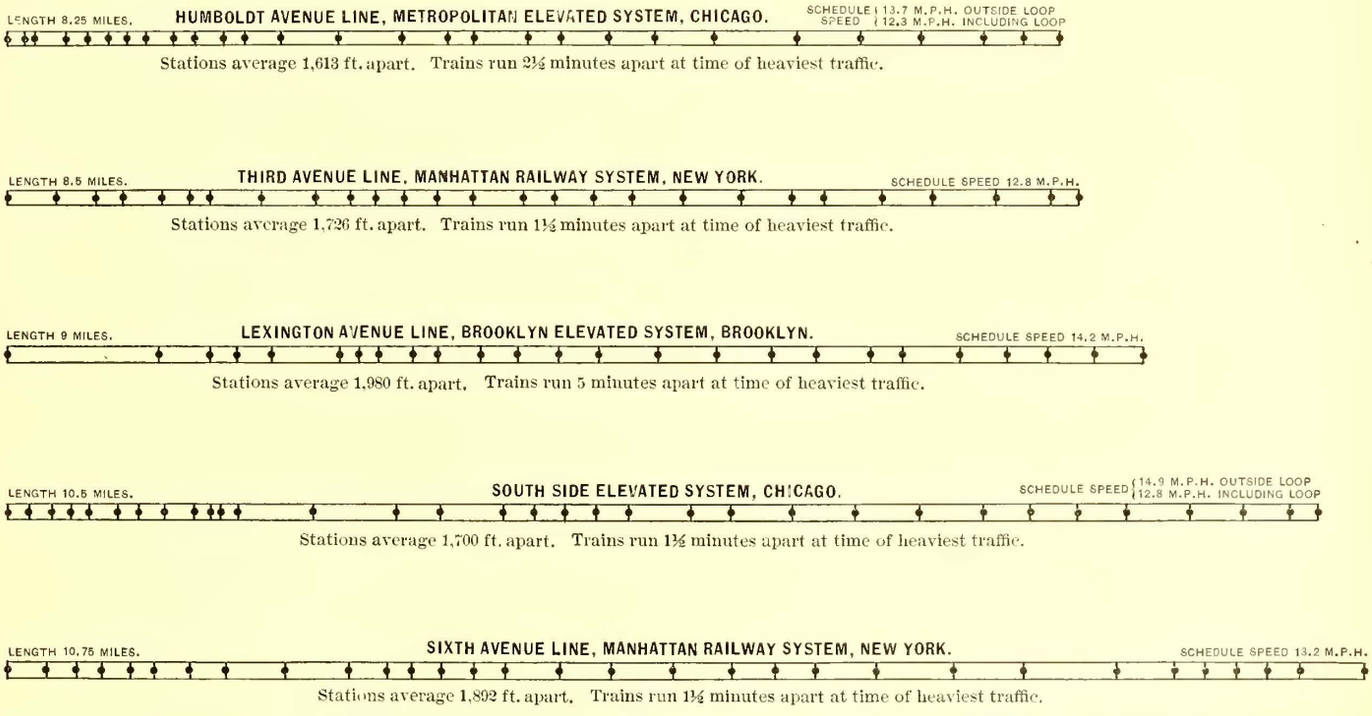


FIG 3— CHARACTERISTICS OF FIVE HEAVY TRAFFIC ELEVATED LINES IN NEW YORK AND CHICAGO

Passing now from these general considerations, which serve only to indicate the character and importance of the problems to be solved, we will consider the actual results already achieved in New York city and Chicago, and the bearing which these have upon the future of elevated railroading in the two cities.

On page 756 are found diagrams of the Manhattan,

Brooklyn and Chicago elevated railway systems reduced to the same scale for comparison and with station frequencies indicated. It will be seen that the Manhattan system is a comparatively simple one, with four main through lines, without branches of importance, while the Brooklyn and Chicago systems are, as a whole, composed of trunk lines with branches, involving more or less complicated switching arrangements. Until about a year ago the three Chicago companies, the Lake Street, the South Side and the Metropolitan, had independent termini in the business

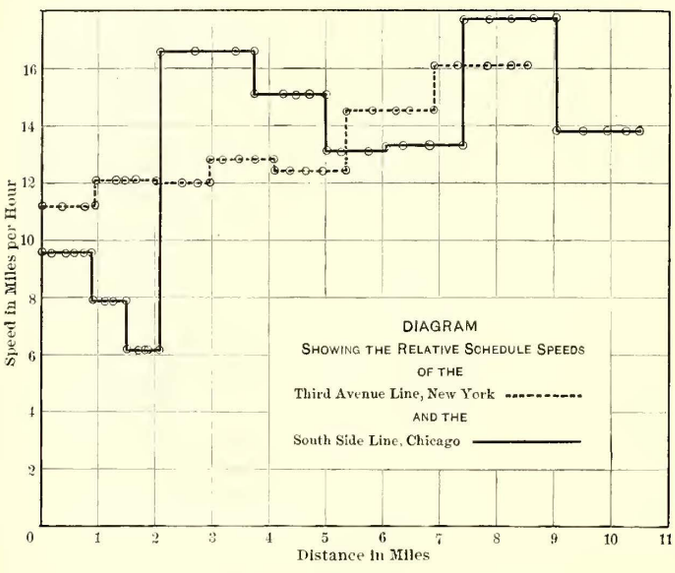


FIG. 5

heart of the city. Now, however, the newly constructed "Loop" encircling the business district, is used as a terminus for all three lines and for a fourth, the Northwestern, now under construction, and all the elevated trains of the city pass around this loop on each trip. The Brooklyn elevated system has lately secured a new terminus on the Manhattan Island side of the Brooklyn Bridge, and experiments are being made with a view to converting the entire Brooklyn system to electricity in the near future. The entire New York system, however, is at present operated by steam locomotives.

In Fig. 4 are presented in diagrammatic form the relative traffic densities of the Manhattan and Brooklyn systems in New York, and of the Metropolitan and South Side systems in Chicago, and in Fig. 5 are presented the relative lengths, station frequencies, schedule speeds and time intervals between trains of five heavy traffic lines in New York and Chicago. From these diagrams a preliminary idea of the conditions met with in the two cities may be quickly obtained. It will be seen that there is no great difference between these conditions except that the Manhattan system has much the greatest traffic density per mile of road, and has, as a consequence, a more frequent train service.

The little Baldwin locomotives in use on the New York system are extremely well designed for their purpose, and have sufficient weight on the drivers to provide for the necessary tractive effort for a five-car train under ordinary conditions of track. The weight of these locomotives is 47,000 lbs., of which 31,500 are on the four 42-in. driving wheels and 15,500 are on the four 30-in. truck wheels. The total wheel base is 193 ins., of which 60 ins. is rigid. The cylinders are 12 ins. in diameter and have a 16-in. stroke. The grate area is 16.5 sq. ft. and the total heating surface is 403.4 sq. ft. There are 154 flues, 1½ ins. in diameter and 75 ins. long.

The standard Manhattan coach weighs 29,088 lbs., has seats for forty-eight and frequently carries 100 passengers. It is mounted on eight 30-in. wheels.

From the above it appears that the total weight of a five-car heavily loaded Manhattan train is not far from 130 tons, of which over 100 tons are behind the locomotive. The weight on the drivers is but 12 per cent of the total train weight, and with 25 per cent adhesion the maximum drawbar pull possible for the locomotive to exert is 7875 lbs.

The electric locomotive car of the Metropolitan Elevated Railway Company, of Chicago, weighs 53,200 lbs. complete with motors, or 40,000 lbs. exclusive of motors. It is, of course, a standard passenger coach with full seating capacity, about one-half of each platform only being taken up with the cab and necessary controlling apparatus. The trail cars weigh about 33,000 lbs. The seating and standing capacity of both motor and trail cars is approximately ninety passengers. The average four-car heavily loaded train will weigh about 100 tons, of which 32.5 tons approximately are on the four wheels of the locomotive's one-motor truck, and 67.5 tons are in the trail cars. From 30 to 35 per cent of the entire train weight is available for traction under these conditions, and the maximum drawbar pull possible to exert without slippage of wheels is, with 25 per cent adhesion, 16,250 lbs. The latest motor cars are equipped with two G. E. 55 motors.

The South Side Elevated Railway Company, of Chicago, is equipped with the Sprague multiple unit system,

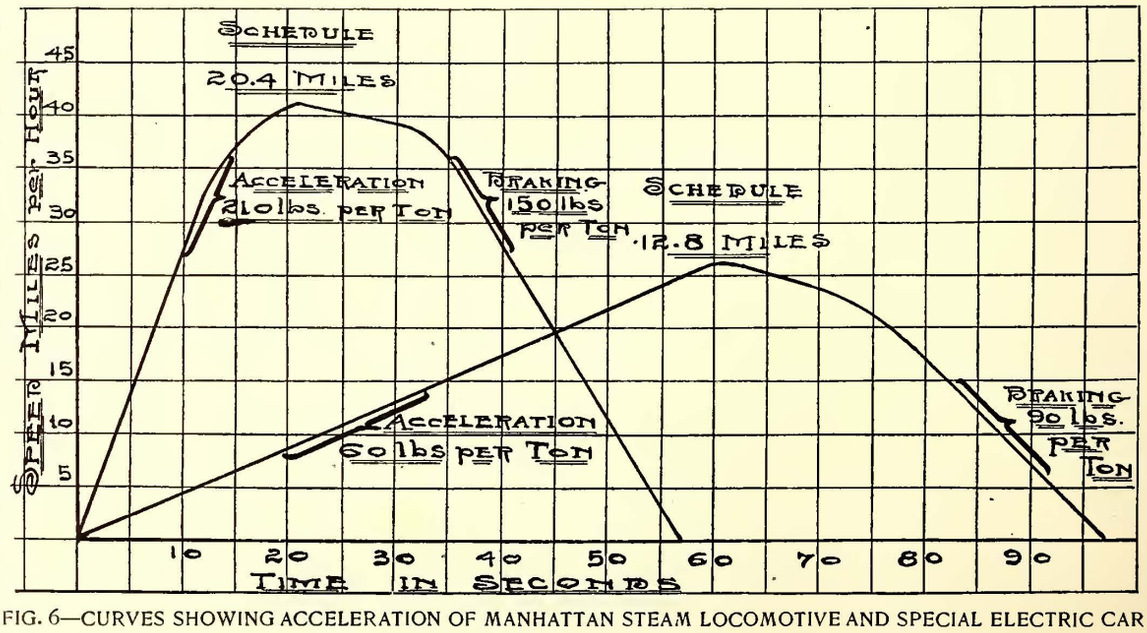


FIG. 6—CURVES SHOWING ACCELERATION OF MANHATTAN STEAM LOCOMOTIVE AND SPECIAL ELECTRIC CAR

by means of which two or more cars in a train are equipped with motors and may be operated in unison by a single controller from any point in the train. As a matter of fact, the company is now operating four-car trains, on each of which is a motor truck carrying two motors. The cars weigh about twenty tons each, without load, and

about 60 per cent of the train weight is available for traction, the maximum drawbar pull possible to exert being about 15 per cent of the entire train weight. The motors are of the G. E. 57 type.

Here, then, are three distinct types of elevated railway equipment, the steam locomotive using 10 to 15 per cent of the train weight for traction under heavy traffic conditions, the electric locomotive using 30 to 35 per cent, and the multiple unit system using any amount desired up to 100 per cent. There is no question, of course, as to which of these systems possesses the greatest possibilities of rapid acceleration. A multiple unit train properly designed can obviously "outrun" the best possible locomotive train in a competitive speed test under any given conditions of station frequency. By the multiple unit system any required rate of acceleration can be obtained, the real limitations being determined by questions of economy rather than of adhesion to rails. The real question which an engineer has to decide upon when considering the question of acceleration for any given railway is as to whether or not the locomotive system will give him the desired rate without slippage of wheels under all conditions of track. If his answer is negative or the results doubtful, he can turn to the multiple unit system with the positive assurance that it will fulfil the acceleration requirement. So much at least is certain, and must be admitted in favor of the multiple unit system even by those who, for economical or other considerations, doubt the wisdom of its application in any particular case.

Let us turn now to actual performances of elevated railway trains of the three different types above described. In Figs. 7 to 10 will be found the curves of acceleration and power consumption of several locomotive trains operating on the Metropolitan and Lake Street lines in Chicago. In Fig. 6 will be found an average acceleration curve of a Manhattan steam locomotive train in comparison with an extremely high acceleration produced by electricity, and in the inset between pages 762 and 763 will be found a complete single trip test run of one car of a Sprague multiple unit train on the South Side Elevated Railway, of Chicago. This was a private test made on Sept. 3, 1898, under the direction of John Lundie, of Chicago, consulting engineer of the Illinois Central and Brooklyn Elevated Railroad Companies, and one of the ablest specialists in railway transportation methods in this country.

[This test has been plotted from data exactly as obtained by a corps of observers in the car, and without any correction or rectification of figures. This accounts for occasional slight discrepancies in time intervals of observations and for other minor imperfections, which do not, however, in any case materially affect the form of the curves or their value for present purposes. In certain places observations were necessarily omitted, owing to breaking of tape and other instrument troubles, as will be seen.—Eds.]

Railway Company.	Remarks.	No. of Cars.	Weight of Train in Net Tons.	Grade.	Type of Brake.	Speed in Miles per Hour on Application of Brakes.	Distance Stopping in Feet.	Time Stopping in Seconds.	Average Rate of Retardation per Second in Miles per Hour.	Equivalent Braking Effort in Lbs. per Net Ton.
Metropolitan Elev	Service	2	44	L	Straight Air	19	181	13	1.45	133
Lake Street Elevated	Service	2	44	L	Autom. Air	25	293	16	1.56	142
Alley Elevated	Service	3	72	L	Autom. Air	31	522	23	1.35	125
Illinois Central	Service	4	116	L	Autom. Air	40	1,086	37	1.08	98
Manhattan Elevated	Service	4	95	L	Vac.	22	387	24	.92	84
Cleveland, Painesville & Eastern	Service	1	20	L	Elec.	40	585	20	2.0	183
Cleveland, Painesville & Eastern	Emergency	1	20	L	Elec.	30	220	10	3.0	275
Lorain & Cleveland	Emergency	1	23	L	Elec.	45	461	14	3.21	295
Schenectady St. Ry	Service	1	9	L	Elec.	23	135	8	2 88	263

BRAKING DATA FROM NUMEROUS TESTS

On the Chicago electric locomotive trains the acceleration continues practically to the point of braking. As a matter of fact, during a large portion of the day the Metropolitan motors are said to be worked in the series position almost entirely, and are not thrown into multiple except to make up lost time. This is done in order to save power, as it is claimed that the trains can make their schedule time, about 14.5 miles per hour exclusive of loop, without multiple working. It is claimed also that there is usually sufficient adhesion to rails with locomotive electric trains in Chicago to prevent slippage of wheels even when the motors are thrown quite rapidly into full multiple, but this is not the case when the rails are wet or greasy, and the rate of acceleration is therefore limited, as would naturally be expected. The Metropolitan and Lake Street elevated lines are in competition with surface lines in their territory and have not been profitable enterprises, neither having earned fixed charges. An increase of two or three miles per hour in the schedule speed ought to place them in a better position to obtain traffic, though at an increase, of course, in operating expenses. It is not probable, however, that such increased schedule can be regularly maintained with the locomotive system, even with all the advantages which the addition of passenger weight to the locomotives supplies.

The Manhattan trains are run at practically the best

Railway Company.	Remarks.	No. of Cars.	Weight of Train in Net Tons.	Grade.	Tractive Effort per Net Ton.				10 Seconds.			20 Seconds.			30 Seconds.			40 Seconds.		
					Maximum for Given Time.		Average for Total Time.		Average Rate of Acceleration.	Speed Miles per Hour.	Distance Run Feet.	Average Rate of Acceleration.	Speed Miles per Hour.	Distance Run Feet.	Average Rate of Acceleration.	Speed Miles per Hour.	Distance Run Feet.	Average Rate of Acceleration.	Speed Miles per Hour.	Distance Run Feet.
					Sec.	Lbs.	Sec.	Lbs.												
Metropolitan Elevated	Elect. (15 lbs. per ton friction)	2	44	L	10	158	40	91	16.4	16 4	120	1.12	22.5	330	1.00	30	660	.87	34.8	1020
Lake Street Elevated	Elect. (15 lbs. per ton friction)	2	44	L	10	121	40	75.2	1.22	12.2	90	1.02	20.5	300	.773	23.2	510	.69	27.6	870
Alley Elevated	Steam (15 lbs. per ton friction)	3	72	L	10	121	40	87.4	1.22	12.2	90	.975	19.5	285	.80	24	540	.715	28.6	840
Illinois Central	Steam (15 lbs. per ton friction)	4	116	L	10	86	40	71	.817	8 17	60	.715	14.3	210	.682	20.5	450	.64	25.6	750
Manhattan Elevated	Steam (15 lbs. per ton friction)	4	95	L	10	80	40	60	.75	7.5	548	.675	13.5	198	.58	17.5	386	.52	21	615
Special Test Gen. Elec. Co.	Elect. (20 lbs. per ton friction)	1	25	L	10	282	20	186	3.	30	220	1.9	38	556	....	....	....	....	....	....
Special Test Gen. Elec. Co.	Elect. (20 lbs. per ton friction)	1	9	L	10	264	20	199	2.8	28	206	2.05	41	600	....	....	....	....	....	....
Special Test Gen. Elec. Co.	Elect. (20 lbs. per ton friction)	1	9	L	10	163	20	126	1.64	16.4	120	1.22	24.5	360	....	....	....	....	....	....

ACCELERATION DATA FROM NUMEROUS TESTS

schedule speeds obtainable with their steam locomotives. The form of the Manhattan locomotive acceleration curve is peculiar and interesting.

In riding upon a South Side train one is instantly impressed with the quick response of the train to the controller, a response which is not, however, disagreeable to passengers. The curves of the Sprague car show the reason for this and furnish an exact measure of the results obtained, and these curves deserve more than passing attention.

As a result of many hundred tests upon the Illinois Central and other railroads under various conditions of load, speed, power consumption, etc., the conclusions reached by John Lundie, by means of the extremely ingenious and beautiful graphic system devised by him of throwing the test results into readable form, were that with any service requiring frequent stops at short intervals any given schedule can be made most economically by accelerating very rapidly at the beginning of the run. The subsequent movement of the speed curve varies with different conditions. In some cases, for example, it is most economical to coast after the period of acceleration to the point of braking. Under other conditions, just enough current may be sent through the motors after completing the acceleration to overcome train friction and keep the speed at a maximum to the point of braking, following this with a strong braking effort. The best method of power use for each case must be determined by experiment. Having full knowledge of all the governing conditions, including station locations and cost of equipment, of coal, of labor and of depreciation, there may be found a rate of acceleration and a method of subsequent current use which will lead to minimum cost of operation to accomplish a given schedule. Mr. Lundie found, for example, that the most economical way of operating the Illinois Central eighty-ton trains was to accelerate them so as to reach a speed of 40 miles per hour in twenty seconds—an extraordinary requirement, of course. This high rate of acceleration was, however, actually accomplished on the General Electric Company's "heel path" test line at Schenectady, a twenty-five ton double truck car being forced in twenty seconds to a speed of 41.2 miles per hour, which required an average accelerative force of 190 lbs. per ton during that period. Adding twenty pounds for train friction, the traction effort amounted to 210 lbs. per ton, and the actual work per ton up to the time of shutting off the power was 3.82 h.p. minutes. If the train had been actuated more slowly, using only 130 lbs. per ton and reaching a maximum of 51 miles so as to make the same car cover the same distance in the same time, the energy required would have been increased by 58 per cent, or to 6.05 h.p. minutes. The electric curve of Fig. 6 is of this special test.

In the light of this statement, the acceleration curves of the Sprague South Side car may be better understood. Such accelerations as are shown in these curves are made in regular daily service on the South Side line, and it is believed with economy in power consumption over Chicago locomotive train results for the desired schedule. If this is so, the South Side line has a margin for improvement upon its present schedule time (about 15 miles per hour) with general economy, and so may enter into sharper competition with the surface lines. At the same time, it must not be forgotten that power consumption increases theoretically as the square of the speed, and practically at times as rapidly as the cube, so that there are decided limits to the economical improvement of schedules. This fact, it may be noted by the way, is the really serious condition which confronts elevated railroads today in their attempt to retain their business or to secure more.

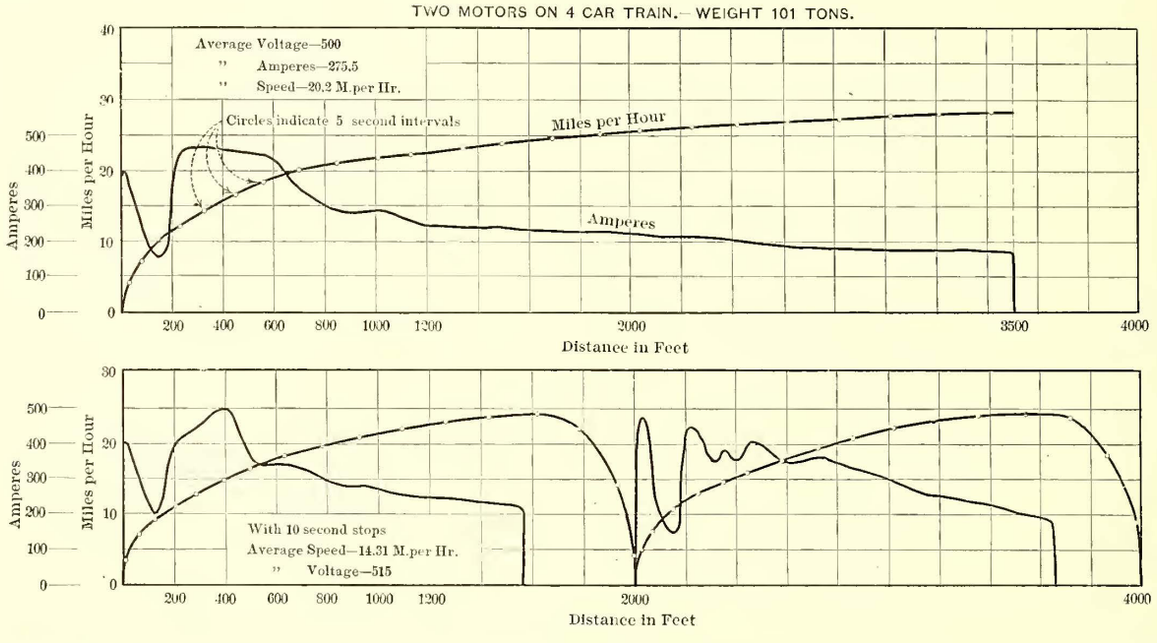


FIG. 7—CURVES SHOWING ACCELERATION AND CURRENT CONSUMPTION OF METROPOLITAN (CHICAGO) TRAIN

On page 759 are reproduced the two tables first appearing in an article by W. B. Potter in the Street Railway Journal for October, 1897 (from which the curve, Fig. 6, page 758, is also taken), as being extremely useful in this connection, showing, as they do, the different rates of acceleration and of braking power obtained in a variety of tests upon electric and steam railroads.

We may pass now from the subject of acceleration to that of economy in elevated railroad operation—from the question of increasing or retaining gross receipts to that of keeping down operating expenses. Here there is comparatively little data collected from the experience of one road which can be applied to the practice of another. The Manhattan or Brooklyn companies cannot obviously accept the operating cost per car mile of the Chicago electric lines as applicable in their case, as the conditions are so greatly different. It is possible, however, to deal with

the subject on somewhat broader lines in the following way:

The operating expenses of the Manhattan Elevated Railway Company for the year ending June 30, 1897, were 12.3 cents per mile, as shown in the accompanying table. Side by side with these figures we may place rough estimates of what these expenses would have been had the same service been performed with electricity. These estimates, of course, merely represent an individual judgment, and are by no means conclusive or worthy of careful study. They do, however, indicate the probable tendencies up or down of the different items, as brought about by a change of motive power and the relative proportions of items so changed in the total presentation.

Maintenance.—There should theoretically, and will probably be practically, some difference in the cost of maintenance of rails and ties between a multiple unit electric train system and a steam locomotion train system, owing to the better distribution of the weight and tractive effort over the trains and the absence of pounding by reciprocating parts. Nevertheless, the proportion of this variable factor to the total "way and structure" cost is so small (12 per cent only in 1897) that the difference may be neglected, as in the table.

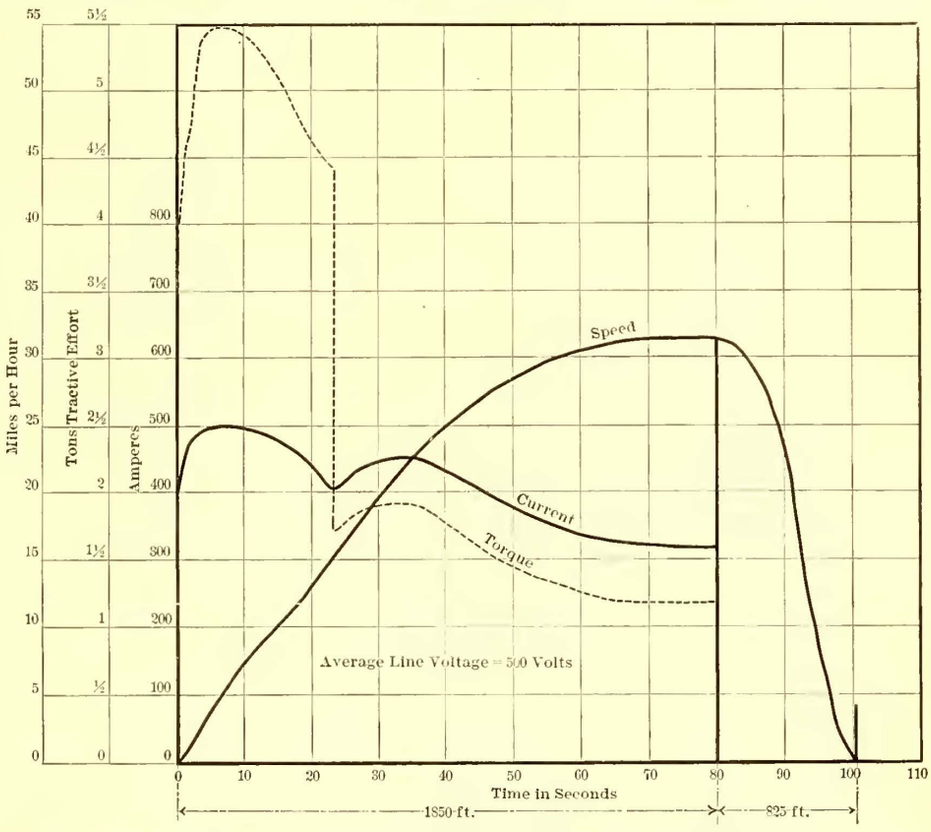


FIG. 8—CURVES SHOWING ACCELERATION AND CURRENT CONSUMPTION OF LAKE ST. (CHICAGO) 5 CAR, 90 TON TRAIN—2 150 H. P. MOTORS

Under the maintenance of equipment come repairs and renewals of passenger cars, shop machinery and tools, stationery and printing and other expenses, none of which should show a material variation with motive power; and repairs and renewals of locomotives, which amount to 0.5 cents per car mile, and replacing which the corresponding charge for the electric system is, of course, repairs and renewals of electric motors and car appliances. Street railway experience shows that this figure should not be greater than 0.5 cents per car mile, and the maintenance accounts would therefore be practically equal for the two motive powers.

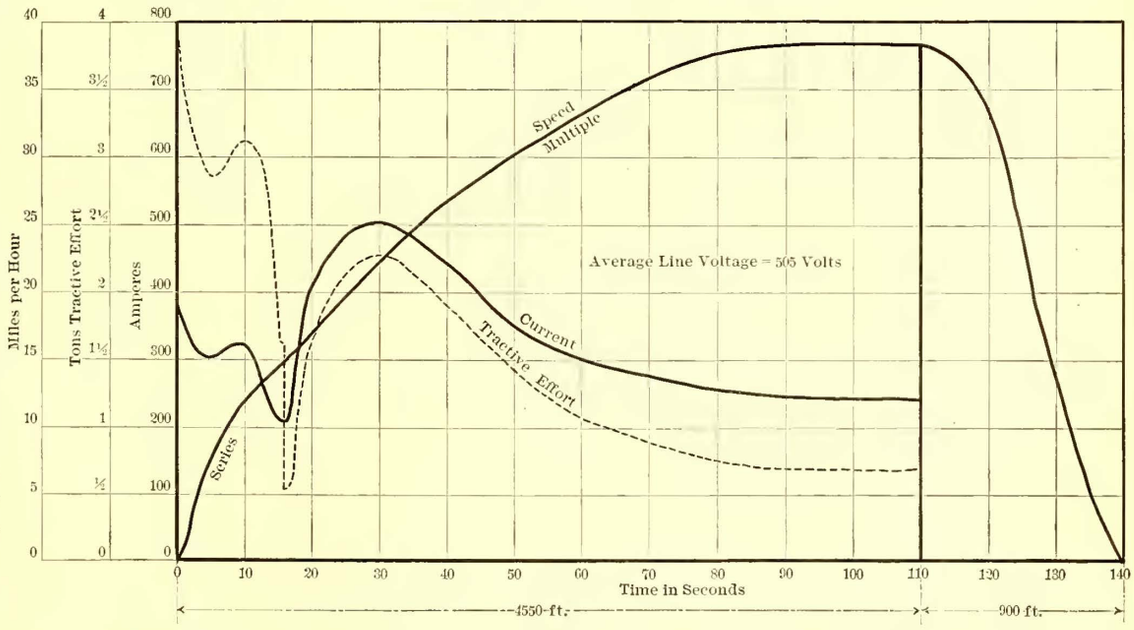


FIG. 9—CURVES SHOWING ACCELERATION AND CURRENT CONSUMPTION OF LAKE ST. (CHICAGO) 3 CAR, 58 TON TRAIN—2 150 H. P. MOTORS

General Expenses.—There should be no important difference in general expenses between the two motive powers.

Conducting Transportation.—It is, of course, in this division that the chief differences due to motive powers appear. Yet we may group together the items of superintendence, switchmen, flagmen and watchmen; train and station supplies and expenses, including telegraphic service; injuries and damages; and miscellaneous transportation expenses other than wages and cost of motive power; as being substantially the same irrespective of motive powers. These items are seen to amount in the aggregate to 2.7 cents per car mile.

		Per car mile.		
		Steam, 43,181,582 car miles.	Electric, 43,181,582 car miles.	Electric, 50,000,000 car miles.
Maintenance:	Total.	Cents.	Cents.	Cents.
Of way and structures exclusive of rails and ties....	$464,039	1.1	1.2	1.04
Of rails and ties.....	55,393	0.1		....

	Total.	Per car mile. Steam. 43,181,582 car miles. Cents.	Electric. 43,181,582 car miles. Cents.	Electric 50,000,000 car miles. Cents.
Maintenance:				
Of locomotives	237,872	0.5	0.5	0.47
Of passenger cars	287,432	0.7	0.7	0.57
Of miscellaneous	115,951	0.3	0.3	0.23
Total maintenance	$1,160,687	2.7	2.7	2.32
Conducting transportation:				
Engineers and firemen	853,904	2.0	1.3	1.12
Train service	936,536	2.2	2.2	1.87
Superintendence and other transportation wages	697,254	1.6	1.6	1.39
Fuel, water, oil, tallow, waste and other supplies for locomotives	844,184	2.0	1.2	1.25
Train and station supplies and expenses and telegraph service	232,077	0.5	0.5	0.46
Injuries and damages	42,702	0.1	0.1	0.08
Other transportation expenses	197,149	0.5	0.5	0.39
Total	$3,803,806	8.9	7.4	6.56
General expenses	337,859	0.8	0.8	0.67
Total operating expenses	$5,302,352	12.3	10.9	9.55

The cost to the Manhattan Company of engineers and flagmen amounted in 1897 to 2 cents per car mile, and of conductors and guards to 2.2 cents per car mile, a total for train wages of 4.2 cents per car mile. The wages per hour paid to the present train force of the Manhattan Company is as shown in the following table, and in comparison with this may be placed an estimate of the wages which would be paid an electric train force operating the same number of passenger cars:

	Steam train wages, per hour.	Electric train wages, per hour.
One engineer or motorman	38.8 cents	38.8 cents
One fireman	22.2 cents	
One conductor or chief gateman	23.0 cents	23.0 cents
Three gatemen	45.0 cents	45.0 cents
Total	$1.290	$1.068

In explanation of the above, it may be stated that while with the latest and most perfect electric controlling appliances the grade of intelligence required to run an electric train is not so high as that to run a steam locomotive train, so that a saving of at least 10 cents per car hour in wages ought to be easily possible without in the least causing anxiety as to danger to the public from "cheap help," it is nevertheless probable that it would be a wise policy on the company's part to keep their present engineers and to perhaps even pay them their present wages in order to secure the benefit of their familiarity with the road and their long experience upon it. It appears, therefore, that substantially the only saving here would be in the wages of the firemen. This amounts to 36.1 per cent of the total expenses for engineers and firemen, and is equal to a saving of 0.7 cent per car mile, as indicated in the table. This is, as are all the estimates in the table, based on the assumption of equal schedule speeds per hour. A different assumption will presently be made.

As a matter of interest in this connection it may be said that the transportation expenses of the South Side Elevated Railway in Chicago for July, August and September, 1897, when steam locomotives were employed, were 2.8 cents per car mile, while in the same months of 1898 they were 1.9 cents per car mile, a saving of nearly 0.9 cent, or 33 per cent.

The cost of fuel, water, oil, tallow, waste and other supplies for locomotives amounted to 2 cents per car mile for the steam system, including steam for heating the cars, but excluding lighting. Now the principal corresponding expense in electric service is the power station charge, and here Chicago experience will help us to form a judgment as to probabilities. During the past year the Lake Street trains have required from their power stations for motive power, heating and lighting the following:

December, 1897	2.98 kw. hours per car mile
January, 1898	2.84 kw. hours per car mile
February, 1898	2.98 kw. hours per car mile
March, 1898	2.82 kw. hours per car mile
April, 1898	2.69 kw. hours per car mile
May, 1898	2.33 kw. hours per car mile
June, 1898	2.15 kw. hours per car mile
July, 1898	2.15 kw. hours per car mile
August, 1898	2.18 kw. hours per car mile
October, 1898	2.19 kw. hours per car mile

The average consumption throughout the ten months was approximately 2.53 kw. hours per car mile. The Metropolitan power consumption compares very closely with these figures. In round numbers it may be said that 3 kw. hours per car mile will be required for driving, heating and lighting elevated cars of the Manhattan pattern the year round, with the greater grades of the New York road.

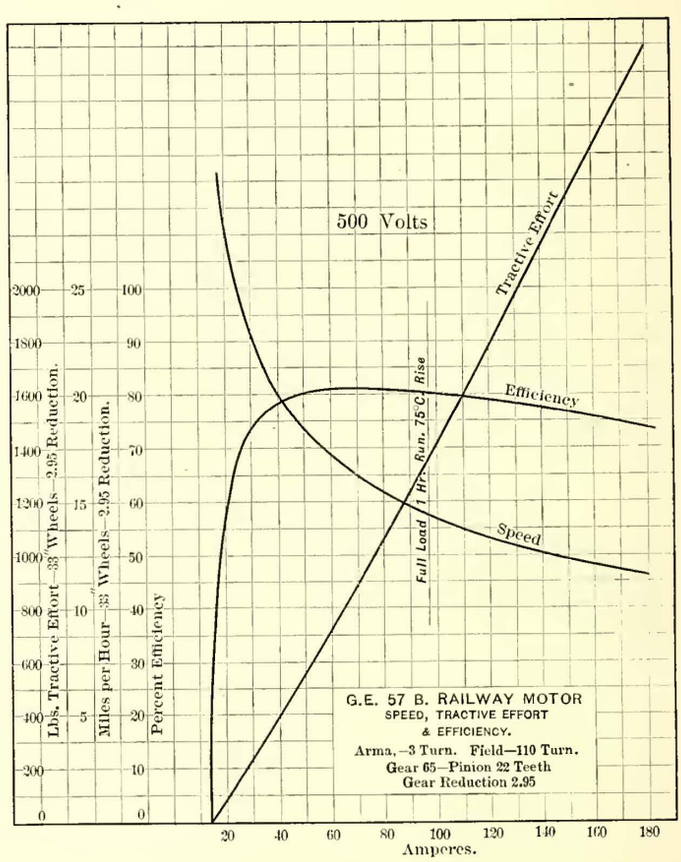


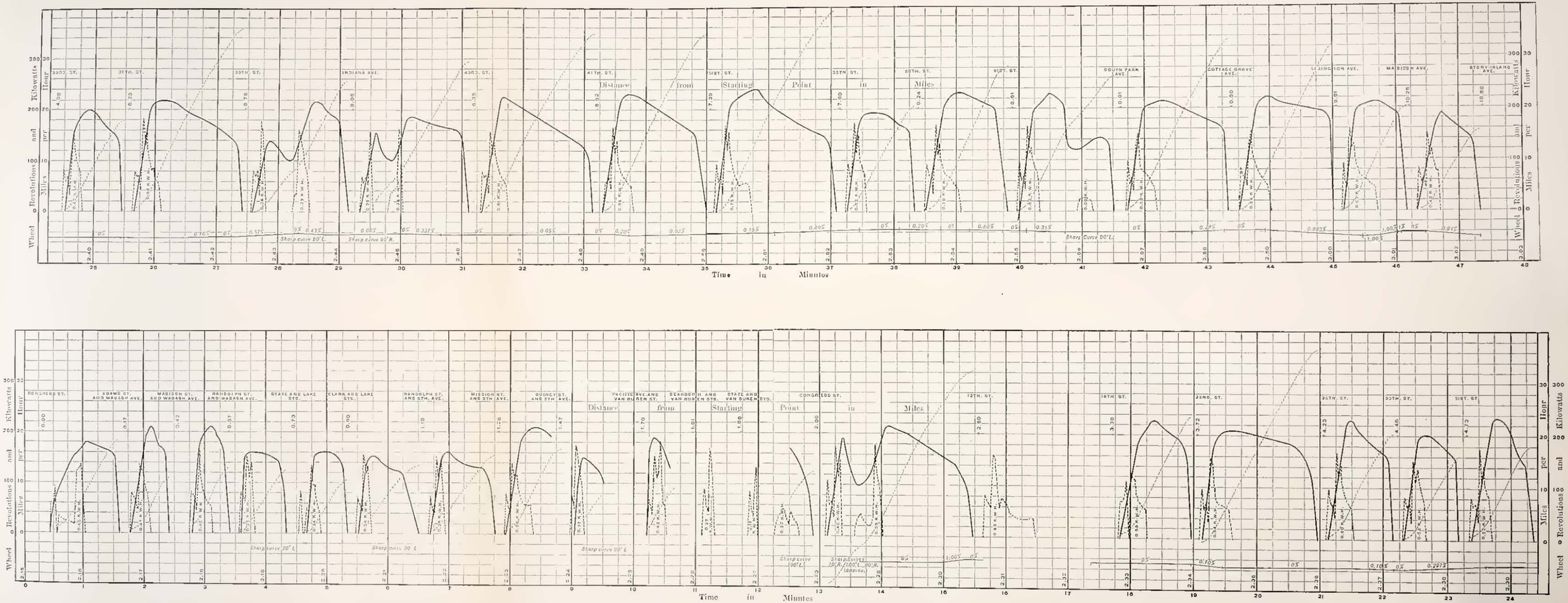
FIG. 10

Now the Manhattan Company can undoubtedly manufacture and deliver electric current in large quantity in New York City for 0.4 cent per kw. hour at least, and probably for less. This would point to a cost per car mile for power of 1.2 cents, which would be a saving over the equivalent cost for locomotive power of .08 cent.

Summing up the above, it would seem that had the Manhattan Company operated the same car mileage at the same schedule speed in 1897-98 by electricity instead of by steam, it would have saved about 1.4 cents only per car mile in operating expenses. Suppose, however, that the same number of trains had been run at an increased speed such that they would have made a total car mileage of 50,000,000 instead of 43,200,000 in the same number of hours. The total operating expenses would have been very little changed from the above electric estimates and the

SOUTH SIDE ELEVATED RAILWAY, CHICAGO

CURVES OF ACCELERATION, SPEED, DISTANCE AND POWER CONSUMPTION



SPRAGUE MULTIPLE UNIT SYSTEM

TESTS MADE SEPT. 3, 1898, ON CAR No. 166—COMPLETE SINGLE (OUT BOUND) TRIP

CAR EQUIPPED WITH 2 G. E. 57 MOTORS

operating expenses would have been brought down quite closely to 9.55 cents per car mile, as per accompanying table. On the other hand, the receipts per car mile would probably have kept well up owing to the greater popularity of the improved service.

Now suppose that the electrical equipment of its lines would have cost the Manhattan Company $10,000,000 (a very large estimate) and that this sum would have been raised by an issue of five per cent bonds, the stock remaining the same. The old and new statements of the Manhattan Company would, therefore, stand about as follows:

	Steam, Actual, 1897-98.		Electric, Estimated.	
Car mileage	43,181,582		50,000,000	
	Total.	Per car mile, cents.	Total.	Per car mile, cents.
Gross receipts (operation)	$9,163,743	21.2	$10,600,000	21.2
Operating expenses	5,302,352	12.3	4,800,000	9.5
Net earnings	$3,861,391	8.9	$5,800,000	11.6
Other income	180,277	.4	180,000	.4
Gross income	$4,041,668	9.3	$5,980,000	12.0
Deductions				
Taxes	820,171	1.9	950,000	1.9
Interest	1,886,846	4.4	2,387,000	4.8
Net income all sources	$1,334,651	3.1	$2,643,000	5.3
Per cent on $30,000,000 stock		4.45		8.81

In other words, the earning power of the Manhattan stock in 1897-8 would have apparently been almost twice as great had 50,000,000 car miles been run by electricity at a schedule speed of 15 miles per hour, as was the actual earning power of 43,181,582 car miles operated by steam. It does not follow, however, that such an improved gross and net earning power could have been kept up in the following year when the surface lines in competition with the elevated went into operation by electricity and gave to the public so perfect a service as to make unexampled inroads upon the Manhattan Company's business. To-day, the latter appears, by its last quarterly statement, to be actually unable to earn the quarter's fixed charges.

There is another difficulty which confronts the Manhattan Elevated Railway, which is that with the magnificent underground conduit electric system of the surface lines in competition and the popularity of the surface cars for short distance riding, the Manhattan Company must be in the future content with a constantly increasing proportion of long distance riding for its cars, and this will greatly disturb the equilibrium by an increase in operating expenses per passenger. The Manhattan Company, will never, however, be driven out of the transportation field in New York City, but on the contrary, however greatly its earnings may fluctuate from year to year, it will eventually regain, not perhaps its *proportion* of the total transportation business of the city, but certainly more *in toto* that it has ever yet enjoyed, the reason being that it is a matter of but a few years only when every transportation agency on Manhattan Island will be crowded to its utmost, with increase in population, and all will enjoy profits. The transportation problem in New York is, and always will be, one of the most serious that confronts the city's development.

As a last word upon the general financial and economical questions connected with this elevated railway equipment, it may be said that the adoption of electricity by the Chicago companies and the building of the Union Loop have unquestionably improved the gross and net earnings of these properties, and with the development of that great city it is by no means unreasonable to hope that they will eventually yield substantial dividends.

The Multiple Unit System on the South Side Elevated Railway of Chicago

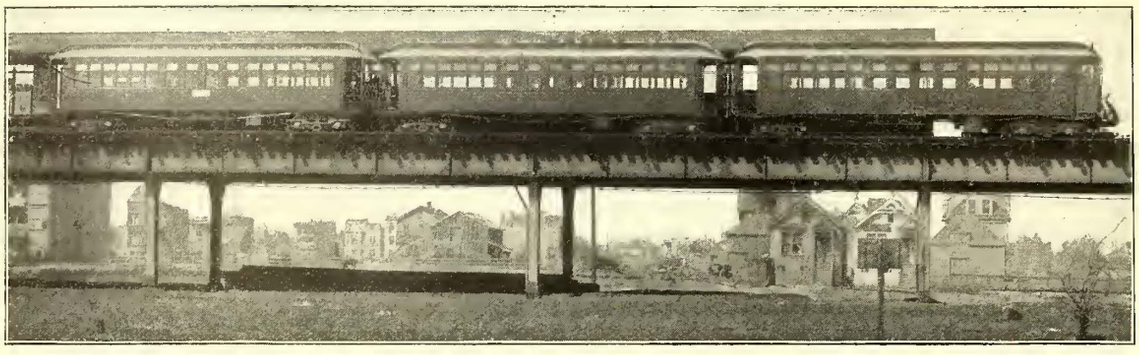
The Sprague multiple unit system in use on the South Side Elevated Railway in Chicago is worthy of special discussion as being the latest and most interesting development of electric traction on a moderately large scale. The essential principle of the system is the equipment of two or more cars of a train with motive power. This at first sight appears a simple proposition, but when the necessity for synchronous control of all the motors of a train is realized, it becomes more complicated. The motors of one car must not be allowed to take more current and thereby do more work than those of another, or frequent burnouts might easily be a consequence. Mr. Sprague's inventions therefore are designed primarily to accomplish this synchronous control of a train, and the methods adopted are certainly ingenious and highly interesting.

The South Side equipment consists of 180 cars, of which 150 are motor cars and 30 are trailers. The motor cars have been remodeled from the old passenger coaches formerly used with steam locomotives. Under one end of these cars is retained the old truck which came originally with the car, and on the other end is placed a motor truck, on which are mounted two G. E. 57 motors, having a normal rated capacity of about 50 h.p., but capable of exerting over 100 h.p. These motors are of the ironclad four-pole type with single reduction gearing and their curves of speed, torque and efficiency are shown in Fig. 11. The gearing is such as to safely allow the motors to work up to the skidding point of the wheels with 60 per cent of the weight of the car and equipment upon them. They were built by the General Electric Company, and the McGuire Company furnished the first 120 trucks, while an order for the last thirty has just been placed with the Peckham Company. Both trucks are described in detail elsewhere in this issue.

A single series multiple controller of the usual General Electric type is placed in the hood over one platform of each car, and is connected in the usual way to the motors. Attached to the spindle of each controller is a small electric "pilot motor," so-called, which operates it, and which is in turn connected to two small "master controllers," one in each cab of the car. Under the seat on one side of the car is located the reverser and the synchronizing system, the latter consisting of five relays, or plungers operated by solenoids, which are in electrical connection with the master controller and through which the current passes to the pilot motor. These synchronizers are arranged to operate by successive stages, and the circuits and connections are so arranged that the pilot motors on all cars of a train throw their controllers simultaneously into the series and multiple positions. This movement is performed gradually and in a certain sense automatically, it being beyond the power of the motorman to throw the current on violently, as the synchronizing devices prevent the flow of more than a determined amount of current to each motor. The motorman must always retain his hold upon the handle, as, when released, it will return automatically to the "off" position and current will be cut off from the motors. Should connection with the trolley wire be broken or the current supply cease, the controller must be returned to the off position and restarted before current can be sent to the motors. It is needless to say, of course, that the entire controller system is electric in character, the connection between controllers, synchronizing devices and motors being by wires. The arrangement of circuits is such that by the use of relay and throttle plungers and the proper inter-

connection betwen the controller circuits, the operator is at liberty to handle the master controller at pleasure and can rely upon the main controller operating satisfactorily. The throttling plunger is set just short of the skidding point of the wheels on a normal track, allowing 15 per cent adhesion and absolutely limits the current input to that which is required by the predetermined rate of acceleration. Any rate less than this can also be obtained by proper handling of the master controller so that any movements, no matter how refined, are perfectly possible.

The train line, by means of which the synchronizing systems of the different cars of a train are connected together,



SOUTH SIDE ELEVATED TRAIN AT STATION

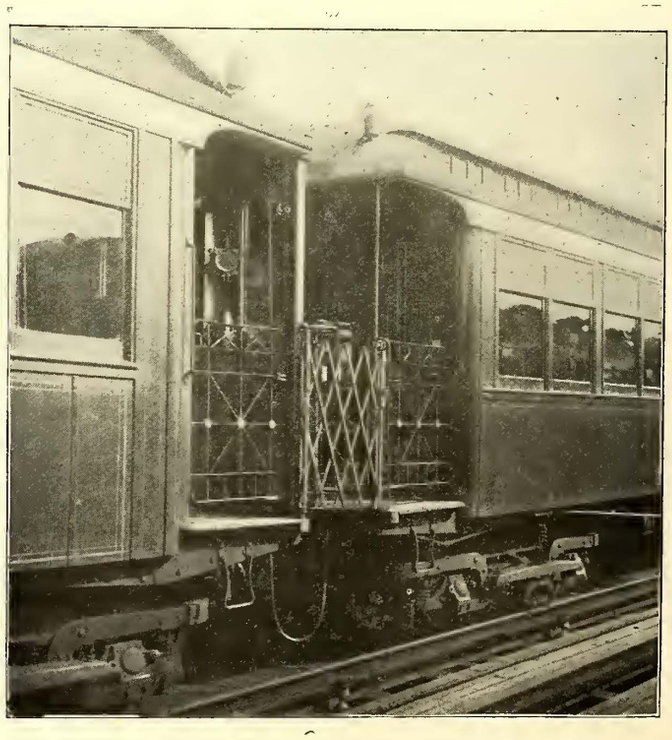
consists of a number of insulated wires formed into a cable and terminating in couplers at each end of the car. When trains are made up, the train lines are connected by a reversible jumper with corresponding wires, and the system is so composed and connected that no matter how the cars are reversed or altered in sequence, the circuits are automatically established so that like train movement is always assured with like hand movement of the master controller. The section of train line in each car is not a part of the normal controlling circuit individual to the control equipment, but is connected with it by switches which enable the local car circuit to be cut off the main train line.

The practical result of the system of train control is such that the characteristics of the entire train in the matter of load capacity, rate of acceleration, etc., are exactly the same as of a single car and each combination is made automatically. If a train should part, three systems of automatics come into play; the reversers go to open circuit, the controllers to the off position and the air brakes are instantly applied. If the main circuit fails, all the reversers open and the controllers must come to the off position, which they will do automatically as soon as current is restored and before current can again be put into the main motors. If the master controller should be instantly reversed by accident or design, the reversers first open circuit, the controllers return to the off position and then start and are instantly arrested on the first contact. Provision is made so that it is impossible to run backward at more than half speed from any platform when operating from that platform.

The series multiple controller, with its pilot motor, the automatic circuit breaker and the car fuse box for lighting and heating circuits, are all boxed in above the platform in the hood of the car and with asbestos linings, a trap door, opening downward, giving access to the mechanism.

The controlling appliances in the cab are extremely simple, and take but little room. They consist of the master controller, which is about 12 ins. x 8 ins. x 5 ins., and is mounted on an iron pipe through which the wires pass to the under side of the flooring; and with the engineer's valve, gage and pipes for the Christensen air brake equipment, which is used on this road. By an ingenious arrangement of doors and gates, the cab itself can be practically folded up, gotten rid of and the gate thrown into the usual position, so that the passengers can pass freely from the station platforms to the cars. By this means there need be but one cab in the train at any time, and that on the forward end, and the particular master controller in that cab will operate all the train motors.

To carry out the essential features of the multiple unit system of control, it is necessary to have on each car a complete and independent air brake equipment, including electric motor compressor, main reservoir and automatic governor. As before stated, the Christensen air brake system has been adopted on the South Side road with the General Electric automatic regulator, and both are working entirely to the company's satisfaction. The automatic regulator is actuated by pressure from the main reservoir. It is necessary first that all the compressors of the train should be stopped and started at the same time. This is accomplished by a balancing wire running from car to car and connected to the wire joining the compressor and governor on each car. With all the canopy switches closed and all the governors in operation, the compressors will continue to operate until the last governor "cuts out." In practice they are all started and stopped by the weakest governor of the chain, the remaining governors usually



PLATFORM AND SHOE

performing no work until they in turn become the weakest governor in some other train. The compressor on any car may, however, be cut out of circuit, in which case the reservoirs of that car are filled by the compressors on the other cars through a balancing pipe line connected with

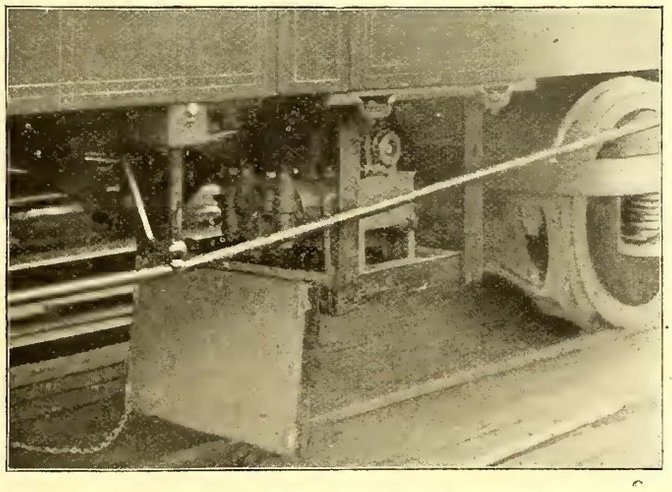
them all. The entire braking mechanism of a car, however, can also be cut out of circuit and the braking performed by the other cars, suitable automatic check valves being arranged to prevent wastage of air from other reservoirs.

The air compressor on the South Side cars is located beneath the car body in an enclosed box, so arranged that access is readily had to the brushes as well as to the suction and discharge valves. The Christensen compressor, engineers' valve and other details have already been described at length in the STREET RAILWAY JOURNAL in various issues. The size used for the South Side cars is the 2 h.p., the smallest of the four sizes built by the Christensen Company. It has a capacity of 10.5 cu. ft. per minute, and takes 3.5 amps. at 90 lbs. pressure. The storage capacity of an entire four-car train is about 38,000 cu. ins. The storage is made at about 75 lbs. pressure and the governors are set to operate within a range of 8 lbs. below this figure.

All the electrical connections betwen the cars are made by flexible cable and universal couplers, so that either end of any car can be electrically coupled to either end of any other. The coupling wires connect with the pilot coupler and operate the mechanism only.

The system of current distribution and supply on the South Side line has some novel and interesting features. An ordinary 40-lb. T rail, rolled in 60-ft. lengths, is carried a few inches away from the ordinary rails and about 4 ins. above their surface. This is known as the "power" rail, and a flexibly mounted shoe carried on the car trucks slides upon this rail and conveys current to the cars. The power rail is divided into sections of variable length, and these sections are joined together by switches or fuse blocks, so as to make the rail electrically continuous under normal conditions. In case of short circuits, however, the section affected is automatically isolated from the rest.

Four feeders connect the power house with this power rail through automatic circuit breakers, and a fifth feeder connects the South Side power station with the Union Ele-

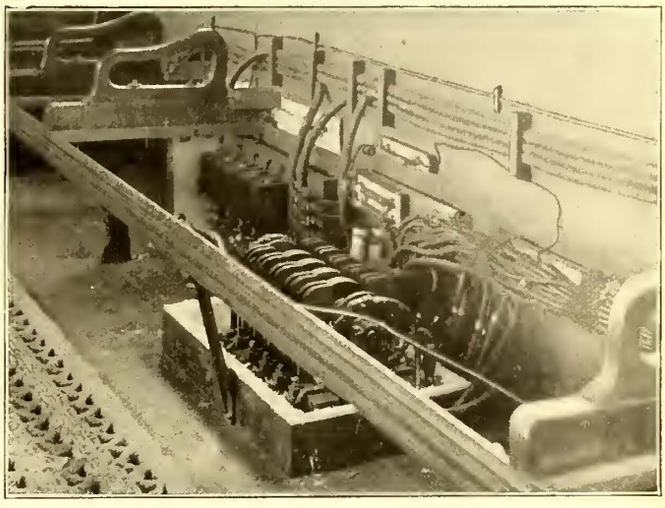


ELECTRIC MOTOR AIR COMPRESSOR

vated Loop power rail, so that in case of emergency the loop may be run from the South Side station. Return circuit is made through the tracks, which weigh 90 lbs. to the yard. There is also a permanent connection between the power rail of the South Side system and the Loop, through a fixed resistance, and cars and trains passing from one system to the other receive current from both stations and are directly connected together at the time of transit through the shoes on cars passing over the gap.

The South Side power station has been already described in the STREET RAILWAY JOURNAL of June, 1898, page 331.

The fluctuations of current on the Sprague system are undoubtedly larger, particularly for a comparatively small number of cars, than is the case with the locomotive train system, inasmuch as eight motors in a four-car train start into operation and pass from series to multiple control at the same moment. It is necessary and highly economical, therefore, to use storage batteries to level off the peaks in the Loop, and in the South Side system are installed two



REVERSER AND RELAYS—MULTIPLE UNIT SYSTEM

535 kw. batteries, one at Twelfth Street and the other at Sixty-first Street.

Each battery consists of 248 "chloride" cells, made by the Electric Storage Battery Company, of Philadelphia. Each cell has 26 pairs of plates, and they are carried in lead lined tanks built for twice the number of plates, to provide for doubling the battery capacity. This addition is now being made. The batteries are placed in multiple with the line without any booster, and their operation is entirely automatic, each one acting both as a reservoir and as a source of supply. The practical effect is, of course, to increase the total capacity of the supply system, and, as a matter of fact, the present battery takes the place of an additional station unit, which would otherwise have to be installed.

The advantages claimed for the multiple unit system of train control may be summarized as follows:

1. Absolute flexibility of operation.
2. Like characteristics for trains, whatever the combination.
3. Practical fixity of relation between the weight on the drivers and the total load with varying length of train.
4. Motive equipment in operation proportioned to the car mileage.
5. Similarity of unit equipment.
6. Any required rates of acceleration or schedule speeds up to the maximum.
7. Highest schedule speed with any given maximum.
8. Reduction of transportation wages per car mile because of increased schedule.
9. Lowest maximum speed with any given schedule.
10. Entire abolition of head and tail switching.
11. Short train intervals when desired.
12. Freedom of turning trains at any cross-over.
13. Lighter cars and trucks.
14. Reduced strains on structure.
15. Less average total weight moved per day.
16. Less average kilo-watt hours per car mile for the same schedule with like conditions of traffic than with slower acceleration.
17. Automatic limitation of current input.

18. Automatic opening of circuit in case of accident to operator.

19. Ability to begin with one schedule and increase to another without changing character of equipment.

20. Ability on crowded tracks of aggregating train units on different lines, and then splitting at junction, thus preserving time intervals on branches but doubling distance intervals on crowded return.

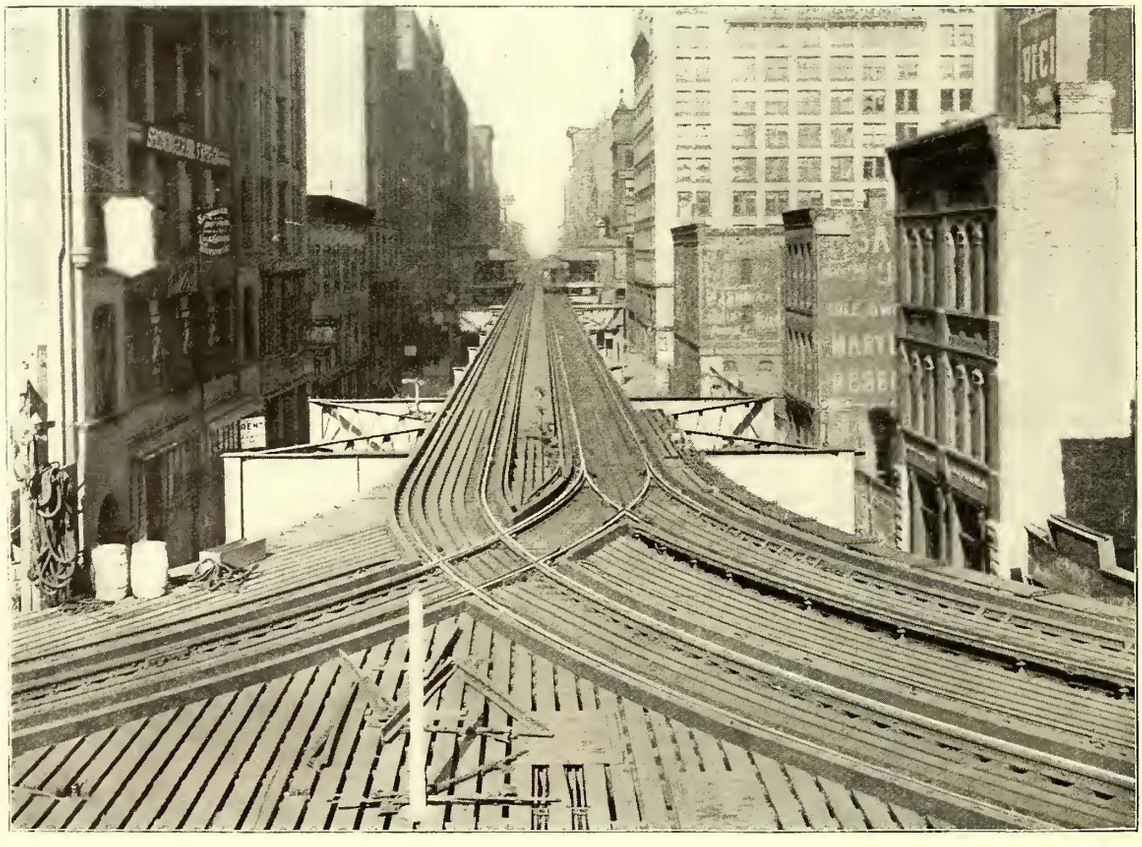
21. Ability to make up time.

It is a remarkable fact that the multiple unit system in Chicago, the detailed development of which was carried out under the great pressure of a large first contract and a short time delivery of apparatus should have proven in its first trial of a six-car train so successful as to justify the directors of the South Side Company in contracting for 120 car equipments and staking the entire success of their reorganized road upon Mr. Sprague's success or failure. It is even more remarkable that the 120 cars have been placed in operation on the road and that, after the first thirty days and during the last three months, not a single complete train interval has been lost, in spite of the fact that the entire 120 equipments are in service each day without any provision for spare. Such a result, it is safe to say, has never before been accomplished in railroading of any kind.

The officers of the South Side Elevated Railroad Company are Leslie Carter, president; Wm. Fleming, vice-president; Marcellus Hopkins, general manager, and J. F. Morrison, superintendent. The balance sheet of Dec. 31, 1897, shows that the property cost its present owners $10,616,783, against which have been issued $10,323,800 in capital stock and $750,000 of 4½ per cent bonds. This is the result of a reorganization. The gross receipts for 11 months ending Dec. 31, 1897, were $637,346 and the net was $149,601. It is locally believed that the company is now earning nearly 4 per cent upon its capital stock.

The Union Elevated Railway of Chicago

One of the most remarkable pieces of railway property in the world is the little two-mile "Loop" in the heart of the city of Chicago, around which all the trains of the three elevated railway systems of the city pass in each trip, and which may eventually be the medium for a closer union between these three systems than at present exists. The Loop property consists of a franchise, a power station, a double-track elevated structure 11,150 ft. long, eleven groups of passenger stations and an interlocking switch and signal system. It owns no rolling stock. On an average day more than one thousand trains and more than three thousand cars pass over its line, and on the heaviest hours of such a day, from 7:30 to 8:30 A. M. and from 5:15 to 6:15 P. M., thirty four-car trains are handled every fourteen minutes, the time taken for a round trip. Its "red letter" record in train handling was made on Chicago Jubilee Day, Oct. 19, 1898, when in twenty-four hours 1366 trains and 4842 cars passed over the structure, and in one hour, between 1 and 2 P. M., after the parade, 28 cars were on the outer loop track and 168 cars on the inner loop, 67 per cent of the inner loop track being at that time covered by trains, which means, of course, that the trains were not a train length apart. In spite of this enormous train movement, no passenger nor employee has been killed during the fourteen months of Loop service, in which 80,000,000 passengers have been carried.



VIEW IN VAN BUREN STREET SIDE OF THE LOOP, CHICAGO

It may easily be seen that only by the creation of a most perfect "machine" can such a wonderful result as this be accomplished. S. S. Neff, the company's superintendent. has, as agent of its board of managers, created such a "machine" and the rules by which it is governed. It is worthy of high admiration as an example of what can be accomplished in the solution of difficult transportation problems, and yet, in spite of all that has been done, the margin for

expansion of business and improvements in speed is still considerable, and congestion of elevated traffic in the heart of Chicago is not yet one of the things to be feared for the immediate future.

The Loop is a rectangle bounded by Fifth Avenue, Lake Street, Wabash Avenue and Van Buren Street. Looking upon a plan of the structure (Fig. 1), the South Side and Metropolitan elevated trains use the inner loop and pass around in a direction opposite the hands of a watch, while the Lake Street and Northwestern (when completed) lines use the outer loop and pass around in the opposite direction. Trains therefore pass each other on the left hand track of the Loop, while outside the Loop they work right-handed as usual. The Metropolitan and South Side trains have to cross over from the outer to the inner track on entering the Loop. Cross-overs are placed at carefully determined points around the Loop, to the end of accomplishing practically any train maneuver in emergency cases, and every effort is made at all times to clear the Loop from all obstructing influences such as broken-down trains, which are, for example, pushed off the Loop by the following train, and the responsibility placed upon the owners to get them permanently out of the way.

In times of emergency, when the clocklike regularity of train movement is for any cause disturbed, a system of telegraphic train orders is instantly put into effect and trains are allowed to proceed around the Loop only in accordance with these orders, making such cross-overs as may be required and otherwise following the instructions

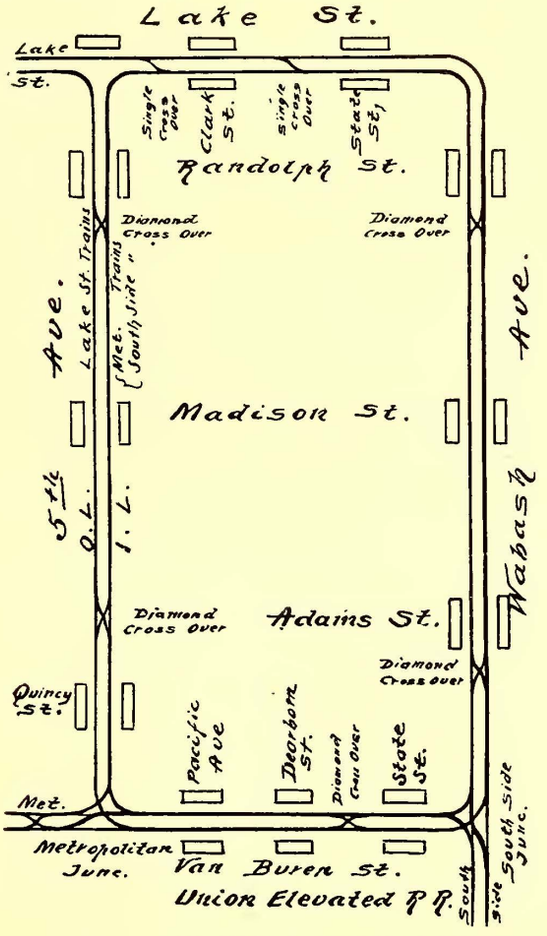


FIG. 1—TRACK PLAN OF THE LOOP

of the train dispatcher. During a fog, fogmen are quickly put in position from 200 to 300 ft. apart on the structure, caution signals are displayed and trains are passed along the line from man to man, about one minute apart.

As a result of this system of operation, there were, during the month of October, but 44 delays out of 34,272 trains handled. The greatest delay was but five minutes and the average delay but 2.63 minutes. None of the delays were caused by the interlocking switch system, but were due to general troubles, such as open drawbridges outside the Loop, which is always one of the serious obstructions to Chicago travel across the Chicago River.

The interlocking switch and signal system is of the National pattern and is equipped with torpedo machines, sand tracks (devised by Superintendent Neff for breaking the

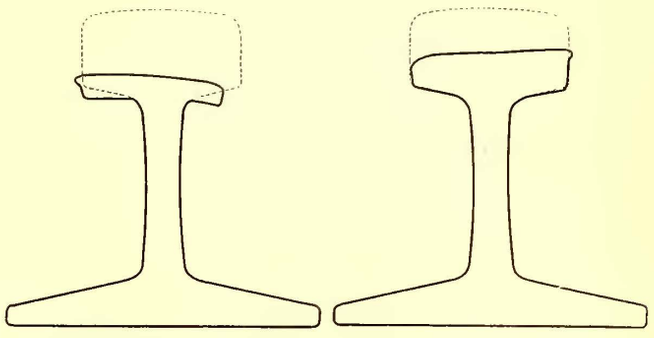


FIG. 2.—RAILS ON CURVE AFTER ONE YEAR'S SERVICE

electric circuit) and Rowell-Potter automatic stops and electric locking, the purpose of the last device being to make certain that if the route is once set up by the towerman it cannot be changed until the train has passed over and released the locking device at the outside limits of the interlocking. The speed through the interlocking 90-ft. radius curves is 8 to 10 miles per hour and on the lighter curves is 15 miles per hour. The speed on straight track, main line, is 18 miles per hour. When the Loop first went into operation the schedule time for making the round trip of 2 miles was placed at twenty minutes in order to absolutely insure safety until more experience should be gained in handling trains. This was successively cut down, however, to eighteen minutes, sixteen minutes, and, as at present, to fourteen minutes, while a still further reduction to twelve minutes will soon be put into effect. The maximum number of trains handled through the interlocking in fourteen minutes is thirty-four, to accomplish which 200 levers have to be thrown in this time. The maximum number of levers thrown during one rush hour is 800.

There are three eight-hour tricks in the towers with two men on each trick, except between 11 P. M. and 7 A. M., when one man only is necessary. During the day the towermen record on their train sheet the number of the motor car, the total number of cars in each train and the time of arrival and departure. Towers are connected by telegraph and telephone with the superintendent's office, which is also connected by telephone with all stations on the Loop. There are eleven groups of stations and four stations, two on each side of the track, in each group. The two inside stations of each group represent the Metropolitan and the South Side lines and the two outside stations represent the Lake Street and the Northwestern (not yet in operation). The stations are of the latest, improved type, are lighted by electricity and are heated by natural gas supplied by the People's Gas Light & Coke Company. Station men are responsible for the amount of gas consumed per month, an allowance to each station based on experience being made.

The great advantage to the public offered by the stations, apart from the legitimate transportation purpose, is as a relief valve to the street crossings. This is accomplished by subways suspended over the street under the structure. Passengers may go from one elevated line to

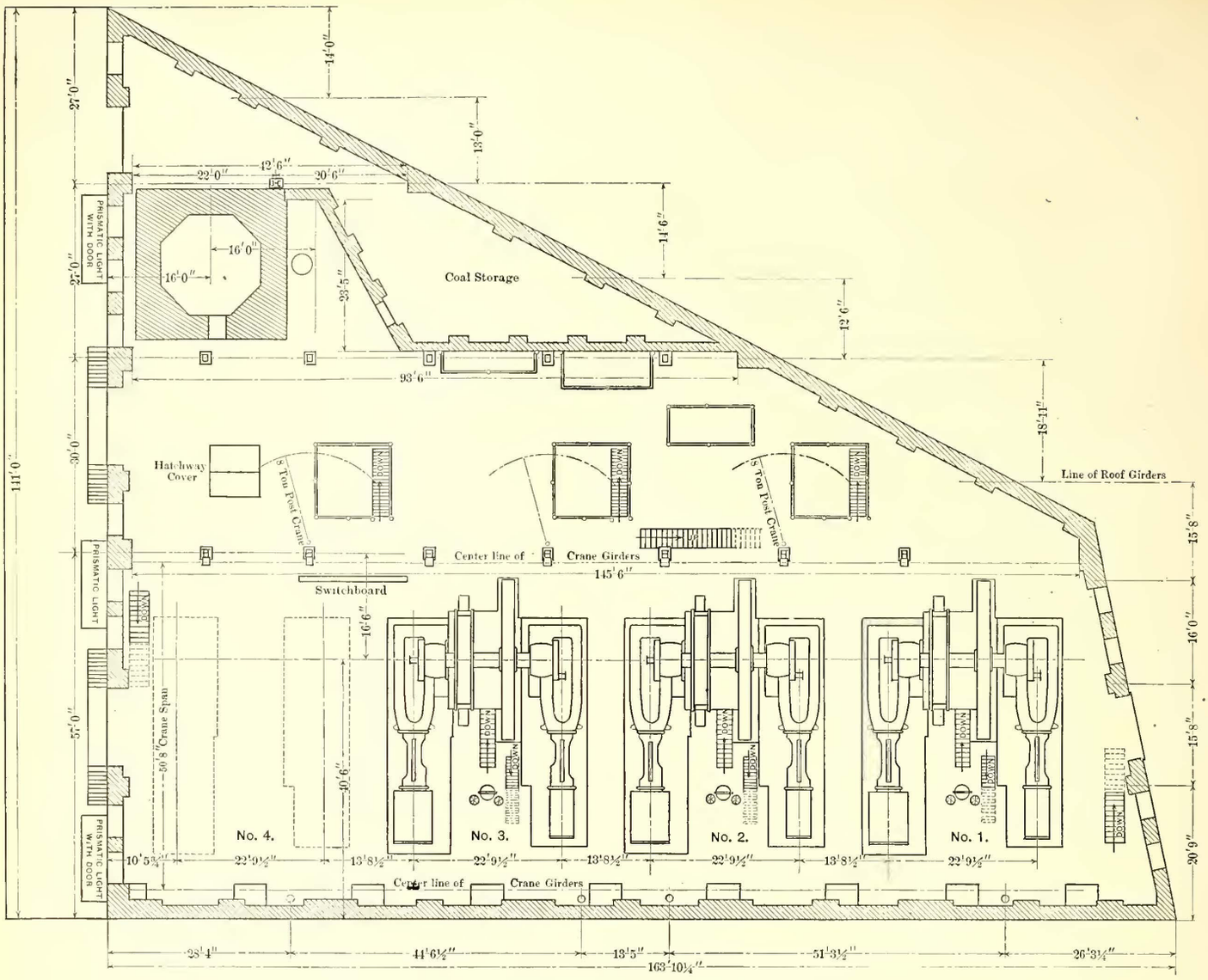


FIG. 3—PLAN OF ENGINE ROOM—LOOP POWER STATION

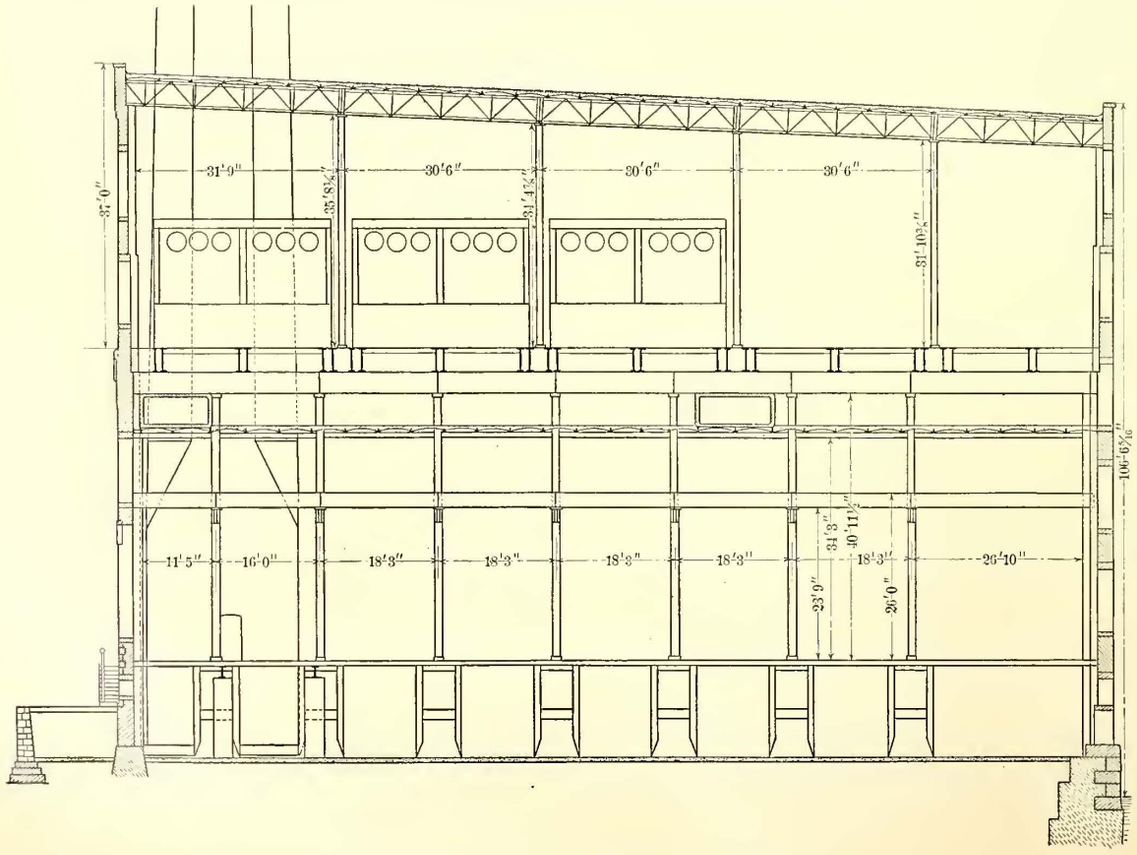


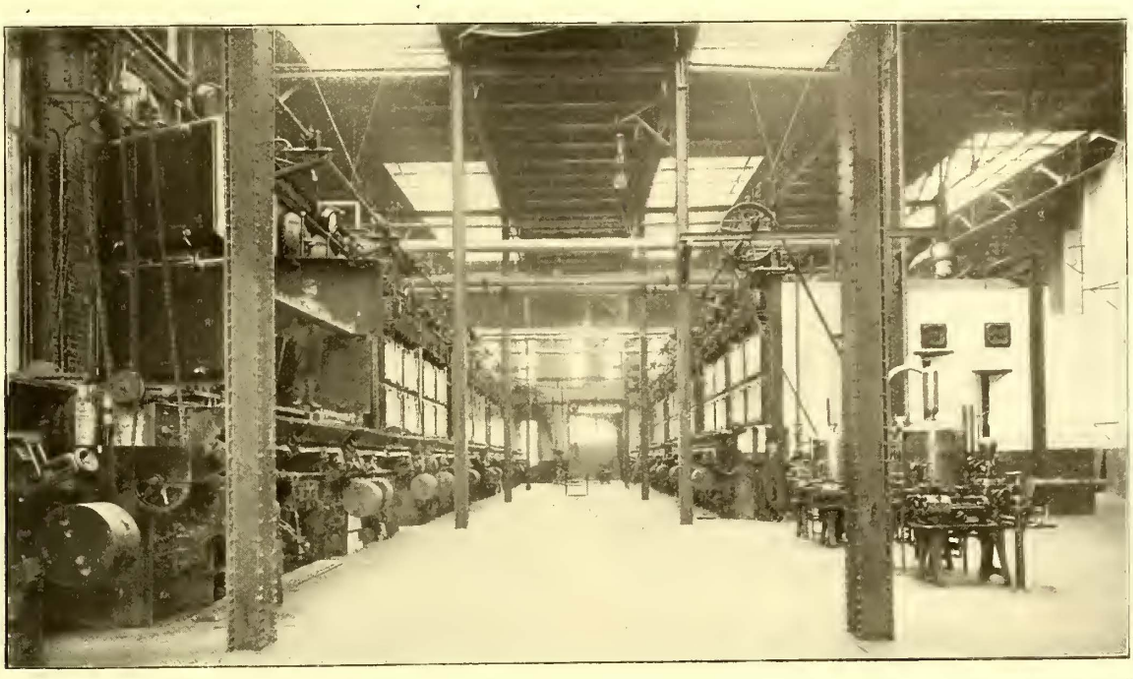
FIG. 4—ELEVATION OF LOOP POWER STATION

any one of the other three without going to the street. Moreover, in times of street congestion, and particularly in case of processions, the subways may be used by non-passengers for crossing the streets, and this use is permitted by the Loop managers, although it is carefully watched and stopped if there is any danger of subway congestion.

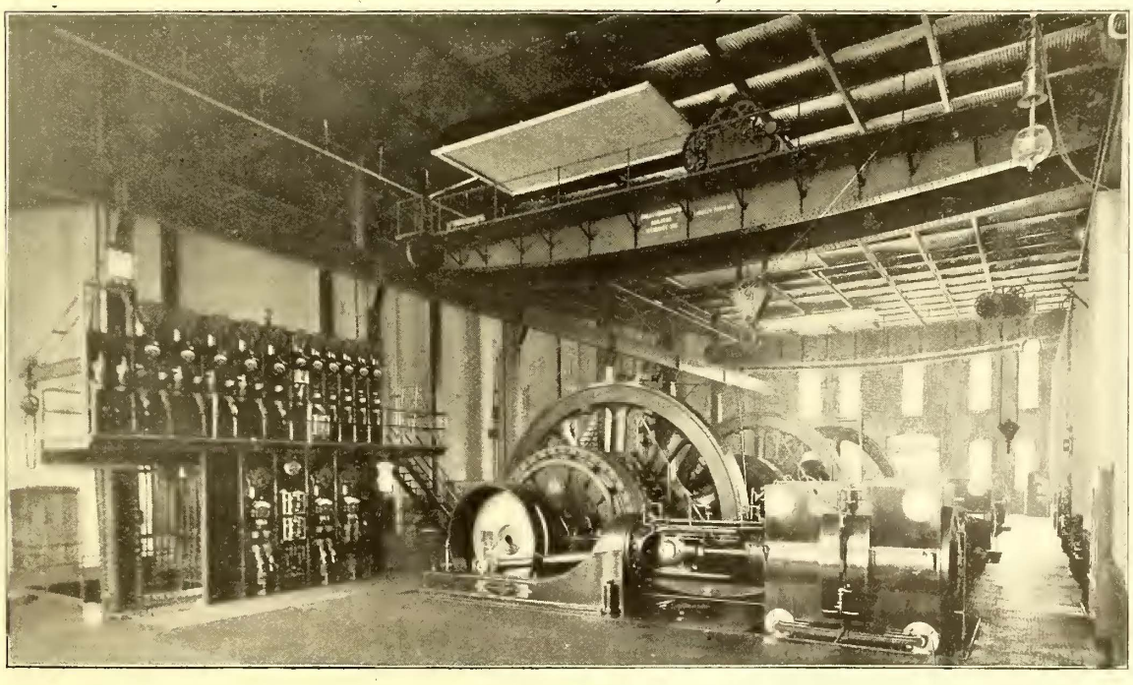
The outside labor force of the Loop, exclusive of power station, consists of seventy regular agents, eleven porters, twenty platform men, two ticket choppers, a foreman of light and heat and helper, a foreman of interlocking and helper, a foreman of track and three men, ten towermen, two dispatchers, one station inspector and one chief clerk.

On Jubilee Day, Oct. 19, 1898, 70,000 people were loaded at the Loop stations in three hours. The unloading record could not, of course, be arrived at. Out of the 70,000 people 30,000 were loaded at three stations, and the total number of people loaded during the day was 140,000, while the total number loaded and unloaded during the day was approximately 375,000. No one was hurt, and there were very slight delays to traffic, in spite of the fact that the South Side line threw a largely increased number of trains upon the Loop by the process of short trips and switchbacks.

All renewals of rails, curves, frogs, switches, etc., are made, of course, during the night hours. Even at such times the longest interval between trains on the inner Loop track is 7.5 minutes. In order to accomplish these renewals emergency movements are arranged for and the



BOILER ROOM—LOOP POWER STATION



ENGINE ROOM—LOOP POWER STATION

trains are handled by telegraph and by written train orders, of which one, for example, reads as follows:

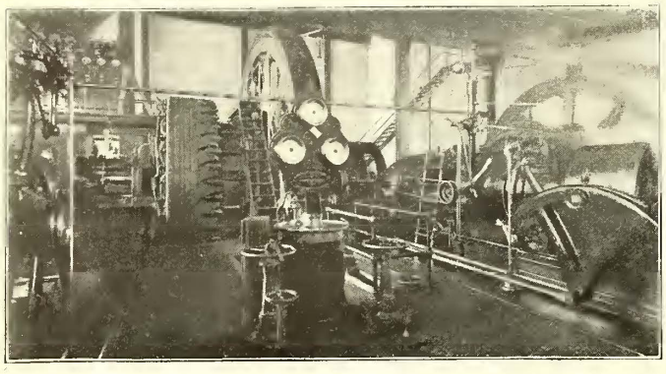
Union Elevated Railroad.
Superintendent's Office, Nov. —, '98.
Train Order No. —.

Until further orders, cross over at State and Lake Street to Outer Loop track and proceed *EAST on Outer Loop track* to Franklin Street station without stopping at Outer Loop stations.

S. S. Neff, Superintendent.

Opr's. Sig———————
Complete ———————

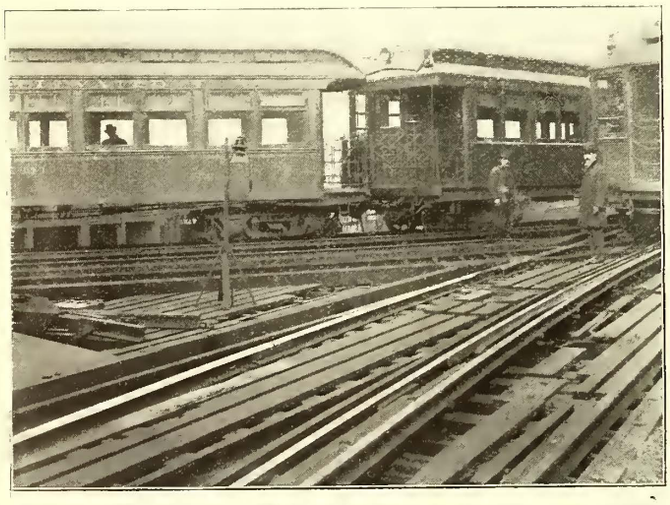
The amount of wear on the curves and switches is terrific, although the straight track does not seem to show



ENGINE GENERATOR UNIT—LOOP POWER STATION

any appreciable wear. In Figs. 2 and 3 are given sections of the outer and inner rails of a curve which have had but about one year's wear. It is estimated that 4,000,000 car wheels have passed over this curve.

The Loop power station occupies a brick building 176 ft. x 141 ft., and is three stories high, the engine room being on the first floor, the boiler room above, while between them is a hanging or intermediate floor. In the basement are the steam accessories, piping, etc. This general arrangement is, of course, designed for the purpose of economizing highly expensive land in the heart of the city. The building itself is an iron, frame structure, constructed, of course,



TRAINS PASSING ON LOOP

stairways and column bases and laid on 10 ins. and 12 ins. most substantially in order to permit of the heavy weights on the upper floors. The floors are 7-16 in. checkered rolled steel plates, fitted around all pilasters, hatchways, I-section floor beams.

In the engine room are three 1500 kw. engine generators with space for a fourth reserved. The engines are built by the George H. Corliss Company of Providence, and are 30 x 60 x 60, cross compound condensing, of 1800 h.p capacity each (they were fully described in the Street Railway Journal of October, 1897, page 628). One of their interesting features is an eighty-ton fly wheel, of which fifty tons are in the rim. The generators were made by the Siemens & Halske Company, and are of 1500 kw., as before stated. The engine generator shaft was made by the Bethlehem Iron Company, of fluid compressed open hearth steel, and was hydraulic forged hollow on a mandrel. These shafts are 28 ins. in diameter at the center.

The switchboard and controlling apparatus of this station were made by the General Electric Company, and the measuring instruments by the Weston Instrument Company. Thomson watt meters are used.

In the upstairs boiler room are sixteen Babcock & Wilcox 400 h.p. boilers, equipped for operation with both coal and oil. The grates are covered with fire brick when oil is used, to preserve them from the intense heat. Automatic stokers are installed ready for use. At present the station is being run with fuel oil, and the plant for accomplishing this is an interesting one, consisting of a system for unloading, handling, storing, circulating, controlling and firing the fuel oil in a safe and permanent manner. The plant was erected by the National Supply Company, of Chicago. The storage capacity consists of three steel tanks 16 ft., 10 ft. and 8 ft. in diameter and 30 ft. high, having a combined capacity of 1764 barrels of 42 gallons each. Two duplex Blake pumps are used in filling the reservoirs from the tank wagons. From the steel storage tanks the oil is pumped to 24-in. stand pipes 70 ft. in height, to a header joining these pipes together. Near the top of the header the oil is conveyed to the oil atomizer loop by two oil heating and circulating systems, Billow design, set upon the boiler room floor.

These systems are erected in such a manner as to automatically maintain a uniform pressure and temperature and a constant flow of oil to the atomizer. The whole circulating system is as near automatic in its action as is desirable, and is duplicated throughout in order to guard against possible accident. Each system is capable of preparing and properly delivering sufficient fuel oil to the atomizer to develop when burned 15,000 h.p., and each system occupies a floor space of 30 sq. ft. and is 9 ft. in height.

The furnaces are erected upon the grate bars of the Acme stoker, and consist of a series of firebrick flues for heating and circulating the incoming air, checker work for distributing the flame, and a baffle wall for directing the flame toward the boilers.

This oil equipment is said to be the largest of its kind ever erected with one exception, that being the World's Columbian Exhibition plant, which had 5.69 miles of oil and steam pipe connections.

Among the accessory apparatus found in the station may be mentioned Wheeler surface condensers and feed water heaters, Blake feed pumps and oil pumps, and Crane, Scott, and Eaton, Cole & Burnham valves. The stack is of brick, 250 ft. high, with 14 ft. flues.

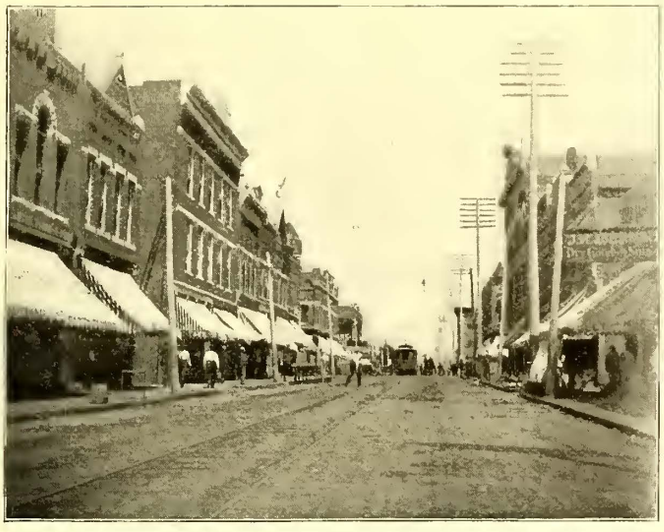
The station operating force consists of one chief engineer, one engineer, one day switchboard man, one apprentice, two day oilers, two night oilers, one day pump man, one night pump man, one day fireman, one night fireman, one fireman's helper, one boiler washer and one janitor—a total force of fifteen men, the smallest, probably, of any power station of the size in the country, due largely, of course, to the use of oil.

The Interurban Railway Between Anderson and Marion, Ind.

Anderson, Ind., lies some 30 miles northeast of Indianapolis. Within the gas belt, it is closely surrounded by a number of those rapidly growing and prosperous towns that owe their existence to cheap fuel. Propositions galore have been presented for joining these cities with electric lines, but the first to be carried out is the one connecting Anderson, Marion and Elwood. As shown on the accompanying map, the main line, running nearly due north and south, connects Anderson and Marion, while a branch from Alexandria to Elwood connects the latter city with the others. Cars are now running from Anderson to Marion, and it is the expectation to have the branch to Elwood completed before the first of the year. This branch and the main line from Anderson as far as Summitville are controlled by the Union Traction Company, which operates the local system at Anderson. The distance from Anderson to Summitville is 17 miles, and from Alexandria to Elwood 9 miles. This track, with the local lines at Anderson, make the Union Traction Company's system 37 miles long, and with those of the Marion City Railway a total connected system of 80 miles of track.

The line from Summitville to Marion is owned by the Marion City Railway Company and is 17 miles in length; thus the connecting point of the two systems is just mid-way between the terminals. As the cars of each company run only to the end of its own line, a union station, 75 ft. x 46 ft., is now building and passengers are to be transferred under cover. This station will have separate waiting rooms for men and women, offices, baggage room and lunch counter. It is a frame structure and will cost, complete, $2,500, including the ground on which it stands.

This interurban line has been successful beyond the ex-

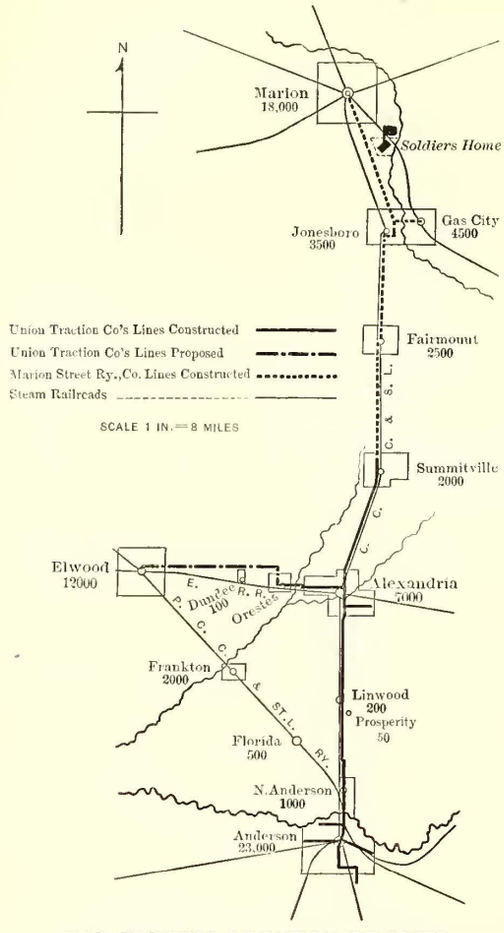


HARRISON STREET, ALEXANDRIA

MAIN STREET, SUMMITVILLE, BEFORE TRACK WAS BALLASTED

INTERURBAN CARS, UNION TRACTION COMPANY'S LINE

pectations of the builders; the cars are crowded almost continually, and, although hourly service is given, it is frequently necessary to run trains of two and three cars; the territory adjacent to it is one of Indiana's rich farming districts; at Marion there is a population of 18,000; at Anderson, 25,000; Elwood, 11,000, and, with the other small towns intervening, the total population tributary to the system is about 65,000 people.

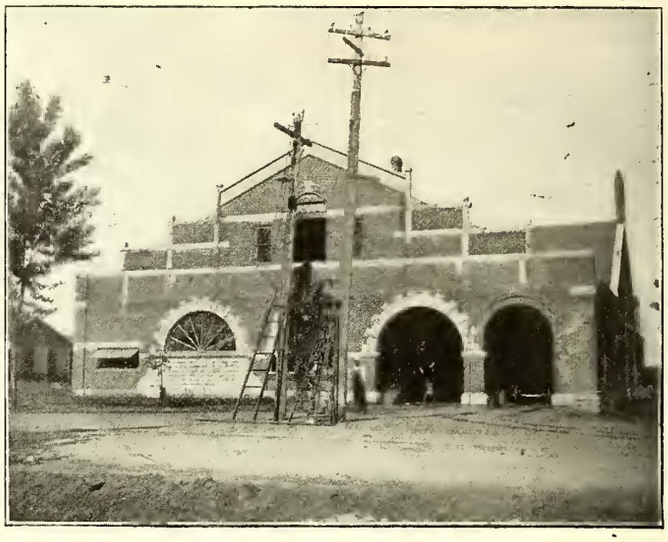


MAP SHOWING LOCATION OF LINES

The interurban runs entirely upon private right of way except when entering towns; the land was bought outright from the owners, and as far as possible the route lies on section lines; this made the price to be paid much lower than if the farms had been cut across promiscuously.

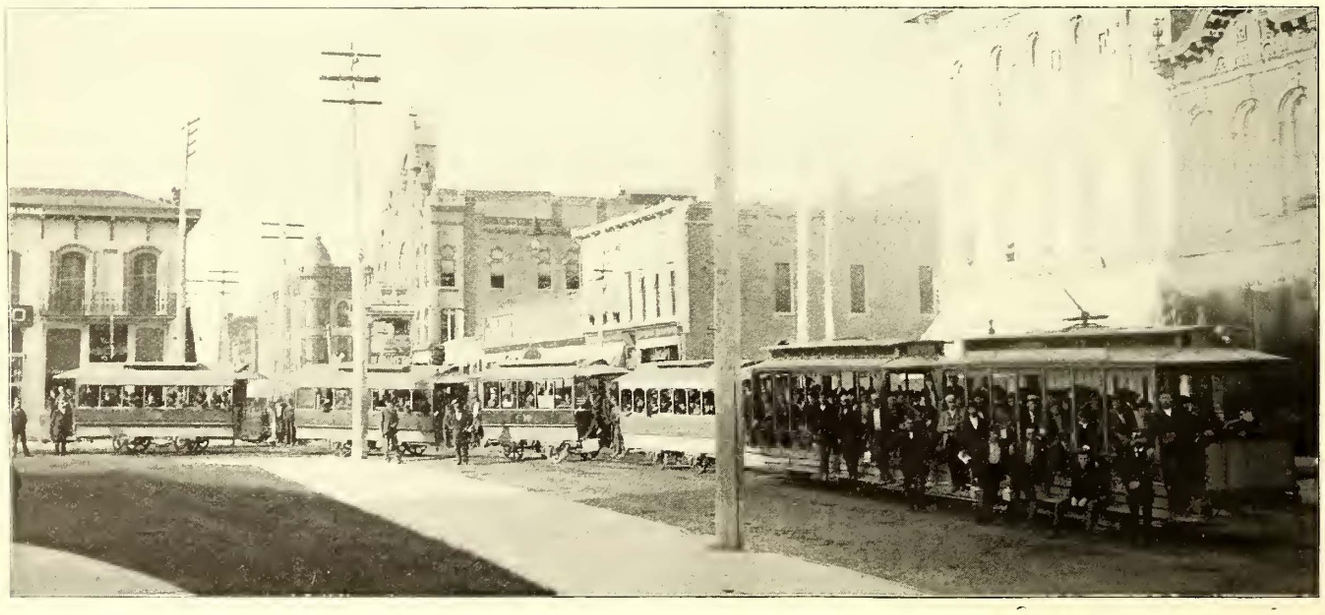
The right of way has been fenced at the expense of the companies and in most cases under an agreement whereby the adjoining land owner will maintain the fence hereafter.

At each highway crossing is a waiting platform and cars stop on signal. For Prosperity and Linwood, small villages opposite each other on either side of the line, there is a small, neat and comfortable waiting station. At Anderson the waiting rooms are in the same building with the company's offices and are similar to the waiting rooms for steam roads.



POWER HOUSE AT ANDERSON

The fare from Anderson to Marion is thirty cents, or less than a cent a mile. The interurban parallels the Big Four between Anderson and Marion and the Lake Erie & Western from Alexandria to Elwood. Notwithstanding the fact that the electric cars carry passengers for less than one-third the fare charged by the steam roads, those companies made no attempt to obstruct the former's progress, and all crossings are at grade with the full consent of the steam



WORK TRAIN RUN TWICE A DAY IN ANDERSON

roads. It is believed, moreover, that the operation of the electric road has created a patronage of its own and that it has not affected the steam road traffic.

The schedule time between Anderson and Marion is three hours, including all stops, but this can easily be reduced to two and a half or two hours when all of the track has been surfaced.

The general character of the route is level, and with the exception of a 4 per cent grade on that part of the Elwood branch now completed to Orestes, there is no grade exceeding 1 per cent. There are a number of steel bridges, and culverts are of steel or vitrified clay pipe.

The road bed is graded with a 12 ft. surface at such an elevation as to avoid the accumulation of snows and with side ditches affording good drainage throughout. The ballast is the best of gravel 6 ins. deep under the ties and filled in between like the standard Pennsylvania Railway construction. The company owning the Anderson end has its own gravel pit, from which it hauls the gravel in its own cars, which were made specially for this kind of work by the Barney & Smith Car Company.

The ties are white oak, 6 ins. x 8 inches, some 7 ft. and some 8 ft. long. The rail is 60-lb. T section in 60 ft. lengths and bonded underneath the angle bar with Atkinson and Washburn & Moen bonds, the terminals of the bonds and the surface of the holes having been amalgamated with Brown's plastic bond material. The bonding of the road is so complete that on several occasions, when the exigency required, the cars have been run as far north as Summitville, a distance of 16 miles from the Anderson power station, with the simple current without any booster, and with only a 00 feed wire as far north as Alexandria. The special work was furnished by the Paige Iron Works and the Lorain Steel Company.

The trolley wire is 00 figure 8 supported by a 5-16 in. steel span wire fastened to cedar poles with ratchets on

INTERURBAN TRACK BETWEEN ANDERSON AND ALEXANDRIA

the outside of the poles. All overhead work is of the Ohio Brass Company's best material.

The interurban cars were all built by the Barney & Smith Company; the ten motor cars are 45 ft. and 49 ft. over all with baggage room of 8 ft. used for a smoking compartment. The trail cars are 44 ft. long. All are vestibuled, and doors at the end allow passengers to pass from one car to another while trains are in motion. They are furnished with all the conveniences of day coaches on steam roads and are of the most handsome and comfortable design. A special mail and express car makes three round trips a day, but in addition to this the regular trains carry light express or packages where there is haste concerning delivery. All cars are mounted on Barney & Smith, class H, trucks. These trucks are fully described and illustrated elsewhere in this issue. Four of the motor

VIEW IN ANDERSON

cars are equipped with two 50 h.p. Westinghouse motors to the car; the remaining ones have four 35 h.p. Westinghouse motors each. This equipment is designed for a maximum speed of about 50 miles per hour, and the cars are making regularly from 45 to 48 miles per hour. It is the intention to purchase open cars for summer use provided it is found that the open cars can be run at high speeds without interfering with the comfort of the passengers.

The cars are equipped with the Christensen Engineering Company's air brakes, the controller being in the vestibule under the immediate eye of the motorman. The pressure is not controlled automatically, but by the motorman, who throws a switch to start the compressor whenever the indicator shows a pressure below a certain point. The cars are heated by Baker hot water heaters, and the Wagenhalls electric headlight is used.

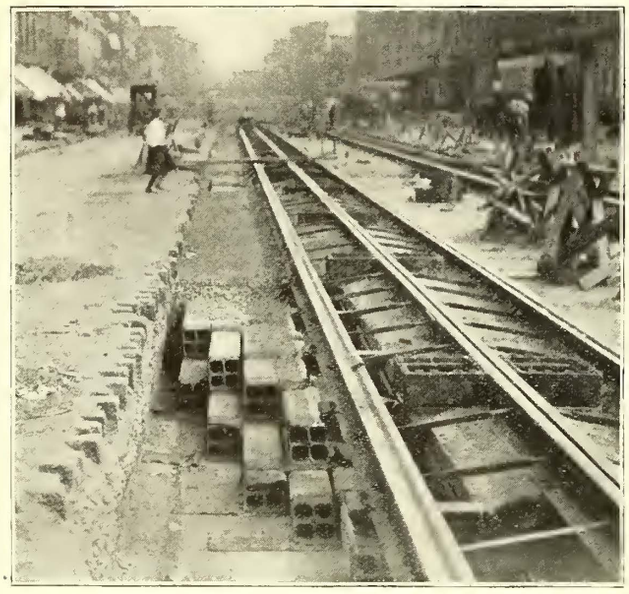
The road is operated by means of the Ramsey signal system with turnouts about 3 miles apart. The Garl railway telephone is installed on the Anderson end with instruments at the company's offices in Anderson, Alexandria, Linwood, Summitville and Elwood. Along the line at intervals of a half mile are cut in boxes from which points the motorman, who carries in each car a portable telephone instrument, may report accidents.

Power is at present furnished from the old power houses; the Union Traction Company will, however, erect a new power house, probably in the vicinity of Alexandria. A new steel car house, 150 ft. x 37½ ft., with 600 ft. of track, has just been completed at Anderson. The Union Traction Company is now building another, 70 ft. x 200 ft., at Alexandria, with 1000 ft. of track.

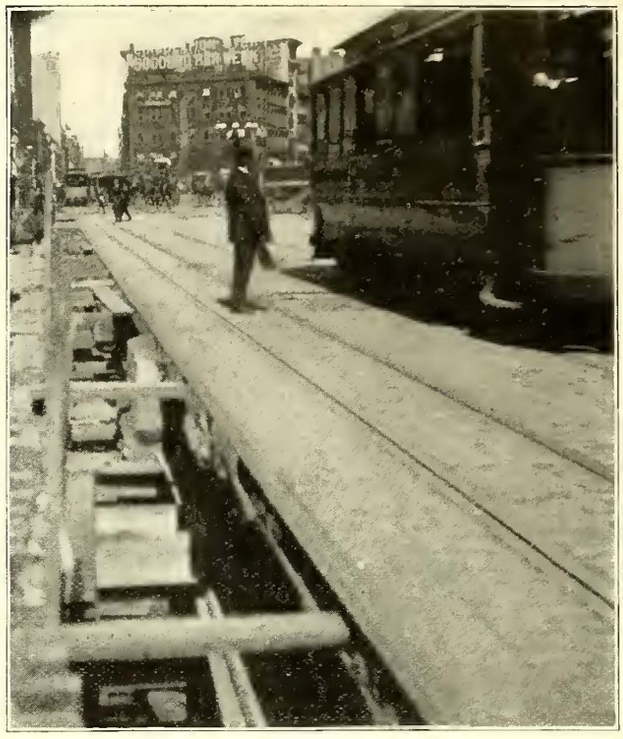
The officers of the Union Traction Company are: Chas. L. Henry, manager; Philip Matter, president, and Chas. Berry, superintendent; of the Marion City Railway Company, Eli Halderman, president; W. C. McWhinney, general manager and superintendent.

Conduit Laying in New York

During the past two months many of the important streets of New York, including Broadway, have presented a very busy appearance, while the installation of the electric feeder conduits for the conduit railways has been carried on. As stated in the last issue of the Street Railway Journal, three types of conduits are being installed by the Metropolitan Street Railway Company. The accompanying views show the method of laying the McRoy conduit, which has been adopted for approximately one-third the work of the Metropolitan Street Railway Company and for about half of the new work of the Third Avenue Railway Company.



COVERING THE PIPES WITH CONCRETE

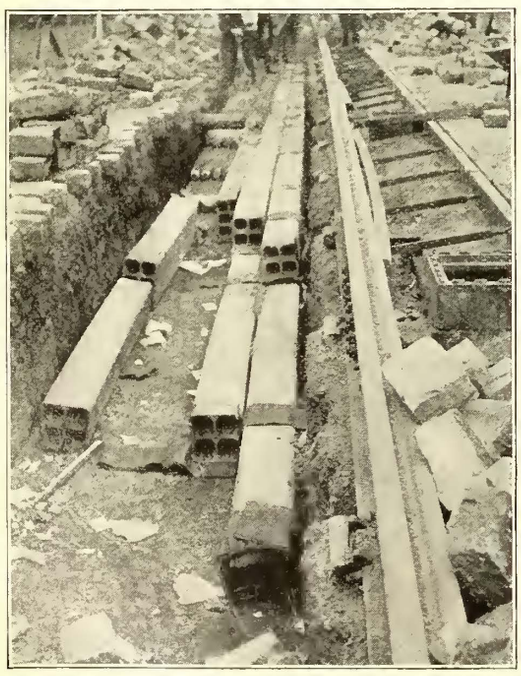


SHORING UP DURING EXCAVATION

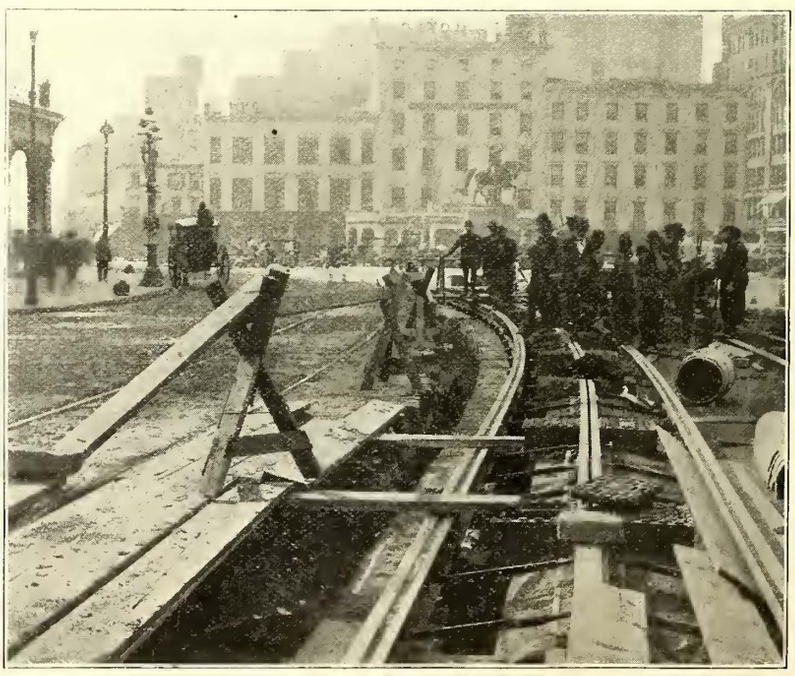
This conduit is made of vitrified clay in 6 ft. lengths, each section having four ducts. A standard four-duct conduit is shown in side and end elevation herewith.

The conduit is laid on a foundation of concrete having a thickness of at least 3 ins. A wall of concrete of at least 2 ins. in thickness incloses the sides of the conduit and the top of the conduit is covered with at least 2 ins. of concrete. Where one or more pipes are laid on top of each other, a thin layer of cement is placed between each course and the joints are broken. In laying the pipes the adjoining ends fit closely and the pipe is held in perfect alignment by iron or steel dowel pins. These pins are 4 ins. in length and have a shoulder at their center to prevent them slipping into the dowel holes further than intended.

The pipes are lined up on mandrels, and after each length is so lined up and the joints made, each duct is tested with the mandrel to secure perfect alignment and continuity. These mandrels are made of wood about 12 ins. in length, of cylindrical pattern, and 3 ins. in diameter.



METHOD OF WRAPPING JOINTS



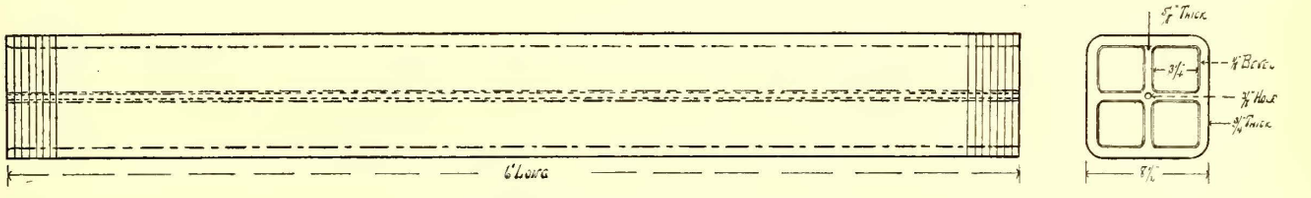
CURVE CONSTRUCTION NEAR UNION SQUARE

Fixed to the end of each is an eye to which is attached a handle made of ¼ in. iron and about 7 ft. long.

The joints are rendered watertight by covering them with a wrap made by thoroughly saturating a double thickness of burlap 8 ins. wide in hot liquid asphalt and wrapping it immediately around the joints. Before applying the wrap it is considered advisable to coat the ends of the conduit with asphalt to insure the wrap taking a firmer hold. Sometimes the joints are made by substituting cement for asphalt. Wherever it is necessary to use lengths of pipe shorter than factory lengths, the cut ends are trimmed smooth and properly beveled at the duct opening and made to resemble the finished end of the factory lengths.

The conduits as installed for the Metropolitan Street Railway Company are laid in a double tier trench 35 ins. in depth below the top of rail, except in special instances, where it becomes necessary to avoid obstructions, mains, etc., and 7 ins. inside of gage line of track, extending out to a distance of 2 ft. or more according to the number of conduits to be laid. They are then covered with about 6 ins. of concrete, where practicable. In one place where the conduit was covered with but 2 ins. of concrete a loaded truck weighing about 30 tons passed over it. After a thorough examination the conduits were found to be absolutely unharmed, showing the enormous bearing strain of the conduit.

The extension manholes are between 210 ft. and 410 ft. apart. These distances vary according to conditions. The minimum inclination of the ducts as laid from manhole to manhole is 4 ins. in 210 ft.



SIDE ELEVATION AND SECTION OF PIPE

The ducts are rodded by either a machine constructed for the purpose or by sections of rods which are screwed one to the other. The rodding with the use of the machine can be accomplished very rapidly. In one of many instances 410 ft. were rodded in 1¾ minutes, or an average of 250 ft. in a minute. The machine is worked from one end only.

A Race Between a Deer and an Electric Car

On Thursday, Nov. 10, an electric car running between Camden and Rockland, Maine, met on the highway a deer which seemed to challenge the motorman to a race. When the car was within about a hundred feet of the deer, the deer turned around and started playfully on the run, waving his tail in the air and shying at objects along the road very much like a horse. When the motorman let the car out at full speed, the deer got right down to work and ran a distance of about a thousand feet; when the car began to overtake the deer the latter gave up the race and ran into the woods. The passengers on the car, including the superintendent of the road, enjoyed this beautiful sight.

The most practical method to pursue is to profit by the successful experience of others, and when we arrive at a point which we will consider will admit of improvement, then put our individual ideas into effect.—From paper read at the St. Louis Convention, 1896.

Some Fallacies Regarding Electrolysis

BY ALBERT B. HERRICK

The problem confronts the street railway manager, water companies, and in some cases the city officials, as to what must be done to determine the existence and extent of electrolysis of underground pipes, as well as the best way to cure this disease. It might be said here that the danger to water pipes and underground conductors from the return railway current is usually much less than is often stated, and while it would be equally erroneous to assume that no destruction of underground pipes can be caused by the railway circuits, such destruction is much more often local rather than general, is usually very slight in extent where it exists at all, and can always be prevented by comparatively inexpensive means if they are installed intelligently and with knowledge of the character of the evils which it is intended to overcome.

We will consider first the physics of electrolysis and the physical conditions necessary for its existence in railway ground return systems; second, the electrical conditions that must be present; third, the electrical conditions that have often been assumed to indicate danger areas, and which do not indicate electrolytic activity; fourth, testing methods to locate and define the paths of destructive currents and the amount of current flow; fifth, the methods to prevent electrolysis, which have been assumed to be general panaceas, but which have only a specific and limited application, each case being a problem in itself and requiring special treatment; sixth, the position taken by railway and water companies, which frequently interferes with the proper methods of prevention.

The electrolysis familiar in laboratory work is the transference of metal from one plate to another by a current of electricity, when immersed in the proper salt solution of that metal, but the electrolysis that occurs in the railway ground returns is of an entirely different character,

The earth in which the metal is buried is an insulator, but it becomes a conductor by the absorption of moisture, and its resistance may vary from nine-tenths of an ohm to over a megohm per cubic yard, this resistance being varied by the amount of water and the solvent salts present. When the current leaves a metallic surface, which is buried in the earth, it does not carry with it the decomposed metals, as in a plating bath, and deposit them on the cathode. Instead they lie adjacent to the surface acted upon, and when the metal is iron generally form oxides. These oxides increase the resistance to the flow of current, and, consequently, the resistance of the return circuits via the earth. This effect is actual as well as theoretical. It is often unconsidered, but the gradual falling off of the current returned by the water pipe system can be noticed in roads where the ground returns are properly located and bonding maintained. The disastrous predictions made years ago regarding the destruction of piping systems by the railway return current have not been realized; and this may be owing to the above condition of electrolytic currents destroying their own paths of conduction. Some of the re-

cent examples of electrolysis that have been unearthed have many appearances of having been formed at a very early period in the art of electric railroading.

There are other changes effected when the current passes from one metal surface to another buried in the soil. It accumulates water at the negative and repels it from the positive plate. This flow of current also increases the capillary activity of the soil, and attracts water into the soil through which the current passes. This action increases as the current density increases, and reduces the earth resistance between two adjacent surfaces. The effects of this action can be seen when measuring the ground return resistance where the return is partly effected through the earth. If under these conditions, as the measuring current is increased the total resistance of the ground return circuit is decreased.

In England the British Board of Trade has limited the voltage that shall exist at maximum loading of the system

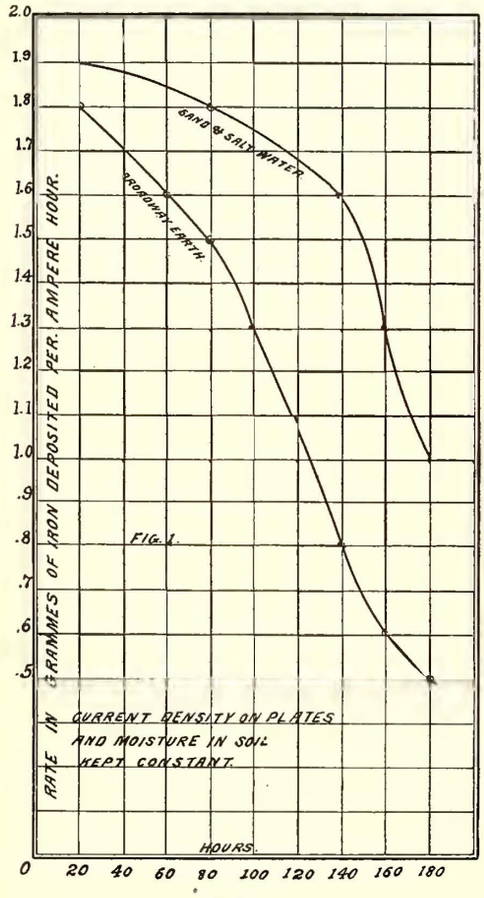


FIG. 1

to 4.5 volts when the pipe is negative to the rail, and 1.5 volts when the pipe is positive in potential to the rail. Dr. J. A. Fleming in his paper read before the British Association shows that electrolysis can occur with voltage difference of 1 volt or under, especially if soluble chlorides are in solution in contact with the positive plate.

The voltage at which electrolysis commences depends largely upon the counter electro-motive force of the electrolyte. In pure water the voltage is 1.5, and in a 10 per cent sodium chloride solution it drops to about .37 volt. Free ammonia, carbonate of soda, potash and the nitrates all tend to reduce below pure water the counter electromotive force of polarization, and the water adjacent to these surfaces underground may be charged with any or all of these impurities. If the energy is sufficient, this water may be decomposed, leaving the oxygen adjacent to the surfaces from which the current flows; or in the case of ammonia it leaves nitric acid as a biproduct of the decomposition. Where sodium chloride is present in the electrolyte nascent chloride will be left adjacent to the positive surface, which may have a further effect in the destruction of the surfaces undergoing electrolysis. The formation of these binary compounds by electrolysis in the electrolyte are very complex, and whether they are of much importance in underground electrolysis is still an open question.

There is often a permanent difference of potential between track and pipe with the power station shut down of from 1-10 to 5-10 of a volt due to the earth battery formed by the masses of buried iron. In the presence of lead services or copper supplementaries, the potential is reversed from that found when the road is in operation, there being a storage effect. This earth current can be reduced in voltage to nearly zero on short-circuiting the water pipe and rail, but will rise again gradually on removing the short circuit.

Danger areas are generally plotted by measurement of the potential difference between the pipes and the rail; those districts which show the pipe positive in potential to the rail, causing the current to flow from the pipe into the soil, are said to be subject to electrolytic action. The conditions which must exist to produce electrolysis are not determined from potential measurements only. A current must flow from the surface into a fluid in order that electrolytic action be set up. It follows that the higher the insulating properties of the soil in which the parallel conductors are buried, the higher may be the potential that can be maintained between them, and the less will be the current flow that produces electrolysis. When the soil becomes an insulator, the potential will become a maximum, and there will be no electrolytic action. So it is evident that the criterion of potential differences is not one by which electrolytic activity should be gaged.

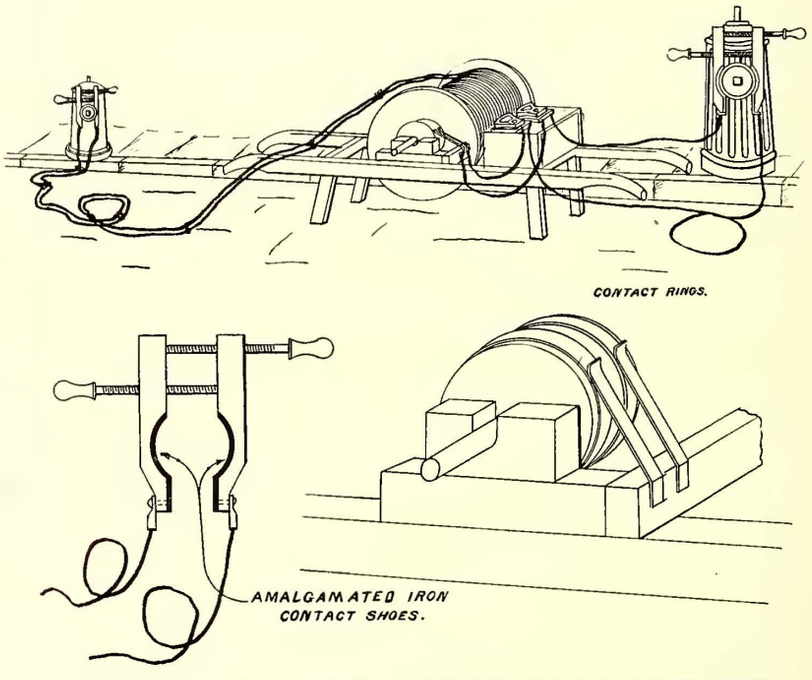


FIG. 2.—APPARATUS FOR MEASURING CURRENT FLOW IN WATER PIPES

In estimating the damage done by electrolysis regarding the amount of iron decomposed, the data is obtained from laboratory determinations, and applied in this way: Suppose the leakage current from the pipes amounted to 100 amps. and this flow was maintained for 20 hours per day, 365 days per annum. We find in the text books that one ampere flowing for one hour will decompose approximately one gramme of iron. Now on this basis, we multiply our 100 amps. and 20 hours and 365 days, which gives us the

grammes lost per annum, which in this example is 73,000 grammes, or 1610 lbs. But we have to consider the whole loss. This current leaving the rail surfaces decomposes the iron rail as well as the water pipe surfaces, so we have to at least double the above weight to get the total damage: further than this, this current also may be shuttled back and forth from rail to pipe, which would result if there were high resistance sections on the water pipe paralleling the railway return; so we can again multiply the above result by two, and arrive at 6440 lbs. per annum without being out of the bounds of reason. This is an excellent determination for the purpose of selling a bond, or disturbing public peace, and one of the many scientific fallacies that a practical railway man has to endure.

The rate of decomposition with a new plate in fresh earth, especially if there are secondary reactions from any salts held in solution, will be higher than the laboratory constant. This value will gradually fall per unit of current flow with time, due to the insulating of the surfaces acted on by the products of electrolysis. Fig. 1 gives the weights decomposed per ampere hour, where two plates each having 10 sq. ins. are buried in earth taken from

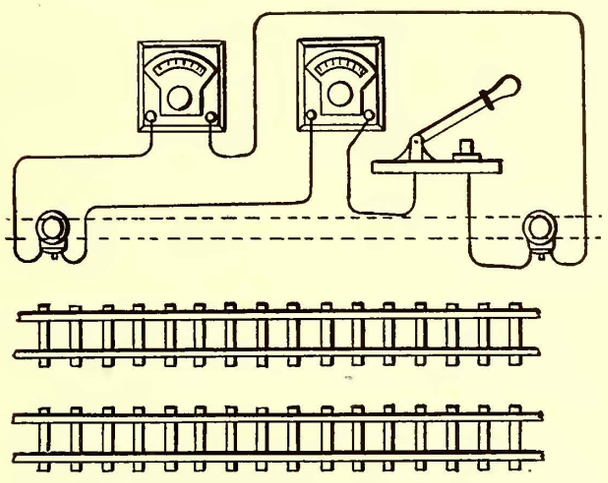


FIG. 3.—DIAGRAM OF CONNECTIONS FOR MEASURING FLOW IN PIPES

Broadway, New York City, and 6 ins. apart. Moisture was maintained at 11 per cent, and the duration of the test was 180 hours. A test of sand moistened with sodium chloride fell much less rapidly. It will be seen that the amount of metal destroyed depends upon the condition of the surfaces acted on. There is again another condition that may arise where the current flow and moisture are both in evidence, yet without electrolytic action, for the reason that a certain energy must be expended at the surface, at which electrolysis takes place, and with a given current and surface the voltage has to exceed a given value before the metal surface is effected. Again, if this current rapidly changes its direction, no electrolysis takes place.

As each case is a special problem, a solution can only be given after careful diagnosis. The special methods which I have used for these tests, from which the true condition underground can be determined, are made as follows:

TO MEASURE A CURRENT FLOW IN A WATER PIPE

Have two leads, one a No. 6 and one No. 14 B. & S. flexible insulated copper wire each 800 ft. long, and taped every 5 ft. to keep them together; also a reel mounted on a cradle so it can be carried by two men, and on this stand can be arranged a place for the instruments; the inside ends of the leads on the reel should be brought out as shown in Fig. 2. Other apparatus requisites are an amperemeter having two scales (4 amps. and 40 give the best ranges for this test), also a voltmeter to read 1 volt and 12 volts full scale. For connections use a joiner's clamp hollowed out as shown in Fig. 2 and lined with amalgamated iron. These can be adjusted to fit the projection to any plug.

The connections are made as shown in Fig. 3. The clamps are put on one water plug after the surface of contact on the plug has been filed so good contact is made. The No. 14 lead is connected to one side of the clamp, and the No. 6 lead to the other. Leads are then taken to the adjacent plug and connections are made to it in the same way. The amperemeter is inserted in the No. 6 lead, and the voltmeter in the No. 14 lead. The reading should first be made with the ampere lead open. This will give voltage drop on the water pipe, say this is 1.2 volts. Then close the current through the amperemeter and read current and volts. Supposing the volts had fallen to 0.8 and amperes were 6, the loss in drop on the pipe is due to the current being diverted through the No. 6 lead. Then, if 6 amps. produce .4 volt drop, the total amount flowing to produce 1.2 volts is 18 amps., which is the current flow sought. The resistance of the earth for such short distances can be neglected.

A high voltage which falls with little current flow when the amperemeter circuit is closed shows a discontinuous pipe or bad joints. A low voltage with little change and large current flow when the amperemeter circuit is closed indicates that adjacent but not connected water pipes are connected together for test. A current flow in adjacent sections of pipe increases toward the station, where receiving current from the soil, and the current flow decreases where the current leaves the pipe. The current flow in the water pipes may be in the reverse direction from the flow in the rails; the reason for this can be found by studying the piping plans.

TO FIND THE CURRENT FLOW FROM RAIL TO WATER PIPE AT ANY POINT

Connection to the water pipe can be left on and connection made to the rail with the same kind of clamp, which if made like sketch will pinch the tram of the rail and make contact. In the ampere leads for this test is inserted a 20-ohm calibrated rheostat. The purpose of this is not to disturb the current flow and divert it through the water pipe connection, which would be the case if a short circuit was established between the rail and pipe. When the rheostat with 20 ohms is in circuit, and this circuit is closed, the following changes may be noted: If on closing the amperemeter lead the potential falls to zero, then there is only a moist earth leak between the rails and pipe. If the rail is positive, the connection is between the observer and the station; if negative, it is located further from the station than the observer. Blind ditches, spots of quick-sand and leaky sewers will give this kind of connection. If the voltage falls when the resistance is cut out of the rheostat, cut out resistance still further until the voltage is just one-half of what it was when the amperemeter lead was open, then the resistance from rail to ground is the same as the resistance inserted. The rheostat should have a tapering capacity on 20 volts from 20 amps. on the first step-down. If the voltage is not effected by this connection, note the current flow; now cut out resistance and again note current and the resistance cut out. Suppose in the first case there is .2 amp. flowing, with 8 volts difference of potential, which gives 40 ohms. Now reduce the rheostat resistance to 10 ohms; the current flow increases to .266 amp.; then the resistances in the two cases are 40 and 20 ohms; subtracting the rheostat R in both cases leaves 20 ohms for the pipe return resistance at this point. For these connections see Fig. 4.

Measurements made where a varying current flows through the earth are only approximate, as the earth contacts rise in resistance as the current density falls. The change in resistance is again dependent on the amount of water in the soil at the time of test. In this test all rails should be connected together to get the full contact rail area, as shown in Fig. 4. These tests have been made so far with the current circulating in the returns. This may vary considerably. Several things may be learned by these variations. Watch the voltage and current when a car approaches. When at that part of the piping system where the rail is positive to the pipe, there will only be an increase of potential between the pipe and rail; when in the zone between the positive and negative rail areas the polarity will change when the car passes beyond, and when in a location where the rail is negative to the pipe the potential will remain unchanged in sign when the car passes.

METHOD OF DETERMINING THE RELATIVE VALUE OF THE DIFFERENT RAILS AND PIPING AS RETURNS

Use a six-way shunt and a barrel water rheostat. One shunt carries all the current from the water rheostat and enters a bus, to which is attached five shunts; one shunt is connected to each rail, and one to the water plug. Two amperemeters are employed (see Fig. 5) in this test one to read from the main shunt *H*, the other can be connected to any of the shunts *C*, *D*, *E*, *F*, *G* at will. The current will now split up from this bus in the same relation as these return conductors bear in their conductivity to each other; open bonds and dead rails over the sections of track can be located in this way. This is an important test, for it is often the case that local electrolysis is caused by a few open bonds in a section, and no cross bonds to connect around open joints.

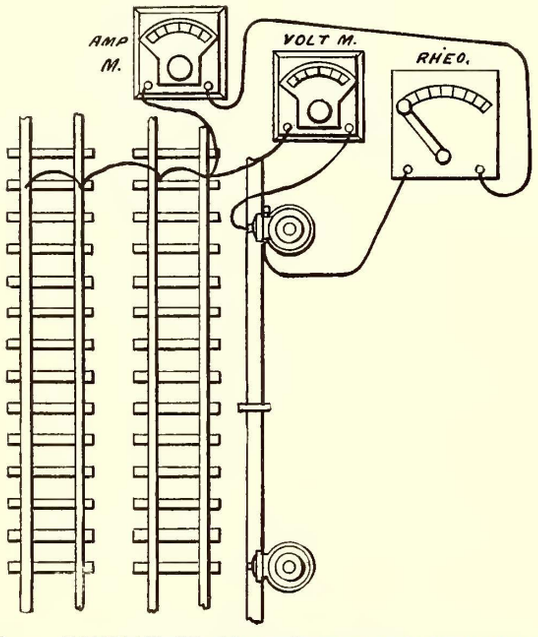


FIG. 4.—DIAGRAM OF CONNECTIONS FOR MEASURING FLOW FROM RAIL TO PIPE

The above methods can be varied to investigate any of the peculiar conditions that arise with two conductors buried and partially connected by a semi-conductor. A preliminary investigation of the water pipe plans and the rail return system is necessary in order to lay out the best methods of proceeding with the tests in order to locate the paths taken by this underground current.

The following data may be of use:

A 9-in. rail presents 1390 sq. ft. of contact per 1000 ft. with the earth
A 7-in. rail presents 1110 sq. ft. of contact per 1000 ft. with the earth
A 5-in. rail presents 960 sq. ft. of contact per 1000 ft. with the earth
A 3-in wrought iron pipe weighs 22 lbs. per yd. approx. res. per yard..... .000096
A 4-in wrought iron pipe weighs 31 lbs. per yd. approx. res. per yard..... .000064
A 6-in wrought iron pipe weighs 62 lbs. per yd. approx. res. per yard..... .000035
A 8-in wrought iron pipe weighs 94 lbs. per yd. approx. res. per yard..... .000023
A 10-in. wrought iron pipe weighs 120 lbs. per yd. approx. res. per yard..... .000016
A 12 in. wrought iron pipe weighs 164 lbs. per yd. approx. res. per yard..... .000013
A 14-in wrought iron pipe weighs 194 lbs. per yd. approx. res. per yard..... .000010
A 50-lb. rail measures approximately .0048 ohms. per 1000 ft.
A 60-lb. rail measures approximately .0040 ohms. per 1000 ft.
A 80-lb. rail measures approximately .0030 ohms. per 1000 ft.
A 90-lb. rail measures approximately .0026 ohms. per 1000 ft.

These resistances vary largely with the percentage of carbon in the steel of the rail.

Unfortunately, up to date there is no panacea, as each problem contains within itself a new combination of conditions requiring special treatment. The numerous conditions which effect this underground trouble may have such relations to each other as to make electrolysis in any individual case a menace or a myth; and it is impossible to predict, without a test and thorough examination, what is taking place. Cases of strictly local electrolysis have been assumed to be of the general type, while electrolysis occurring over extended areas has not been evident until serious damage was done. Then again in the case of a water company, an increase in leaks has been attributed in several instances to electrolysis, when an increase of water pressure was responsible, there being no electrolysis. So it goes.

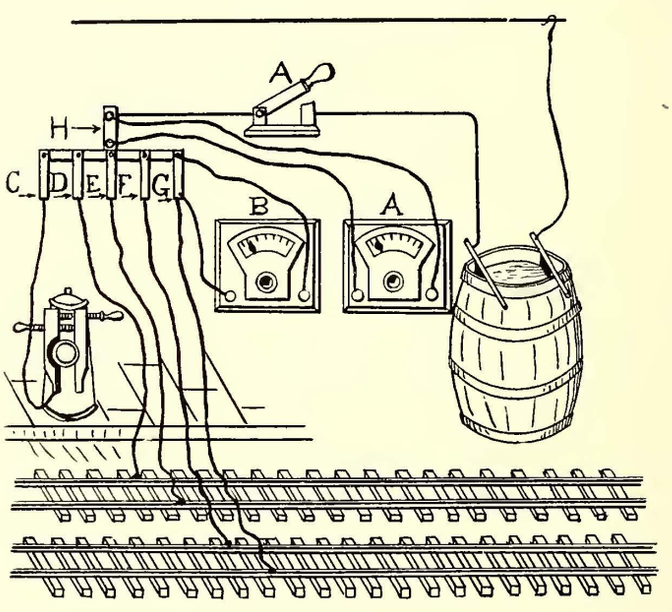


FIG. 5.—DIAGRAM OF CONNECTIONS FOR MEASURING RELATIVE VALUE OF RETURNS

The methods that have been employed for its prevention are the interconnecting of the rail and pipe to a common ground return. This should be ample in section to carry the current back to the station without causing sufficient drop at maximum load in the return conductor to cause a current circulation between pipe connections. A frequent cause is found in the ground return feeders themselves. They are very rarely of the proper sectional area to bring in the current to the station without excessive drop, and they are not connected to the rails at points which give them fairly equal loading, causing water pipes to perform

the function of an equalizer, and this is one of the most fruitful causes of electrolysis. Ground plates are again considered as a ground return, but they are generally found carrying practically no current after a few months' service.

Another method has been to keep the water pipe system at a lower potential than the rails: this will cause the current to flow from the rails to the water pipe, making the water pipe system a sump for all stray currents, transferring all the electrolysis to the rails. But the objection in practice to this system is that electrolysis takes place more rapidly where the current density is greatest, and this method focuses the action of electrolysis on exposed bond wires and supplementary ground returns buried in the earth. As a result the bond wires will quickly be eaten away, where exposed, and the return circuit will be opened. This method, therefore, should never be attempted where the bond wire is small and the current carried by the rail return is large, since, as stated, it will open up the bonds due to this local electrolysis of the bond.

This method also increases the current flow in the piping system and increases the destructive action at the pipe joints. But if the generator, placed between the water pipe and rail return, would cause a low potential alternating current to be maintained between the rails and pipe from a theoretical standpoint, it would certainly prevent electrolysis, but whether it would be satisfactory in practice has not yet been determined.

Mr. Parshall in the Dublin Railway return system uses boosters on the rail returns, which compensates for the losses in these returns, and the return feeders are connected to the rail at points selected, so the potential difference will not exceed the Board of Trade regulations. These boosters are excited by the current which is fed into the system, and in this way the boosting effect is automatic, and falls and rises with the loading on the system.

The water companies have attempted to protect themselves by painting the piping with several coats of asphalt paint, with great hopes of preventing electrolysis; but where these pipes are buried in city soil charged with gases I have noticed after six months that all signs of paint had disappeared, and I suppose the insulating properties also.

Another attempt is to introduce insulating joints in the water pipe main; but to introduce a few joints in an affected location leads to more trouble than it cures, for the current will produce local electrolysis around these insulated joints. But if insulated joints, such as a rust joint in a pipe, are introduced in every ten lengths of pipe, it breaks up to a large extent the pipe as a conductor system, for the water pipe will only carry the current back to the station in the ratio that its conductivity bears to that of the ground return of the railway.

It may be found after making a test of the water pipe system that it is not advisable to attempt to use it as a return, even where permission is granted, because the water pipe is not laid out or connected together electrically to be depended upon as a continuous conductor system.

One very troublesome condition, occurring frequently in the older water pipe systems, is where the pipes are cement lined, that is, made by moulding a sheathing of cement on the inside and outside of a thin sheet iron pipe, and where more recent extensions to the water works system are made of steel, iron or cast iron pipe. This mixed system of piping makes it next to impossible to hold joints and services where the current flows from the iron to the cement piping, and a connection at the power station under this condition of piping would be the worst thing to do. Again, the connection to a long lateral pipe from the main, especially if this pipe was supplying water to the station, would be both poor engineering and an unsatisfactory connection. In a case of this kind the return current corroded out two joints in the water supply pipe to the station in six weeks after the connection was made.

Gas pipes are not so generally affected, for the medium they convey is an insulator, and the joints in this piping tend to destroy their usefulness as an auxiliary return. But these pipes sometimes lie in a position to bridge two parallel water pipes where a considerable difference of potential exists. Here local electrolysis takes place, and under these conditions the gas pipes are usually found to fail. Lead covered cables underground also catch a return current. The simplest solution of this trouble is to tie their sheathing together and connect them to a metallic return to the station, and as an additional precaution it is wise to tie these sheathings together at several man-holes along the route where these cables are paralleled by the railway system. Ventilation of the ducts will also reduce this current, as it generally seeps in through surface leakage.

Another case discovered was where poor insulators were used for the feeders and iron poles for the construction. After several poles had broken off at the surface of the earth an examination was made. It was found that the iron had been eaten away by the leak current, in wet weather, escaping through the light covering of earth over the cement foundation, and reducing the strength of the poles where they had to bear the greatest strain.

The test of a number of systems shows that over bridges and railroad crossings it is very hard to hold bonding at these places. The bonding should here be reinforced by a supplementary, especially where the bridge is iron, as these points show up to be weak spots in a track return system.

It is not difficult as a rule to prevent electrolysis where freedom is given to use the best method for the special conditions and where both parties take the matter up in a spirit of equity; but where there is an unreasonable position taken by either party, the problem becomes complicated. The railway people on the one hand will deny there is any trouble from electrolysis, while the companies owning the piping system attribute all the depreciation and underground troubles to this cause. Then, again, one company will not allow any connections to be made, and another company will require connections to be made to the water pipes, and sometimes specify where these connections shall be made, and if their judgment has been at fault, electrolysis may be greatly increased. Another case arose where two competitive railways were operated in one town; neither for a long time would relieve the water company for fear of improving the ground return of its competitor. Again, where two companies were jointly operating with the piping system as a ground return, they took the ground that the extent of their individual damages could not be proved, consequently they were not liable.

For the railway company to possess full knowledge of the conditions that are existing in its ground return circuits places them in possession of data from which can be easily deduced the best possible means to prevent further trouble from electrolysis, and of increasing the efficiency of the conductor system, as the energy frittered away in the earth could with economy be employed to do useful work.

One of the advantages of the transfer system is that it induces a great many people to travel for fresh air, making as long trips as they can into the suburbs. It tends more than anything else to build up the suburbs, and I think that every one will recognize that it is of very great importance to street railway people to build up the suburbs. —From address at the Montreal Convention, 1895.

Report of Committee on Standard Rules and Regulations for the Guidance and Government of Employees

The committee on standards of the American Street Railway Association has issued the following report:

Columbus, Ohio, Oct. 13, 1898.

To the American Street Railway Association:

Gentlemen: Your committee appointed to prepare standard rules and regulations for conductors and motormen beg leave to submit for your consideration the following report:

So far as possible it has been the aim of your committee to suggest only such rules as are applicable to the largest number of street railway systems, and which experience has shown to be of value. No attempt has been made to suggest rules especially applicable to street railways operated by horse or cable power, as roads of this class are few in number and rapidly passing out of existence.

Minor details of punishment for neglect of duty or infraction of rules are likewise omitted, as these are largely controlled by local conditions. We would suggest, however, that punishment involving suspension from duty be made as infrequent as is consistent with good discipline.

Careful examination has been made of a large number of rule books of various railway companies, and such features as seemed most desirable have been to some extent included in this report.

No especial claim is made for originality and no attempt has been made at elegant phraseology. It has been the aim of the committee to state all rules in a clear and explicit manner and to include none which are not essential.

Your kindly criticism and suggestions are asked on rules and suggestions which follow. Respectfully submitted,

E. C. FOSTER,
IRA A. M'CORMACK,
W. F. KELLY,
Committee.

GENERAL REQUIREMENTS

In order to secure the best service and exclude many undesirable applicants, there should be a standard of physical requirements, and all applicants should be rejected who fail on any of the required points.

Applicants for position as conductor should not be less than 5 feet 8 inches, weight 160 pounds, sound hearing, heart and lungs, good eyesight without the use of glasses, not crippled in hands, arms or feet, have no venereal or constitutional disease, and be between 24 and 40 years of age.

Applicants for position as motormen or gripmen should conform to the same standard in all respects except weight, which should be not less than 175 pounds.

Applicants for any position on the car should have a fair common school education, be able to read English intelligently, sign their name legibly and perform simple arithmetical operations; should be of temperate habits and not addicted to the use of liquors, frequenting saloons, gambling houses or houses of ill-repute.

Before entering service applicant should present a certificate from company's examining physician, stating that he conforms to the standard as regards physical requirements.

All applicants should be required to file a written testimonial from some reputable citizen as to honesty and good character.

It is rarely advisable to employ more than one from the same family or those nearly related. Employees should not be permitted to recommend others for employment.

All desirable applicants should be accepted only on trial and should be placed in actual service, without pay, under the instruction of skilled and competent employees, for a period of one to two weeks. During the period of instruction, the instructor should receive in addition to his daily wages 25 to 50 cents per day, as an incentive to careful instruction.

All instructors should make a written report of the number of days the new recruit has been in their care, and state whether or not he is, in their judgment, qualified to discharge the duties of conductor or motorman. This report should be placed in the hands of the division foreman and should be indorsed by him and sent to the superintendent of transportation.

Before placing the new employee in charge of a car he should be examined by an inspector, to determine whether or not he is sufficiently familiar with the duties he is about to undertake. If he is to enter upon duty as a conductor, he should be carefully questioned as to the detailed duties of his work, as well as his duties to the traveling public, reporting accidents, etc. If he is to be a motorman or gripman, he should have a fairly intelligent conception of the machinery entrusted to his care, know what results will follow from improper operation and how to remedy such minor troubles as may occur in its operation. If he is not clear in his conception of these points he should be sent to the shop for further instructions, and not permitted to have charge of a car until his shop instructor has certified to his fitness on these points. After all this instruction, if he is not a man of steady nerves and cool judgment and quick decision, he should be rejected.

All employees should make a deposit of at least $10 for the badge furnished them, and $20 for cost of uniform.

All new men should be assigned to the "extra" list and never be placed on a regular run in preference to men older in the regular service. This rule should be inflexible and no favoritism permitted.

Promotions to the regular ranks should be made from the extra list solely on merit and not on account of priority of employment.

GENERAL NOTICE

The safety of passengers is of the first importance, and all operations of working, repairing or constructing this road must be subservient thereto. To this, with the regularity and punctuality of the cars and the comfort and convenience of the passengers, all work must be entirely subordinate.

It is of the utmost importance that proper rules for the government of the employees of a railroad company should be literally and absolutely enforced in order to make such rules efficient. If they cannot or should not be enforced, they should not exist. Officers or employees whose duty it may be to make or enforce rules, however temporary or unimportant they may seem, should keep this clearly in mind. If in the judgment of any one whose duty it is to enforce a rule, such rule cannot or should not be enforced, he should at once bring it to the attention of those in authority.

All employees are required to be polite and considerate in their intercourse with the public. The reputation and prosperity of a company depends upon the promptness with which its business is conducted and the manner in which its patrons are treated by its employees.

GENERAL RULES

1. The rules herein set forth apply to and govern all roads operated by the.....Company.

They shall take effect.....189.., and shall supersede all prior rules and instructions, in whatsoever form issued, which are inconsistent therewith.

2. In addition to these rules, special instructions will be issued from time to time, as may be found necessary, and such instructions, whether in conflict with these rules or not, which may be given by the proper authority, shall be fully observed while in force.

3. The head of each department must be conversant with the rules, supply copies of them to his subordinates, see that they are understood, enforce obedience to them, and report to the proper officer all violations and the action taken thereon.

4. Every employee of this company whose duties are in any way prescribed by these rules, must always have a copy of them at hand, when on duty, and must be conversant with every rule. They must render all the assistance in their power in carrying them out, and immediately report any infringement of them to the head of the department.

5. The fact that any person enters or remains in the service of the company will be considered as an assurance of willingness to obey its rules. No one will be excused for the violation of them, even though not included in those applicable to his department.

6. If in doubt as to the meaning of any rule or special instructions, application must at once be made to the proper authority for an explanation. IGNORANCE IS NO EXCUSE FOR NEGLECT OF DUTY.

7. All employees will be regarded as in the line of promotion. advancement depending upon the faithful discharge of duty and capacity for increased responsibility.

8. Disobedience of orders, violations of rules, or neglect of duty will always be considered sufficient cause for dismissal.

9. If an employee should become incapacitated by sickness, or other cause, the right to claim compensation will not be recognized. An allowance, if made, will be a gratuity justified by the circumstances of the case and the previous good conduct of employee.

10. The use of intoxicating drink on the road, or about the premises of the corporation, is STRICTLY FORBIDDEN. No one will be employed, or continued in employment, who is known to be in the habit of using intoxicating liquor. SMOKING OR CHEWING TOBACCO by an employee while on duty IS FORBIDDEN.

11. When an employee is discharged from the company's ser-

vice he will not be re-employed without the consent of the officer who dismissed him and that of the head of the department from which he was discharged.

12. Employees when leaving the service of the company must sign receipt for their final pay, and return to the company all the company's property with which they have been entrusted.

13. No employee will be allowed to absent himself from duty without special permission from the head of the department in which he is employed, nor will any employee be allowed to engage a substitute to perform his duties while he is absent.

14. Employees must wear the prescribed badge and uniform while on duty.

15. DAMAGE TO PROPERTY.—Every employee of the company will be held responsible for care and protection of the property of the company coming into his hands, and any damage caused by neglect or carelessness of such employee will be charged to his account.

BELL SIGNAL RULES

CONDUCTORS TO MOTORMEN:

1. One tap of the bell is the signal to stop at the next crossing or trolley station, whichever comes first.

2. Two quick taps of the bell is the signal to START.

3. Three quick taps of the bell WHEN CAR IS STANDING is the signal to BACK.

4. Three quick taps of the bell when car is RUNNING is the signal to stop immediately. This signal should be used to prevent accidents, or when trolley is off the wire.

MOTORMEN TO CONDUCTORS:

1. Two quick taps of the signal bell when the car is RUNNING is the signal to conductor to SET REAR BRAKE.

2. Three quick taps of the bell when the car is STANDING is notice to the conductor that the car must be BACKED.

3. Four quick taps of the bell is the signal for the CONDUCTOR'S AID.

4. A succession of quick taps of the bell is the signal that the trolley pole has left wire.

5. Signal conductor by one bell for each passenger boarding car by front platform.

SPECIAL: YOU MUST KEEP YOUR HAND OFF THE BELL CORD UNTIL ALL PASSENGERS ARE SAFELY ON OR OFF, AND NEVER SIGNAL CAR TO START UNTIL CERTAIN THAT IT IS SAFE TO DO SO.

DEPOT MASTERS

Depot masters report to and receive instructions from their superintendent.

They will have charge of the depot, and the company's property at which they are located, and of all the persons employed therein, unless otherwise instructed.

They will be held responsible for properly conducting the company's business, and the safety of the property entrusted to their care.

They must attend to the proper arrangement of cars, and see that they leave promptly on time, and that all cars are properly cleaned, heated, lighted and inspected.

They must be familiar with the RULES, REGULATIONS and REQUIREMENTS of the service, and see that depot employees are prompt and efficient in the discharge of their various duties.

They must see that conductors and motormen are ready for duty at the time required, and are provided with all the appliances necessary for the safety and proper management of the cars.

They must preserve order about the depots, preventing confusion, delays, lounging, drinking of liquors and eating in cars.

They must not allow conductors and motormen to go on duty unless they present a cleanly appearance and are properly uniformed.

They will report to their superintendent any rudeness, incivility or any violation of the rules and regulations that may come under their observation.

They must require all employees to deliver at their office all articles left in the cars by passengers. They must see that the date and finder's name is marked on each article, and forward same to the "Lost Property Department at the Main Office," where all persons applying for same should be directed.

No transfer of cars or property shall be made from their depot without a written order from proper authorities, and they must immediately notify their superintendent when the transfer is made.

They must see that all the blank forms and reports used in the transaction of the company's business are properly filled out and forwarded.

They must see that the conductors turn in their money, transfer tickets, etc., to the receivers at the depot, and should any conductor fail to do so, they must call him to an account at once.

They must see that the daily reports of conductors and motormen are properly made out, and that the correct number of trips run during the day be accounted for.

They will see that all shorts are collected and returns made as directed by the accounting department.

They must not permit a car to start from depot with a conductor or motorman who is under the influence of liquor, or unfit for duty, nor fail to report such occurrence at once to the superintendent.

They must arrange to be notified in case of fire, blockade or severe storms, and must go at once to the place and take charge of the operation of the lines until the arrival of the superintendent.

In case of snow storms, they must arrange for snow plows and sweepers to be run, and the lines kept open. They must arrange to sand the rail when necessary, giving special attention to grades, junction points and surface railway crossings.

Any defects in track or overhead wires or holes between or near our tracks must be reported to proper authority at once, and necessary precautions taken to avoid accidents.

RECEIVERS

They will report to and receive their instructions from the division superintendents; they will obey the orders of the depot master and comply with instructions received from the accounting department.

INSPECTORS

1. Inspectors report to and receive instructions from their superintendent.

2. They will be assigned to different lines, and will see that cars are operated on schedule time, and properly spaced, and must have at all times while on duty a copy of the RULES and REGULATIONS governing EMPLOYEES. They must be conversant with every rule, render all assistance in their power in carrying them out, and report any infringement of them to their superintendent.

3. They must have a copy of the time-table and be familiar with the running time and time points. They will take charge when blockades occur, and removement of cars will be under their direction, except when superior officer is in charge.

4. They will confer with their superintendent in regard to the operation of the time-table, and bring to his notice such changes that in their judgment the service requires. They must keep themselves informed of any entertainments, exhibitions or gatherings at churches, theaters or halls along the line, and bring the same to the notice of their superintendent in time for him to make arrangements for the proper handling of the same. At all times endeavor to improve the service. If anything comes to your attention which in your opinion would tend to do this call it to the attention of your superintendent at once.

5. They will make frequent examinations of the "bulletin boards" and keep themselves informed of all instructions issued by the officials of the company, and see that they are complied with.

6. They have authority to relieve conductors and motormen from duty on the road on account of sickness or any other cause that would prevent them from properly doing their duty.

7. The condition of the cars as to whether they are properly cleaned, heated, ventilated and lighted, should be noted, and see that all signs are properly displayed.

8. When a car becomes disabled have the following car push it to the first turn-out and transfer passengers to the next car of the same line. After the delayed cars have been passed, have it hauled to its proper depot. When a car is being pushed, run slowly and with proper care, and see that the reversing switch of the disabled car is set in the direction that the car is moving.

During rush hours they must remain on the part of the line assigned to them, and must not leave unless it is absolutely necessary to take a car to the depot.

9. If any buildings are to be moved across the tracks, or if there are any excavations to be made under or at the side of the tracks, the same must be reported to the superintendent at once.

In the event of a snow storm, whether on or off duty, they must place themselves in communication with their superintendent at once, who will advise them as to the time their services are required.

10. They must be familiar with the transfer points of all lines, and also the names and location of streets on or near which our lines run, so that they can give intelligent information to the traveling public when asked.

11. They will report all defects in track or overhead work to their superintendent.

In case of break in the overhead line, or serious derailments of cars, you will at once notify the nearest emergency station, stating cause and location of trouble.

When necessary to call out emergency crews, use the nearest telephone. Should it happen to be "pay station," ask for a receipt and turn same over to your superintendent, who will refund the amount paid.

12. They will make a careful count of the passengers on every car they board, and compare same with the REGISTERS. In case of any discrepancy they will take same up with the conductor, and have the matter satisfactorily explained at the time, reporting the occurrence to their superintendent.

13. Each inspector should be supplied with the following equipment:

One pair of pliers.
One pair of rubber gloves.
One screw driver.
One small monkey wrench.
A number of fuses; also clips for overhead wire.
Plugs for connections of electric lights; also ten feet of insulated wire, to be used in case of grounds or cars off the track.

14. Let the conductors and motormen know that you desire to aid them. Be careful and avoid giving offense when calling their attention to any neglect of duty; also, refrain from all unnecessary conversation with employees on duty.

15. Inspectors should be familiar with the different types of motors and controllers, and be able to remedy slight defects occurring on the road.

16. They should give special attention to sanding the track on hills, junction points and terminals, when the rail is in a slippery condition, and must see that switches and grooved rails on curves are kept clean.

When accidents occur, they will assist the conductor in obtaining the names of witnesses, so as to avoid unnecessary delay: also, get any information which you think would be beneficial to the company. Whenever an accident occurs under your observation, or of which you may learn, it will be your duty to go at once to the nearest telephone station and notify the claim department, giving all the facts as far as you are able to procure them; in addition to this, you will make out a written report on the regular "accident blank" and see that the same is forwarded to the claim department. It is very important that there be no exceptions to this rule, however slight the accident may appear to be at the time. Even if the injured person seems to be entirely at fault and the injury seems to be but slight, you are to make a full report as stated above. This must in all cases, if you can obtain the information, include the number of the car, the name of the motorman and conductor, together with the names of such witnesses as you may be able to discover.

17. When a fire occurs that interferes with the operation of the cars, the TERMINAL DEPOTS OF THE LINES AFFECTED must be notified; also, the EMERGENCY CREWS OF THAT DISTRICT.

18. You will be instructed by your superintendent at what points and under what condition delayed cars will be turned back.

19. Should the armature, terminal wires, brush holders, brush or any part of the motor break, cut out the motor so disabled.

Never attempt to cut out a motor while a car is in motion or the current on.

Never carry any metal of any kind in the upper pocket, for in bending over it is likely to fall out and drop on motors.

20. In case of storms, when it is noticeable that the power is beginning to run low, in all cases shut off the heaters to the first notch, and in case the power continues to diminish cut them out entirely.

21. MAIL AND PARLOR CARS: Inspectors must do everything in their power to facilitate the movement of these cars.

GENERAL RULES FOR CONDUCTORS AND MOTORMEN

1. Conductors and motormen report to and receive their instructions from their superintendent. They must also comply with instructions of depot master, starters and inspectors.

2. When first appointed conductors and motormen are to serve as extras in turn according to time of appointment.

3. Conductors and motormen must be neat and clean in appearance, wear the uniform and badge prescribed by the company, and have a watch in good running order, which must be kept exactly with the clock at their depot. The uniform buttons furnished conductors and motormen will remain the property of the company and must be surrendered when they leave the service.

4. Compensation will be a certain rate per day, or per trip, according to line where employed.

5. When vacancies occur, conductors and motormen will be advanced in seniority according to their standing on the list.

6. Conductors and motormen having regular or swing runs must report to the starter verbally at least ten minutes before starting time. If starter is not at his post, they will wait his return and then report.

7. Extras must be in attendance at depot before starting time of first car in the morning, and be prompt in attendance of all changes thereafter during the day.

8. No conductor or motorman will be excused from duty until he sees his name is posted on the excused list, except in case of sickness, when word must be sent to starter at depot by special messenger. No telephone or telegraph messages will be accepted.

9. Under no circumstances must a conductor and motorman be away from the car at the same time unless properly relieved.

10. When any fire department vehicle, ambulance or the company's emergency wagon is running in the street, cars must be stopped until such vehicle has passed. Avoid as far as possible stopping on a cross street or alongside of standing cars or wagon.

11. Bulletin board must be consulted before starting and at the end of each day's work.

12. The official badge must never be worn by any one except to whom it is issued.

13. Motormen and conductors will be held responsible for all damage caused by their neglect or carelessness.

14. CHARGE OF CARS: The conductor has charge of the car and the motorman is under his direction and will obey his orders (so far as reasonable). In case the motorman fails to observe any of the RULES and REGULATIONS, the conductor must report the case to the superintendent at once, or he will also be held responsible. He will report to the superintendent the name of any motorman who claims or asks from him, either directly or indirectly, any fee, gift, treat, cigar or any entertainment whatever.

15. In the absence of the conductor, the motorman is held responsible for the car and its management, and must notify the conductor the number of passengers who entered car in conductor's absence.

16. STEAM RAILROAD CROSSINGS: Motormen must bring their cars to a full stop, not nearer than twenty-five feet to the nearest track, and at a heavy descending grade toward steam track not nearer than fifty feet, except where derailing switches are used, when special instructions will govern. The motorman must not proceed with his car until the conductor has gone ahead onto the steam railroad track and looked both ways, and given him signal to start. The motorman will also observe the utmost watchfulness for approaching trains, and should, in his judgment, danger be imminent from any source, he will refuse to start his car until the crossing is clear and free from all danger. When the conductor has gone ahead of car, before starting, the motorman will look back and see that there is no one getting on or off the car.

17. STARTING AND STOPPING: Except in case of emergency, brakes must be applied gradually so as not to throw standing passengers. When stopping, release the brake a little so as to make an easy stop; never slide the wheels when it is possible to avoid it, and do not apply the brake when the current is on. Motormen are required to use care and judgment in running the car, to start and stop with as little jar as possible, and in no case where the car has been stopped, to start until the conductor has given the proper signal with bell.

18. SIGNALS: If for any cause the motorman has stopped the car without a signal, and a passenger should want to get off or on, the conductor will give the signal to stop the same as if the car was in motion. The motorman must wait for conductor's signal before starting the car, whether he has received a signal to stop or not.

TRANSFER SIGNAL: Four taps on foot gong in quick and regular succession is signal to conductor ahead that a passenger wishes to transfer to his car.

The conductor will give this signal from the rear gong and the motorman will repeat it from the forward gong.

19. CONFORMING TO TIME-TABLE: Conductors and motormen must conform to time-table in running their cars, and be particular in making the time points as laid down on the time-cards and avoid all loitering on the line.

20. If any motorman shall at any time attempt to diminish the receipts of any conductor by increasing the speed of car or not promptly stopping for passengers upon the signal of the conductor, or shall directly or indirectly harass any conductor or be guilty of any misconduct, the conductor will at once report the same to the superintendent.

21. Passengers: It is the duty of both conductors and motormen to be on the lookout for passengers. Motormen must never pass by passengers unless instructed to do so by the conductor; they must then shout to them, "Please take the car behind," at the same time pointing to the rear.

22. ANNOUNCING ROUTE: When on the stand at terminal points and when approaching passengers at night, conductors and motormen must announce in clear and distinct tone of voice the destination and route of their car.

23. AVOID ACCIDENTS: When passengers attempt to get off or on the car while it is in motion, call out to them, "Please wait until the car stops." When passengers are alighting from your car and you see a car approaching in an opposite direction, notify them politely to look out for the car on the other track.

24. RIDING ON FRONT PLATFORM: No one except the officers of the company and its inspectors will be permitted to ride on the front platform of closed cars under any circumstances.

25. Conductors and motormen while on duty must not shout, signal or telegraph to motormen or conductors on passing cars, nor carry on any unnecessary conversation with each other or any other person. Information concerning the affairs of the company must not be given to any one, except its officers. READING while on duty is PROHIBITED.

26. SITTING DOWN: Conductors and motormen on duty are not allowed to sit down while car is in motion.

27. SIGNS: Before leaving car house or end of route, conductors and motormen must see that the signs are properly adjusted, thereby showing the destination of the car.

28. HOUSING CARS: When your car is run in the house in the day or night, always shut off lights, remove your trolley from the wire, and turn up seats of closed cars before leaving the car.

SPECIAL RULES FOR MOTORMEN

1. Motormen will be expected to become familiar with the electrical equipment of the cars, that they may be able to meet emergencies when they arise on the road.

2. SPEED OF CARS: Motormen must regulate the speed of cars so as to be nearly uniform with the time card as possible, and not lose time on one portion of the road and make it up on another. If you should unavoidably get behind time, it is not to be made up in the next two or three blocks by a spurt, but gradually by running slightly faster.

3. VIGILANCE: When the car is in motion, responsibility for safe running rests with the motorman. Appliances are furnished for controlling the car quickly and accidents CAN AND MUST BE AVOIDED.

The exercise of good judgment, avoiding risks, and strict compliance with the rules and orders will prevent accidents.

The moment any person, wagon or other obstacle is seen on the track, motormen must bring their cars under perfect control. Never take any risk in so important a matter and do not approach any vehicle closer than twenty-five feet.

4. Motormen will sound the gong at least twice, seventy-five or one hundred feet before passing cross streets along the line, when approaching a standing car, on crowded thoroughfare and at any time when it is necessary to call attention to movement of car. Should the first signal be unheeded, it must be repeated as often as necessary. No car shall be run past a standing car at a greater rate of speed than four miles per hour.

5. SPACING OF CARS: Motormen must keep their cars properly spaced; when practicable this space should not be less than.....feet, except on.....

6. GRADES: In descending grades, motormen must allow car to coast, using power as little as possible; they must be very careful to always keep car under control, never allowing it to run down grade faster than motors will take it up same grade.

Rolling or coasting with brakes off is good practice on slight grades, and should be done whenever possible.

7. SAND BOXES: Under no circumstances must a motorman pass or leave the car house in either direction without a sufficient quantity of sand in the box to answer all wants until he reaches another standing station. The use of the same, except in cases of absolute necessity, is positively forbidden.

8. BRAKES: Except in cases of emergency, brakes must be applied gradually, so as not to throw standing passengers. When stopping, release the brake a little so as to make an easy stop. Never slide the wheels if it is possible to avoid it, and never apply the brake when the current is on.

9. RIGHT OF WAY: Cars must not pass on curves. When both reach the junction at the same time, the car on the outside track has the right of way. When two cars arrive at the junction at the same time the car of the main line will have the right of way.

Never run against a switch point when meeting a car, but slacken the speed of your car and allow the car moving in the opposite direction to pass before striking the switch point. This rule refers particularly to all crossovers and curves having switch points facing opposite to that in which your car is going.

10. SIGNALS: Before reaching a curve the conductor will signal you by ringing your bell twice to go ahead, if he has the trolley cord in his hand. Should you fail to receive the signals, ring the conductor's bell twice. If you fail to get the go-ahead signal, stop your car until you do.

11. SWITCHES AND CURVES: Motormen must not pass over any switch until they know that the tongue is properly turned. Speed must be reduced to two miles per hour on curves, switches and crossings. Stops must not be made on curves except to prevent an accident. It must be remembered that there is a switch in the trolley wire, and until the trolley wheel has passed it and the signal given by the conductor, current must not be turned on.

12. STOPPING AND STARTING: Motormen are required to use care and judgment in running the car; to start and stop with as little jar as possible; and in no case where the car has been stopped, to start until conductor has given proper signal with the bell.

13. OBSTRUCTIONS: Motormen must not run over any wire, stones, sticks or other obstructions, but see that the same are removed before proceeding.

In all cases where the streets are dug up for sewers, water pipes, paving or where otherwise dangerous, no risks are to be taken at any time or under any circumstances, but be sure of safety. In passing men on the street, motormen must proceed carefully.

14. PASSING SCHOOLHOUSES: Motormen must use the utmost care and caution while passing schoolhouses during recess or when children are assembling or leaving school; the car should be under perfect control and the speed materially slackened.

15. LEAVING CAR: Motormen must never leave platform of car without taking controller handle with them, throwing off the overhead switch and applying brakes. They must be careful to see that the hands point to the "OFF" mark before taking off controller handle.

16. SNOW AND WATER: During or after a rain or snow storm, when tracks are covered with water or slush, motormen must be careful about running through it. Never run car fast enough to splash the water up on the motors, and turn current off, if possible to run without it.

17. HEADLIGHTS: Motormen must keep the headlight glass clean and see that headlight is properly lighted when car is running on the road after dark.

18. FUSES: Motormen must never leave the car house without three extra fuses. They must examine the fuse boxes and see that they are supplied with the regular ampere fuses provided by this company.

NEVER use heavy copper wire or anything of that sort for a fuse.

19. CARE IN STARTING CAR: Before starting car from terminus and before the trolley pole is allowed to touch the trolley wire, see that the reversing switch is set correctly and controller on "OFF" stop. Then close the overhead switch ready to start. Release brakes before starting car. Apply current gradually until car starts. SUDDEN APPLICATION IS LIABLE TO BLOW FUSES AND STRIP GEARS. Never throw the controller on the last point if the car does not start on the preceding ones.

20. CURRENT: When current is accidentally cut off from power house, or by trolley leaving wire or any other cause, place controller handle on "OFF" stop. Locate trouble before starting car. To ascertain if current is off car, switch in the lamp circuit.

If there is no evidence of current, throw on the lamp circuit and notice the other cars. If they are moving, the trouble is in your car. In case the car is on a dirty rail, take a piece of insulated wire and make a good connection between the rail and the wheel. The rail may be dead, so in this case make connection between the wheel and the nearest rail. Be careful to break contact with the wheel first; otherwise, a shock will be received.

Try both controllers, and if one works the trouble is probably due to poor contact in the other. If neither controller works, ascertain whether the fuse has been blown. If the fuse is blown, remove the trolley pole from the wire before putting in a new one. Should a new fuse be blown out, pull down trolley and be towed to depot.

21. REVERSE. Never reverse the switch except in cases of extreme necessity, such as avoiding a collision or running over a human being. If there is time apply the brake and then reverse slowly to first point; if not, reverse to first point instantly and apply the brake vigorously at the same time, but let it off as soon as the car begins to move backward.

Reversing is a severe strain on the apparatus, especially when the car is under high speed, and should not be resorted to except when absolutely necessary.

22. INFORMATION: You must apply to the shop foreman in charge of cars for any specific information regarding operation which you do not thoroughly understand, such as replacing blown

fuses, tension of trolleys or any part or parts of machinery which is liable to get out of order during service.

23. CONDITION OF ELECTRIC APPARATUS: Examine the bearings of motors as often as possible at terminus of line. If they are too warm, report this fact on first return to depot. Before touching any part of motors, wire or lightning arresters be sure the trolley is off, or overhead switch turned, as otherwise you might get a shock.

The armature, field coils, diverter, coils and commutator should never get so hot that it is impossible to hold the hand on them. Never try to run a motor that is seriously out of order, as it is liable to greatly increase the trouble.

PENALTIES:

Following are considered good grounds for dismissal from service: Insubordination, failure or refusal to obey orders or rules of the company, dishonesty, lying, violent temper, the habitual use of profane or obscene language or slovenly personal habits, drunkenness, drinking intoxicating liquors while on duty, smoking, reading newspapers, discourteous conduct toward passengers, failure to collect or register fares, making false or dishonest returns; failure to make out promptly report of accidents, running into an open switch, rear-end collisions, reckless running, running ahead of time, permitting unauthorized persons to operate car, incompetence or inattention to duty.

For other offenses not meriting dismissal the penalties should be reprimand, or assignment for a limited time to extra duty. Men should never be suspended without pay. It encourages dishonesty, hatred and discontent. If a man is not amenable to reproof and is not in earnest in his endeavor to render better service, his service is no longer desirable.

A written record should be kept of every employee from the day he enters service. This record should contain date and brief statement of every failure to report for duty, neglect of duty, disobedience of orders, accidents, etc.; in other words, a brief record of his shortcomings. This should be frequently consulted by the manager, and employee duly cautioned to mend his ways.

SPECIAL RULES FOR CONDUCTORS.

1. POLITENESS: Conductors must not use profane or improper language while on duty in or about the depot, and they must be civil and attentive to all passengers, giving special and proper attention to ladies, children or elderly persons, but must not unnecessarily place their hands on passengers who are getting on or off the car. As far as possible provide seats for all passengers, and when necessary request passengers to sit close together on the seats.

2. SETTING REGISTERS: You must set your REGISTER "UP" or "DOWN," "IN" or OUT," in accordance with the direction the car is going, and must turn register back to "ZERO" before leaving on any half trip.

Special instructions will be issued as to which direction is UP or DOWN, IN or OUT.

3. PROMPT COLLECTION AND REGISTERING OF FARES: You must promptly collect and register the fares of all passengers at the rate of five cents in cash for each adult (except policemen and firemen in full uniform, inspectors, conductors, motormen and switchmen in employ of the company when prescribed uniform, cap and official buttons are worn), and three cents for each child between the ages of three and twelve (except on..... lines, and..... and.....) or one of the company's passenger tickets; also, transfer tickets properly punched.

Conductors will be required to enter on the back of their day card the "BADGE NUMBER" of employees passed free in accordance with the above rules. When collecting fares in crowded cars, call out, "FARES, PLEASE."

4. COUNTING PASSENGERS ON REAR PLATFORM: You should never go inside the car, or to the front, without first counting the number of passengers on the rear platform, and if more are there on your return, call out "FARES, PLEASE," without addressing any one in particular.

5. REFUNDING FARE: In case a passenger pays fare and after your registering same passenger finds that he is on the wrong car and makes a demand for the return of his fare, use your judgment as to whether it is right and proper to return it. If fare be refunded, you must not under any circumstances fail to REGISTER all subsequent fares, but must report on the back of your day card the trip, the number and time of day of such occurrence and deduct same from the receipts of that trip.

If you ring for more fares than you receive and you see your mistake, such mistake can only be corrected by reporting to the office.

6. TRANSFERRING PASSENGERS: When passengers are transferred from one car to another at any place other than the regular transfer point, the number of persons transferred will be noted, with both car numbers, on the back of both day cards by conductors engaged in the transaction; no fares are to be collected by the conductor to whose car such transfers are made, but they must be registered. CONDUCTOR MUST REMAIN IN CHARGE OF DISABLED CAR UNTIL RELIEVED.

CONDUCTOR ON DISABLED CAR MUST SEE THAT PASSENGERS have received transfers requested by them at the payment of fare.

7. CONDUCTORS' DAY CARDS; TRANSFER PADS AND PUNCHES: A day card will be furnished by the starter, on which you must enter the number of the car, number of persons carried on each half trip, the time of arriving at either end of the route, state of register as noted on card, your full name and name of motorman. You must make up your day card at the end of the route, and will be held responsible for the fare of each person riding on the car (except as provided in rule 3) and the accuracy of the time as noted on day card; such day cards to be turned in to the receiver at the depot when day's work is finished, or on swing runs at the end of each swing.

Transfer pads and punches will be furnished by the receiver, and must be turned in to them at the end of each swing or day's work, as the case may be. You will receive from them a check with the number of pad on it, which you must present next day when receiving all transfer pads and punches.

Cash collected must be turned in to the receiver at the end of each swing or day's work as the case may be.

Transfer tickets collected must be turned in at the end of each trip.

8. FREE PASSENGERS: Not more than five policemen, firemen or employees (in full uniform) will be permitted to ride free on same car at any time (except in case of policemen and firemen going to a fire).

When more than this number board the car you must request them to take the following car, giving the reason. If they insist on riding you must collect fare.

Employees while riding free must not smoke or occupy seats to the exclusion of passengers.

9. CHANGE OF CAR: Should a conductor for any reason whatever change his car after commencing his day's work, he must note the number on his day card opposite the half trip on which the change occurred.

10. EJECTMENT FROM CARS: You must never eject a person from the car for disorderly conduct or non-payment of fare, unless you get the names of witnesses to sustain you. Use no more force than absolutely necessary in making ejectments, and the car must first be brought to a FULL stop. When you are uncertain whether passengers have paid fare or not, and they insist that they have, you will give them the benefit of the doubt, making notation on back of card.

11. RESPONSIBLE FOR ARTICLES: You must not take charge of or become responsible for any basket, package or article which may be brought on car, except articles and messages placed in your care by some officer or authorized employee of the company.

12. LOST ARTICLES: You must deposit all articles found in your car with the STARTER, noting on an envelope attached to the article, YOUR NAME, THE NUMBER OF YOUR CAR, TRIP, DATE and TIME OF FINDING.

13. PEDDLING: You are to prohibit from selling on the cars, CONFECTIONERY, BOOKS, PICTURES, FLOWERS or any other article.

14. POSITION OF CONDUCTORS: When not otherwise engaged they must be on the rear platform and be on the lookout for passengers who wish to take or leave the car.

NEVER START THE CAR UNTIL THEY ARE ON OR OFF, and try to prevent passengers boarding or leaving the car while it is in motion, using great caution to prevent them from being injured by passing cars or vehicles when leaving cars. You must not signal the motorman to go ahead until aged or infirm persons are seated or landed on the street.

You must keep the rear platform, doorway and rear brake free from obstruction as far as possible, and not allow passengers to stand in front of the controller box. When the platform becomes crowded, request passengers in a polite manner to step inside of car, and at no time have your back to the door. When compelled to make change in car, face the rear platform.

Do not collect fare when approaching any railroad crossing, curves, switches or transfer points.

On closed cars when standing passengers crowd the rear door, you will request them to please step forward in car.

While on the stand, you must be on the rear platform, to solicit passengers and give information.

15. CONDITION OF CARS: Conductors must use good judgment in keeping their cars neat and clean while in their charge; waste, etc., used in cleaning, must be kept out of sight.

16. GRADES: When on down grade you must be ready to apply brake in case of accident.

17. CHANGE: Each conductor must provide himself with two dollars in change before going on duty.

18. GATES AND CHAINS: Front and rear gates on closed cars on the side between the tracks must always be kept closed and securely fastened when running on the road. On open cars the chains and rods must be kept fastened on the side between the tracks. When gates or chains or their fastenings are broken or out of order, conductor must report it to starter at depot immediately on arrival.

19. DISCRETION: In all matters not fully covered by these rules (in your dealings with your passengers and others with whom your duties bring you in contact), you will use your own judgment.

20. ACCIDENTS: The starter will furnish conductors with blank form of report, which they must be very particular to fill out according to the following instructions:

GIVE DATE OF ACCIDENT.
THE EXACT TIME IT OCCURRED.
THE EXACT SPOT OF ACCIDENT.
THE FULL NAME AND ADDRESS OF PARTY INJURED, IN EVERY CASE; THE OWNER OF PROPERTY DAMAGED OR DOING DAMAGE TO COMPANY'S PROPERTY.
THE NATURE OF ACCIDENT AND CAUSE FOR ITS OCCURRENCE.
ASCERTAIN THE EXTENT OF INJURIES OR DAMAGES AS FAR AS POSSIBLE BEFORE LEAVING THE SPOT.
GET THE FULL NAMES AND ADDRESSES OF ALL PASSENGERS AND BYSTANDERS AND EMPLOYEES AS FAR AS POSSIBLE, AND DO THIS WHETHER THEY SAW HOW THE ACCIDENT HAPPENED OR NOT.

Conductors must be very particular in this respect, as it is one of their most important duties, no matter how slight the accident may be.

Under "REMARKS," GIVING FULL PARTICULARS, making a true statement of all and everything known about the occurrence; also, what the motorman knows about it.

Any conductor omitting this important duty will be suspended or discharged.

Conductors must not talk about or give any information whatever about any accident to any person other than the proper officer of the company.

The report must be delivered at once to the DEPOT MASTER upon arrival at the depot.

21. CALLING OUT STREETS: Conductors must announce the names of streets, railroad crossings, ferries and public buildings when passing them, and on arriving at transfer points, the points to which transfers are made.

22. SIGNS OF CARS: Cars will invariably run through according to signs on cars.

23. WHERE TO ALLOW SMOKING: On open cars, smoking will be allowed on three rear seats. On closed cars, smoking will be allowed on.....

24. LEAVING CAR: Never leave your car to make returns at the office or for other purposes without notifying the motorman, to insure safety of passengers and care of car.

25. Request passengers to not place their feet on the seats.

26. THUNDER STORMS: In case of thunder storm, turn the lamp circuit on. While making a stop for a length of time, conductors must draw the trolley wheel away from the wire until ready to start again.

27. Conductors must have the trolley pole follow the car in all cases. When a motor car is being towed, the trolley pole must be drawn down near the top of car and tied to the dashboard.

Conductors must never remove the trolley from the wire until the power is shut off, nor change the direction of trolley pole until the car is fully stopped. Conductors must never put the trolley on the wire until the motorman is at his post on the front platform.

28. When two cars are coupled for running, the signal for starting must be given by the conductor on the rear car first, and promptly repeated by the conductor on forward car; each conductor being careful to know that passengers are safely on or off his car.

29. TROLLEY; CARE OF SAME: Conductors must be on the rear end of their cars when passing an overhead switch, track crossover or switch, with hand upon the trolley rope. Should the trolley leave the wire, the conductor must at once pull down the trolley and signal the motorman to stop. After the trolley is on the wire, ring two bells for the motorman to start, first looking carefully around and through the car to see if any persons are leaving or boarding the same. They must see that passengers keep their hands off of trolley cord.

30. LAYING UP CARS: When cars are laid up, conductors when possible must reverse the trolley ready for starting and remove it from the wire.

31. ELECTRIC HEATING APPARATUS: You must not handle these at all, or change the position of the regulator governing the heater. Should the heater be out of order, or the car too hot or too cold, it should be reported to the first inspector you meet, or to the depot master or starter.

32. OPERATING CARS: Conductors must never, under any circumstances, operate the controlling mechanism of the car.

33. LIGHTS: It is your duty to test the lights and see that they are in good order before leaving depot, and you also must be very careful and particular to see that the headlight (in the direction your car is moving) is lighted, and must see that your car is provided with a switch light plug before leaving depot.

Electrolysis of Cast Iron Water Pipes at Dayton, Ohio *

BY HAROLD P. BROWN

The injury of water pipes by electrolysis is at present so well understood that my only excuse for again calling your attention to the subject is found in the peculiar and unusual conditions disclosed at Dayton, Ohio, in an examination made last July. This city has a population of about 90,000, fully 80 miles of electric roads, and over 225 cars. Electrically considered, it is cut into four parts by the Stillwater and Mad Rivers, which unite to form the Great Miami, and by Wolf Creek, meeting the Miami 2 miles or so below. Three of these parts are further subdivided by canals.

The business portion of the city is thus practically located upon an island, and the electric current used by the street cars must follow the rails across bridges or pass on the pipes under the river to get back to the power house. Practically 90 per cent of the entire current from the business portion of the city crosses the river on one 12-in. and one 10-in. water pipe, one 8-in. gas pipe and one 10-in. natural gas pipe.

The two main power houses are about ¼ mile apart on the west side of the Miami River. A third but smaller power house is on the east side of the river, but quite a distance south of the business portion of the city. Two other roads have their terminals in Dayton, but their power houses are elsewhere.

Following my ordinary methods, a switchboard was mounted on a wagon, and provided with a complete set of Weston electrical instruments, reading from 0.0001 volt per degree up to 750 volts, and from ½ amp. to 150 amps. At each hydrant along the electric roads of the city a reading was taken from the trolley wire to each of the four rails, from the trolley wire to the pipe and from the pipe to each of the rails. These measurements were made in sets of three in such a manner that any poor contact or any defective condition of the testing apparatus was at once indicated and corrected. The instruments had recently been compared with standards, and were known to be correct.

Over twenty-five hundred electrical measurements were made, and the results of the readings were plotted out upon a map of the city. Fifteen excavations were made, and the measurements repeated on the pipes themselves. A careful examination was then made of the physical condition of the pipes by J. H. Shaffer, metallurgist; and chemical analyses were made of samples of soil and the metals of the pipes and incrustations upon them. These were made by E. E. Brownell, E. E., and Jas. O. Handy, chief chemist.

These electrical tests showed that the pipes in the business portion of the city, 1½ to 2 miles from the power houses, were positive to the rails, and therefore subject to electrical corrosion. The highest readings in this part of the city were 4½ volts near Fifth Street Bridge and near Washington Street Bridge. Near the power house on the west side of the river the pipes were 9 volts positive to the rails, and the danger district extended about three-quarters of a mile to the west. In the southern part of the city the highest positive reading was 2 volts in front of the Oakwood Avenue power house.

In making the electrical tests the time of the reading was noted, since the pressure depends on the amount of load carried at the power house, and will vary correspondingly in all parts of the city. For instance, in front of the power house of the People's Railway, on Washington Street, at 5 P. M., during the heavy load, the pipes were 9 volts positive to the rails, while at 2 P. M. they were but 6 volts positive.

* Abstract of paper read before the meeting of the American Society of Municipal Improvement at Washington, Oct. 21, 1898.

It was at once evident that the danger district was extremely large, since in the area in which the pipes are positive to the rails they are liable to injury. This was verified by the records of the water board, which showed a large number of service pipe renewals. Unless a remedy for the electrical condition of the pipes is very quickly applied in Dayton it is certain that a large amount of excavating, replacing of pipes and paving will need to be done.

Cast iron pipe is usually not affected by electrolysis, since the coating of adherent moulding sand and tar paint protect it. In the ordinary soil an iron pipe submitted to electrolytic corrosion is covered with a layer of iron oxide, which is a poor conductor of electricity, so that with a given pressure, the deeper is the layer of rust and the slower the rate of corrosion. But, to my surprise, the soil surrounding pipes in Dayton gives an entirely different reaction when a current passes through it. The tar seems to be no protection whatever, and the surface of the pipe in the danger district is changed into a soft, black material resembling graphite and easily cut with a knife.

This material is such an excellent conductor that instead of checking, it tends to increase the action by reducing the resistance of the path through which the current must flow in order to reach the rail. Moreover, the stones and pebbles near the pipes are actually electro-plated with the metal of the pipe, whether iron or lead. This condition I had never before seen, and, as far as I know, it has not been previously reported. Since my Dayton report was published I have received a letter from Dabney H. Maury, Jr., superintendent of the Peoria Water Company, Peoria, Ill., in which he states that he has encountered the same phenomena.

In order to electrically deposit a layer of metal two things are necessary; first, a liquid which will dissolve the metal, and second, an electrical current exceeding 0.01 of a volt in pressure flowing away from the metal through the liquid. The fact that the pebbles are electro-plated showed that both these conditions exist, but in order to prove conclusively that the soil itself did not injure the pipes a pipe surrounded by the same soil was uncovered in another portion of the city where there was absolutely no trace of an electrical current. This pipe was on Logan Street, near the Canal, the records showed that it was put down in 1874, while the pipe taken out at the west end of Fifth Street bridge had been in use ten years and exposed to electrolysis for four years. If the damage was caused by the soil itself this pipe would, of course, have been in a worse condition than the Fifth Street pipe, but the Logan Street pipe was apparently as good as new.

To make the comparison absolutely beyond criticism, a section of each pipe was taken out, chemically analyzed and mechanically tested. The chemical analysis of the iron pipes were nearly identical, and are as follows:

	Logan Street Pipe. Per Cent.	Fifth Street Pipe. Per Cent.
Phosphorus	.789	.800
Sulphur	.073	.057
Silicon	2.270	2.500
Iron	Not det.	Not det.
Carbon combined	.13	.24
Carbon graphitic	3.43	2.88

The samples of the incrustation of the Fifth Street pipe analyzed as follows:

	Per Cent.
Phosphorus	1.821
Sulphur	None
Silicon	Not det.
Iron	33.43
Carbon combined and carbon graphitic	7.12

This analysis showed that the percentage of iron was greatly diminished, while the percentage of carbon was more than doubled; careful investigation showed that the carbon was merely the amount originally in the pipe, the carbon being left, while a large portion of the iron had been carried away.

The chemical analyses of the soil showed that the solvent was produced electrically from carbonate of sodium and chloride of sodium in the soil. Neither of these by itself in the small proportion shown by the analysis would injure a cast iron pipe covered with tar, though, as is well known, a strong solution of chloride of sodium or common salt will rust wrought iron; but in the presence of even 0.01 per cent reduces the electrical resistance of the iron, and the passage of the current decomposes those salts and forms muriatic, or hydrochloric acid, which dissolves the metals. Having thus determined the cause of the trouble, it remained to fix its extent. Fifteen excavations were made in different parts of the city to determine how much electrical pressure is required to seriously injure the cast iron.

A pressure of 3 volts and less is found to cause a graphite coating not exceeding 1-32 in. in depth; the iron seems to be uninjured. From 3 to 4½ volts the thickness of the layer is increased in a ratio depending upon the length of time during which the pipe has sustained this pressure. With a knife or file soft spots can be found in a pipe from 1-16 in. to ¼ in. deep. With higher electrical pressures the extent of the injury is even greater. In all cases the damage is directly proportional to the pressure and to the length of time during which the current has been flowing; while it is inversely proportional to the distance between the rails and the pipes. In my opinion, all main and service pipes in Dayton are seriously injured where submitted to 3 volts pressure or more for two or more years when within 4 ft. of the rails. This would mean less than 1 mile of mains, but with lead or wrought iron service pipes the pressure limit should be as low as 1 volt. Chas. E. Rowe, secretary of the waterworks, however, feels that 17,513 ft. of mains should be replaced, at a cost of $77,000.

To determine what percentage of mechanical injury has been sustained by the pipes it was intended to compare the hydrostatic pressures required to rupture the Logan Street and the Fifth Street pipes, but defects in the apparatus employed prevented a fair test. The Fifth Street pipe, at 150 lbs. pressure, leaked through the corroded spots, while the other pipe was able to stand 300 lbs. pressure. Test bars were cut from the best portions of both pipes, and broken on a Riehle testing machine. The average transverse strength of the Logan Street pipe was 1800 lbs. per square inch, as against 1085 lbs. to the other. The tensile strengths were respectively 16,000 and 11,425 lbs., and the deflections were 0.25 and 0.20 in. Four years of electrolysis had robbed the Fifth Street pipe of about 30 per cent of its transverse strength and about 45 per cent of its tensile strength, and had caused it to leak at 150 lbs. pressure.

Since I wished to avoid any suspicion of unfairness, I asked the managers of each of the three leading electric roads to allow their experts to accompany me, and to check my instruments, methods and readings. This was cheerfully done, and I received from the gentlemen full information concerning their plants and connections, as well as every possible courtesy during my examination.

The rail joints on several lines of road had recently been removed, the rail ends brightened with the sand blast and the "cast weld" joint applied. This was done by the railways with an idea that it would reduce electrolysis, as well as make a fine mechanical joint. It was a success mechanically, but was an electrical failure, as was shown by tests of individual joints and by electrical measurements of several stretches of 1000 to 1200 ft. of the four rails and of the pipes below them. The measurements were compared with others made last February on same rails before the "weld" was applied, when very small bond wires were used on the rails. There was practically no variation in the results, as would have been the case had the "weld" possessed high electrical conductivity. I found that two of the rails were carrying no current whatever, while the other two carried but one-twentieth of the amount of the current on the pipes below them.

I feel confident that if the railroads would unite in the expenditure of $5,000 to $7,000 for the proper electrical apparatus and connections, all the water pipes in Dayton could be maintained negative to the rails. Then the pipes would harden, as is the case with the section of the pipe which I have brought to show you. Moreover, any further electrolysis that might occur would be in the opposite direction, and would therefore add a layer of metal to the pipes instead of injuring them. I will not here enter into a discussion of the electrical methods required in Dayton to obtain this result, but it is evident that no plan heretofore suggested for electrolysis prevention will effect a cure there, owing to the unusual conductivity of the soil and the peculiar division of the city.

I should like to offer a few comments and four or five practical suggestions. Do not imagine that because your pipes are not leaking and bursting that they are safe from electrolysis. If the electrical conditions are against them they are getting weaker day by day. On the other hand, do not antagonize the railway companies the moment that the subject of electrolysis comes up in your city. They are not intentionally injuring your property, and if a friendly talk is had and a joint investigation is made, you are likely to get the speediest and most satisfactory action. The railway manager is as much interested in stopping the trouble as you are; every pound of metal taken from your pipes means to him a heavy loss of power, increased investment for engines, boilers, dynamos and conductors, and if it is finally established by legal decisions that his current has injured your property he will have to settle the bill.

The best course for all concerned, it seems to me, is to take mutual action while that bill is small, and not wait until a bursting main during a fire spreads the loss over the entire community. The usual procedure brings a deadlock. The waterworks people discover signs of electrolysis, and at once pounce upon the railway managers. They either refuse to believe that they are responsible for the trouble and thus bring upon themselves a shower of threats, or they say that, although they cannot admit the fault is theirs, they are, nevertheless, willing, rather than earn the ill will of the public, to do anything in reason if the others

will only tell them what to do. Then the others suspect some cunningly hidden legal trap, and decline to give any directions whatever; and so nothing is done.

The following will be found practical suggestions:

(1.) Obtain complete and accurate information concerning the electrical, chemical and mechanical condition of your pipes, especially in the vicinity of the power houses. The trouble may be confined entirely to the lead in the service pipes and in the calking of joints on your mains, but even here serious damage may result if the matter is neglected for years.

(2.) Do not put down any more lead or wrought iron service pipes, as those are the first victims of electrolysis, and their replacing means ruin to pavements. Use instead wooden pipe banded with a close spiral of hoop iron and covered heavily with asphaltum. This will stand the heaviest pressure in use, and is not affected by electrolysis, since the hoop iron is low in conductivity and is not electrically connected at the joints. Its cost is said to be reasonable, and it has a successful record of many years' service.

(3.) Use the same kind of pipe for new mains in any district in which a railway power house is likely to be erected, and heavily paint the red calking of cast iron mains, using asphalt or petroleum wax.

(4.) In the danger district along the lines of electric roads and on intersecting streets put into your water and gas mains two or more consecutive lengths of those wooden pipes, so as to break the electrical continuity of the mains, and thus make their resistance greater than that of the rails. Fill in the space around them with broken stone and connect with drain, if possible.

(5.) Midway between the wooden sections on each main attach insulated pilot wires, leading to a central office. Connect similar wires to the rails nearest the pipe wires, and make daily electrical tests at times of heavy load. If any section shows positive to the rails cut it at once into smaller sections, and call upon the railway to rebond its line upon that street. This, with the proper electrical management of the railway feeder wires and apparatus, will effectively protect your mains.

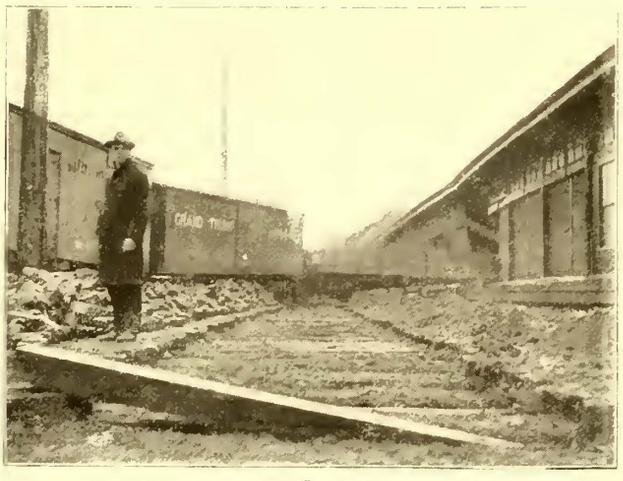
Chicago's Street Railway Fight

Some two years ago charters were granted by the Chicago City Council for numerous lines of street railways paralleling in a measure those of the Chicago City Railway Company. The new company was known as the General Electric Railway Company. Its lines enter the down-town district by way of Dearborn Street, Plymouth Place and Custom House Place. At the time of the granting of the franchises the new company encountered great opposition and the proposition lay dormant for two years or more, when on Oct. 29, at midnight, an army of men was thrown on the work with the view of completing a mile or more of track before Sunday night. This would easily have been completed had not active opposition been encountered. This opposition, instead of coming from the Chicago City Railway Company, as had been expected, struck as a veritable cyclone from the direction of the Chicago and Western Indiana Railroad Company, which is the owner of an extensive terminal system in the city. When it is stated that the route of the General Electric passes the freight houses of the company mentioned the reason for the Western Indiana's opposition becomes apparent.

The first move by the steam railroad company was the cutting of one of its yard tracks and the wrecking of several freight cars, which were thrown across the street railway company's right of way in Plymouth Place, between Taylor and Twelfth Streets. This occurred about three hours after work had begun, and a few hours later a similar wreck was thrown across Dearborn Street, between Fifteenth and Sixteenth Streets. The accompanying illustration shows the extent of the effort made to stop the work of the street railway company and the contractors. The purpose of throwing out these wrecks was to scare off the contractors until an injunction could be served. When it became apparent to the railway company that the expensive wrecks would not be effective it set about to procure an injunction, which it succeeded in having served about one o'clock Sunday afternoon, thus stopping further work for that day at least. However, during the thirteen hours' work the contractors succeeded in laying about three-quarters of a mile of track, and a storage battery car was put in operation on one stretch about half a mile in length, from which it would appear that had the contractors been given three or four hours more, even the injunction would have been of no avail.

The following Wednesday the original injunction was dissolved, and five minutes thereafter more than 300 men were again at work closing the gap left open when work stopped the Sunday previous, and the mile or more of track originally contemplated was in successful operation. The work involved the taking up of granite block pavement laid on macadam and the laying of one reverse and two plain right-angle curves and one cross over, the special work for which had been prepared previously. The General Electric Railway Company was represented by Fred. H. Fitch. The contractor was the Electrical Installation Company, which organized and prepared for the work on less than thirty-six hours' notice.

There are now several injunctions on other disputed portions of the road, all of which are to be argued shortly in the higher courts. Withal, it is a merry war, with the chance apparently that the General Electric Railway Company will win the fight, notwithstanding the power of the opposition arrayed against it. Work has been temporarily suspended, but will be resumed as soon as the network of injunctions has been untangled. That part of the road built, up to date, is in daily operation with storage battery cars, and is doing a splendid business.



OBSTRUCTIONS PLACED ON TRACK OF GENERAL ELECTRIC RAILWAY CO., CHICAGO

Tramways in France

From an extensive report on the French tramways published in a recent issue of the "Zeitschrift für Kleinbahnen" the following facts are obtained of the condition of the roads at the end of 1896:

Gage.	Km. in operation	Km. in construction
1. Standard Gage.		
a. Operated by mechanical power:		
For passengers and freight	46	20
For passengers and package transportation	248	27
b. With animal power:		
For passengers and freight	40	1
For passengers and package transportation	433	24
2. Narrow Gage Lines.		
a. With mechanical power:		
For passengers and freight:		
With 1-meter gage	1,394	990
With 0.60-meter gage	97	..
For passenger traffic:		
With 1.06-meter gage	3	..
With 1-meter gage	105	66
With .075-meter gage	3	..
With .060-meter gage	15	..
b. With animal power:		
For passengers:		
With 1-meter gage	37	11
For passengers and freight:		
With 0.060-meter gage	3	2
Total	2,424	1,141

It is said that the Siemens & Halske Electric Company of Chicago, Ill., is considering a proposition from the Japanese Government to form a syndicate with a capitalization of about $10,000,000 to install and operate electric street car lines, incandescent lighting and electric power plants in Japan.

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Special effort will be made to answer promptly, and without charge, any reasonable request for information which may be received from our readers and advertisers, answers being given through the columns of the JOURNAL, *when of general interest, otherwise by letter.*

Street railway news and all information regarding changes of officers, new equipment, extensions, financial changes, etc., will be greatly appreciated for use in our Directory, our Financial Supplement, or our news columns.

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Our annual index published with this issue has been arranged with great care and regard for the convenience of readers. The articles are indexed by subjects, not titles, so that the great advantage of a subject reference work is obtained by those who bind their copies. The JOURNAL is so nearly encyclopædic in character as regards the street railway industry that we strongly recommend engineers and managers to preserve their copies in bound volumes for later use. Even now, we cannot undertake to supply complete volumes of recent years, while early volumes are practically unobtainable. This year's index contains the titles of articles published in both American and International Editions of the STREET RAILWAY JOURNAL, proper reference letters being affixed, as explained in the key.

Our discussion last month of the "Comparative Cost of Cable, Electric and Horse Railway Operation in New York City" has naturally excited much attention at home and abroad, and has been commented upon at length in the various technical and daily papers of Europe and America. During the month the electric underground conduit system has had a severe test. On Nov. 26-27 one of the heaviest snow storms which the Eastern Atlantic seaboard has experienced since the blizzard of 1888 "came to town" and found both the Street Cleaning Department and the street railway companies of New York almost entirely unprepared for its reception, a heavy snow storm so early in the winter being of extremely rare occurrence. The result on railroad and street railway traffic is interesting. Railroad trains in New England, New York, Philadelphia and New Jersey were quite generally blocked, and trains came in many hours late. Railroad traffic between New York and Boston was abandoned for about forty-eight hours. The overhead electric lines of New York City (Boroughs of Brooklyn, Bronx and Richmond) were forced to suspend operations for awhile, and were with difficulty gotten into running order again after twenty-four hours of partial paralysis. On Manhattan Island traffic was given up for thirteen hours on the underground conduit electric lines, while the horse and cable lines were kept in spasmodic operation, but with difficulty. The stoppage of the underground conduit lines was not due to electrical difficulties, as current was always kept on the conductors within the conduit ready for use. The trouble was that the storm came at the time of the heaviest evening traffic, and on Saturday, too, when the theater patronage is the largest of the week. The homeward bound cars were unable to keep to schedules with slippery tracks, and the snow plows, sandwiched in between passenger cars, could not help out the road. As a consequence, the snow got the upper hand of the railroads and was caked down in a freezing mass upon the rails, so that the car wheels could not reach the latter. The cable lines, being propelled by mechanical power, could keep both cars and sweepers in operation, though the engines in the station were loaded to the maximum. An enormous force of shovellers was put to work as soon as possible, and the rails cleaned of snow, so that by Sunday afternoon cars were again running by electricity. The danger feared by many that the conduits would fill up with snow or water was not realized, as there was at no time any difficulty from this cause. There were quite a number of burnouts of plows, due to the soaking of the latter in salt water, and these plows made occasional short circuits between the conductor bars in the conduit, which were, of course, taken care of without trouble by the feeder circuit breakers at the station. Altogether, the underground conduit system *per se* behaved admirably, and its difficulties were those incident to any form of self-propelled motive power.

The announcement was made last month that the tramway system of Havana had passed into the hands of English capitalists who are proposing to install the trolley system in that city. Outside of Havana and Santiago the opportunity for tramway lines of the ordinary character seems rather meagre. In this connection, however, the suggestion of General Roy Stone for an extensive system of electric railways for plantation service in Porto Rico is interesting, and the plan proposed, it would seem, can be applied to Cuba and other tropical countries to advantage. Contrary to the general impression, Porto Rico, it seems,

has not a good system of wagon roads. There is one important military road across the island, built, it is estimated, at a cost of nearly $100,000 per mile, but the enormous tropical rainfall as well as the mountainous condition of the country have prevented, and in the nature of things will prevent, it is said, the construction of an extended system of permanent roadways for anything like an amount of money which it would be possible to expend for this purpose. Those who are familiar with the post roads of Switzerland are acquainted with the difficulties of road construction in mountainous countries as well as the extent of attendant cost, and the attempt to reproduce in the Carribean or Philippine Islands an extended system of roadways of like character would be practically impossible. It is just here that the value of the electric railway appears. These roads could be laid with comparatively little grading, and could be much more thoroughly drained and protected against the floods which are incident to the tropical rainfall than can ordinary roads. General Stone believes that the electric railway will thus furnish the solution for connecting the plantations of our new tropical possessions. Again, the islands have plenty of undeveloped power in the way of waterfalls, and these should be utilized to generate the electric current. While yet only a suggestion, the plan looks inviting at first thought. The industrial railway for farms was suggested in this country long ago, and it was thought that it would come into extended use, but as yet only a few of such lines have been built. In Mexico there are, however, a great many such tramways, working with horses. It would be curious if Porto Rico or Cuba should lead the United States and other countries in the construction of this class of road.

There seems to be a recrudescence of the electrolysis scare, which was quite prevalent four or five years ago, but of which little has been heard since then until recently. If all the destruction of water and other subterranean pipes is going on which some would have the public believe, in three or four years there would be nothing to show the location of the destroyed conductors but lines of rusty and decomposed metal. But large electric railways have been in operation in many cities for a much longer time than this, and for the greater part of that period with much inferior ground returns and methods of bonding than at present in use, yet no such wholesale destruction has yet occurred. The article elsewhere in this issue on "Some Fallacies Regarding Electrolysis" certainly throws new light on this whole subject. The results given are taken from an extended practical experience, and the points made should be useful in meeting a number of erroneous popular impressions regarding electrolysis, as it takes place underground when the return current leaves the buried surface. It has been generally assumed that the difference of potential between the water pipe and adjacent rail indicates a condition in which electrolysis takes place, whereas the difference of potential is only one element necessary. The current flow and water adjacent to the surfaces from which the current flows are the real necessary elements under which errosion of these surfaces can occur. The difference of potential indicates only a static condition. If the soil in which these conductors are buried were an insulator, the potential would be at a maximum and no electrolysis could take place; so that the mapping out of potential differences between the rails and the water pipe is not a criterion from which the locations or extent of electrolytic activity should be judged. This proposition can be readily proven in any road where the differences of potential between a water pipe and rail are taken in midsummer and the same measurements are repeated in midwinter, when the earth is frozen and surrounds the rails with a partial insulator. It will be noticed that under these conditions the potential differences will be greater when the rails are surrounded by frozen soil, yet the flow of current is reduced to zero under these conditions. Another particular in which the electrolysis under ground differs from that of the laboratory experiment of two plates in a liquid electrolyte, is that in the laboratory experiment there is a transference from the anode to the cathode of the products of electrolysis. When the surface is buried in earth there is no such transfusion; the products of electrolysis remain adjacent to the surfaces acted on, and in the case of iron these surfaces are protected from further action. The methods used for testing for electrolysis described show the current flow in the earth, and are devised for locating and determining the flow of these currents, this being the element of the current which produces electrolysis. The article also shows that a number of methods to prevent this trouble have only specific and not general application, and the sphere of usefulness of each method is carefully analyzed, so they will not be misapplied in practice.

Street railway managers have sought a perfect type of convertible car as eagerly as the old alchemists did the philosopher's stone. There is no doubt that all railway managers would welcome the design of a perfect convertible car, but the need is particularly urgent in the case of large city roads where the space taken by the winter equipment in summer and the summer equipment in winter forms a very large item of expense. This, with the loss of interest on the first investment of apparatus not in use and the inevitable deterioration which comes to rolling stock in storage, amounts to a very much larger figure than many who have not given attention to the subject appreciate. One prominent railway manager estimates the expense to his company of being obliged to keep a double equipment in stock as $500 per year *per car;* another who is in control of one of the largest systems in this country is inclined to put the figures still higher, viz.: at $700 per year *per car.* Another prominent manager recently stated that he has found that cars deteriorate as rapidly when not in use and in the car house as when in service. At the same time experience has shown that it is almost as impossible to make the public ride in a closed car in summer as it is to try to force them to ride in an open car in winter. For this reason a double equipment has been, until recently certainly, a "Hobson's choice," or was generally thought to be, and while a few companies have tried the use of composite cars, these have not proved generally popular, outside of a few isolated cases, except on the Pacific coast, where the climate is particularly favorable for them. We are of the opinion, however, that there is a solution to the question of a convertible car, although it may be a question whether the proper solution has yet been reached.

* * * * * *

Convertible cars may be divided into three classes. In the first class can be included those which are convertible

in name only, and which consist of a car with a very low window rail. These cars are usually arranged with the sash in two pieces so that it can be dropped into the side of the car when the latter is "open." A disadvantage of this car is that as a center aisle is necessary, one-fifth of the seating capacity of the car is lost. The officials of the Nassau Railroad Company, of Brooklyn, have attempted to avoid this by the use of the compartment car, with running board, illustrated in our last issue. This type of car is classed with the one just mentioned because the sides are permanently attached to the posts. It is doubtful, however, whether this car fulfils the conditions demanded or that it has proved to be especially popular with the traveling public. In the second class of convertible car will be included those in which the entire side can be removed and stored during summer. When used "closed" these cars have a center aisle, but this space may be filled with seats in summer, if desired, making through benches. There are several objections to this car, and one of them is the necessity of practically rebuilding the car at least once a year; second, that of storing the parts during summer, with the difficulty of keeping them in good condition for attachment later to the posts; and third, the difficulty of getting good joints at the ends. These objections have brought out a third type of car, viz.: that in which the side panels are in sections and slide in grooves in the posts. This car, being self-contained, can be changed from one condition to the other in a short space of time, and this avoids the necessity of storing any parts. Cars of this type are familiar to our readers, and while not yet on the market for any great length of time, promise possibly to answer the requirements.

The Future of Elevated Railways

The equipment by electricity of the Manhattan and Brooklyn Elevated Railway systems in New York City is practically determined upon, and it is generally believed that the principal contracts will be let within a very short time. It is superfluous to state that this step has been forced upon the elevated railway companies, and is taken with reluctance, if not against the real wishes of those holding the largest interests in the properties, the reason being the natural one, that large sums of additional money must be invested in the properties in order to bring about the electrical equipment, and that during the transition period of two or three years the gross and net earnings are not likely to suffer.

There is no help for it, however,—the step must be taken, for the earnings of the elevated railway companies have fallen off frightfully, particularly on Manhattan Island, where the surface railways are run on broad gage principles and are giving a greatly improved and highly popular service to the public. To those who knew the Manhattan Railway property in its palmiest days five years ago, its loss of traffic during the last two or three years, and particularly during the last six months, when so many of the underground conduit electric lines paralleling it have gone into operation, is almost unbelievable. The current quarter's report, for example, shows that the company is not only not earning its quarter's proportion of the moderate 4 per cent dividend, with which its stockholders have lately been forced to be content, but that it is actually failing to meet its quarter's proportion of the fixed charges. A comparison of this quarter with that of the corresponding quarter of 1891 gives the following astonishing result:

Quarter ending Sept. 30:	1892.	1898.
Gross receipts	$2,468,730	$1,788,613
Operating expenses	1,294,251	1,249,003
Net earnings	$1,174,479	$539,610
Other income	35,000	47,500
Total	$1,209,479	$587,110
Interest, taxes, etc	681,089	607,172
For stock	surplus $528,390	def. $20,062

Moreover, looking still longer upon the dark side of the elevated railway picture, it is true that even in these days of tremendous energy in the conduct of large enterprises and the remarkable results achieved by skill and forethought in their management, a railway company cannot, merely by the fiat of its board of directors or by the rubbing of an Aladdin's lamp, create in a moment the immense amount of steam and electrical equipment required. We are entering upon a period of great activity in all industrial enterprises, and in spite of the magnitude of our engineering and manufacturing establishments, orders for even a moderate amount of manufactured product must be placed many months in advance of wished for delivery. Available power station sites, none too numerous in any large city, must be determined upon and purchased, usually after long negotiations with several owners. Should the Manhattan Company place contracts to-day for the equipment of any of its lines, we doubt if the first car would run over that line short of a year or the steam locomotive be entirely withdrawn in less than two years.

But there is a brighter side to the picture. Elsewhere in this issue we have set forth a rough estimate of the effect of the change to electricity by the Manhattan Company upon its earning power—this as an incident in an extended discussion of the influence of improved schedule speeds and more popular service upon the earning power of roads of this character. From a careful study and analysis of the Manhattan Company's gross receipts and operating expenses for the year ending June 30, 1897, we are convinced that had the company *in that year* run the same number of trains on a schedule faster by only two miles an hour than its then steam schedules, and had the motive power been electricity, the earnings available for dividends on stock, after paying 5 per cent on an estimated cost of electrical equipment of $10,000,000, would have been nearly or quite double what they actually were in that year—8.81 per cent instead of 4.45 per cent. This does not mean, however, that the Manhattan Company could accomplish so favorable a result to-day, for the surface railway competition is, as before stated, cutting into its earning power greatly, and is taking from it the major portion of its most profitable traffic—the short-distance riding.

Ten or perhaps fifteen years hence, however, there will be, we believe, enough traffic for all the transportation agencies in New York City. Surface railway cars will be overcrowded and many of their would-be passengers will return to the elevated, particularly if the service given by the latter is up to date and generous. The elevated will, however, carry the long distance traffic, while the surface lines will obtain the short distance.

Conduit Construction of the Third Avenue Railway Company, New York

The announcement has been made that the Third Avenue Railway Company of New York is planning to introduce the electric conduit system, not only on its Boulevard and 125th Street line, but upon all the lines comprised in its main line on Third Avenue, its 125th Street and Amsterdam Avenue line, the system of the Forty-second Street, Manhattanville and St. Nicholas Avenue Railway and the Dry Dock, East Broadway and Battery Railway. Of these, 45.16 miles are operated at present by horse, and 28.5 miles by cable, and of the cable railways mentioned, the main line of the company on Third Avenue is one of the heaviest traffic roads in the city. The reasons for the change from cable to electricity were given in the July issue of the STREET RAILWAY JOURNAL, and, as stated by a prominent official of the company, are to secure pleasanter service, as well as a uniform system for all the lines, as the electrical equipment of the present horse lines is a manifest necessity.

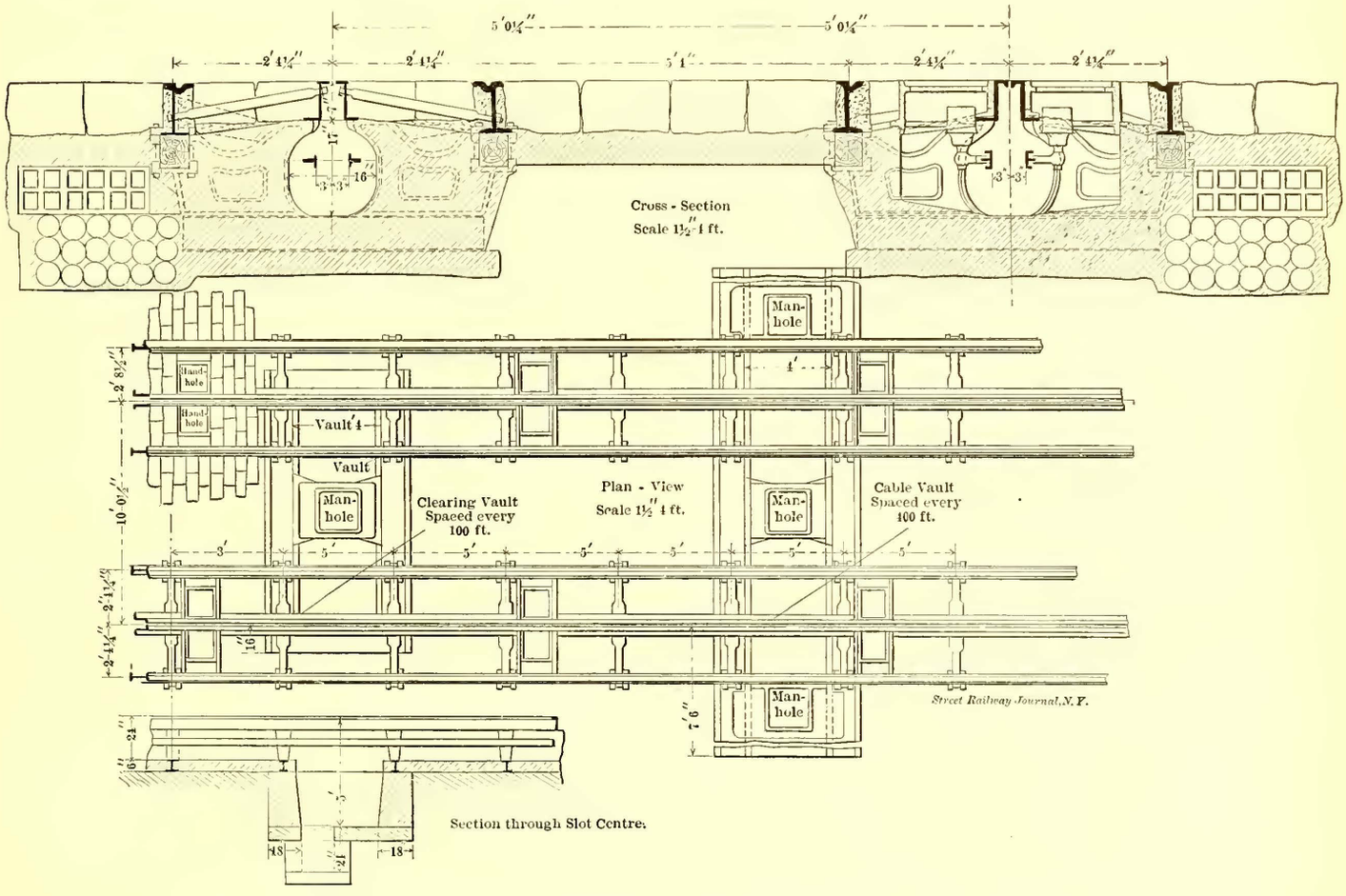


FIG. 1.—PLAN AND SECTIONS OF STANDARD NEW CONSTRUCTION, THIRD AVENUE RAILWAY

Two types of electric conduit construction will be employed; that for new construction, and that where the old cable conduit is to be retained. As the cable railway on 125th Street and Tenth Avenue was installed long before that on Third Avenue, and is now somewhat antiquated, it will be removed entirely, and the new type of construction will be employed there, and the modified conduit will be used only on Third Avenue. Fig. 1 shows a section and plan of the new construction adopted. As will be seen, it differs radically from anything which has yet been installed, the chief features of the novelty lying in the carrying of the rails upon a wooden stringer 5½ ins. wide x 6 ins. high. This has been done to secure an easy riding track, and this quality, in the opinion of the officials of the railway, will be an important one in attracting traffic in the future. The concrete is packed under and on the inside of this stringer, but not on the outside, where broken stone is used. This provides ample drainage and insures the dryness of the timber.

The yokes are spaced 5 ft. apart, and are built up of three pieces riveted together, viz.: a steel I beam weighing 105 lbs., and two cast iron side pieces weighing 122 lbs. each. The yokes rest on a continuous bed of 4 ins. of concrete. The conduit between the yokes is of solid concrete. The wooden stringer is laid in 30-ft. lengths, and is of selected yellow pine, creosoted and planed to size. The slot rail is laid in 30-ft. lengths, is 7 ins. high and weighs 66 lbs. per yard. The tie rods between track rail and slot rail are spaced every 2 ft. 6 ins., besides which there are the braces at every yoke, as illustrated. The track rail is laid in 60-ft. lengths, is 9 ins. high, and weighs 107 lbs. per yard. It is of the Crimmins section, similar to that employed on the Metropolitan Street Railway. Insulator boxes are located every 15 ft. As shown in the diagram, they are hung on the slot rails, and can be slid either way, insuring facility in setting. When the structure is completed they are set in position. The conductor rail is of steel, "T" in section and weighs 21 lbs. per yard.

In installing the conduit a trench is first dug 35 ins. deep and the width of the roadbed. The 4-in. concrete bed is then laid, after which all of the iron structure is erected complete before the concrete is installed. In building up the latter between the yokes sheet iron linings are used between the latter until the concrete is set. These linings, which are in two pieces, so that they can be slid through the slot, are held in position in the conduit by collapsible forms, which are also slipped through the slot and then opened by a lever, pressing the lining in position against the yoke. Two of these are used between every yoke.

The ducts for carrying the feeders are sometimes placed on the inside, between the tracks, and sometimes on the outside. A feeder vault will be located every block, or 260 ft., and between each feeder vault will be two cleaning vaults. The manhole curbs of the cable vaults are kept small, viz.: 20 ins. x 20 ins.

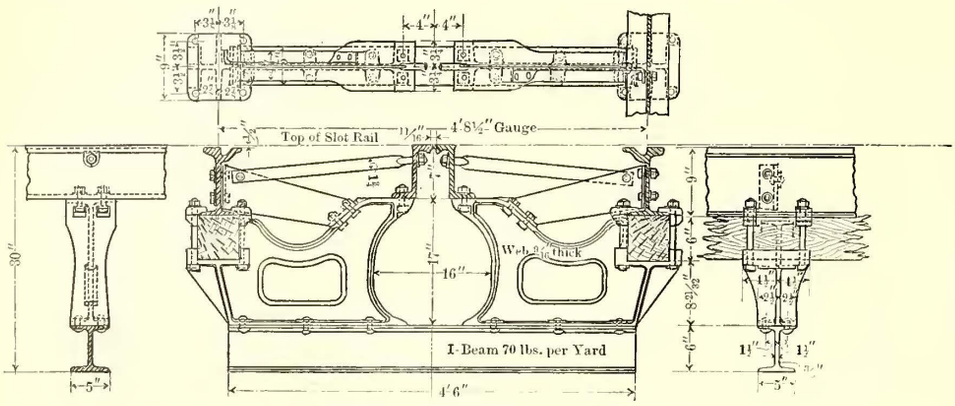


FIG. 2.—STANDARD YOKE, NEW CONSTRUCTION

The insulator employed is the same as that used on the Metropolitan Railway, and the method of hanging it is the same, except that the Third Avenue Railway Company will fasten the insulator to the frames of the insulator boxes, instead of to the slot rail. The position of the conductor rails in the conduit will be the same as in the Metropolitan Street Railway construction, so that the same cars can run over either construction. The same type of plow will also be used. This has been described in former issues.

Two types of feeder ducts will be installed: the McRoy, for high tension circuits, and the National cement line tubes, which will be used for the low tension circuits.

On the Third Avenue main line, where the present conduit will be retained, a different type of construction had to be adopted, as the good condition of this conduit and the immense cost of its installation were such that the company wished to utilize it if possible. New track rails, however, will be laid, and provision must be made for installing conductors and insulators. The present height of the track rail is 7 ins., and this height has, of course, to be retained as there will be no change in the yokes. The company will therefore put in a 7-in., 104-lb. Crimmins type of rail, and will cast weld the joints. The present pulley carrying vaults, which are spaced every 35 ft., will be undisturbed, and will be used as cleaning vaults. The feeder vaults will be built under both tracks, and will be 5 ft. wide and 24 ft. ½ in. long inside, from one wall to the other. They will be located every 400 ft. The insulators will be hung in the insulator boxes on hangers, so that they can slide at right angles to the slot rails. In this way the conductors can be installed without interfering with the cable operation, and when the company changes over from one system to the other the conductors, with their insulators, can be slid out to position in the conduit. The conductors will be slipped into the conduit at the present grip-traps, and will then be carried along till they are opposite the proper insulators.

A special feature of the track construction on the main line will be the use of a spring liner, illustrated in Fig. 5, placed between the base of the rail and its seat on the yoke. The object of this liner is to secure an easy riding track, and this, it is thought, will not only prove attractive to passengers, but will increase the life of the rolling stock and rails. The traffic on this line is continuous and heavy,

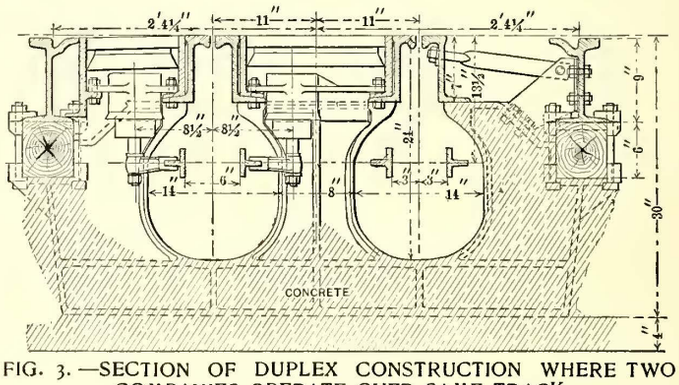


FIG. 3.—SECTION OF DUPLEX CONSTRUCTION WHERE TWO COMPANIES OPERATE OVER SAME TRACK

and it is estimated that 3600 wheels pass over a given spot in twenty-four hours, and that the weight on each wheel is about 6375 lbs. The deflection of each rail at the yoke, according to the specifications issued to the spring manufacturers, is not to exceed 1-16 in. when a loaded car passes. The spring adopted is not of the elliptic type, but is so designed that when the center goes down the ends rise, presenting a corrugated surface of enormous strength, the weight to compress which flat is estimated at from 10,000 to 12,000 lbs. The springs are 4 ins. wide.

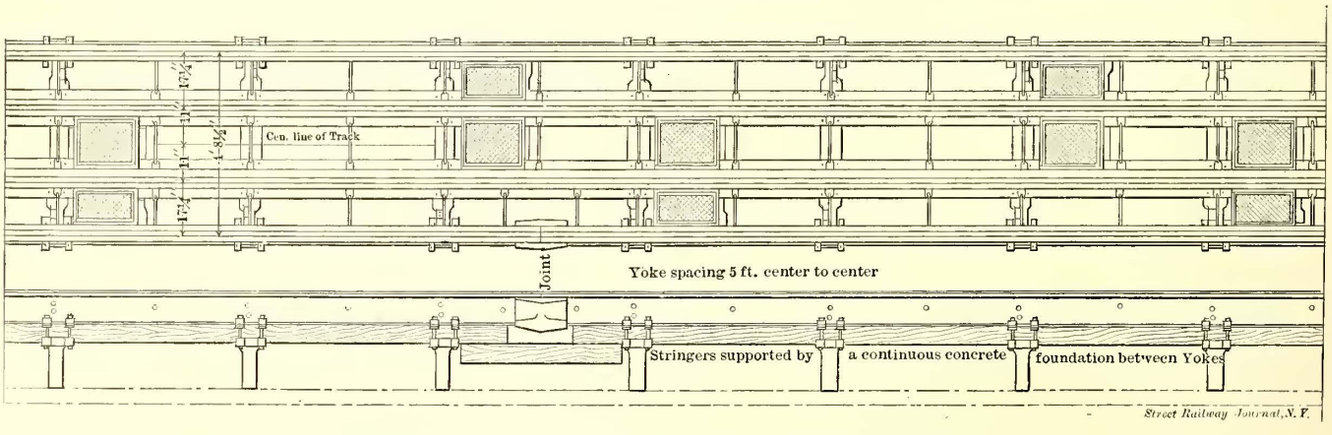


FIG. 4.—PLAN AND SIDE ELEVATION OF NEW CONSTRUCTION

The rails on the main line will be cast welded, the Falk system being used, and at the special work expansion joints will be employed. The contracts already awarded are as follows: roadwork, Naughton & Company; under-

ground feeder conduits, J. T. McRoy and National Conduit and Insulation Company; rails and special work, Lorain Steel Company; yokes, manhole frames and covers, Pennsylvania Iron Works; bolts, tie rods, etc., Sternberg & Company; drop forgings, Wyman & Gordon; creosoted timber, Eppinger & Russell; spring liners under rails, Charles Scott Spring Company; cast welded joints, The Falk Manufacturing Company.

The system of flexible track to be used is the design of John H. Robertson, superintendent of the company, who has also general charge of the engineering features of the new line. Mr. Robertson is assisted in this work by C. A. Psilander. The consulting engineer of the company is Dr. Louis Duncan.

The Third Avenue Railroad Company is not only planning the important changes outlined for its track construction and motive power, but also will introduce improvements in rolling stock. The company has long felt the need of a convertible car of a practicable type. While this would prove useful on nearly all roads, the need has been accentuated in the case of the Third Avenue Company by certain local conditions, chief among which has been the large expense and trouble of storing cars. The high cost realizes the deterioration to which cars in storage are subject. The company has decided, therefore, to try the use of the car shown on page 794, which is practically a

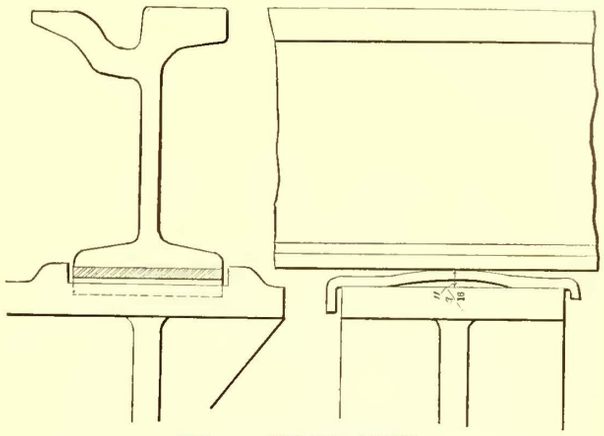


FIG. 5.—SPRING LINER

convertible open and closed car, and which has been built by the J. G. Brill Company.

Owing to the heavy traffic on the line and the fact that

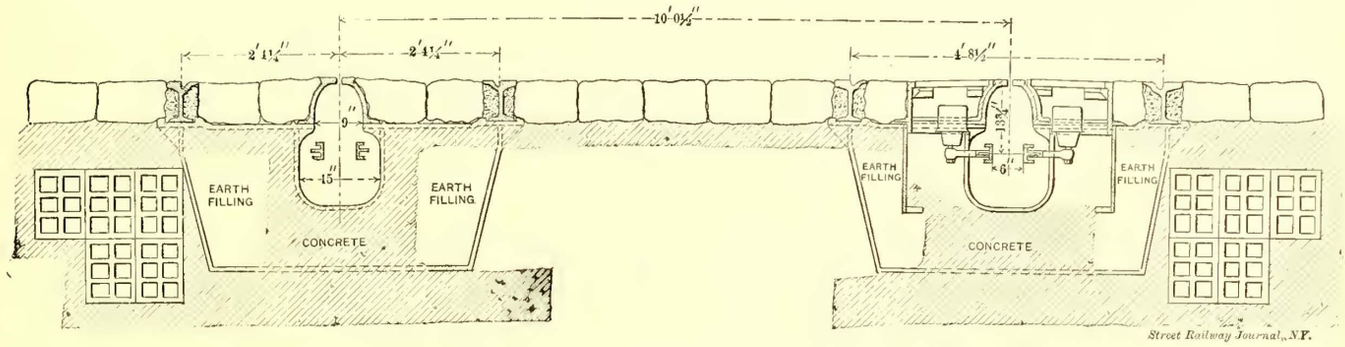


FIG. 6.—SECTION THROUGH ROADBED ON THIRD AVENUE

of real estate in New York compels the company to use car houses having two floors and in its Harlem car house, which is the main car house of the company, the equipment not in continuous use is stored on the second floor, while that in regular service is kept on the ground floor. If a

FIG. 7.—INTERIOR OF CAR

sudden change of temperature comes on, therefore, it takes the greater part of a day to change over the type of cars, so that often the need for the change disappears before the change itself can be effected. The company also the large proportion of it is made up of long distance passengers, cross seats have been adopted instead of longitudinal seats in this new car, as it is found that the former are much more agreeable to long distance riders.

In order to secure greater strength and depth of sill, a special form of side sill construction, designed by Mr. Robertson, is employed. Each sill is made double and consists of a channel and a single angle iron, each 9 ins. in height, spaced about 1½ ins. apart and bolted together with their flanges projecting outward. The channel iron is placed on the outside and the angle iron on the inside of the car, and the ends are bent around so as to form the end sills, which are thus continuous with the side sills. Inside the iron sills there is a supplementary sill or packing piece of wood. In this the ash posts are mortised in the usual manner and held fast by a toe bolt secured with a nut underneath. Two screws hold the toe bolt fast to the post. On the inside of the packing piece are pressed steel pockets to receive the cross sills. Double tie rods at each go through the sills on both sides and are secured by nuts. Bolts and nuts are always preferred for work of this kind, as they are not only stronger, but can at any time be examined and made secure if working or straining of the parts has taken place. In this way a very rigid and substantial framing is secured throughout the car. The four corner posts are reinforced where they are joined to the floor beams. Where channel and angle bars meet in the center of the ends of the car under each doorway, they are fastened together by iron plates resembling fish plates in their construction. The sides of the car are straight, and are sheathed up with narrow matched stuff.

The windows have a sash in two pieces with metal stiles. The larger is 2 ft. 7 ins. high, and the smaller one is 1 ft. 4½ ins. high. The smaller is at the top, and when both are lowered they drop into the wall of the car entirely below the window rail, which is about 2 ft. above the car floor. When lowered the sash are entirely out of sight, and are held firmly by guides and springs at the side, so that it is impossible for them to rattle. The opening is then covered with a tight-fitting cap running the length of the window frame. The windows are fitted with curtains of the usual type.

The seats are of the "Walkover" pattern, and were

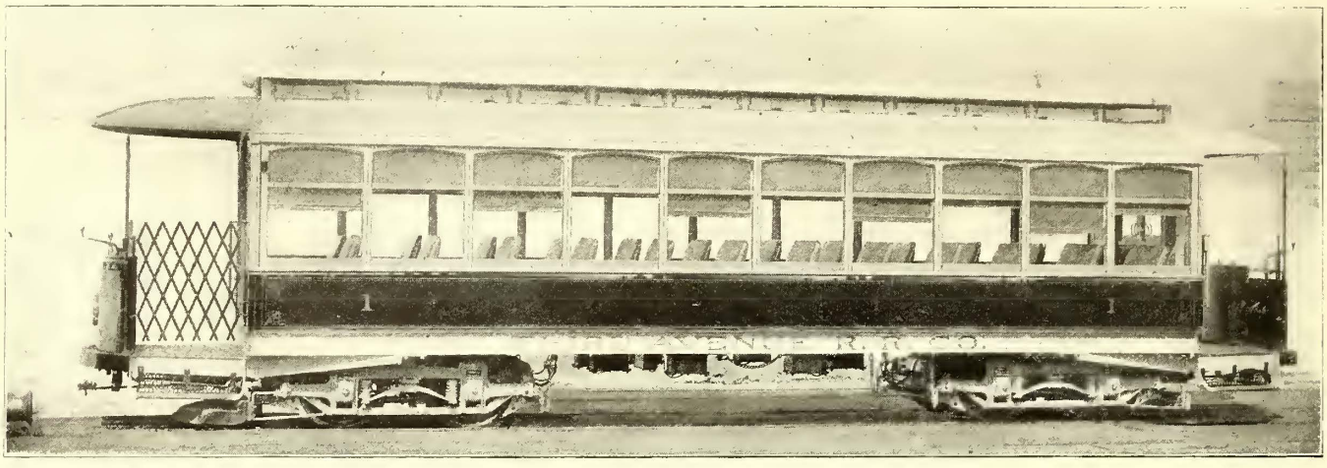


FIG. 8.—SIDE VIEW OF CAR, WHEN CLOSED

manufactured by the Hale & Kilburn Manufacturing Company. They are of a type recently brought out by that company, and embody a number of new features. All of the slideways, etc., are removed from the side of the seat, and are put underneath, enabling the seat cushion to be carried out the full width of the frame. The seats are upholstered in Pantasote, which was selected as the best material for the service on this road, as it is very easily cleaned and always presents a bright appearance. No hand-poles or straps for passengers are placed in the car, but the seats are provided with a new grab-handle, which is one of the recent Hale & Kilburn specialties. This handle enables passengers standing in the aisles to steady themselves with less effort than when they are required to hold onto a strap. This handle is clearly shown in the view of the interior given herewith.

The general dimensions of the car are as follows: length, 32 ft.; width at sills, 8 ft. 2 ins.; length of platforms, 4 ft. 6 ins. The step is 15½ ins. from the rails, and has a 14-in. riser. The wheels are 33 ins. in diameter, and the trucks have a 4-ft. wheel base with truck centers 22 ft. apart. The motors are G. E. No. 52, and the trucks are the Brill No. 27 G, or "Universal." The head lining of the car is white maple veneer decorated, and gloss finish. The doors are double automatic, and the floor is covered with longitudinal strips. The total weight of the car with motors is 36,000 lbs.

To facilitate the movement of this car in the storage floors in the shop the electrical terminals are brought to a socket at each corner post. Into this a special trolley pole can be fixed, and by means of this pole connection is made with overhead wires, so that the cars can be moved about under their own motive power.

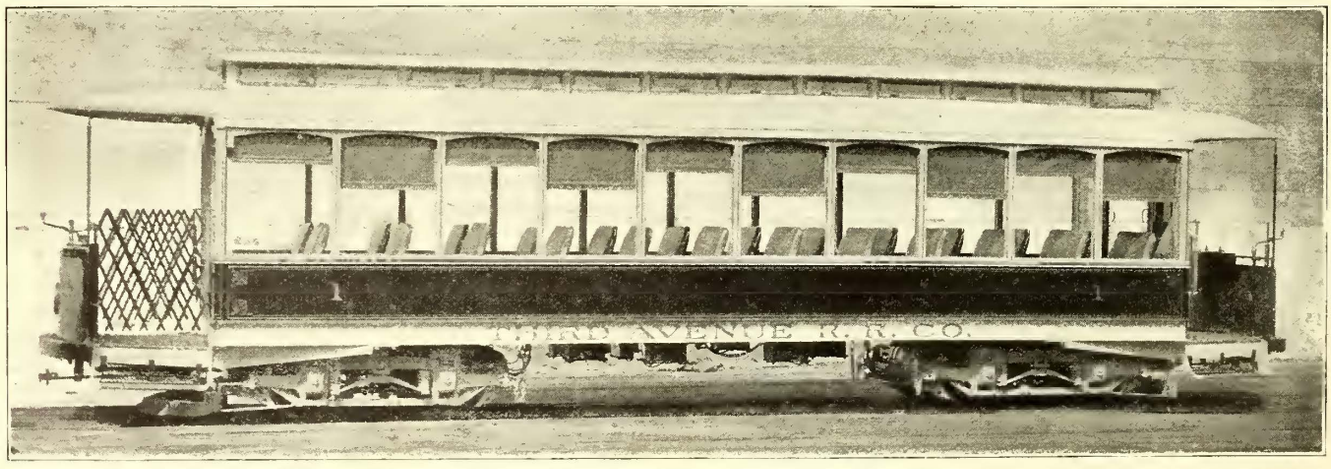


FIG. 9.—SIDE VIEW OF CAR, WHEN OPEN

Third Rail in the B. & O. Tunnel

The elaborate overhead structure for supplying current to the electric locomotives in the tunnel of the Baltimore & Ohio Railroad at Baltimore will soon be abandoned and its place taken by the third rail. The latter will be installed by the Safety Third Rail Company of New York, whose system of a sectional third rail will be used. The line is about a mile in length, and there will be twenty sections on each track, or forty sections in all. Each section will be controlled by a special switch designed for this purpose. As will be remembered, by this system only that section of track over which the car is being operated is alive, all others being cut out of the circuit. The change was made, it is understood, on account of the excessive wear of the overhead system.

Methods of Increasing Traffic

BY W. BANKS

Electric railways, like the steam roads, have found that traffic will not come by merely opening the road, so it has been found necessary to have a staff to cater for traffic. At present the Toronto Railway Company, with more than 80 miles of tracks, has only one park under its absolute control, but the beauty of that one park, its fine location on the prettiest and healthiest part of Lake Ontario, makes it one of the most attractive and pleasant of summer resorts. It is known as Munro Park, and is a very short distance outside of the eastern city limits. By arrangements with the owners, the company has access to Victoria Park, Long Branch, and other pleasure resorts, while the whole of the many extensive and beautiful city parks are all located on the routes of the company.

The summer traffic is limited to the months of May, June, July, August and September, but fully five-sixths of it to June, July and August. Owing to the necessary improvements in Munro Park not being quite finished, the Toronto Railway Company has been compelled to confine its entertainments this last summer to band concerts and minor attractions. All of these, however, have been very profitable, and the company is already preparing for a busy season next year. This city has an extensive water front and beautiful island summer resort within the city limits, and it is anticipated that at no distant date boat trolleys will be placed in operation along the water front by our company to carry passengers to and from and around the island.

Admission to our park and pavilions being free, we have to look to the passenger traffic for a return of our expenditure on entertainments in the park and in the grounds to which we have access. Our attractions will be of a very high class, and there will not be a single performance to which the most refined cannot come. We also endeavor to avoid entertainments deserving close attention for any length of time, our desire being to amuse the groups of picnickers, none of whom care to sit for even half an hour closely watching a performance. We propose also trying the experiment of giving financial aid to any first-class entertainment to be given on grounds close to our car routes, and to issue round trip tickets to include admission to such entertainments. Where we give financial backing our own staff will sell tickets and control the finances. We have, of course, absolutely no control over the city parks, but we reap some benefit from traffic caused by a series of band concerts in these parks, for which the city council pays. The municipality is not always the best caterer for the public, so we are anxious to see a higher class of concerts, and the convenience of the public better provided for by the erection of more pavilions and greater facilities for obtaining necessary refreshments, cooling drinks, etc. All these details may appear commonplace to many managers, but on them a very great deal of our traffic depends.

The private car and moonlight excursion traffic grows in popularity, and we have done a great deal to foster and encourage it; our circulars have been sent to every clergyman, Sunday-school superintendent, secretary of church society, and to all the secret, fraternal, national, and labor organizations in the city and within an area of 10 miles around. Our charter compels us to carry passengers from any part of the city to any other part at a single fare; fixes the fare at five cents, and also fixes the prices of tickets bought in quantities, and requires us to give workmen's tickets at the rate of eight for a quarter, available during certain hours in the morning and evening. We have not, therefore, much room for special cheap excursion rates, yet we have devised means for this description of traffic, and small or large parties can have a percentage on a certain class of tickets, while we ourselves run three nights per week cheap excursions to Long Branch.

Many of our storekeepers give street car tickets as bonuses to their customers, and find it a most successful plan for securing business. When a customer knows that car fare from and to any part of the city can be had at a store, the distance from such store is no drawback, but, especially in fine weather, is an added inducement to patronizing that place. The storekeepers get no discount on the tickets they buy for this purpose.

Almost all plans for increasing traffic touched on by other managers, and described in the STREET RAILWAY JOURNAL, are now, or shortly will be, in vogue on the Toronto Railway Company's lines, except reduced prices for lunch, and we are endeavoring to perfect plans for sharing in the steam railway and steamboat traffic. We have all around our city, villages, towns and cities, from which we propose to arrange for excursions by boat or rail, as the case may be. The tickets for such excursions will, of course, include our charges for special cars to meet the parties at the wharves or depots, convey them to our park, and back in the evening, including a trip around the city. There are immense possibilities in this traffic, which will, of course, require a good deal of hard work and attention to make a success. We also propose arranging with those railways in the States which have through booking rates to Toronto to keep us posted on all excursions announced for this city, so that we can arrange for special trips. Many of these excursionists are often in the city for only a few hours, and would gladly avail themselves of our cheap, pleasant and speedy mode of seeing the sights. We are putting ourselves in communication with excursion agents everywhere, with a view to developing this traffic.

Many star singers, actors, lecturers and public entertainers visit Toronto, and the railways frequently run excursions from neighboring towns on the occasion of such visits. The traffic thus brought in, we also desire to handle, and make arrangements for special cars, and for the attaching of our passage coupons to entertainment tickets or railway tickets, entitling the holder to ride on our cars to and from the depots or steamers. We are always prepared to deal liberally with good circuses and big shows of any kind.

One of the drawbacks supposed to exist in Canada to electric railway excursion traffic is the alleged long and severe winter, popularly associated in the United States and Great Britain with this Dominion. No greater mistake ever existed than that about the Canadian winter. Of course, if a person go north as far as the Hudson Bay regions he will enjoy a long, bracing winter, but here we seldom see snow until December, and scarcely ever have a heavy fall until after Christmas, and by the middle of March there is very little of the snow left. The "oldest inhabitant" has stories of long winters, but these have evidently disappeared since the introduction of railways. It is a rare event for the street car traffic of this city to be seriously interfered with for more than an hour or two any winter. To us, however, the winter brings no cessation in our work of catering for traffic. Theatrical performances, concerts, skating carnivals, hockey matches, ice-boat racing, curling, sleighing, snow-shoe racing, and all other winter sports, are utilized for our benefit. A series of matches for valuable prizes will be arranged during the coming winter, always on grounds or in rinks on our routes. We contemplate giving some winter in our park realistic plays, showing Nansen's famous journey in search of the pole, the Peary expedition, and from England

we may bring some genuine Franklin relics, to be shown in a series of performances illustrating the last voyage of that famous explorer. We also hope to secure the presence in the city of the most noted skaters and snow-shoe racers of the world, and intend to give in our grounds "The Bells," the play made famous by Irving, making the sleigh ride a great feature. Then there are the possibilities of the Ice Palace, with the many attendant attractions it would give opportunities to present.

The intense love of everything British, which characterizes our people here, is a valuable asset of the electric railway, for in the winter it will enable us to present to the present generation realistic exhibitions of the Crimean campaign, securing for the purpose the co-operation of the three volunteer regiments of the city, as well as that of the permanent force. This will insure an interest in the performance of more than twenty-five hundred men, and the same rule applies to all performances of a military nature. The British spirit of our people induced us to try and get Piper Findlater, of Dargai fame, to visit Canada under our direction. Should he come here with several of his comrades of the famous Gordon Highlanders we can put the show in enclosed grounds, and give a round-trip ticket from any part of the city, including a reserved seat on the grand stand, for twenty-five cents, and we have no fear that the numbers attending will be less than twenty-five thousand daily. We can sell round-trip tickets with numbered reserved seat coupons attached at our offices throughout the city until two hours and a half before each performance, after that a special man on each car on the main routes will sell the tickets. This will leave our regular staff free to deal with the ordinary traffic. A similar plan can be pursued in other cases where large crowds may be expected.

This is an outline of the leading features of the plans adopted or in contemplation for the encouragement of traffic on this road. There are many other ideas constantly cropping up, but from this it will be seen that we do not propose laying out expensive racing grounds or bicycle tracks. My opinion is that we should bend our own energies to securing each first-class attraction as soon as it is in evidence, leaving private parties to speculate in grounds for sports. Of course, wherever such grounds are convenient for our cars we are always ready to assist in making such sports successful.

We may give our American visitors a treat on an early date by showing on the lake in front of our park exactly how Santiago was captured. We will have the work done under the direction of a naval officer of known ability. This reminds me that the location of Munro Park enables us to present land and water fêtes with equal success. We are able to turn the water front into a fine amphitheater, from which ten to twenty thousand people can witness "Pinafore," "Billie Taylor," or other performances of a naval character, and the stage will be a floating pontoon. We can reverse that order, and place our audiences on the pontoon, with our stage at the water's edge.

Of course, all descriptions of canoe, boat and yacht racing has our attention, with water polo, etc. With a first-class shore for bathing purposes, we will derive revenue by providing the best accommodation for bathers at nominal charges.

I have left myself little space to speak of plans for carrying into the city farm, dairy and garden produce to storage warehouses under our own control. All this, however, is receiving attention. I am not at all afraid of the horseless carriage—auto-car, or by whatever name the much-discussed vehicle may be known. It seems to me that the vehicle can only be a success when used in connection with electric cars. There are in all large cities streets on which tracks will never be laid, although the routes thereon would be profitable, and there are others on which it will not pay to lay tracks, but from which a good deal of traffic can be obtained. If the auto-car can be cheaply and neatly constructed and easily managed I would use it on such routes as those referred to as traffic feeders for the cars, and I would be prepared to convey one or more persons by these vehicles to church or weddings, or any other place or service, more speedily, cleanly and promptly than the liverymen now do such work.

In concluding, I am satisfied that the possibilities of electric railway traffic are practically inexhaustible, and that when the traffic and entertainment managers of these roads hold their next convention it will be the convention of men standing at the beginning of a great and successful movement, such as few other undertakings can expect to attain.

Theory of Reserve and Suspense Accounts

BY A. O. KITTREDGE, F. I. A.

If all the items of expense or cost of a street railway or other business enterprise could be managed so as to be paid in the month, quarter or year to which they rightfully belong, or if the payment of expenses in one fiscal period which belong to another could be avoided, the necessity of suspense accounts and of reserve accounts as well would be removed. It is impossible, however, to so adjust payments as to bring into a given period all that belongs to that period and nothing more. Hence arises the necessity of reserve accounts, on the one hand, to accumulate amounts corresponding to the expenses or costs of various kinds properly chargeable to the present fiscal period which will be paid at some future date, and of suspense accounts, on the other hand, to receive the charges for expenditures made during the present fiscal period which belong to the operations of some future time.

Fiscal periods are of various lengths. Formerly, as a rule, they were much longer than at present. The tendency of the day is to contract or shorten the fiscal period—in other words, to diminish the time between statements. Whereas, only a little while ago, comparatively speaking, a year was the shortest unit of time in business, and is still the common limit, to the extent, at least, of public reports in various industries, the tendency, so far as accounting is concerned, is at present to take half, quarter or even a twelfth of that period as the unit or the limit of time between statements.

The highest form of accounting, in place of yearly, semi-annual or quarterly showings, maintains a perpetual balance sheet. It makes the business statement bearing this name an integral part of the bookkeeping system and keeps it up to date, just as the cash account is kept up to date. It shows profit and loss results daily, weekly, or, at longest, monthly, as circumstances may warrant. In a street railway enterprise a monthly showing is the extreme that should be tolerated. In other words, a month between complete balance sheets is the longest allowable time. A weekly showing can be had just as well as not, while a daily showing is attended with no particular difficulties. If profit and loss showings and balance sheet statements are thus to be perpetual, more especially is there the necessity of introducing into the bookkeeping system proper reserve accounts and suitable suspense accounts. The object to be attained is that each day, week or month, as the case may be, shall stand by itself correctly charged with the expenses, as well as correctly credited with the earnings belonging to it.

One or two familiar illustrations will make this part of my argument entirely clear. Suppose, for example, that we are conducting our accounting system upon the basis of a monthly showing of profits and losses. If, in the course of our transactions, we pay in advance a quarter's rent on some building or warehouse, or if we pay our telephone bill quarterly in advance, then to protect the present month we must suspend so much of this disbursement as belongs to the two months succeeding. To charge the whole of either of these bills to the present month would be to load this month beyond its proper share.

The same principle applies to all kinds of supplies and materials. If we are using, for example, one hundred tons of coal per month, but in a certain month, for the purpose of taking advantage of the season of the year, or of the price of coal or of low freight rates, we purchase one thousand tons, it certainly would be unfair to the month in which the purchase is made to charge up as an expense the whole of the thousand tons of coal. Instead, we open a coal account, to which the cost of the thousand tons is carried and from which, in turn, we charge to the several monthly accounts whatever quantity of coal is consumed in each of them.

It is the usual rule to maintain material and supply accounts analogous to the coal account above suggested, but there are various expenditures, like rent, telephone charges, advertising and special outlays of various kinds, including, among others, insurance premiums, which are always demanded in advance, for which no regular account is provided and which are likely to be charged into monthly expenses unless a special suspense account is opened to receive the amounts. Just what the suspense accounts should be in any given business depends so much upon the nature of the business itself and the customs of the community in which it is conducted that it is hard to cite examples by way of illustration that would apply everywhere. The suspense accounts of any two given street railway enterprises would not be exactly alike.

A suspense account usually carries a debit balance. As a rule, it represents an expense belonging to some future period, which has been paid in the current period. There are various exceptions to this, however. For example, I know of at least one street railway company which sells tickets in various quantities at graded rates, and therefore has a considerable income on passenger account somewhat in advance of actual service rendered. It is the rule with this company to pass all its ticket receipts to the credit of a special suspense account and to debit out of this account daily amounts, corresponding to the tickets taken up by the conductors, which are carried to the credit of passenger earnings.

Reserve accounts in character are just the reverse of suspense accounts. Certain expenses belong to the business of the present month which cannot be discharged in cash the present month, nor yet are they evidenced by invoices, bills and the like. To charge this month therefore with what fairly belongs to it, certain sums must be carried into the current expense account for which there is no contra account to be credited, save only as a reserve account for the item is opened up. In other words, expenses must be properly pro rated to the months, letting the payments fall where they will.

Take it in the case of taxes. One twelfth of the annual taxes that a street railway company must pay is an expense belonging to each month in the year. But the taxes are paid annually—not monthly. A reserve account for taxes, therefore, is to be opened up. The debit of one-twelfth the annual amount is to be charged into the expenses of each month, while the taxes reserve account gets the corresponding credit. In turn, when the time to pay the taxes arrives, the taxes reserve account is debited for the amount, thus taking up what has been set aside for the purpose.

Interest on bonded indebtedness, for example, is a charge, a twelfth of the annual amount of which properly falls to each month. The business of the railway company each month must show an earning larger than its current expenses, with the pro rata of interest on bonds and taxes included, in order to insure a dividend on its stock. A reserve account for interest on bonds, therefore, is opened, to which an amount is credited each month equal to one-twelfth of the annual charge. When interest day arrives the interest reserve account is debited with the check that is drawn for the payment of the interest.

There are other reserve accounts that should be maintained by street railways, besides those like taxes and interest, which are an immediate lien upon the cash in the treasury. The wear and tear upon rails and roadbed, power plant and cars, as well as upon all kinds of equipment, are costs that must be provided for out of earnings before dividends can be rightfully paid. Maintenance is something which every street railway manager has learned to face. He also comprehends the meaning of depreciation. He knows that however well sustained are the repairs to roadbed, rails, machinery, cars and general equipment, still there is a depreciation in value constantly in progress. Not only does the entire equipment constantly diminish in value by age, but it is ever threatened with new and improved forms which may supersede it before it has reached half its theoretical age. As a prudent man, therefore, he looks over all the facilities and appliances which the road is using, and says, "It will cost so much per year to keep this property in proper repair." This conclusion reached, the application of it is that one-twelfth of this amount, whatever it is, is of the nature of an expense to be charged each month into the costs for that month. To charge it into the costs means to credit the reserve account of corresponding name. Then the expenditure for the repairs can be made whenever convenient.

Again, the manager says to himself, "We are not safe in counting on longer than so many years' life for all this equipment. In that time it will have either run down to such an extent as to make a replacement in kind absolutely necessary, or else it will have been superseded by something of a different character." This conclusion reached, the course for the accountant becomes plain. If the life of the entire equipment be fixed at twenty years, for example, then one-twentieth of the entire value must be written off as an expense each year. That is to say, one-twelfth of this one-twentieth must be charged as an expense each month. To charge into monthly expenses this amount there must be opened a reserve account of corresponding name and character. It may be called reserve for replacement or reserve for depreciation, or by other name, as the taste of the management may be. The expense or loss from depreciation goes on constantly, and the expense of wear and tear is also a constant quantity. They must be charged up regularly without regard to the time when money is spent to offset them.

Bridges, culverts, roadways, tracks, etc., have to be repaired, but such work cannot be done advantageously at all seasons of the year. It would be foolish in our Northern climates at least to undertake to replace rails and rebuild culverts between the first of December and the first of March, but the wear and tear upon the roadbed and equipment in general in the months in which no repairs can be made and no replacements advantageously undertaken are just as great as in the summer months, when this work can be carried on economically and expeditiously. This, then, is the argument for the charge for

repairs and renewals month by month. It is fair to the property and permits the expenditures to be made whenever the season favors.

Again it is inexpedient, in view of certain financial conditions that occasionally prevail, for very large outlays for maintenance, replacements, etc., to be made at certain dates. This, however, is no reason why the company should not set aside, month by month, a proper pro rata to be expended in lump whenever conditions become more favorable. Depreciation of property and wear out of property are constant expenses, and therefore should be charged for every month irrespective of any other condition.

Every transportation enterprise is subject to emergencies, such as accidents, damage claims, destruction of property, etc. Against some of these contingencies an insurance is possible. Against the others the company must insure itself. A reserve account, therefore, which shall accumulate an amount for emergency expenditures, is desirable. A monthly debit of the amount required as determined by past experience should be included in expenses, the credit being carried to "Reserve for Emergencies." Then when the expenses of the accident come to be paid they are charged to this account.

The expenses of a street railway company, in the light of the foregoing, are made up, month by month, somewhat as follows: First, the direct charges under the head of transportation, as, for example, the cost of operating the power plant and the cost of the car service. Next the general expenses, a portion of which may be described as administrative. These include salaries of general officers and clerks, printing, stationery, general legal expenses, rents, insurance, etc. Then come the allowance for depreciation of way and of structures and equipment, the provision for an emergency fund, the provision for taxes and the provision for interest on funded and floating debt. Finally, there is the proper pro rata from the suspense accounts, to which attention has been directed above.

The common objection urged against reserve accounts is that charging into monthly expenses an allowance for maintenance, an allowance for depreciation, an allowance for emergencies, etc., will reduce the current net earnings to such an extent as to make a very poor showing. This argument is very frequently heard, and by some it would seem to be accepted as conclusive, but it contains within itself its own refutation. The truth should be told regardless of all considerations whatsoever; while we may be able to fool ourselves and the public for a little while, we cannot expect to fool ourselves, much less the public, for an indefinite period. Equipment will wear out and must be replaced whether we provide for it or not. Accidents will occur and their expense must be borne whether we have set aside something in advance for them or not.

Conservative and prudent management provides for all these things in advance, or rather day by day, as the enterprise is conducted. Reckless management says, "Let the future take care of itself." Those stockholders who buy for permanent investment favor proper provision for all these different items, while those stockholders who buy on speculation, with the expectation of selling out as soon as a rise in price can be secured by the declaration of a liberal dividend, are naturally opposed to all allowances for a future contingency.

Another argument sometimes advanced against some of the reserve accounts here suggested is that the amounts are really offset by items of another character or by amounts on the opposite side of the account. This statement when examined is frequently found to include among offsetting items the suspense amounts described above. The answer to this is that every tub should stand on its own bottom, and that even though the amounts, debit and credit, should by chance offset each other to a dollar, still it were better to have charged the one and credited the other and thus to have demonstrated their agreement than to have guessed at it. However, in truth, these two classes of items never exactly balance. Sometimes one is greatly in excess, and sometimes the other. By some systems of management the amount of one class of items will be very large, while at the hands of other managers the reverse will be the case, and this is true even where all general conditions are substantially the same. The accountant is only the historian of the enterprise, and as historian he should aim to learn all the facts and to record them in their proper classes.

Theoretically, there can be no objections raised to the employment of proper suspense accounts and proper reserve accounts. Every accountant and every progressive business man will acknowledge not only the utility but the practical necessity of such devices. But it will be urged, in various individual cases, that the enterprise in hand will not stand the charges to expense which form the credits to the reserve accounts; that a given road, for example, is not yet sufficiently developed to have the rule so rigidly applied, and that upon this plan a showing could not be made nearly good enough to satisfy stockholders. Such pleas are not arguments. To avoid proper charges to expense for the sake of a good showing savors too much of dishonest management to be a pleasant suggestion.

In the convention of the Street Railway Accountants at Boston a few weeks since some one casually asked about "depreciation" accounts. One or two of the foremost accountants in the convention at once indicated that they were maintaining depreciation accounts—in other words, that they were setting aside reserves against depreciation of property. The majority of the convention, however, as it appeared to an outsider, treated the suggestion as a huge joke. Several exclaimed: "We are not ready for such refinements." But such refinements in accounting, if reserves for depreciation are to be called refinements, are fast becoming a necessity, and it will not be very long, if I correctly read the signs of the times, before every board of street railway directors will order a proper charge into each month's expenses to offset depreciation, to prepare for emergencies, and perhaps even for sinking funds for the redemption of the bonded debt. It only requires a little more information and a little more familiarity with the subject to show every street railway stockholder that nothing short of this general course is safe to follow.

The Citizens' Street Railway Company, of Detroit, Mich., has been much troubled with counterfeit tickets, 36,000 of which are said to have been made from plates prepared by a journeyman engraver residing in Chicago. Attention was first called to the deception by some of the counters in the company's office, who noticed that some of the tickets stained their fingers yellow. Several conductors have been arrested on the charge of receiving and passing the tickets, and one was recently convicted. The engraver and printer have also been apprehended.

The Ashland (Ky.) & Catlettsburg Street Railway Company gave a novel entertainment recently at its pleasure resort, Clyffside Park. It consisted of a realistic reproduction on the lake of the capture of Ponce Bay, Porto Rico. The chief actor on the American side was a model of the "Gloucester," which, after considerable firing, captured and blew up the Spanish gunboats and the Spanish forts. About 5000 spectators were present.

LEGAL NOTES AND COMMENTS*

EDITED BY J. ASPINWALL HODGE, JR., AND ROBERT ERNEST, OF THE NEW YORK BAR.

The Value of a Child's Life

What treatises, what essays, what poems might not be written upon such a subject?

But we have to deal here simply with the question of the pecuniary value of the life of a child, of either sex, to its next of kin, who, in the vast majority of cases, are its parents.

The question is a practical one to stockholders, officers and counsel of the street railway, and perhaps more nearly affects their business interests than it does the business interests of corporations engaged in any other business. Accidents resulting in the death of children in the crowded tenement districts of the large cities, where streets and avenues form playgrounds and are traversed by cars, are constantly occurring, and are inevitable. A claim is made in almost every such case, and, except in those where the company and its servants are clearly not at fault, the question of the pecuniary value of the child's life is an issue to be determined upon the settlement or the trial of the case.

In 1896, in the March number of the JOURNAL, the propriety of six-cent verdicts in death cases generally is discussed. The cause of action, as there pointed out, is wholly statutory, and the statute in almost all of the states provides only for the recovery of damages for the "pecuniary loss." Juries, however, and, judging from the decisions and opinions of many of our courts, even the Appellate tribunals themselves, have come to look upon the damages awarded as something in the nature of a punishment, thus stretching the clear meaning and intent of the statute and all the carefully considered decisions under it.

That children are an expense, rather than a pecuniary benefit (except in the rarest instances) during the greater portion of their minority, is a fact that must be universally admitted. But the plaintiff's counsel in the accident case argues that the chances are that this expense incurred in nourishing, protecting and educating the youngster—boy or girl—will be more than repaid to the parents by the pecuniary benefit they will receive in their advancing years, and it is left to the common sense of the jury to determine the probabilities.

In some of the states they are left practically unrestricted, and $5,000 verdicts have been sustained, but in New York, where an intermediate Appellate tribunal is the final tribunal to pass upon the question as to whether the verdict is excessive, the highest court in the only case where a $5,000 verdict for an infant has been brought to their attention, very pointedly imply that the intermediate appellate tribunal erred in supposing that they were without power to set aside the verdict, and they should have done so. In that case the child was a girl six years old; an only child; bright, intelligent and healthy; the daughter of a market gardener. (Houghkirk vs. D. & H. L. R. R. Co., 92 N. Y., 219.)

The average verdict for a child's death in the twenty cases reviewed by the Court of Appeals of New York is $2,000, the highest being $5,000, and the lowest $120. Verdicts for six cents damages in the case of the death of a child have been not infrequently sustained by the courts.

The adverse comment that has been caused by a recent decision of the Supreme Court of New Jersey, in the case of Graham, administrator, vs. Consolidated Traction Company, seems unwarranted. There, the plaintiff's intestate, a boy four years old, was run over by the cars of the defendant, and the case came on to be tried September, 1896, and a verdict was rendered for the plaintiff for $5,000. The Appellate Court directed that the verdict be set aside "as absurdly excessive," and that a new trial be had, unless the plaintiff consented to have the verdict reduced to $1,000.

It certainly is self-evident that the Jersey court is grossly inconsistent, for, if its reasoning be correct, and there seems much in it which is compatible with human experience, then the reduced verdict of $1,000, which it provided for on the first appeal, is as absurd and unjustifiable as one of $5,000.

How does it stand in the mouth of the Appellate tribunal to say that children are in ninety-nine cases out of a hundred an expense and not a pecuniary benefit; that, therefore, the valuation of $5,000 upon a four-year-old child's life is excessive, and then to say that they are able to determine that it is worth about $1,000. Consistency, coupled with a requisite amount of courage and a total freedom from any lurking idea that damages in death cases are to be viewed as punitive, should have led them to announce the logical result of their premises, to wit: that the only verdict sustainable in the premises is one for six cents.

The plaintiff chose the alternative of a new trial, and in October, 1897, secured a second verdict for $5,000.

In deciding a motion for a new trial, Judge Gummere, after citing Chief Justice Beadsley, in Paulmier vs. Railroad Co. (34 N. J. Law, 158), says: "Children are more often an expense than a pecuniary benefit to the father. If, at the father's death, an account were stated showing on the one side the moneys expended by him in the education, maintenance and support of the child, and, on the other side, the moneys received by the father from his child, in a majority of every 100 cases the moneys expended for the benefit of the child would be found to be far in excess of the amount received from him. And yet, on the theory upon which this verdict is based, the larger a man's family is, the more likely is he to die rich. In the present case, if the father of the decedent had a reasonable expectation of being benefited in dollars and cents to the extent of $5,000 by the continuance of the life of his deceased child, a family of ten sons would justify the assumption that at his death he would be better off by $50,000 than he would be if he had never had issue. The mere statement of such an assumption makes its absurdity apparent."

He, therefore, sets the verdict aside as "palpably and grossly excessive."

Even should the reasoning of the Jersey court finally obtain, and verdicts for six cents in the case of the death of children become the rule, there still would be room for exceptions.

For example, a widow in humble circumstances, with one or two boys, however young, naturally looks, and generally finds, that in the end they become her support. So, some children, who show great genius in music or in art, may with reasonable expectation be looked upon as the future and even present support of their immediate family.

The legislatures in one or two of the states have passed acts which prevent six-cent verdicts in death cases by providing for a minimum verdict of $500 or $750. There the theory apparently is that some sum should be awarded, if merely as deterrent or punitive damages.

Many a counsel for a defendant railroad company is afraid of exciting the prejudices of a jury by talking to

*Communications relating to this department may be addressed to the Editors, Johnston Building, 30 Broad Street, New York.

them plainly of the insignificant pecuniary value to a parent of a child's life. As a matter of policy they abstain, but it is a very grave question as to whether the more courageous course is not the better one, and would not in the end accomplish better results, both generally and in the special case. H.

A Novel Index of Negligence Law

The recent work* of T. F. Hamilton, of the New York bar, is worthy of mention, for it is unique. It is not a digest of the law. It is certainly not a text-book, and, unless we call it an index (which hardly describes it) we must borrow a whole clause from its title to give it a name. It is a classification of cases "according to the facts." It is a labor saver for the attorney, the counsel, and the loss adjuster, who is desirous of finding what cases have been decided in the State of New York in which the *facts* are similar to those in the case under his consideration.

The six thousand cases decided in the state, after being tagged, and with not more than four or five words on the tag for each case, have been arranged according to a very definite system, and within the compass of less than 500 pages of large, clear and well-spaced type. This method of arrangement, so far as we know, has never been attempted in a work treating of any class of cases, and the big field offered by the negligence cases in the State of New York is one peculiarly adapted for this sort of treatment.

Let us assume that an accident has happened through alleged negligence at a draw-bridge. It would involve a very considerable amount of reading through the fine print of many columns in the digests to be able to say that the searcher had a list of all the cases where accidents had happened at draw-bridges, but Mr. Hamilton enables the searcher to look under the heading "Highways," and then under the sub-heading "Bridges," and there find the eight cases in this state, and presumably the only cases decided prior to Jan. 1, 1898, where the courts have passed upon the facts involving negligence at a draw-bridge, and he is further able to see at a glance in which of the eight there was negligence in leaving the draw open and in which the negligence consisted in other facts, such as the catching of a foot in closing the draw, or other like mishap. If he wishes to learn more and to discover what legal questions were passed upon he must go to his library for the reports.

One excellent result of this mode of classification is that all the appeals of each case are to be found in one place.

The work purports also to give citations to all the cases where any particular case has been criticised, modified or followed, and the work would be more useful if this promise were fulfilled, but its bulk would be much increased. Mr. Hamilton is also somewhat inconsistent in including actions for ejectment from railroad trains and street cars among negligence cases, and is guilty of a double inconsistency in that, while he gives us a few under that heading, he does not include all which have been decided in this state.

We notice, too, that each case is cited but once, whereas many of the cases would, appropriately, find their place under more than one of the headings.

But a careful examination of the work cannot fail to impress the reader with its utility, as well as with the fact that it is unique. The book is one which is sure to grow more valuable as the practitioner becomes more and more familiar with the author's method of arrangement. Typographically the work is excellent. H.

*Hamilton's New York Negligence Cases, Classified according to the Facts. By T. F. Hamilton. Remick, Schilling & Co. New York, 1898.

CHARTERS, ORDINANCES, FRANCHISES, ETC.

INDIANA.—Highways—Presumption of Dedication—Use by Owner—Public Improvements—Petition—Sufficiency of Ordinance.

1. Such user as amounts to an easement and establishment of right by prescription is sufficient to raise a presumption of dedication or condemnation, as between the fee owner and the public.

2. In an action to enjoin a town from paving a street on the ground that it was the private property of a railroad, it appeared that the land had been used by the public continuously for thirty years, and that the public had accepted it to a definite width as a public highway, and the town authorities had ditched, graded, and cared for it in the same manner and to the same extent as for other streets of the town. Residences had been erected in the village with reference to it, and a livery barn had for years been maintained near it, with its only entrance from this street, all without objection from the railroad company. Held, that these facts raised a presumption of dedication to the public use.

3. The owner's participation in the use of a highway, constructed by him, in a manner not inconsistent with the public use, will not defeat a presumption of dedication.

4. One who relies on his disability to resist adverse user, to defeat a presumption of dedication to the public use as a highway, must show such disability.

5. The fact that during a part of the adverse user the owner of the land was out of possession, and the property was held by a tenant under a lease from him, will not defeat a presumption of ancient dedication to the public use.

6. A town board has the right to order a street paved, by a two-thirds vote of the board; and a petition of property owners, requesting such pavement, is not necessary to jurisdiction.

7. A recital, in an ordinance directing the construction of a public improvement, that it was passed by a two-thirds vote, is conclusive of the fact stated, on a collateral attack.

8. An ordinance providing for the construction of improvements on certain streets described one of them as "Railroad Street." Prior thereto, an ordinance had been passed naming the street connecting two other streets in the village as "Railroad Street." No other street connected the two named streets. Held, that the description of the street was sufficient.—(Pittsburgh, C. C. & St. L. Ry. Co. v. Town of Crownpoint et al., 50 N. E. Rep. 741.

NEW YORK.—Witness—Examination—Impeachment.

Where a witness who has testified positively to a material fact concerning which the evidence is conflicting is discredited upon his cross-examination, which tends to show that he was coached as to his testimony, the exclusion of questions on the redirect which seek to elicit a full account of the circumstances relating to the alleged coaching constitutes reversible error.—(Marsullo v. Metropolitan St. Ry. Co., 52 N. Y. Suppl. 286.)

LIABILITY FOR NEGLIGENCE

ILLINOIS.—Injury to Child on Track—Evidence.

Plaintiff, a boy between four and five years of age, and another boy, when first seen by defendant's gripman, at the distance of about 150 ft., while the car, approaching from the east, was running at the rate of about 10 miles an hour, were standing in the street, 2 or 3 ft. from the curbstone, which was about 12 ft. south of the east-bound cable track. When the grip car was about 30 ft. away, plaintiff's companion started to run north, across the street, and when he had gone about 15 ft. plaintiff started to run across, directly in front of the approaching car. The gripman shouted at each when they started, and applied the brake, and reversed the lever when the first boy started, but could not stop in time to save plaintiff, who was struck and injured by the car. Held, that a verdict for defendant was properly directed.—(Rack v. Chicago City Ry. Co., 50 N. E. Rep., 668.)

LOUISIANA.—Collision—Evidence.

1. In an action for damages received from a collision between a cart and a street car, moving side by side in the same course, with a short space between them (one cannot strike the other if each remains in its direction), it being evident that the car did not turn, but that the cart was turned so that it struck the side of the car, the presumption of negligence was not against the street car.

2. To recover it was incumbent upon the plaintiff to prove that the collision was caused by the negligent acts of the defendant. On the contrary it appears that it proceeded from the incautious act of the driver in pulling his horse to the left.

3. Held, that the injury was not caused by defendant's negligence, and that there is no ground for deciding that the unanimous verdict of the jury and the judgment of the court pronounced thereon were erroneous.—(Rombach v. Crescent City R. Co., 23 So. Rep., 604.)

LOUISIANA.—Collision with Electric Car.

The proof disclosing that the driver of a small pleasure wagon had halted his team within a few feet of a street electric car track at the intersection of Carrollton avenue and Canal street, in the city of New Orleans, to wait for a steam train and an electric street car to pass, and suddenly put his horse and wagon in motion for the purpose of crossing the track, in front of another electric car, which was rapidly approaching, and only a short distance away and within easy open view, held, that the street car company, its agents and employees, are not guilty of culpable negligence which renders the defendant liable for the damages resulting from a collison betwen the car and wagon.—(Hemmingway vs. New Orleans C. & L. R. Co., 23 So. Rep., 952.)

MINNESOTA.—Injury to Passenger—Damages—Expert Evidence.

1. Evidence considered, and held that it supports the verdict, and that the damages awarded are not so excessive as to justify the conclusion that they were given under the influence of passion or prejudice.

2. A medical expert gave an opinion in this case, and, on his cross-examination, testified that his opinion was based entirely upon his examination of the plaintiff, and what was elicited during the examination from her. Held, on the evidence, that the trial court did not err in refusing to strike out his opinion.—(Fulmore v. St. Paul City Ry. Co., 75 N. W. Rep., 589.)

MISSOURI. — Damages—Personal Injuries—Appeal—Presumptions.

1. The value of medical treatment necessitated by a personal injury, but for which no charge was made, is not an element of recovery for the wrong.

2. Where the jury was instructed to consider an improper item in awarding damages to plaintiff for a personal injury, their verdict for him is presumed to have included it.—(Morris v. Grand Ave. Ry. Co., 46 S. W. Rep., 170.)

NEW YORK.—1. Expert Evidence—Propriety of Questions.

At the trial of an action to recover damages for personal injuries, an expert medical witness for the plaintiff was asked, in reference to an attack of illness experienced by the plaintiff in the court room, and observed by the witness: "From your examination of the plaintiff, and the facts stated and testified to here, what do you say was the cause of that?" To this question defendant's counsel objected "as incompetent and immaterial; no proper foundation laid for the question, and not a subject of opinion." The objection was overruled, and defendant excepted. Held, that as the question was based in part on what other witnesses had testified to, instead of being put in hypothetical form, it was improper.

2. Same—Sufficiency of Objection.

Held, further, that the objection was sufficiently specific to call attention to the viciousness of the question.—(McGuire v. Brooklyn Heights R. Co., 51 N. Y. Suppl., 1075.)

NEW YORK.—Injury to Passenger—Instructions.

At the trial of an action to recover damages for personal injuries resulting in the death of the plaintiff's intestate, and occasioned by the sudden starting of a car while he was attempting to board it, and in which the controlling issue was whether in fact the car had previously come to a standstill, so as to constitute an invitation to him to board it, the judge's charge failed to call this question to the attention of the jury; and the defendant's counsel requested the court to say to the jury that, if they believed that the car did not come to a complete stop, their verdict should be for the defendant. Held, while the request was somewhat indefinite as to time and place, it was sufficient to inform the court as to the point, and that the judge's refusal to charge substantially as requested was error. Patterson J., dissenting.—(Savage v. Third Ave. R. Co., 51 N. Y. Suppl. 1066.)

NEW YORK.—Imputed Negligence—Accident at Crossing.

The fact that a woman who is riding in a carriage at the invitation and as the guest of the driver, a competent and sober man, warns him of danger just before they reach a railway track, does not constitute such an assumption of authority or control as to impute to her liability for his negligence, which contributes to an accident resulting in injury to her.—(Bergold v. Nassau Electric R. Co., 52 N. Y. Suppl. 11.)

NEW YORK.—Action for Causing Death—Pecuniary Loss—Excessive Verdict—Rule of Damages.

1. Under Code Civ. Proc., sec. 1904, providing that the damages awarded may be such a sum as the jury believes will fairly compensate the person for whose benefit the action is brought for pecuniary injuries resulting from decedent's death, a verdict of $800 for the negligent killing of a woman about 70 years of age, who was supported by her children, but who was in fair health, and rendered assistance to her daughter, with whom she lived, is not so excessive as to justify interference with it.

2. Same.—The rule of damages in actions for causing death has not been changed by reason of the fact that the $5,000 limitation has been abolished by the constitution.—(Phalen vs. Rochester Ry. Co., 52 N. Y. Suppl., 836.)

NEW YORK.—Collision—Degree of Care Required.

In an action by the driver of a truck to recover damages from a surface railroad company for personal injuries resulting from a collision between the truck and one of defendant's cars, the judge charged, in substance, that, upon the questions of negligence and contributory negligence, both parties were bound to exercise that degree of care which a person of ordinary experience and prudence should have exercised to avoid the collision, "because the same degree of care must be exercised by one as by the other." Held, no error.—(Seagriff v. Brooklyn Heights R. Co., 52 N. Y. Suppl. 236.)

NEW YORK.—Right of Way.

1. As between a trolley car running on a city street, and the driver of a wagon crossing its tracks in the line of an intersecting street, the former has no superior right of way.

2. Juror—Competency—Waiver of Objections.

By failing to challenge a juror, a party not only waives any objection to his competency, but also any objection to the rulings of the court on his examination.

3. Same—Examination.

A question put to a juror, upon his examination before being sworn, which involves propositions of law, as to which a fair and competent juror might well be ignorant, and which, without explanation, even an educated layman might not clearly comprehend, is properly excluded by the court.—(O'Rourke vs. Yonkers R. Co., 52 N. Y. Suppl., 706.)

NEW YORK.—Rights of Vehicles.

1. The rights of drivers of vehicles and of cable cars upon a city street are reciprocal, and the gripman of a cable car is bound to use as much diligence to avoid running into a vehicle that is crossing its track as the driver of the vehicle is to avoid running into a cable car which may cross its path.

2. Same—Crossing Track.

The driver of a vehicle in a city street has the right to cross the track of a cable car, when there is a reasonable opportunity to do so, even though it requires the cable car to slacken its speed in order that it may not upset his vehicle.—(Kennedy vs. Third Ave R. Co., 52 N. Y. Suppl., 552.)

NEW YORK.—Appeal—Verdict Against Evidence.

1. A verdict is not to be set aside as against the evidence merely because there is an absence of proof to corroborate the personal statements of the prevailing party, where his failure to furnish such corroboration may be and is readily accounted for.

2. Injury to Passenger—Contributory Negligence.

If a passenger on a crowded surface car occupies a seat provided for the purpose, on the front platform, and yields it to another passenger, the fact that thereafter he continues standing on the platform is not of itself negligence, unless he knows or ought to know that he is in a position of danger, from which he could escape by going inside the car, and has an opportunity to do so.

3. Damages—Excessive Verdict.

In an action to recover damages for an injury, due to defendant's alleged negligence, resulting in a sprain or partial dislocation of the plaintiff's left wrist joint, it appeared that he was a waiter, on small daily wages, and the permanency of the injury, which had largely disappeared, and the seriousness of pains in his back, to which he testified, were not very clearly established. Held, that a verdict for $1,100 was excessive.—(Still vs. Nassau Elec. R. Co., 52 N. Y. Suppl., 975.)

NEW YORK.—Injury to Passengers.

Where the construction and method of propulsion of a surface car are such as to involve a serious jerk in starting, a jury would be warranted in inferring want of ordinary care in its operation, from the fact that a woman passenger was thrown to the floor and injured through the starting of the car before she was able to reach a seat.—(Dochtermann vs. Brooklyn Heights R. Co., 52 N. Y. Suppl., 1051.)

NEW YORK.—Attorney's Lien.

Code Civ. Proc., sec. 66, giving an attorney a lien on his client's cause of action which cannot be affected by any settlement between the parties before or after judgment, includes an unassignable cause of action for a tort.—(Astraud vs. Brooklyn Heights R. Co., 53 N. Y. Suppl., 294.)

NEW YORK.—Accident to Car—Refusal to Transfer—Damages.

If a surface railroad company undertakes with a passenger, who pays his fare, to convey him with reasonable speed to his destination, and the car breaks down on the way, and the company refuses to transfer him to another car without payment of another fare, his cause of action for resulting damages at once arises, and he cannot, by attempting to transfer himself to another car, and resisting his expulsion therefrom by the conductor, in accordance with the company's rules, subject the company to any further liability.—(Taylor vs. Nassau Electric R. Co., 53 N. Y. Suppl., 5.)

NEW YORK.—Injury to Person on Street—Contributory Negligence.

If, in an action for damages for personal injuries received by a decedent in a collision with a trolley car, there is some evidence, growing out of the facts and circumstances of the case, and out of the presumption that the decedent would not intentionally drive in front of a near and swiftly approaching car, which might justify reasonably minded men in differing as to the presence or absence of contributory negligence, the question should be submitted to the jury.

2. Same—Duty to Look and Listen.

The necessity of looking and listening before attempting to cross the tracks of a steam railroad does not apply in the case of a street surface railroad, where both parties are making use of the highway, and where the crossing is made at the intersection of streets. In that case both parties are required to use such care as ordinarily prudent men would use under the circumstances.

3. Death by Wrongful Act—Damages.

Upon the question of the amount of damages sustained by the widow and next of kin of a decedent through his death by wrongful act, evidence of his profits from a temporary partnership, doing work under public contracts secured by competitive bidding, and involving the use of capital, and his part in the operations of which is not shown, is too speculative, and is accordingly incompetent.—(Read vs. Brooklyn Heights R. Co., 53 N. Y. Suppl., 209.)

NEW YORK.—Nonsuit—Question for Jury.

If, in an action by a passenger to recover damages from a surface railway company for personal injuries sustained by the plaintiff through the alleged negligence of the defendant in suddenly starting a car while the plaintiff was leaving it, the plaintiff testifies positively that, when he was stepping from the car, it had, for that purpose, been brought to a full stop, and was then suddenly started, a motion for a nonsuit, made at the close of the plaintiff's case, is properly denied.—(Freeman vs. Consolidated Traction Co., 53 N. Y. Suppl., 410.)

NEW JERSEY.—Damages—Excessive Verdict.

In suits to recover for personal injuries or for death by wrongful acts, a verdict which is grossly excessive will be set aside without regard to the number of times the case has previously been tried.—(Consolidated Traction Co. vs. Graham, 40 Atl. Rep., 773.)

PENNSYLVANIA.—Contributory Negligence—Collision.

Plaintiff, driving at night on a city street, saw, when 50 feet from the track, a heavily loaded street car approaching on a down grade; and when his horse was about to step on the track, on which he drove it without quickening its pace, he saw that the car, which was going very slowly, was quite near; but he thought he could get away, and that the car would be stopped. Held, guilty of contributory negligence.—(Smith vs. Electric Traction Co., 40 Atl. Rep., 966.)

PENNSYLVANIA.—Construction—Accident to Child on Track—Evidence.

1. A street railway company, in obeying the direction of the township supervisors to lay its tracks below the surface, so that they would be on a level therewith after the change of grade they intended to make, does not violate its duty to conform to the grade of the road in laying its tracks.

2. Evidence merely that a child, standing 5 ft. to the side of the street-car tracks when the front of a car passed, got under the rear wheels, and was killed, or, as another child testified, that she took a step forward, and "the street car pulled her down," does not show that the accident was caused by the tracks being 8 ins. below the street surface, or by that and a low mound of earth, 2 ft. outside the tracks, caused by the earth being displaced by heavy wagons.—(Miller et ux. v. Lebanon & A. St. Ry. Co.

TEXAS.—Implied Negligence—Question for Jury—Diligence—Instruction—Contributory Negligence—Weight of Evidence—Refusal to Charge.

1. Where a statute or ordinance does not require it, there is no implied negligence in a failure to sound the gong or bell of a street car while persons are on or near the track, to warn them of its approach.

2. Whether failure to sound the gong or bell of a street car prior to a collision is negligence, is for the jury, in an action for resulting damages.

3. It is the duty of one passing over a street railway track to exercise diligence to ascertain if a car is approaching, as well as caution to avoid a collision.

4. A charge that if plaintiff negligently failed to listen for defendant's approaching street car at a time and place where he collided with it, where an ordinarily prudent person would have looked and listened, and discovered it in time to avoid the injury, and his failure contributed thereto, he is guilty of contributory negligence, but leaving the jury to determine his negligence, was improperly refused, where there was evidence of such conduct.

5. In an action for an injury by collision with a street car, the charge that it was plaintiff's duty to use greater diligence if his senses of hearing and seeing were impaired goes to the weight of the evidence.

6. An instruction not warranted by the evidence is properly refused.—(Citizens' Ry. Co. v. Holmes, 46 S. W. Rep., 116.)

UTAH.—Injury to Person in Street—Contributory Negligence—Question for Court—Care Required.

1. B., at the middle of a block in a city, attempted to cross the street, having two railroad tracks thereon, the street running east and west. When he started to cross, he looked for a westbound car, but not for an eastbound car. The westbound car approached, and stopped, and B. told the conductor to "Go on," and stepped behind that car across the space between the tracks, on to the next track, and was struck by an eastbound car, and knocked down. There is evidence to show that, after the car which struck B. was brought to a stop, it was again started, and moved a foot or two, thereby injuring B.'s foot. The motorman of the car upon discovering B.'s perilous condition, did all he could to stop the car, which was running at a low rate of speed. In an action brought by B. against the street car company for personal injuries received at the time of the occurrence, held, that B. was not entitled to recover for any injuries sustained by his first collision with the car; that, if he had any right of recovery, it was for injuries which he received, if any, after the car had come in the first instance to a full stop; that it was error for the court to refuse to charge the jury that the plaintiff could not recover for any injury sustained by him prior to the time when the car was first brought to a full stop after the collision.

2. Where, in an action for personal injuries, alleged to have been caused through negligence, the facts shown by the evidence are such that all reasonable men must draw the same conclusion from them, the question of negligence becomes one of law for the court.

3. A person, in crossing a street having street car tracks thereon, is bound to exercise the same degree of care which it is incumbent upon the railroad company to exercise.—(Burgess vs. Salt Lake City R. Co., 53 Pac. Rep., 1013.)

Important Boiler Contract

The Stirling Company has just closed an important contract with the William Cramp & Sons Ship & Engine Building Company which is of particular interest just at the present time. It has acquired all of the Cramp Company's rights, patents, etc., in water tube boilers for marine purposes, and is to manufacture all of such boilers that the Cramp Company may require for a period of ten years. Some idea of the importance of the negotiations may be formed from the fact that the first order for boilers for a Russian battleship and cruiser represents 40,000 h.p.

The Niclausse boiler, which will be used in the equipment of the Russian vessels, has been standardized by the French and Italian navies and is being installed in all of the battleships and cruisers now being built in this country and France for the Russian Government. The advantages that the boiler offers over the old Scotch form of boiler which has hitherto been used almost exclusively are safety, economy, and finally, great saving in weight. That this last very important object is accomplished in the construction of the Niclausse boiler is demonstrated by the fact that Niclausse boilers required for a battleship weigh no less than 350 tons less than boilers of the Scotch type to develop the same power.

The sales of Stirling boilers continue heavy, a gain of over 150 per cent in excess of the corresponding period of last year being shown. The shops of the company at Barberton, O., which were doubled in the spring, will now be again enlarged to provide for the large volume of business which is confidently expected in the marine field with the development and growth of the shipping interests of the country.

Railway Men in the Late War

The part taken during the late war by electrical engineers and railway men was a particularly prominent one, and deserves more than passing mention. A number of those who volunteered their services were graduates of the national academies at West Point and Annapolis. Many of these were occupying positions of great responsibility at the time of the breaking out of the war, and their enlistment involved very considerable sacrifices of a personal and pecuniary character; nevertheless the unanimity with which they offered to defend the nation must always be a source of pride not only to all graduates of these academies but to the nation as well. Many of the others who volunteered their services had formerly been connected with the State militia or naval militia bodies, while others had no previous military training, but their electrical and mechanical knowledge served the Government in good stead in the engineering operations involved in the coast defense and in Col. Griffin's engineering brigade. Service in the latter appealed particularly to electrical engineers.

The war brought sorrow to many homes, and among those who volunteered from the electric railway industry there were a number of deaths, including those of Lieuts. William Tiffany and Clarence G. Davenport.

It would be impossible to give the names in the STREET RAILWAY JOURNAL of all those who volunteered and fought for love of their country during the last summer, and who were well-known figures in the electric railway industry. It is the intention of this article to mention a few only of those who can be classed in this number.

One representative street railway manager to enter the army at the breaking out of the war was Gen. Bancroft, first vice-president of the Boston Elevated Railway Company. Gen. Bancroft at the opening of hostilities was summoned by the Governor of Massachusetts as one of his military advisers, and later was placed in command of the State forces stationed along the Massachusetts coast, with headquarters at Marblehead. He was appointed Brigadier General of the United States Volunteers by President McKinley on May 27, and was assigned to the Seventh Corps (Lee's), which was stationed at Jacksonville, Fla. By the corps commander he was assigned to the Second Division (Arnold's) and placed in command of the Second Brigade, composed of the First Wisconsin, the Fiftieth Iowa and the Fourth Illinois. Later, the Fourth Illinois was transferred to the Third place to Gen. Bancroft. Division and the Ninth Illinois assigned in its The corps was not ordered on foreign service, but he remained in camp until the President ordered hostilities to cease, when he resigned. While in the army Gen. Bancroft labored to make his brigade efficient, rising habitually at 4:30 o'clock A. M and devoting many hours daily to the drill, discipline and sanitary condition of his brigade. Having left an engrossing business at some personal sacrifice to enter the army, he hurried back as soon as the war was over to resume his duties with the Boston Elevated Railway Company, and was at his desk the morning after his return.

GEN. W. A. BANCROFT

To Col. Eugene Griffin must be given the principal credit for the establishment of the brigade of volunteer engineers authorized by President McKinley soon after the outbreak of the war. He not only was one of the first to advocate the plan and urge the importance of it before Congress, securing its passage, but also through personal efforts assisted largely in the recruiting of the brigade, and as Colonel of the First Regiment perfected its organization.

Col. Griffin was graduated from West Point in 1875, and was at once appointed second lieutenant of engineers in the United States army and assigned to duty at the Engineering School of Application at Willett's Point, where he remained until 1877. During the next four years he was engaged in important work for the United States Geographical Survey, and in 1883-85 was assistant professor of civil and military engineering and the art of war at West Point. In 1885-86 he was chief engineer of the military division of the Atlantic and Department of the East, and of Columbia, having charge, under the commission, of pavements, country roads, and all matters relating to electric lighting, telephone and telegraph companies in the City of Washington. In 1887 he was promoted to be captain in the corps of engineers, and in 1889 resigned in order to take charge of the railway department of the Thomson-Houston Electric Company, which was organized in 1888. His business career has been marked by the same energy and ability as his military record, and as first vice-president of the General Electric Company he has done much to give that company the prominent position which it holds in the manufacture of electrical apparatus. As Colonel of the First Regiment of Volunteers he had entire charge of the organization of this body. He was sent to Porto Rico shortly after the invasion of that island by Gen. Miles. While in the service there Col. Griffin contracted a severe attack of sickness, which compelled his return to this country.

COL. EUGENE GRIFFIN

MAJ. LOUIS DUNCAN

The New York Naval Reserve was represented by three officers who are well known in the street railway field, Lieut. W. Butler Duncan and Junior Lieutenants S. Dana Greene and John H. Barnard. The record of this branch of the naval militia was particularly brilliant. Being called to man the U. S. S "Yankee," they sailed from New York May 9. After several weeks on the coast patrol the "Yankee" was ordered south, reaching Santiago only a few hours after the sinking of the "Merrimac" by Hobson under Morro Castle. The vessel served in the blockade of Santiago, except when sent on detached service, until the end of June, participating in the bombardment of June 6. It was also engaged at Guantanamo, Cienfuegos and Casilda.

Lieut. Greene was graduated from the Annapolis Academy in 1883, and is a son of the late Commander S. Dana Greene, who was second in command of the "Monitor" during its engagement with the "Merrimac," and in full command during the greater part of the battle, owing to the disablement of Capt. Worden shortly after its commencement. He resigned from the navy with the rank of Ensign in 1888 to enter the employ of the Sprague Electric Railway and Motor Company, of which he was chief engineer. His connection with the electrical business since that time is well known, and he has held various positions of great responsibility and trust, and is now chief of the electric lighting department of the General Electric Company. He has always kept his interest in navy matters, and joined the New York Naval Militia when it was organized in 1891, and was Chief of Staff when the war broke out. The Navy Department requested the Governor of New York in April, just after war had been declared, to detail eleven officers and about 290 men from the New York Naval Militia to man the New York cruiser "Yankee," commanded by W. H. Brownson. Mr. Greene served on this vessel throughout the war as second watch and division officer, having command of the four after 5-in. quick-firing guns on the gun deck.

Mr. Barnard was graduated from the Naval Academy in the class of 1883, and resigned shortly after graduation and was for nearly a year in the service of the American Ship Building Company, which was organized by the late Commander Gorringe. Among the many ships that were built by that company during its short life was the "Chatham," which was afterward purchased by the Navy Department and turned into the repair ship "Vulcan," in which capacity it has achieved a world-wide reputation. Mr

Barnard later became interested in and undertook the management of the Asheville Electric Light Company, and afterward organized and did most of the building of the first Asheville street railway, which was one of the very first of the successful early electric railways. Afterward Mr. Barnard resigned from its management to devote his entire time to the agency of the Sprague Electric Railway & Motor Company in North and South Carolina and Georgia, and afterward became agent of the Southern Department of the Edison General Electric Company. Later he organized the Wilmington (N. C.) Street Railway Company, and afterward removed to New York City, where for two years he was manager of the Interior Telephone Company. In the fall of 1897 he accompanied the Nicaragua Canal Commission to Nicaragua, but resigned from this to return home when hostilities seemed imminent. During his residence in North Carolina he was largely instrumental in the organization of the Naval Militia of that State, and upon his removal to New York joined, in 1895, the New York Battalion as lieutenant, junior grade. Upon the resignation of Lieut. W. B. Duncan, Jr., he was elected to the command of the Third Division. On April 30 he was appointed lieutenant, junior grade, on the "Yankee," on which vessel he served during the war and was honorably discharged Sept. 13, 1898.

LIEUT. S. D. GREENE

CHIEF ENG. W. D. WEAVER

LIEUT. W. B. DUNCAN, JR.

LIEUT. T. C. WOOD

LIEUT. J. H. BARNARD

CAPT. F. S. DE RONDE

LIEUT. WM. TIFFANY

MR. W. J. CLARK

Lieut. W. B. Duncan, Jr., was graduated from the Naval Academy at Annapolis in 1882 and resigned from the service in 1884, becoming connected with the American Shipbuilding Company. He was largely instrumental in the organization of the New York Naval Militia in 1891, and upon its formation was appointed in command of a division of that body. He resigned from the service in 1896, but was elected commander of the battalion in 1897, and led the first detail of volunteers which went to the war. This was on April 11, 1898, when he was sent to Philadelphia to take the monitor "Nahant" from that city to New York. He was later assigned to the "Yankee" as senior watch officer with the rank of lieutenant, and served on that vessel until he was mustered out.

Dr. Louis Duncan is another graduate of the United States Naval Academy at Annapolis who volunteered his services at the breaking out of the war. He was born in Washington in 1862, and after graduation at Annapolis in 1880 spent two years at sea on the South Pacific Station. At the expiration of that time he was ordered to land service and was stationed at the Johns Hopkins University, of Baltimore, where he remained three years, devoting himself to the theoretical and practical study of electricity. During this time he assisted in the labor of the determination of the value of the ohm, made for the United States Government, and conducted various other valuable investigations. In 1885 he took the degree of doctor of philosophy at that institution, and after that spent another year at sea, employed on special work testing various electrical devices for naval use. In 1886 he resigned from the navy, having accepted a position as associate professor of electricity at Johns Hopkins University, where he took charge of the department of electrical engineering, which was then established. He is past president of the American Institute of Electrical Engineers, and has acted as consulting and electrical engineer for many important railway installations. As an original investigator in electrical science Dr. Duncan has achieved a world-wide reputation, some of his papers having been epoch-making in their effect. At the outbreak of the war he was the representative of the Naval Militia on the staff of the Governor of Maryland, in which position he was given charge of important work connected with the harbor defenses of Baltimore. Recognizing the value in the prosecution of the war of a corps of technical men and engineers, he joined with Col. Griffin in securing the passage of a bill authorizing the establishment of three regiments of volunteer engineers, and was later commissioned Major in the First Regiment of Volunteer Engineers.

The electrical and technical press had a prominent representative in the war in the person of Chief Engineer W. D. Weaver, editor of the "American Electrician." Lieut. Weaver entered the United States Naval Academy as cadet engineer in 1876 from the sophomore class of Kentucky University, and was graduated in 1880. For the next three years he was on the North Atlantic Station, and in 1883, as an officer of the U. S. S. "Yantic," took part in the first Greeley relief expedition, the other vessel of which, the "Proteus," was sunk by the ice, and spent two months within the Arctic Circle. He passed 1884 in Europe on leave of absence, and attended the lectures of Mascart at the Collège de France, and took a course in the electrical laboratory of the Sorbonne, Paris, and at the then celebrated Hanover Square School of Electrical Engineering, London. In 1885-88 he was on sea duty, spending about two years in China, Japan and Corea, proceeding east by way of the Suez Canal and returning via Panama, thus completing the circuit of the world. He was stationed at the Navy Department in Washington from August, 1888, to January, 1889, and at the New York Navy Yard from the latter date till January, 1891, when he resigned from the navy, the resignation taking effect a

year later. While at the New York Navy Yard he designed and erected there an elaborate apparatus for testing steam indicators, and also an electrical apparatus for accurately registering the data of speed trials and the launching speed of war ships. In 1891, with Mr. E. G. Bernard, he founded at Troy, N. Y., the firm of E. G. Bernard & Co., electrical contractors and manufacturers. He was editor of the "Electrical World" from 1893 to 1896, resigning in the latter year to accept the position of editor of the "American Electrician," which office he holds at present. He has been a manager of the American Institute of Electrical Engineers, and is a member of the Société Internationale des Electriciens, Society of Naval Architects and Marine Engineers, etc.

At the outbreak of the war he volunteered his services to the Government and was chosen chief engineer of the U. S. S. "Glacier," the refrigerating ship of Admiral Watson's squadron, which vessel was later sent to duty in Cuban waters. He returned from Cuba Nov. 1 to resume his editorial work, and will receive an honorable discharge from the naval service Dec. 1. Owing to the large size of that vessel—about 10,000 tons displacement—and to the complicated nature of the machinery of the large refrigerating plant it carried, the assignment indicates to a marked degree the importance with which Lieut. Weaver's services were held by the Government.

Lieut. Thomas C. Wood was born in Utica in 1850, and in 1866 received an appointment at the Naval Academy from the Hon. Roscoe Conkling. He was graduated in 1871 as midshipman, and for the next two years served on the "Wabash" with the flagship of Admiral Alden. In May, 1874, he passed an examination for promotion to ensign, and was ordered to the "Plymouth" for service in the West Indies. He remained on this ship part of the time as watch officer, and took part in the expedition sent up the Rio Grande to co-operate with the army in the suppression of cattle raiding from Texas into Mexico. In 1876 he resigned to engage in business, and in November of that year formed a partnership in Erie, under the title of Skinner & Wood, to build portable and stationary steam engines. From small beginnings his business grew rapidly, and in 1885 he retired, disposing of his business to his partners. For two years he traveled with his family, and returning to the United States, took up his residence in New York. In 1888 he again entered active business, and established with Mr. Vincent the firm of C. R. Vincent & Co., engaged as contracting engineers. In 1891 this business was absorbed by the Ball & Wood Company, builders of steam engines largely for electrical work, where he remains at present, with his office at 120 Liberty Street, the works of the company being at Elizabeth, N. J.

At the time of the "Maine" disaster, when indications pointed to a rupture of our relations with Spain, Mr. Wood, as an old graduate of Annapolis, offered his services to the Navy Department, and in May of this year was commissioned lieutenant in the navy, the rank then held by his old class. He was ordered to the "Gloucester," Lieutenant Commander Wainwright commanding, and served on her during the Spanish campaign, taking part in all the operations on the southern coast of Cuba, including the bombardment of Guantanamo, Aguadores, and the naval action with Cervera's fleet off Santiago. Lieut. Wood had the honor of attending, as naval aide, the ceremonies incident to the surrender of Santiago. Later the "Gloucester" was ordered to accompany the Porto Rican expedition under Gen. Miles, and Mr. Wood was so fortunate as to command the first landing expeditions at Guanica and Arroyo, made in advance of the army operations. During this service he performed gallant duty in holding against attacks of the enemy and with a small force one of the captured towns. The conclusion of hostilities found the "Gloucester" at Arroyo, and upon her return home in September Mr. Wood was honorably discharged and has resumed his business connections with the Ball & Wood Company.

W. J. Clark, general manager of the railway department of the General Electric Company, although not a member of the military or naval forces of the country during the last war, rendered signal service to the Government through his expert knowledge of Cuban affairs. Mr. Clark is well known as a close observer, and has held important offices in the Government service before his connection with the electrical industry. His first connection with electric railways was in 1886, when he secured a charter to build a street railway connecting Ansonia, Derby and Birmingham, Conn. In 1888 his services were secured by the Thomson-Houston Company to organize its railway department, and he continued to act as general agent of that corporation until its consolidation with the Edison General Electric Company in 1892. After the latter event he was put in charge of the railway department of the General Electric Company in New York. Being called on business frequently to Cuba, he made a special study of that country, and his book, "Commercial Cuba," published during the last few months by Scribner's, and the immense amount of additional information of which he was possessed and which he placed at the disposal of the Government at the commencement of hostilities, were of great aid to the latter. Early in October he was appointed by the Secretary of War one of three members of a Government Commission to select camp sites and report on facilities for transporting troops, etc., in the Island of Cuba during and after the evacuation of the island by the Spanish troops. Mr Clark returned to the United States from this trip Oct. 25, and it is understood his report has been highly commended.

Capt. Frank S. De Ronde, in addition to his duties as general manager of the Standard Paint Company, of New York, has long been a prominent member of the New Jersey National Guard. He enlisted as a private in 1888, and in the following year was made corporal and two years later sergeant. In January, 1896, he was appointed second lieutenant of Company F, Second Regiment, N. J. N. G., and in October of the same year captain. On April 27, 1898, the Second Regiment of New Jersey was mustered into State camp at Sea Girt, and from this point went direct to Camp Cuba Libre, Jacksonville, where Capt. De Ronde's company formed part of the Seventh Army Corps under Brigadier-General Fitzhugh Lee. It remained there until September 1, when, owing to the increase of sickness, the regiment was moved to Pablo Beach, where Capt. De Ronde was taken with typhoid fever and compelled to return home on September 10. The company under Capt. De Ronde's command was particularly fortunate in being the only one in the regiment in which no deaths occurred. Capt. De Ronde resides in Englewood, and his company was composed largely of representative young men of that place.

Lieut. William Tiffany, secretary and treasurer of the Sterling Supply & Manufacturing Company, of New York, was one who lost his life in the service. Lieut. Tiffany was the son of George Tiffany, the well-known jeweler of New York, and grand-nephew of Commodore Perry. On the outbreak of the recent war he enlisted as a private in the Rough Riders, and was soon promoted to the position of corporal and then to sergeant. His bravery on the battlefield before Santiago earned for him his position as lieutenant. At this place, however, he contracted fever, and was then taken to Montauk Point, and later to Boston, where he died on August 25, of fever brought on through hardship endured in the Cuban campaign.

Clarence G. Davenport was another to give up his life for his country. He was born in 1870, in Waterbury, Conn., and was a graduate of the Worcester Polytechnic Institute. After leaving this school he entered the Lynn Works and became engineer for the supply department of the New York office of the General Electric Company. He made a specialty of wattmeters and transformers. He was a son of the Rev. John Davenport, of Waterbury, and his great grandfather, grandfather and father served in the wars of the Revolution, 1812 and the Civil War. He had a wide circle of acquaintances with whom he was very popular.

Gilbert Wilkes is another graduate of the Naval Academy, and at the outbreak of the war received a commission as lieutenant and was ordered to the "Yosemite," manned by the Michigan Naval Battalion. Lieut. Wilkes is a consulting engineer in Detroit, and had charge of the construction of a number of important electric railways and other electrical installations in and near that city. He was at one time chief engineer of the Detroit Electrical Works, and previously was connected with the General Electric Company.

Strathearn Hendrie, general manager of the Detroit & Pontiac Railway, commanded one of the divisions of the Michigan naval battalions during the year and served as an ensign on the "Yosemite."

James B. Andrews was born at Saratoga in 1868, and entered the military academy at West Point in 1886. He was graduated from this school in 1890, and was commissioned as second lieutenant of cavalry. He served in this connection during the next two years, taking part in the Sioux campaign of 1890 and 1891 in Eastern Montana and Dakota, and in service against the Apaches. After his resignation he became connected with the Schenectady Locomotive Works and afterward with the power and mining department of the General Electric Company. In 1895 he was commissioned as first lieutenant of the Thirty-sixth Separate Company, N. G. N. Y., and in 1898 captain of the same company. At the outbreak of the war he volunteered his services and was appointed the captain of Company E, Second New York Volunteer Infantry, and served at Camp Black, N. Y.; Chickamauga, Ga.; Tampa and Fernandina, Fla. He was appointed assistant adjutant-general by Brigadier-General L. H. Carpenter, commanding First Division, Third Army Corps, but refused such appointment, preferring to serve with his company. He acted in this capacity, however, for three weeks at Chickamauga and Fernandina, his company being selected for duty at division headquarters, a signal honor.

The first volunteer regiment of engineers contained a number

of electrical engineers, among whom was Capt. Edward M. Sawtelle, of the Westinghouse Electric & Manufaeturing Company. In all, about fifty men volunteered from the Westinghouse works and office in Pittsburgh.

The staff of the Boston offices of the General Electric Company distinguished itself during the war by carrying out important work in connection with the laying of mines in Boston Harbor. The electrical connections of these mines made the task one to which their knowledge particularly fitted them. The officers in charge of this work, all of whom are well known in electrical circles, were Dr. Louis Bell, first executive officer; S. B. Paine, adjutant-quartermaster; H. S. Kimball, Division 1, in charge of range finder and military connections; F. M. Kimball, Division 2, in charge of mine laying and fortification wiring; Charles E. Burleigh, Division 3, in charge of mine loading, casement construction and emergency mine planting; Joseph Grant, Division 4, steam engineering. Caryl D. Haskins and several others connected with the Boston office also rendered signal service in this work.

Among those who served on the "Yankee" with Lieut. S. Dana Greene were H. J. Coolidge, formerly of the railway supply department of the General Electric Company and now with Cornell, Underhill & Boyd, who was captain of the forecastle 5-in. gun, and Harold Footman, assistant to the treasurer of the General Electric Company.

Steam Railroad Statistics

The report of the Interstate Commerce Commission on the steam railroads of the United States for the year ending June 30, 1897, will contain a mass of figures of great interest and value to all interested in the subject. The labor and time required in collecting and compiling these statistics are the cause of the delay in making public these figures, which now date back more than a year. From advance sheets of this report recently received, through the kindness of the secretary of the Commission, the following figures are taken:

On June 30, 1897, there were 128 roads in the hands of receivers. These roads operated a mileage of 17,862 miles, the mileage owned by them being 14,895 miles. These figures, as compared with those for 1896, show that there was a net decrease of 12,614 miles in mileage operated and 8623 miles in mileage owned by roads in the charge of receivers. During the year ending June 30, 1897, 51 roads were removed from the control of receivers and 28 roads were placed under their management.

The total railway mileage in the United States on June 30, 1897, was 184,428 miles, there being an increase of 1652 miles, or .90 per cent during the year. The aggregate length of mileage including all tracks on June 30, 1897, was 243,444, there being 11,018 of second track, 996 miles of third track and 780 miles of fourth track. The mileage of yard track and sidings amounted to 46,221 miles. The total number of locomotives in service on June 30, 1897, was 35,986, the increase in number as compared with the preceding year being 36. Of the total number of locomotives 10,017 were passenger locomotives, 20,398 were freight, and 5102 were used for switching purposes. The number of locomotives not classified was 469. The total number of cars of all classes reported in service was 1,297,480, a decrease of 169 from the preceding year. Of the total cars reported 33,626 were in passenger service, 1,221,730 were in freight service, and 42,124 were in special service of the railway companies. The number of men employed by the railways of the United States was 823,476. The total capital liabilities of all the steam roads were $10,635,008,074, or $59,620 per mile of line. The amount of capital stock was $5,364,642,255, of which $4,367,056,657 was common stock and $997,585,598 was preferred stock. The amount of funded debt was $5,270,365,819. Of the capital stock upon which dividends were paid, 5.37 per cent of the total stock outstanding paid from 1 to 4 per cent, 6.53 per cent outstanding paid from 4 to 5 per cent, 5.99 per cent outstanding paid from 5 to 6 per cent, 3.58 per cent outstanding from 6 to 7 per cent, and 4.62 per cent outstanding from 7 to 8 per cent. The total amount of dividends was $87,110,599, equivalent to a rate of 5.43 per cent on the amount of stock on which some dividend was declared. The total number of passengers carried on all roads was 489,445,198, a decrease of 22,327,539 from the previous year. The gross earnings of all railways for the year, as reported for an operating mileage of 183,285, were $1,122,089,773. The expenses of the operation of these railways were $752,524,764. The net earnings were $369,565,009. The income from other sources, mainly derived from leases and investments in stocks and bonds, were $125,090,010, which added to the income from operation makes a total income of $494,655,019. The total deductions from the income were $413,397,513, leaving a net income applicable to dividends of $81,257,506.

Consolidation of Steel Interests

The Federal Steel Company, which was recently organized, has secured control of the Lorain Steel Company, formerly the Johnson Company, of Lorain, Ohio, and Johnstown, Pa., the Illinois Steel Company, and several allied interests. The business formerly conducted by the Johnson Company, manufacturer of both girder rails, special work and trucks, will be continued at both Lorain and Johnstown under the title of the Lorain Steel Company. This company is the only manufacturer of girder rails as yet controlled by the Federal Steel Company. The New York office of the Lorain Steel Company will be at the Empire Building, corner of Broadway and Rector Street, and will be in charge of Major H. C. Evans, who has represented the Johnson Company for a long time in New York.

NEWS OF THE MONTH

The management of the Brooklyn Elevated Railroad Company recently distributed 60,000 free tickets for rides on its Fifth Avenue branch among the women of the South Brooklyn district. It is expected that the distribution of these tickets will eventually stimulate traffic on the elevated road and will do away with the prejudice that is said to exist to a large extent among women against the necessity of walking up the flight of stairs leading to the stations. The officers of the company hope in the near future to secure a large proportion of the shopping traffic to the downtown stores in Brooklyn and New York.

The members of the Worcester Consolidated Street Railway Relief Association, of Worcester, Mass., gave their fifth annual concert and ball on Nov. 11. About 1200 people were present, and a very enjoyable evening was spent by all. This association is composed of the employees of the Consolidated Street Railway Company.

The employees of the Dallas Consolidated Electric Street Railway Company, of Dallas, Tex., went on strike on Nov. 9. The men had an agreement with the company which secured the recognition by the officials of the Employees' Union. The men struck as they claimed that several employees were discharged in violation of this agreement. The railway company holds that it has not broken its contract with the men.

It is stated that the Albany Railway, of Albany, N. Y., was the first street railway in this country to introduce an express service, the first express car having been run over the lines of that company in 1894. The service was inaugurated with three express cars, and the first year the receipts were $585. There are now six express cars on the road, the system is continually increasing its scope, and the earnings for the year ending October 31, 1898, amounted to $2,242.

The citizens of Brooklyn, N. Y., have filed a number of petitions with the city authorities protesting against the use of the new side door convertible cars in operation on the lines of the Nassau Electric Railroad Company. These cars were described in the November issue of the Street Railway Journal.

The Atlanta Consolidated Street Railway Company, of Atlanta, Ga., has recently paid a small bill brought against it by the water department for alleged damages done to the city water pipes by electrolysis caused by the return current of the street railway lines. The bill was paid under protest, however, the street railway company claiming that there was no evidence that the current from its tracks had done any damage.

The lines of the London Street Railway Company, of London, Ont., were completely tied up during the last week in October by a strike of the employees. The trouble arose through the demand of the men for an increase of wages from fourteen to sixteen cents per hour.

The Brunswick Traction Company, of New Brunswick, N. J., opened its new trolley line between Bound Brook and Plainfield on Oct. 30. The road was opened with appropriate ceremonies, and the first car was run through the town of Lincoln by Mrs. Emma Engel, president of the Borough Council. When the car reached the station at Lincoln Mrs. Engel alighted and drove a silver spike into place, this being the last spike in the line.

The Albany Railway has recently ordered fifteen long combination cars for the accommodation of smokers. The cars contain smokers' vestibules, and will be built with all the modern improvements. Under the present rules of the Albany Railway, passengers are not allowed to smoke except on the rear seat of summer cars and not at all on closed cars. The new cars, it is believed, will be very popular with a large part of the company's patrons.

A serious accident occurred on the line of the Tacoma (Wash.) Railway Company on November 16. The motorman lost control of an electric car on a heavy grade, and the car was badly wrecked by striking the side of a cut ten feet deep through which it was traveling. There were seven persons on the car at the time, and all received more or less serious injuries.

A rather novel association has been formed at Omaha, Neb., by the residents of the suburbs of that city. The association is formed for the avowed purpose of preventing overcrowding on the street railway lines. The first demonstration made by the society occurred one evening about 6 o'clock, during the business hour of the day. Several members of the society boarded a car, and when it was comfortably filled ordered the conductor to go ahead, threatening to throw him off the car if he did not. It is stated that if the street railway company does not give better facilities the association will appeal to the courts to prevent more people being taken on a car than can find seats.

A daily newspaper contains an interesting account of a gigantic bonfire, which it is stated cost about $110,500. The Brooklyn Heights Railroad Company had 223 antiquated horse cars, for which it could find no market, and decided that the cheapest way to get rid of them was to burn them. Among the cars were a number of short electric cars which were purchased several years ago and which are useless for present purposes.

The Montreal Street Railway Company, of Montreal, Can., makes the following report for the year ending Sept. 30, 1898. The reports for the years ending Sept. 30, 1892 and 1897 are also given herewith for comparison:

	1898.	1897.	1892.
Gross receipts	$1,471,940	$1,342,368	$564,410
Operating expenses	764,884	736,429	466,648
Net earnings	707,055	605,939	97,762
Passengers carried	35,353,036	32,047,317	11,631,386
Transfers issued	10,508,603	8,765,903	.....
Per cent operating expenses to earnings	52.15	55.05	82.68
Per cent net income to capital stock	13.0	12.41	....

The Kings County Elevated Railroad Company has secured permission to run its trains across the Brooklyn Bridge, with the same rights and privileges now enjoyed by the Brooklyn Elevated Railroad Company, with the exception that one Kings County train is to be operated to two Brooklyn trains. If the former road, however, in the rush hours requires more service it may operate additional trains, provided that such additional operation shall not interfere with the operation of the Brooklyn Elevated Railroad Company's trains.

New Type of Fender

Frederick J. Graf, of New York, has recently brought out a new type of fender, which, when not in use, is carried under the platform of the car. The fender is operated by the motorman, but should he fail to apply the releasing mechanism by which it is projected from beneath the front platform, the fender works automatically by contact with the person struck. By being normally protected in this way, it cannot well be damaged from collisions and does not take up any valuable space in the street. The fender can also be used normally in an extended position. In this case, if a vehicle should come too near, the motorman can return the fender under the platform by pressing a foot treadle. The fender is patented in all the leading countries.

Direct Current Enclosed Arc Lamp

Following next in the line of enclosed arc lamps developed by the General Electric Company, a substantial, simple and efficient power circuit lamp has been perfected for use two in series on 220-volt circuits, or five in series on 500-volt circuits. In outward appearance it resembles the alternating direct current carbon feed enclosed arc lamps of the same company, and is manufactured in both single and double globe types.

To conform to insurance regulations covering the use of arc lamps on high voltage circuits, a safe, positive and reliable cutout is incorporated in the lamp, together with an extra set of resistance coils. Should the carbons stick or the lamp for any reason fail to operate, the cutout sends the current through these subsidiary resistance coils, instead of through the carbons, without detriment to the lamp. The efficiency of this cutout has been demonstrated by cutting out lamps in circuit and allowing them to remain cut out for several consecutive hours, without resultant injury either to coils or lamp.

The mechanism is simple and made of but few parts. The carbon is fed by a double cam clutch, smooth and positive in action. An adjustable resistance in the upper part of the lamp allows it to be employed two in series on circuits of 200 to 240 or five in series on circuits of 500 to 600 volts. With one 12-in. positive and one 5½ negative ½-in. carbons it burns after one trimming for from 130 to 150 hours, and after the run the remainder of the positive carbon can be used in the lower carbon holder for a second run of equal duration. The current required is 5 amps.

The lamp is furnished with the globe lowering device which has been fitted to over 30,000 General Electric enclosed arc lamps, and which permits the globe to be lowered gently by merely turning a milled thumbscrew at the side of the casing. The globe holder is locked automatically by a single upward movement of the globe holder. Power circuit lamps are furnished in weatherproof black or brass casings.

Test of Elevated Railway Truck

An interesting test of one of the trucks built by the Peckham Truck Company for the Chicago South Side Elevated Railway Company, of Chicago, was conducted at the Peckham works, at Kingston, N. Y., Nov. 21. The test was made by Robt. W. Hunt & Co., of New York, and was supervised by officials from the South Side Company. The object of the test was to determine the transfer strength of the side frames of the truck.

The side frames were placed in a horizontal position opposite each other in a wheel press, and braced apart at the spring seat with blocks of wood and iron. The load was applied at the center on the bars which supported the transoms, by means of the ram of the wheel press, and readings of deflection were taken at the center and at either end, in order to correct the deflection or lost motion in the wooden supports. Observations were also taken at the various points in the truck in order to note any movement of the different members.

The following were the deflections, corrected for the compression of the wooden blocks, and represent the deflection and permanent set in one frame:

Load.	Total deflection.	Permanent set.
5 tons	.00 ins.	.00 in
10 "	.00 "	.00 "
15 "	.04 "	.00 "
20 "	.03 "	.00 "
25 "	.08 "	.00 "
30 "	.14 "	.06 "
35 "	.32 "	.20 "
40 "	.38 "	.26 "
45 "	.52 "	.34 "

50½ tons—At this point the lower tension member broke through the first rivet hole and the malleable casting at one end. The fracture of steel bar showed crystalline.

No distortion or movement of the various members was noted except in the lower tension member, which, at a load of 45 tons, showed an elongation of .12 in. between the rivets in the connecting malleable castings.

The test was regarded as a highly favorable one for the truck and Mr. Peckham received many congratulations for the successful outcome of the trial.

The following were present at the test: Paul Taves, Rio Janeiro; A. W. Taves, Rio Janeiro; James Mitchell, Rio Janeiro; A. J. Allen, engineer South Side Elevated Railway Company, Chicago; J. E. McMynn, engineer, Hunt & Co., Chicago; John J. Cohen, engineer, Hunt & Co., New York; Capt. J. McLeod Murphy, chief engineer, Safety Third Rail Company, New York; Alfred Stern, engineer, Belgium; F. H. Shepard, engineer, Sprague Electric Company, New York; H. W. Blake, STREET RAILWAY JOURNAL, New York; George L. Fowler, engineer and representative of the Railroad Gazette, New York; H. J. Kenfield, Street Railway Review, Chicago; E. Peckham, president, E. G. Long, vice-president, C. F. Uebelacker, engineer, H. K. Price, superintendent, George H. Bowers, and W. Cogswill Rogers, of the Peckham Motor Truck & Wheel Company, New York.

New Convertible Cars in Baltimore

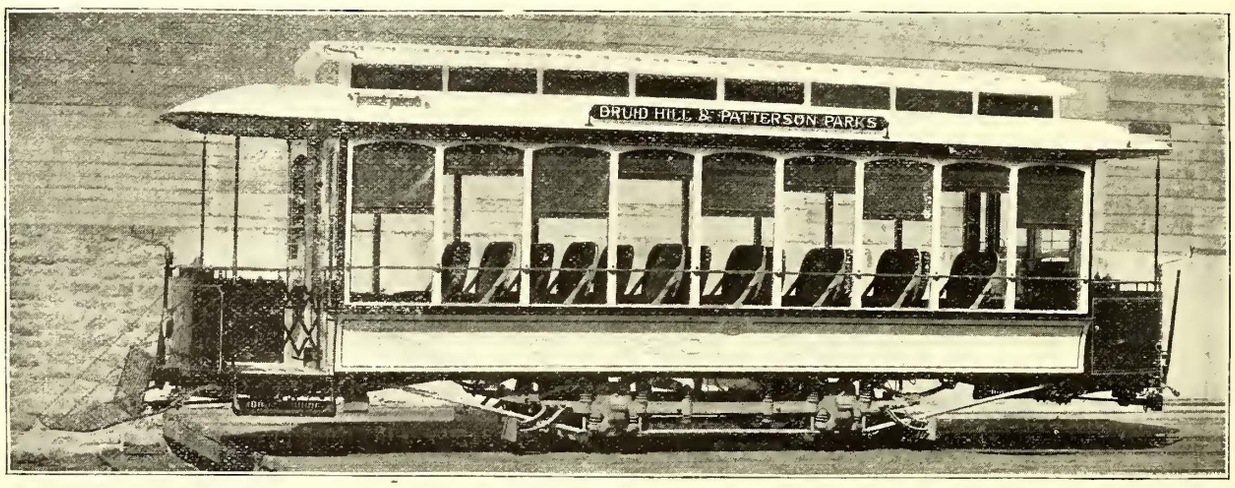
The Baltimore Consolidated Railway Company is having constructed a number of convertible cars, part of which are in process of shipment.

The new cars are about 31½ ft. over all and have bodies a fraction under 23 ft. long. The platforms are 4 ft. in length. The car is 7 ft. wide at the bottom and 7 ft. 10 ins. at the widest point. The doors of the car are placed at diagonally opposite corners. The entrance being from the rear platform only, the other side of the platform is closed. This position of the door and the fact that the brake shaft and levers are outside of the dashers, makes a very roomy and convenient platform. There are fourteen cross seats and four stationary seats; the latter are at the ends of the cars on each side of the door, giving a total seating capacity of thirty-four passengers. The cross seats have reversible backs and are upholstered with dark maroon plush in a manner similar to that of first-class steam railway coaches. This makes a car exceedingly comfortable for the passengers who face forward as in the standard form of summer cars. The interior finish is very light and handsome. The headlining of the roof is of decorated birch, the material being three-ply veneer. The height in the center of the car is 8 ft. 2 ins. from the floor. On each post there is a push button for signaling the conductor.

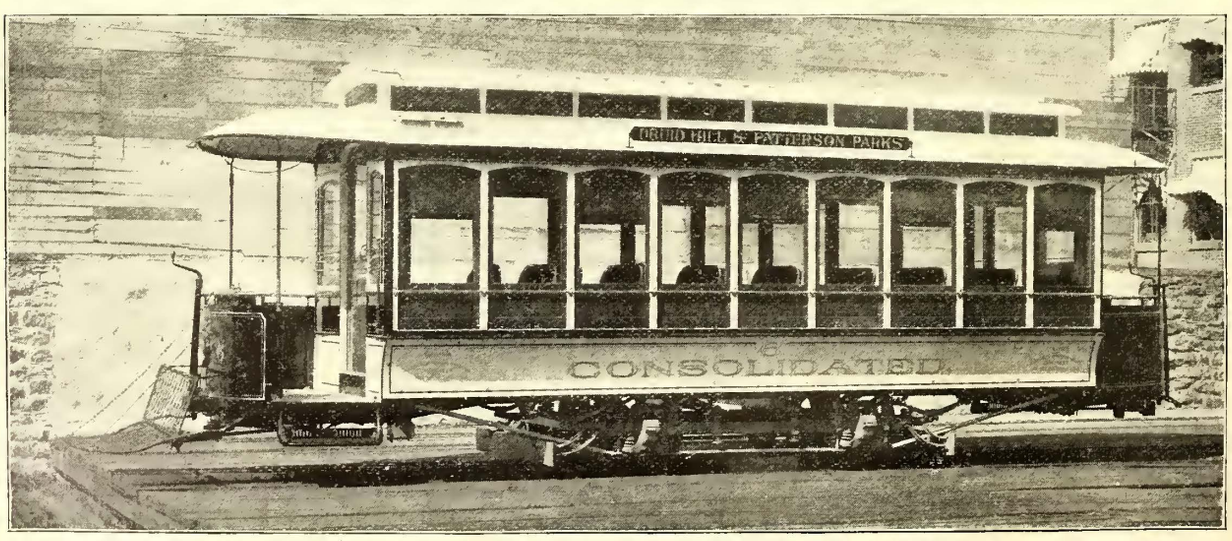
The details of construction are of great interest to mechanical men and those familiar with car building, such details for example as the platforms being made of maple carefully tongued and grooved and laid in white lead, the sash set in cast rubber seats carefully screwed in, all points which show that the builders, the J. G. Brill Company, of Philadelphia, have taken the utmost pains to make a car which shall not only be satisfactory in appearance but exceedingly desirable. The trimmings or hardware of the car are bronze throughout. The electric light fixtures, the candle stands, etc., are of the Consolidated Railway Company's standard forms. The window guards are of bronze pipe and extend the whole length of the car at the level of the sash bottom.

INTERIOR OF BALTIMORE CAR

The painting of the car is very tasteful. All the woodwork outside is painted white. The lettering is done with aluminum leaf; the belt rail or member which passes around the car at the level of the seats is maroon, as are the dashers. The sash, which have rigid tops, are on one piece with the upper panels, are finished in the natural color of the cherry, and this makes a very pleasant contrast with the maroon trimmings and white body color. Two motors are employed, of the style known as Westinghouse No. 49.



APPEARANCE WHEN USED AS AN OPEN CAR



APPEARANCE WHEN USED AS A CLOSED CAR

Third Rail System at Coney Island

The Safety Third Rail Company of New York has taken a contract and has commenced construction on a railway using its third rail system at Manhattan Beach, Coney Island. The road will connect the Manhattan Beach Hotel with the Oriental Hotel and also with the Brighton Beach Hotel. It will be in two sections with a total length of 3850 ft., and will comprise the old Marine Railway at Manhattan Beach. The third rail to be used will be of the same section as that employed by the New York, New Haven & Hartford Railroad Company, and it will be mounted on granite blocks and thoroughly insulated. The road will be equipped with three cars—two on the Marine Railway and one on the Manhattan Beach Railway. Those on the former will draw two trailers each. The cars will be 39 ft. over all and the bodies will be supplied by the Duplex Car Company and will be extremely tasteful in finish. The cars will be mounted on Peckham trucks and will be equipped with two G. E. 800 motors.

INTERIOR OF DUPLEX CAR

The accompanying engraving gives an idea of the appearance of the interior of the car to be employed.

Capt. J. McL. Murphy, who is personally installing the system, will also supervise the construction of the electric power house for supplying power to the electric railway, as well as for illuminating the Manhattan Beach Hotel and the Oriental Hotel. The station will have a capacity of about 800 h.p.

Recent Developments in Electric Heaters

The Gold electric heater, using the crimped or zig-zag rod for supporting the resistance coils, was described in the STREET RAILWAY JOURNAL for August, since which time the Gold Street Car Heating Company has closed a number of contracts for its use on electric cars. Fig. 1 illustrates the Gold panel electric heater as it is now made, using a new and strikingly handsome design of front casing.

FIG. 1—PANEL OF GOLD HEATER

In this heater the manufacturers claim to have perfected the principle of obtaining the very freest circulation of air through the resistance coils, as well as the details of the interior arrangement of the heater regarding the graduation of the heat, the insulation, etc. In this heating device, which is wired to give three degrees of heat on every heater, the connections from heater to heater are brought out through the solid porcelain blocks which form the end of the heaters. This makes the connections, it is claimed, as simple as they could possibly be, and further avoids the use of small porcelain bushings at such points.

This heater embodies the many improvements that the Gold Company has introduced in electric heaters, and the special claims made for it are efficiency in heating the car, uniformity of heat distribution, economical consumption of current, first-class mechanical construction, neatness and elegance of design and general appearance, and above all durability.

FIG. 2—HEATER FOR WAITING ROOMS

Fig. 2 shows a new and tasteful design of combination heater which the Gold Company is now producing for heating offices, waiting rooms etc. It employs the same means of supporting the resistance coils as in all of the improved Gold heaters with the exception that the supports are carried in a series of extended circles within the heater. This heater is provided with a three- point switch, so that three degrees of heat can be had as wished. It is ordinarily wired for 110 volts direct current.

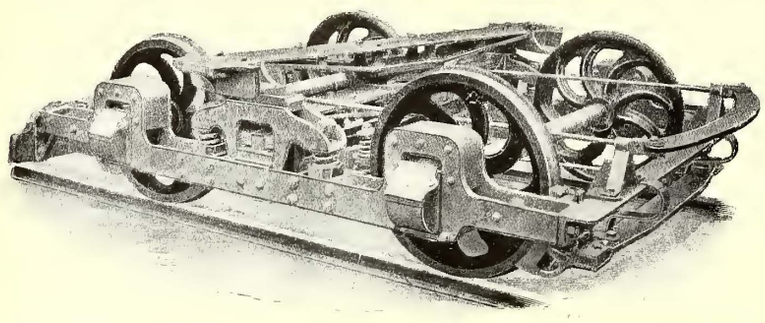
Class "H" Double Truck for Electric Cars

The accompanying illustration shows the class "H" double truck for heavy interurban electric railway cars built by the Barney & Smith Car Company, of Dayton, Ohio. This truck is in use on the interurban electric railway from Anderson to Marion, Ind., described elsewhere, as well as on other roads, and is noticeably strong and durable. The general dimensions of the truck are as follows: Length over frame, 9 ft.; width over frame, 6 ft. 9¼ ins.; height from rail, 22⅞ in.; wheel base, 5 ft. 10 ins.; width inside frame, 5 ft. 8¾ ins.; thickness of side frames, 6¼ ins.; distance center to center of side frames, 6 ft. 3 ins.; track gage, 4 ft. 8½ ins.

The side pieces of the frame, or wheel plates, are made of two pieces of 15½ ins. x ⅝ in. soft steel formed into shape, as shown in the cut. These plates are spaced 5 ins. apart to allow space for distance casting and springs between them. At the center between plates is securely riveted or bolted a cast iron column or spring seat casting. This column is so arranged at top to form a seat for a half elliptic spring and the sides of said casting are shaped to form a guide for side bearings. At an equal distance each way from the center of the truck side frame are two other columns, which are bolted between side frame plates by two ¾-in. bolts or rivets in each; and further out, located the same distance each side the center of frame, are two column thrust castings. These castings are spaced far enough from the other columns to allow malleable the iron spring pocket to work freely between them. The outside

column or thrust casting is securely fastened between the side plates by three ¾-in. bolts or rivets in each. This casting is to receive the thrust from the side bearings. Over each oil box and securely fastened between the side frames by means of nine ⅝-in. rivets or bolts in each, are malleable iron pedestals. These have a pocket on the inside and directly over the oil box to receive a coil spring 4 ins. in diameter, 5 ins. high, made of 1 in. round steel, which rests on top of the oil box.

Between the side frame at each end is placed a distance column, which is securely bolted or riveted by two ¾-in. bolts each to side frames. To this column or distance casting on the outside end of the truck is bolted by one ⅞-in. bolt in each a wrought iron scraper board bracket made of 2 ins. x ½ in. iron. To this bracket is securely fastened the scraper board by two ⅝-in. bolts in each end. The size of this scraper board is 1¾ in. x 3 ins. x 7 ft. 0 in. oak. At the other or inside end of truck, the end sill of truck, made of 4 ins. x ¾ in. iron, is securely fastened to the end side frame columns by one ⅞-in. bolt at each end. To this end sill is fastened the brake rod guides and supports for the crescent connections, which are made of 3½ ins. x ¾ in. wrought iron and bent to a correct radius struck from the center or swivel point of the truck. The ends of this connection are provided with 13-16-in. holes to receive the brake connection pins.



CLASS "H" TRUCK

At an equal distance each side of the center of the truck are cross bars made of 6 in. x ¾ in. iron. These bars have their ends turned out a sufficient distance and are securely fastened to the side frames by the ¾-in. bolts or rivets, which pass through the side frames, distance column, and thrust casting, making a very substantial fastening. In the center and between the ends of the cross bars is a malleable iron bracket casting, which is securely fastened to the side frame by the two ¾-in. bolts which pass through the spring seat, and by six ⅝-in. bolts through the bracket and cross bars.

To the cross bars and at a proper distance from center to center are secured the malleable iron brake hanger brackets. These are bolted to cross bars with four ⅝-in. bolts. The upper end of this bracket is made to receive the brake hanger, and provision is made in both brake bracket and brake shoe for taking up the wear on the brake hanger. This is done by tightening up the nuts on the end of the wedge which adjusts the brake hanger block or box. The truck is equipped with an inside hung brake. The brake levers are of 3 in. x ¾ in. iron. The lower brake connection is of 1¼-in. round iron, with a jaw at each end, and is connected in the center by a 1¼-in. wrought iron turn buckle to adjust the brake. The rods are provided with nuts so that they can be jammed against the turn buckle to keep it in place. This enables the operator to adjust the brake very close to the wheels. The braking power is equally divided between the four brake shoes. Brackets made of wrought iron are securely bolted to cross bars for carrying motor bars and springs.

At the center and running from side frame to side frame is a transom made of two bars of 8 in. x ⅝ in. iron. These bars are securely bolted to brackets cast on malleable iron side bearings by four ¾-in. bolts in each bracket. At the center the bars are spread apart and four columns placed between them, thus forming a truss. On the top of the transom, and at the center, is placed the center plate (made of cast iron), which is fastened to the transom by four ¾-in. bolts passing through the center plate, top transom bar, distance columns, lower transom bar, columns and lower tie bar, made of 8 in. x ½ in. iron. This bar reaches from one side of the truck to the other and the ends are spread and securely fastened to the lower ends of the side bearings by two ⅝-in. bolts in each end. The side bearing has an oil chamber at the top for automatically lubricating the faces of the truck and body side bearing. The truck side bearing is faced with brass plate; the body side bearing with steel plate.

The side bearings are of malleable iron and of a design especially adapted to this truck. They are constructed with a spring seat on each end, and at the center they have a jaw which fits over the center cast iron column, as described. On the inside and cast with the side bearing is a bracket which receives the ends of the center transom, as described.

Over each oil box is a 4 in. x 5 in. coil spring made of 1-in. steel. This spring fits into a pocket in the pedestal and rests on a cup cast on top of the oil box, as before described. This spring receives the motion of the wheels and thus lessens the jar on the body.

In the center of the truck frames is placed a 24-in. half elliptic spring which rests on top of the center column casting. At each end of this spring and passing through the ends of same is a 1-in. T bolt, which passes through the spring cap on each end of the side bearing and through a coil spring 4¼ ins. in diameter and of proper height to carry the load of the car. Through the spring seat at the lower end of said T bolts are also two nuts, so that the height of the car can be adjusted. This spring cup is held in position by guides or distance columns and side frames, thus forming a guide for the spring pocket to work in. The elliptic springs carry the body, assisted by the two coil springs on each side. These coil springs also serve as equalizer springs between the springs located over the oil box and the body spring.

The brake is very simple. It is known as an inside hung brake, which can be readily understood from the accompanying cut, and as has been explained in the foregoing paragraphs.

The body transom is made up of two bars; the top is 10 ins. x ½ in. and the bottom is 10 ins. x ⅝ in. and made after the style of the steam car transom. It is very strong and durable. At the center the center plate is located and bolted to the transom with four ¾-in. bolts. At or near the ends there are side bearings which are securely fastened to the transom by four ¾-in. bolts in each. These side bearings are made so that the face of the body side bearings will come in contact with the side bearing on the truck.

The axles are of the best double hammered iron; size of journal, 3½ ins. x 6 ins.; size of wheel seat, 4½ ins.: diameter center of axle to suit motor used. The oil boxes are of cast iron with malleable iron spring covers. Wedges of malleable iron; bearings of brass, lead lined. The wheels are 33 ins. in diameter, double plate, with chilled treads, and are especially designed for rapid interurban service.

Moroccoline

One of the most attractive exhibits at the recent convention of the American Street Railway Association in Boston was the display of Moroccoline, and many street railway men took that occasion to carefully examine this material. All who saw the exhibit were undoubtedly impressed with the beauty of colors and designs shown in the six reversible car seats upholstered with it and in the samples of goods displayed in the piece. This material possesses great merit, and combines two qualities that seem almost paradoxical, although they are most essential in a car seat covering. The surface is so hard and flinty that it cannot be scratched or defaced, and yet has a softness and pliability with no tendency whatever to become brittle or crack. The manufacturers state that this combination of qualities is one that no other imitation of leather in the market possesses and that it makes Moroccoline preeminently superior to all other coverings.

The goods are being used quite largely by the steam roads and in many of the theaters and public halls throughout the country, where they are giving excellent satisfaction.

From a sanitary point of view Moroccoline, it is claimed, is superior to plush, carpet and rattan for street cars, as it can be kept clean without injuring the appearance of the goods, this being another of the many points in its favor. Moroccoline is manufactured solely by the Boston Artificial Leather Company, of Boston, Mass.

Paint for Galvanized Iron

It is often difficult to secure a paint that will adhere satisfactorily to galvanized surfaces. Paint that will serve its purpose well if applied to wood and steel often is entirely useless for application to metals that are galvanized. After long and close application and study of the requirements of paint suited for galvanized iron, the Goheen Manufacturing Company, of Canton, Ohio, has introduced upon the market a composition known as "Galvanum," for which it is claimed that it will adhere for years to galvanized surfaces. Floyd Davis, of Des Moines, Ia., analytical and consulting chemist, has made a number of tests of this paint, and states that he has found it to be excellent for the use intended.

Convertible Car in Brooklyn

One of the most interesting exhibits at the recent convention at Boston was the new type of convertible car shown by the J. G. Brill Company. The car attracted particular attention from its close resemblance to an ordinary box car when closed, and to an open car when the side panels were raised. A car of this type has recently been put in service on the Brooklyn Heights Railroad, and is illustrated herewith.

One chief result aimed at by the builders of this car in its construction was to produce a car which could be quickly changed from the open to the closed type, and vice versa, by being self-contained, and yet avoid cylindrical appearance. They also sought to produce a car which when used "open" could be entered from the side.

Fig. 1 shows the car when used in summer. The casual observer sees an open car with a center aisle. He might, upon examination, notice that the posts come down outside of the round corner seat and panels, and perhaps might observe that the curve of the roof was a little more convex than usual. In other respects there would be nothing different from the ordinary open car. From the inside he would see that the monitor or raised deck was somewhat narrower than the fashion, and that the curve of the roof was slightly more convex and apparently set at a slightly steeper angle. But even these points might escape observation, so nearly is the car like those in common use.

The posts, however, carry a complete set of panels, sash and glass, as well as roller curtains. Space is found for all these in the roof, completely out of way and out of sight. Held in place by the ordinary sash-lock is first a panel which, when in place, fills the opening at the end of the seat. This panel is elastic. It may be either metal or fibre, and is in any case backed by horizontal slats. These panels are also lined with Wilton carpet, so that the side of the car, with its air space, becomes warmer, it is claimed,

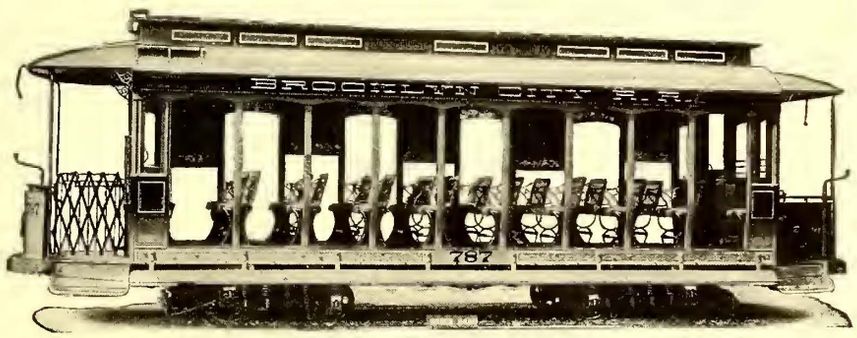


FIG. 1.—CONVERTIBLE CAR USED OPEN

than that of a car with the usual form of solid side. This construction enables it to conform to the curves of the grooves, which vary in their sweep according to the sweep of the posts. The latter, it should be understood, have the same form as the outside line of an ordinary open car. When the panels have been let down the lock for the sash is exposed, and the sash is brought down in place. It is made in two parts hinged together. Apparently they slide in the same groove as the panels; they do not, however. By putting one groove at the bottom of the other, what is equivalent to a double track is secured over one line. The sash, by means of trunnions, slide in the bottom groove. When they reach the top of the posts, where a switch would otherwise be necessary, the sash is turned off to its own line without the intervention of any apparatus, while the panel is carried off in another direction, quite clear from, and in front of, the sash. The advantages of this construction are simplicity of operation and mechanism and a gain of 2 ins. in the inside width of the car, without increasing the outside width.

In designing this car, among the important matters considered was that of the external appearance. It has been one aim to produce a car which shall be as much as possible like the ordinary convertible car, with low sides. This car has both convex and concave panels. For winter service it had double sash, making it light and pleasant.

The handling of the sash and panels is precisely the same as that of raising or lowering the sash of an ordinary window or car. The solid yet flexible panel comes down and makes a solid side below the seat, the top of which is just level with the elbow. This is claimed to be the first time that a solid panel has been made to slide in a groove with double or reverse curves. It comes down and passes the curves with great ease. After bringing down the panel the sash is lowered in the usual way, and when sash and panels are in place the curtains can be operated in the usual manner, and come down to the tops of the panels. The curtains are

FIG. 3.—INTERIOR OF CAR

upon rollers placed inside the other fixtures. When the sash and panels are up, these curtains come all the way down to the floor, completely closing the opening between the seats. There is an inner and entirely independent groove in the posts in which the curtains operate. Both open and closed, the car has all the facility of operation that could be desired in a car of either class.

As the change from one style to the other can be quickly made, and as the materials for the transformation are carried in the car itself, it is always possible to command that type of car suitable to the weather. In case of sudden storm or rain or a sudden change of temperature, the car can be made to suit the conditions without delay or expense and without sacrificing the comfort of the passengers.

The car shown in the engravings has the following general dimensions: Length of body, 25 ft. 9 ins.; width at sills, 7 ft. 1 in.; width at belt rail, 7 ft. 9 ins.; length of platforms, one at each end of the car, 3 ft. 11½ ins.; length over all, 35 ft. 4 ins. Each end of the car is fitted with the Brill angle iron buffer. The platforms are arranged with steps, as usual, but the opening on the left is fitted with a high-hinged gate and is not used for an entrance. A folding gate is placed on the opposite side.

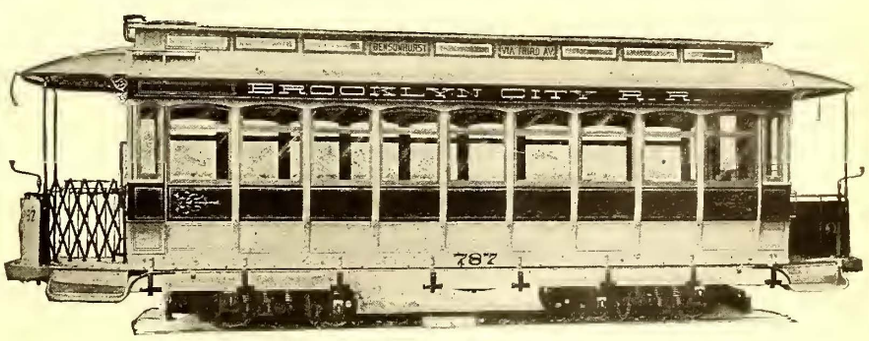


FIG. 2.—CONVERTIBLE CAR USED CLOSED

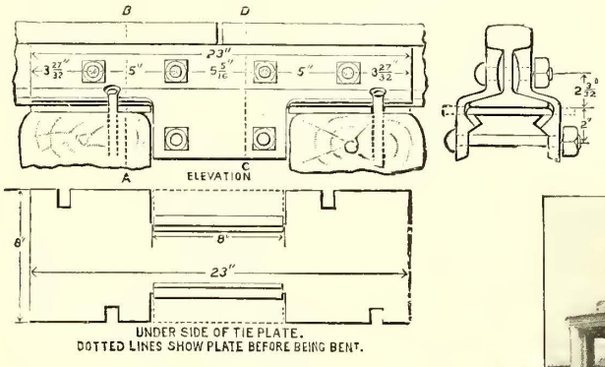
There are eighteen cross seats, 34 ins. long, with reversible backs. The backs and seats are covered with spring cane. There is a center aisle as well as the side entrances at each seat. Round corner seat end panels are used, which add much to the ease and safety of entrance from the aisles. At the ends of the car there are the usual stationary seats. The total seating capacity thus obtained is forty.

There is a running board or step the whole length of the car on each side. This is at the usual height, 18 ins., and folds up like the step of an open car. At the platform there are the usual platform steps with 13-in. risers. These are 13¾ ins. from the head of the rail, and being low, give women and children easy access to the car.

The chief features of this car has been fully patented by J. A. Brill in all the principal European countries, as well as in the United States.

The "Churchill" Rail Joint And "Diamond" Spike

The accompanying engraving shows the Churchill rail joint, which was designed by a practical railway engineer and seems to be rapidly winning favor among railway men. It is made for either T or girder rails, and consists of a peculiarly well-formed trussed angle bar, with a base plate acting as a bridge for supporting the rail ends between the ties. The angle bars are rolled with a deep projection of varying lengths opposite the rail ends, thus giving them that truss reinforcement which renders them exceptionally strong. The interior surfaces of the truss portions of the bars are rolled with projections running along the inner surface of same, the upper face of which projections are made at an angle of 45 degs. to exactly correspond with the pitch of the down-



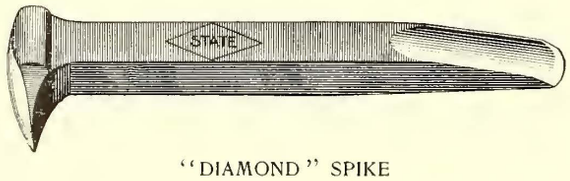
CHURCHILL JOINT

turned edges of the engaging portions of the base plate, so that when the two lower truss bolts are tightened up, there is formed a wedge adjustment which insures the keeping of the parts always in close contact, making them practically one with the rail, giving it great security and strength.

The upper parts of the plate, which gives support to the under head of the rail, are formed with concave surfaces, as in ordinary practice, there being two such surfaces with reinforcing center ribs on plates designed for girder rails. The base plate is designed to rest upon the ties adjoining the joints, so that ends of the truss part of the joint plates rest against the ties, and tend to prevent the creeping of the rails.

It will be readily observed that the joint is designed so that it confines, and securely holds both the web and the flanges of the rail, for which reason all lateral and vertical movements of rail ends is prevented, and the essential feature of perfect joints is secured.

A second engraving illustrates the "Diamond" type of railway spike, which, as will be noted from the illustration, is shaped at



"DIAMOND" SPIKE

the point somewhat like the carpenter's gouge, its exact form being determined after a great many practical tests while experimenting to secure a clean cut of the wood fibres of the ties. The body of the spike was further designed so as to be easily and squarely driven without a tendency to split the ties, and which, when in position, holds more tenaciously than any other type of spike. Both the rail joint and spike are manufactured and sold only by the Diamond State Iron Company, of Wilmington, Del.

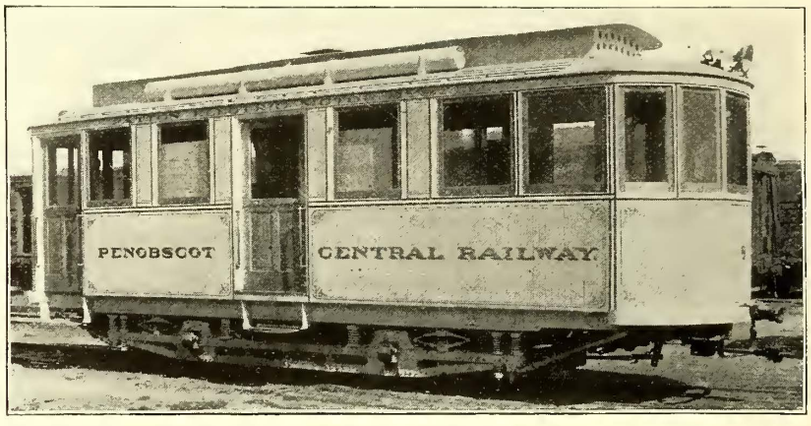
Patton Motors in Maine

The opening of the new Penobscot Central Railway of Bangor, Me., was made recently. This road connects Bangor with a number of prosperous nearby towns and is equipped with Patton motor cars. The first passenger train over the new road consisted of a combination motor and passenger car and a passenger car as a trailer. A large party of prominent men were present at the opening, including Mayor Beale, of Bangor, and several Aldermen. The train was enthusiastically greeted all along the line by cheers, cannon and fireworks.

The Patton motor car, which was used in the opening ceremonies and which is shown herewith, is 32 ft. over all and weighs 28 tons. Its equipment includes two 50 h.p. motors, an engine of 50 h.p., a dynamo of 30 kw. and a battery consisting of 110 cells with a capacity of 280 amp. hours. The dynamo and motor were manufactured by the Walker Company, of Cleveland, Ohio. The engine was made by the National Meter Company, of New York, and the car was equipped with Christensen air brakes. Several additional combination cars are now in course of construction, or will be constructed shortly, for use on the Penobscot Central Railway. They will all be operated by the Patton system.

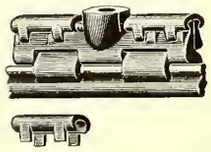
Mechanical Clip for Holding Fig. 8 Trolley Wire

A strong, simple clip for securely holding Fig. 8 trolley wire has recently been brought out by the A. & J. M. Anderson Manufacturing Company, of South Boston, Mass., and is shown in the accompanying illustrations. The larger view shows the clip complete fastened to the wire, and the smaller view shows the small clamp, of which there are two on each clip. As will be seen, the



MOTOR CAR—BANGOR

clip is made of two interlocking parts so designed that when the upper edges of the two parts come together the jaws also come together in the right position to clamp on to the upper part of Fig. 8 wire. The upper edges of the two clip parts when brought together have a slight taper from the center to either side and are so shaped that they will just enter the grooves in the small clamps.



CLIP

To apply the clamp the jaws are placed to engage the upper part of the trolley wire, the upper parts of the clips are brought together and the small clamps driven on to this tapering upper edge, thereby drawing the clip still more closely together and permanently fastening the grip of the jaws on the wire. To prevent the clamps sliding back the fingers on small clamps are bent down and engage the small lugs on each side of the clip. These lugs are staggered so that some of them will always be in position to engage the fingers. This device is used in the Boston Subway and is known as the "Bartley" mechanical clip.

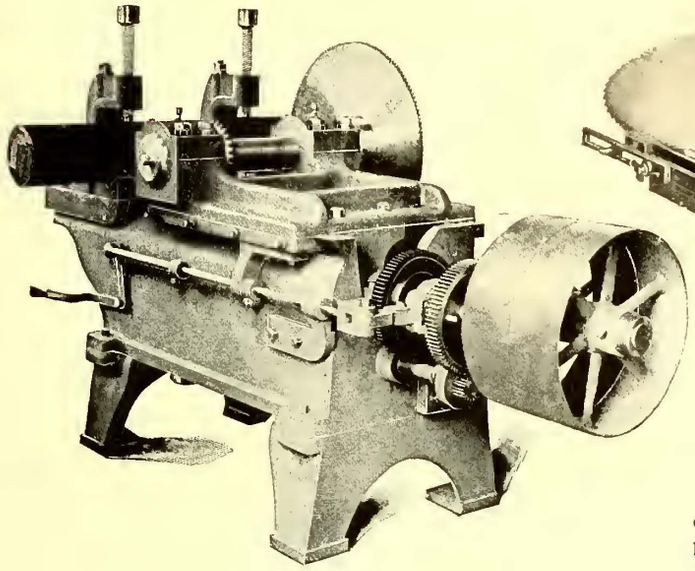
Transporting Standard Gage Cars on Narrow Gage Roads

Mention was made in the last issue of the Street Railway Journal of an ingenious truck employed on the lines of the Société Genevoise des chemins de fer à voie étroite for transporting standard gage cars on narrow gage railways. This truck is manufactured by Maschinenfabrick Esslinger, of Esslingen, Germany, except for France and Belgium, where it is manufactured under license by Soret & Cie., at La Cachette-Nouson (Ardennes, France). A large number of them are in use on the royal narrow gage railways of Wurtemberg and Saxony, where large-sized passenger cars by their means are transported over narrow-gage railways at a speed of 20 km. per hour. Curves with as short a radius as 15 m. present no difficulties to this truck. The operation of the device at Geneva during the recent convention in that city of the International Tramways Union was carefully inspected and commended by the delegates present.

Power Sawing Machine for Cutting Steel Rails

To meet the varied requirements of metal workers, street and steam railways, and manufacturers who cut large quantities of steel rails, bar iron, steel shafting, etc., ranging in size from 3 ins. to 8 ins. round and square, the Q. & C. Company, of Chicago, Ill., has brought out a new and special cold saw, which carries a blade 25 ins. in diameter, ¼ in. thick, and which is provided with fine teeth, the blade itself being arbor driven. The front view of this power saw is shown herewith.

The details of this machine are as follows: Weight on straight base, about 3000 lbs.; floor space occupied, 2½ ft. x 7 ft.; amount of power required to run, from 2½ h.p. to 3½ h.p.; saw-blade

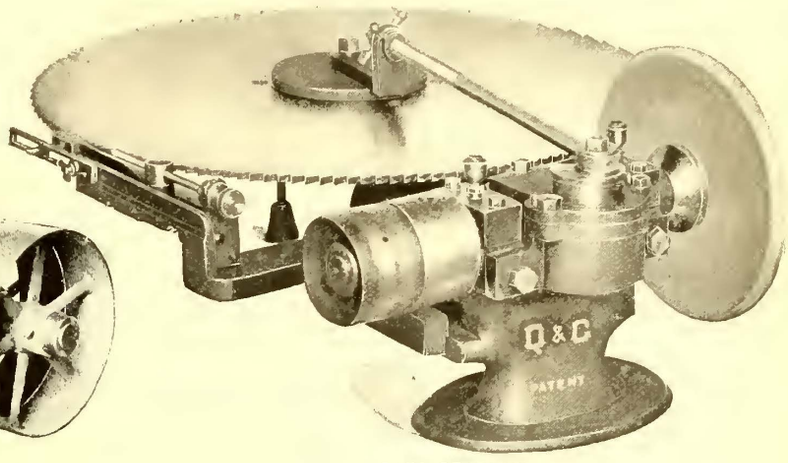


RAIL SAW

available for work, 8¼ ins.; diameter of collar, 8½ ins.; revolutions of saw-blade per minute, 11; travel of saw carriage, 10 in.; cutting speed per mile, 7-16 in. The machine is fitted with automatic feed to meet varied requirements.

Where it is desirable to cut large quantities of steel rails, bar iron, shafting, etc., a special chuck for holding from three to six pieces at a time is furnished, thereby reducing the time necessary to clamp the work as well as decreasing the time necessary to make a cut. This insures most rapid and best results where blades are kept in good cutting condition. A series of tests in cutting steel rails was recently made on one of these machines, the results showing 160 cuts with scarcely any perceptible dullness of saw-blade, indicating the large amount of work that can be done without stopping to grind, and showing as well the long life of saw-blades under the proper conditions of care and handling. Additional tests made recently in cutting badly crystallized rails prove that the machine is particularly adapted for cutting rails which have been exposed to the elements for considerable time.

The Q. & C. Company has also recently placed on the market a new automatic saw-grinder, which is very simple in construction and positive in action. It is shown herewith. A slotted disc crank is marked showing where to place the connecting rod in order to get the proper throw to grind saws furnished with the Q. & C. machines. An extra emery wheel is furnished with this grinder to grind the top of the teeth of the saw, giving them the proper clearance.



SAW GRINDER

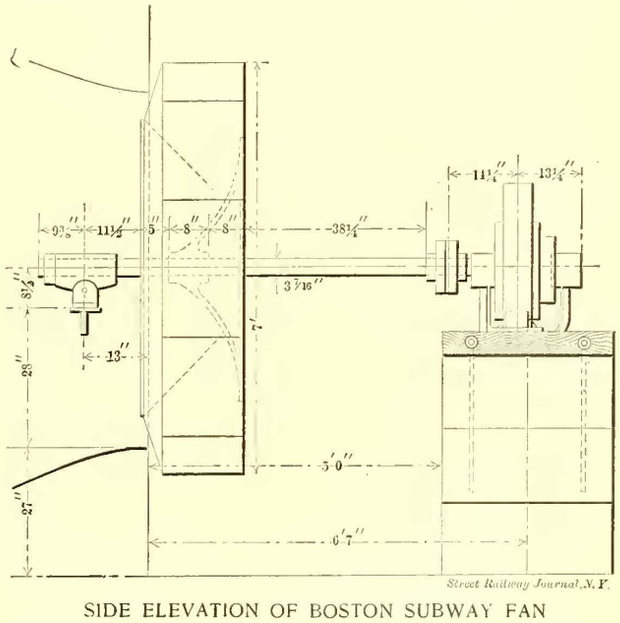
Ventilation of the Boston Subway

The original designs of the Boston Transit Commission for ventilating the Boston Subway contemplated the introduction of electrically driven fans at suitable points along the route. Four of these have already been constructed and installed by the B. F. Sturtevant Company, of Boston; two near West Street, and two between Hollis and Eliot Streets. The former location is practically midway between the Boylston and Park Street entrances, at each of which there is ample opportunity for the free ingress of air. The space coming under the control of the fans at this point is about 1,050,000 cu. ft. The Hollis and Eliot Street section contains about 900,000 cu. ft.

The fans were, in each case, designed to have a capacity equivalent to an air change in each section once in about fifteen minutes. In the accompanying engraving is shown the general arrangement of the fans at the Hollis and Eliot Street chamber. The air is drawn from the subway and forced through the chamber to a point above the surface of the ground.

The fans are all of the Sturtevant cone type, each consisting of a cast iron conoidal center with annular back plate of steel attached thereto, and a series of reverse curved steel plate blades or floats, tapering from inlet to periphery, attached to the annular back plate and to the front plate containing the inlet opening. In its course through the fan the direction of the air is gradually changed from axial to radial, the curvature of the blades being such as to offer the least resistance to the passage of the air and to secure the highest efficiency.

The two fans between Hollis and Eliot Streets are each 7 ft. in diameter, and were designed to each deliver 30,000 cu. ft. of air per minute, when operated at 175 r.p.m. and to require an expenditure of about 7 h.p. each for their operation under ordinary atmospheric conditions. At one-half the speed the power expenditure would be about 1 h.p. Both of those values will naturally vary with the density of the air and the existing temperatures



SIDE ELEVATION OF BOSTON SUBWAY FAN

within and without the subway. The two fans near West Street are both 8 ft. in diameter, each designed to deliver 37,000 cu. ft. of air per minute at 170 revolutions with a power expenditure of about 10 h.p., and to require 1.25 h.p. when driven at half speed.

Each fan is provided with an electric motor of the special Sturtevant M. P. 8 type, direct connected to the fan shaft by an insulated coupling. The armatures are of the drum type, thoroughly ventilated and rendered moisture proof by being saturated in japan and thoroughly baked after having been effectually insulated with mica and oilcloth. They are shunt wound for maximum speed at 550 volts and arranged for series or parallel operation, having a starting and regulating resistance giving different speeds for each combination. The maximum temperature rise for ten hours continuous operation is limited to 45 degs. C. for the armature and to 50 deg. C. for the commutator or fields. Each motor is mounted

on a substantial insulating base frame constructed of Southern hard pine thoroughly filled to prevent absorption of moisture, and anchor bolted to the concrete foundation.

Extra Strong Truck for Chicago

Mention was made last month of the selection of the Peckham truck for the equipment of the new cars on the South Side Elevated Railway, of Chicago. This truck is constructed on the same general lines as the Peckham Company's 14-A "Extra Strong," only such alterations being made from standard design as were necessary to suit it for use under the cars already in service on the South Side Elevated Railway.

The side frames are of the standard built up type, composed of mild steel bars fitted into heavy malleable iron yokes and secured with machine driven rivets. As can be seen in the illustration, the members of these frames are so arranged as to constitute a truss between the yokes, so that all the parts are strained in direct tension or compression and not subjected to bending moments. These frames must carry a maximum load of 15,000 lbs. each, including an allowance of 33 1-3 per cent of the actual dead weight for shocks. Their ultimate strength is estimated at 90,000 lbs., or, for a factor of safety of 6. Tests, however, have proved that they would not break down under short of 100,000 lbs.

These frames are constructed with a 5 ft. 6 in. wheel base, although they carry two G.E. 57 motors and a swing bolster.

The transoms are 5½ ins. x 1 in. mild steel bars. They are secured to the side frames by malleable iron transom holders, which show plainly in the illustration. These transom holders are so designed as to furnish heavy corner braces for the transom and to receive the upper bolster link pins. They are riveted to the transom and secured to the side frames by six turned bolts driven into reamed holes. The transom bars carry, in addition to the links on which the spring plank swings, supporting brackets for the motor spring and safety stirrups which reach under the spring plank to catch it should any of the supports give way.

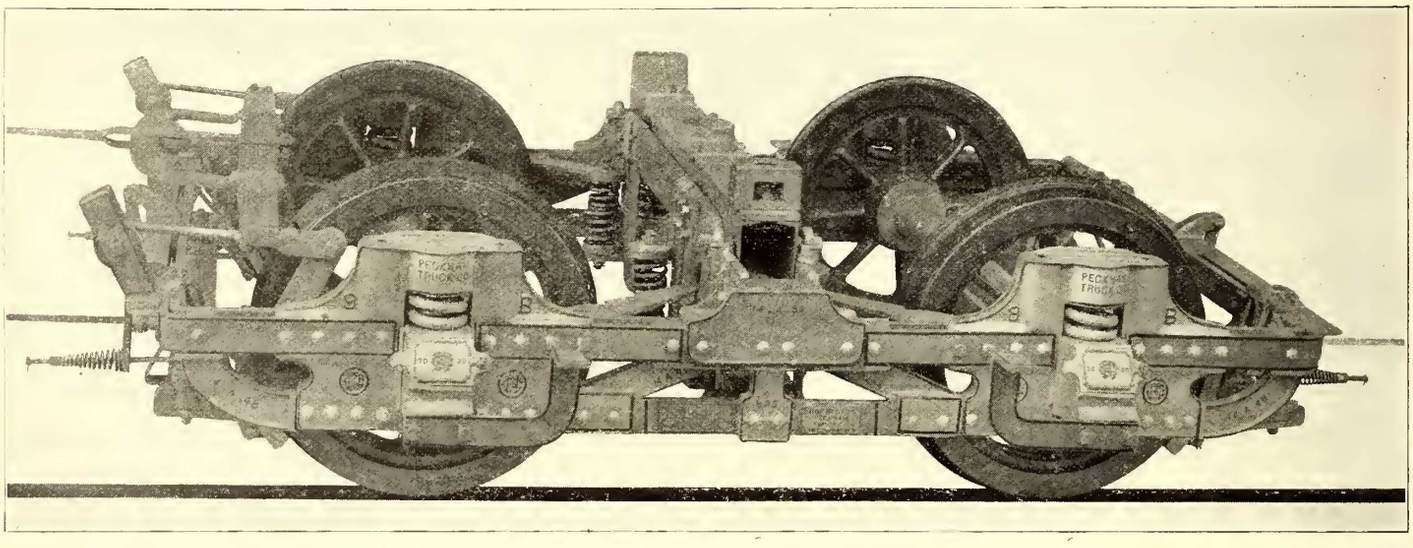
The spring plank is built of 4½ ins. x 1 in. mild steel bars set on edge. Between these bars are secured pockets to receive the two spiral nest springs and the half elliptic springs upon which the bolster is carried. The arrangement of these springs with the half elliptic in the center and a coil at each end of the bolster enables one side of the truck to rise, when forced up by the superelevation of the rail, on entering a curve, without having to compress half of the whole spring system. The effect of this spring arrangement in lessening the twisting strain on car bodies is especially noticeable on the elevated tracks, where the superelevation of the outside rail is large.

The spring plank is supported on four swinging links, 18 ins. long between centers of pins and with a 1 3-8-in. round shank. These links are hinged in the transom holders above by 1½-in. cold rolled steel pins, and in the spring planks below with an 1¾ in. pin of the same material. Between the lower pin and the spring plank is placed a rubber cushion 1½ ins. thick and 3½ ins. square, which breaks the chain of metallic contact from the wheels to the bolster, and deadens the small vibrations which are transmitted to the springs.

The bolster is built of two heavy 8-in. channels, held together at the top by a ¾-in. cover plate and at the bottom by the malleable iron spring pockets. It is free to move between the transom bars vertically with the changes in load and horizontally with the swing of the spring plank upon its links. This swinging motion is limited, however, by spring plungers, one in each end of the bolster, which press against the side frames, if the swing becomes excessive. The combination of these spring plungers and the long swinging links gives a remarkably easy motion in curving.

On the bolster are secured, by turned bolts in reamed holes, the center or swivel plate and the two roller side bearings, all of cast steel.

The brakes are of the double upright lever type. The upright levers are connected at the top by an equalizer, bearing a curved arch to provide against any tightening of the brakes on entering a curve. The brake rods are of 2 in. x 7-8 in. double refined iron, and are carried outside of the wheels in order to provide good clearance and working space around the motors. The brake rods connect at the outside end of the truck with dead levers in order to equalize the pressure on the front and rear shoes. The adjustment is arranged back of the dead lever where it can be reached and handled wherever the car stands in the yard. All the holes in the levers are bushed with hardened steel bushings. The brake beams are 4½ ins. x ¾ in. special steel bars swung from the truck frame by double forged steel links, bearing on 1-in. cold rolled steel pins top and bottom. Safety hangers secured to the frame prevent the brake rigging from falling should the links in which it is swung give way. The shoe heads are of malleable iron and are arranged to hold an interchangeable shoe by two key bolts. The shoes used are the Allen & Morrison patent, with which all cars on the South Side Elevated Railway are equipped.



PECKHAM TRUCK FOR SOUTH SIDE ELEVATED RAILWAY, CHICAGO

The appearance of the truck at once suggests strength and stiffness, all parts being accurately proportioned for the strains to be carried, while the low sides give access to all the electrical connections without the necessity of jacking up the car body.

An interesting experiment is being tried in Bradford, England. The corporation of Bradford has bought a number of good, reliable motors and is offering them for hire to the owners of electrical undertakings, power plants, etc. Albert H. Gibbings, the City Electrical Engineer, in a report recently made upon the venture, states that a rental charge of ten per cent upon the initial cost of each motor has been found amply sufficient to yield acceptaple returns. The system is working very satisfactorily.

The street car strike in Waco., Tex., which was inaugurated on Oct. 4, was declared off on Oct. 22, and the Employees' Union was disbanded. The striking employees were released from any obligation to the Union, and most of them have filed applications for their old positions. The street railway company has accepted the applications and notified its old men that whenever vacancies occur they will be put back, but will have to take their places on the extra list as new men. The result is a complete victory for the company.

The Baltimore (Md.) & Northern Electric Railway Company has instituted an express system in operation over its line.

The New Meaker Register

To the street railway man there is probably no name more thoroughly familiar than that of Meaker. For twenty years the name has been associated with that branch of the business which has to do with securing to the company the full return of the fares collected by the conductor. These twenty years have been devoted to the constant study of register mechanisms, each success or failure constituting a fund of knowledge from which the new register just placed upon the market is evolved. It is reasonable to expect that constant application along one line for so many years would result in a very superior output, and the claims made for the Meaker register show the result of this work. Some of the advantages are in detail as follows: The new register is a hundred thousand register, but instead of the totalizer being entirely of figures, it is a combination of letters with figures, the former so arranged that they may be changed like a combination lock, making it impossible for any one unacquainted with the key to read the register. This feature prevents the general public from making notes as to the company's business and avoids cumbersome numbers in bookkeeping as well as forming a check on the bookkeeping. If, however, it is desired to convert the totalizer entirely into figures, the change may be effected in a few moments.

FIG. 1.—FRONT OF REGISTER

Fig. 1 is the front of the machine, and to the man acquainted with register mechanisms shows the extreme simplicity of this system.

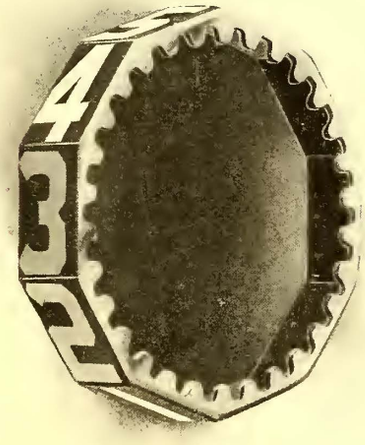


FIG. 2.—FIGURE WHEEL RIM

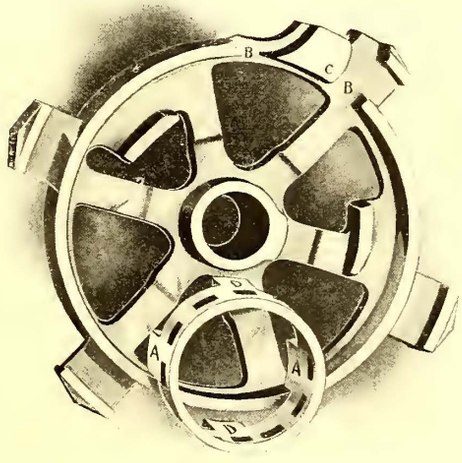


FIG. 3.—WHEEL FRAME AND ACTUATING RING

In Fig. 2 is shown the figure wheel rim separately, which is a steel shell fitting over a cast wheel, shown in Fig. 3. In this cut is also shown the manner of locking and engaging the next wheel. The small wheel of Fig. 3 is the actuating ring; into its perforations mesh the large teeth of the next ten-sided figure rim same as Fig. 2. The four projections of the small ring form a lock and operate as shown. Two of the four projections, *A A* of the actuating ring, rest upon the rim of the wheel. It is evident that the actuating ring and the next higher figure wheel, the teeth of which are engaged in the ring's perforations, cannot move until the wheel in its revolution brings the channeled openings at *B B* to the proper place. The outer projection marked *D* is then engaged by the cam *C* and a quarter turn is imparted to the actuating ring. This leaves the two projections *D D* resting upon the rim, locking the wheel as before. This quarter turn of the actuating ring moves the next higher figure wheel one-tenth of its circumference, and the registration is accomplished.

There are no other parts for each figure wheel than those named; there are no springs or stops for the reason that all motions are positive. The parts are so formed that they will only go together with the totalizer standing at 99,999 and the trip number at 999. This prevents taking the machine apart and putting it together at a lower number for the enriching of the employee.

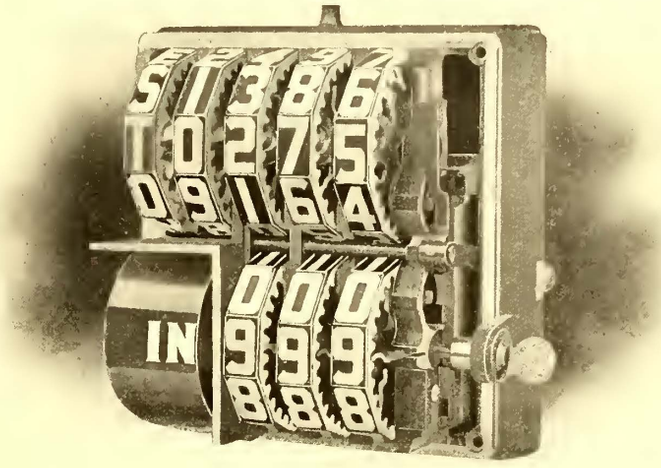


FIG. 4.—REGISTER WITH FRONT REMOVED

The registration movement and alarm can be produced only by the movement of the slide which operates the register and governs its motions. It is provided with phosphor-bronze guides, and carries a large hardened steel dog, which, traveling over a hardened ratchet, guarantees complete strokes. The bell hammer is actuated by this dog, and is only thrown by its dropping from the last ratchet. An incomplete stroke cannot ring the bell, nor can it be rung a second time until another stroke is made.

The dog, in its movement over the ratchet, throws the actuating bar into engagement with the rings, and holds it there while its work is being done. These rings are then locked while the slide returns to place. The trip figures may be set back to zero at any time by pulling out the thumb button and giving it one turn to the right; further, it is impossible to operate the register until the trip figures show zero and the thumb button has been placed in its proper position. Red shutters appear at both windows and will not disappear until the fare is recorded and the bell rings; it is impossible, too, for the ringing to be done so rapidly that it cannot be counted.

A few terse points that may further be mentioned are: The parts of the register are of phosphor-bronze or steel treated with a new process making it strictly rust proof; the mechanism is dust tight, the bell chamber, which is ordinarily a road for dust to enter, being separate; there are but seventeen pieces in the recording apparatus and but three springs in the entire register. The company is also bringing out a new and very simple pulling device adjustable for long or short cars, cord or rod pull.

The company's factory is equipped with new machinery for turning out the register parts almost automatically.

Friedrich Tischendorfer, chief engineer for Elektricitats-Aktiengesellschaft, formerly Schuckert & Company, Nuremburg, Germany, was in New York last month. While in this country Mr. Tischendorfer will arrange for new connections and will make extensive purchases in electrical machinery.

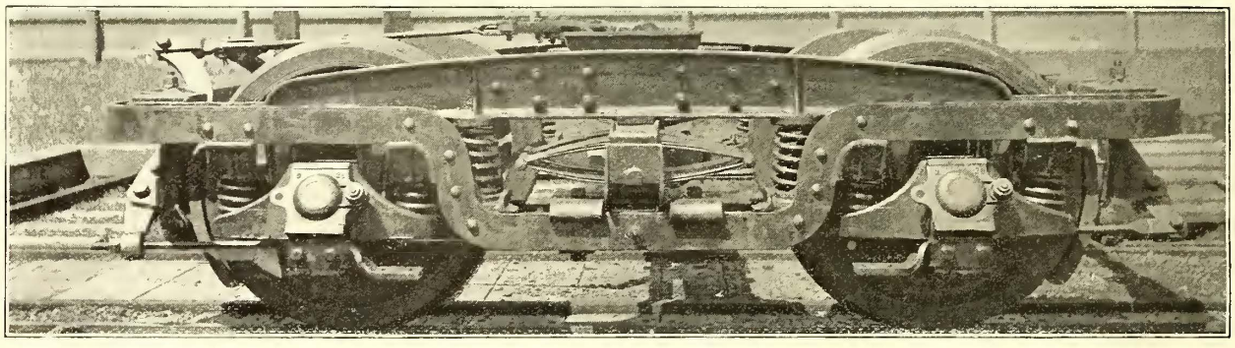
The No. 28 Pivotal Truck

The McGuire No. 28 pivotal truck is in use on this line under 120 passenger cars on the South Side Elevated Railway, of Chicago, as mentioned elsewhere, and is illustrated herewith. This truck was especially designed by the McGuire Manufacturing Company for elevated railway service, and contains many interesting features which are worthy of special mention. Chief among these is its dual construction. The truck is really two, combined in one. The two frames make a truck of great strength, especially diagonally, so that the wheels are always square, giving the most perfect curving, the lightest running, and the least flange wear possible. The brakes and motors are hung on the lower frame, independent of the main car springs, so that the noise and jar of their operation are not transmitted to the car-body, and the disagreeable jerk, caused by the tilting of the truck frame when braking, is not experienced. The draft base is the wheel base of the truck, and consequently the frictional resistance to the free action of the car-body vertically and laterally when the motors are pulling is not increased by leverage, as it is in the ordinary "swing bolster." For instance, under ordinary conditions, in such service as above described, the drawbar pull of a motor car during acceleration is about 400 lbs. per ton of load, and a corresponding reverse action during retardation. An ordinary motor car with four 100 h.p. motors weighs about 18 tons, giving a drawbar pull of a little over 7000 lbs. or a horizontal effort for each motor truck of 3500 lbs.

The equalizing bars continue clear around the ends of the truck, and are machine jointed and riveted together, making a solid frame, while the side bars containing the pedestal jaws are machined and bolted to the transom, the transom having an extra large base so as to resist diagonal strains, making the side bars and transom into another frame. Either frame will carry the load independently of the other in case an accident should befall one. The lower frame rests on spiral springs in wings on the journal box, and the motors and brakes rest upon and are supported entirely by this lower frame, giving a short, easy cushion for the motors and brakes. The upper frame is carried on a combination of spiral and elliptic spring. The swing bolster is swung upon links after the M. C. B. standard, while the whole top frame is set upon a rocker bearing which permits it to relieve the spring bolster in case of necessity, thus preventing any unusual shocks or jars or strains to come upon the side bars of the truck.

All the brake connections are double throughout and built according to McGuire's patented elastic brake design, being just powerful enough to secure the greatest retardation, but not powerful enough for the automatic brakes to slide the wheels. In fact, to epitomize, the peculiar construction of this truck makes it possible to reach the maximum speed in the shortest space of time, which means the greatest practicable rate of acceleration, and with the braking devices enables the manufacturers to get the greatest practicable rate of retardation in order to bring the train to a state of rest in the shortest practicable time. In fact, it is evident that these are the requirements of the modern elevated railway, and a truck to stand this severe test for any length of time will certainly have to be of the very best. These trucks have now been in use a little over one year, and show absolutely no signs of deterioration as yet.

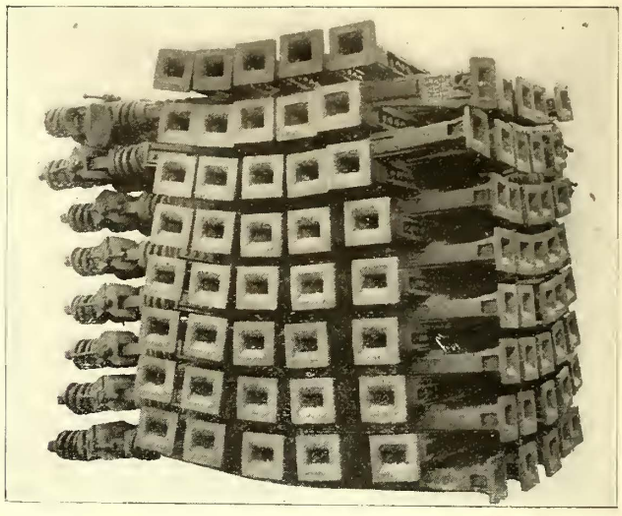
The mechanical construction of this truck is as good, if not superior, to that usually put upon locomotives. All bearings are machine fitted, all holes are reamed, all bolts turned and driven, and all the steel castings subjected to the most rigid tests, and absolutely free from any cracks, blowholes, or other imperfections, and has proved itself to be a thing of comfort and safety to the traveling public as well as the minimum of cost of maintenance, to the company.



NO. 28—PIVOTAL TRUCK IN CHICAGO

Large Order for Couplings

The large pile of couplings shown herewith represents one-quarter of the order lately received from the Brooklyn (N. Y.) Elevated Railway Company, by the W. T. Van Dorn Company, for the Van Dorn Standard No. 3 automatic coupler applied to the Barnes patent swivel on the body bolster. This same style and class of couplings are on all the trail cars of the Metropolitan



COUPLINGS FOR CHICAGO

West Side Elevated Railway, of Chicago, and are giving entire satisfaction to the management of that road. The large order just received from Brooklyn is an excellent indication of the merit possessed by the couplings manufactured by the Van Dorn Company.

The Van Dorn couplings are being made the standard by many of the larger elevated, underground and surface railway companies both in this country and in Europe. It is claimed that with this device there is no lost motion whatever between the motor car and the trail car, and the train starts and stops as if composed of but one car. The use of this appliance has been the means of saving the life and limbs of employees, as it is almost impossible for any accidents to occur when cars are being coupled. They are entirely automatic in their action and thus a large amount of time is saved. The Van Dorn Company now has eleven sizes of couplings for different conditions.

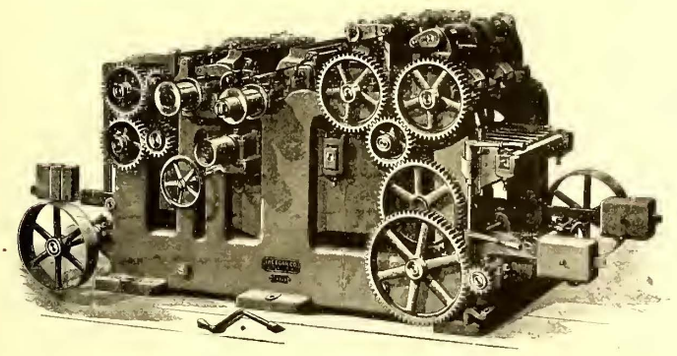
New Triple Cylinder Surfacer

The triple cylinder surfacer shown in the accompanying illustration is built by the Egan Company, of Cincinnati, O., to meet the exacting demands made upon planers by the class of work required to be done in car shops, etc. The company has attempted to eliminate from this machine all weaknesses in construction and design that experience has developed in other planers where subjected to the hardest use.

The main frame is massive and heavy, cored throughout, and with heavy cross girts and broad base. The body is made with a heavy deep web and fitted into the main frame in four long dovetailed ways by strong gibs made adjustable for taking up wear. It raises and lowers on four powerful screws by means of friction

feed instantly stopped and started by a lever at the front of the machine convenient to the operator, or may be adjusted by hand by a large hand wheel at the front. The four screws are located at each corner of the bed and run in ball-bearings.

There are six feed rolls, 8 in. in diameter, powerfully driven, and all rolls have parallel lift, so as to give full bearing across the entire width surface of the material being planed. The two upper rolls before the cylinder are divided, and each section separately driven and separately weighted. Each section is driven by gear meshing into the center and driving down. The lower rolls are driven by expansion gearing, thus avoiding bevel gears or universal joints. Each cylinder is three-sided, slotted and double



TRIPLE CYLINDER SURFACER

belted. The lower cylinder, with its bearings, is mounted on long dove-tailed slide, that may be quickly drawn out endwise for sharpening and adjusting knives.

The Egan Company has had a special corps of expert mechanics and draftsmen at work for the past year designing and perfecting new and improved wood-working machinery, and this surfacer is one of the machines designed by them. The Egan Company makes a full and complete line of high-grade machines for manufacturing articles of every description out of wood.

The Manufacture of Bolts and Spikes

The works of the Diamond State Iron Works, which have a long-established reputation in the production of bolts and nuts, railroad spikes, splice bars, rivets and horseshoes, etc., are located near Wilmington, Del., on both sides of the Christiana River, 30 miles below Philadelphia, Pa. The buildings are very compact and cover about six acres of ground, and each division of the works has separate furnaces and rolling mills, as well as the different class of bolt and nut machinery. The mills on the north side produce machine and carriage bolts, rivets, lag screws and some special products, while on the south side the principal output is railroad spikes and track bolts, boiler and bridge rivets, bridge rods, horseshoes, etc., and also embraces the foundry and the principal machine shop. The use of so many of these articles in the electric railway industry will undoubtedly make some particulars of their manufacture interesting.

Leaving the rolling mills for the present, we follow the rods to the bolt department of Mill No. 1, and here it should be noted that there are two processes, or rather three, of feeding the material to the shaping machines. In No. 1 mill the bars for machine bolts are first cut cold into exact lengths known as blanks, and are then heated in oil-burning furnaces, and fed by means of tongs very rapidly into the jaws of the forming machines, which give them a squeeze and drop them out on the under side with the head perfectly formed, and with the trade mark of the company, consisting of a diamond inclosing the letter S stamped on the head. In this department there are many machines for making bolts of different sizes, operated by men and boys, who are very expert in feeding the blanks to suit the movement of the dies. The next process consists in pointing or rounding off the ends of the bolts, which is done by inserting the ends in revolving mandrels and then pressing them against the cutting tools. This work is done by boys, who put the bolts in position and take them out about as fast as one can count. The thread-cutting follows and this is done on machines in which the dies are held in revolving heads, placed longitudinally in gangs of from two to four, and which are fed by a single attendant. In the process of cutting, oil flows freely over the bolts and cutting tools, and is gathered in a vat just beneath.

Nearby the bolt cutters are the nut-forming and threading machines. The nuts for machine and carriage bolts are cut cold from rolled bars from 3 ft. to 4 ft. in length. The holes are first punched at suitable intervals the whole length of the bar, which is turned for each alternate hole to prevent its becoming bent out of shape. When the bars are passed through the cutting-up machine or shear, the individual nuts are collected in baskets and delivered to the trueing machines, in which the edges are squared out in a die. At the same time the hole is trued by a plunger of standard size, and in the same operation the corners of one side are slightly rounded off by pressure. In this machine the nuts are fed in by hand, but automatically pass from one process to the other. The reaming process follows, the nuts being fed into inclined hoppers, which hold from ten to twenty each, there being one to each of the six spindles of the machine. The reaming tools descend together and finish the six, when the tools are raised and the finished blank is moved to one side and drops out of sight, when the next lot moves in place and the tools again descend and repeat the operation. The thread-cutting machines have a number of vertical spindles, on some as many as eight. The blanks are fed in by hand, and, as the cutter passes through, the nuts are left to accumulate on the shank of the cutter, till a certain number is reached, when the tool is removed and the nuts drop off from the upper end. In the operation oil runs freely over the cutting tools, which facilitates the operation and prevents heating. In the process of thread cutting, both for the bolt and nut, great accuracy is required, and the cutters are frequently renewed lest the wear of the tools should throw the threads of the bolts and nuts out of adjustment, as any wear of the bolt cutter tends to enlarge the thread, while the wear of the tool which cuts the thread in the nut tends to reduce the diameter.

Carriage bolts or the blanks are usually cut from continuous round rods, which are coiled like wire on wheels, the stock being automatically drawn into the machines, which cut it to suitable lengths and at the same time upset or enlarge one end so as to provide sufficient metal for forming the head and square shank, which is a characteristic of carriage bolts. Small rivets are made by the same class of machines, the wire being placed on reels which feed automatically. Two motions are required to cut off and form the heads, and this is done faster than one can count, especially in the smaller sizes, which require a thousand to weigh 3 lbs. We next follow the blanks for carriage bolts to the upper floors, where they are pointed and the heads trimmed to spherical shape. This is done by placing the blank in a mandrel, while a cutting tool, about 2 ins. square, with a handle at the center, is held deftly against the head, and as it revolves shaves off the surplus of metal. The heads of the larger sizes of carriage bolts are trimmed and flattened by the same process. After this the threads are cut, as described, for other bolts, and the nuts are adjusted to the bolts by hand, for which work boys are chiefly employed, who work by the piece, and unite the bolts and nuts very rapidly, while at the same time they inspect them for proper fit. All employees throughout the establishment work by the piece, the price being fixed for each independent process. It may be noted in passing that the stock is all weighed as it is delivered to the different departments, and all the chips and scraps are collected and weighed, so that very accurate check is kept of all the material. Carriage bolts and some other classes of bolts are annealed after being made. For this process cast iron pans, with covers, are used. After being filled with bolts, these pans are placed in charcoal furnaces, which process gives the surface a bluish cast, and reduces the liability to rust.

Lag screws are formed in about the same manner as described for bolts, but are pointed or tapered before the threads are cut, and a modified process of thread cutting is employed, in order to give the gimlet point that is a characteristic of lag screws. The output from this department, including machine and carriage bolts and cold-punched nuts, is about 6000 tons per annum.

We will now cross the river to the Old Ferry mills and watch the process of making track bolts and spikes, as well as bridge bolts. The nuts for the larger bolts are usually hot pressed and punched, the rods being heated in oil furnaces when the end is thrust into the machine, which punches and cuts off the nut to proper size, either square or sexagon or octagon. After being allowed to cool, the blanks are trimmed to accurate size on a powerful punch which forces them through a die, in which process all the surplus metal is shaved off. There is but little difference between the product produced by the cold or hot pressers, except by the latter process a little lower grade of metal can be employed. In forming bridge bolts, which are of all sizes and lengths, the ends of the rods are first heated. They are then upset or enlarged in a suitable machine, which accomplishes the work in two blows. The rod comes out perfectly round, and with sufficient additional metal to allow of the cutting of the large thread without weakening the cross section of the bolt, so that it is as strong in the thread as at any other point. The main building, which is occupied by the bolt and spike department of this mill, is 600 ft. x 100 ft., and the machines for making the bolts, rivets and spikes are arranged in two rows lengthwise of the building, with the heat-

ing furnaces adjoining each machine. Room is left for a line of track between the machine on each side of the building, and there is also a line of track down the middle upon which run trucks which deliver the material to each line of machines and remove the finished product.

A large number of both automatic and hand machines are devoted to the manufacture of spikes, both for railroad and wharf building purposes. The machines for making the small sized spike form them very rapidly, the ends of the rods being heated when they are fed in by hand, and the complete spikes are formed one or two in a second. The company manufactures a special design of railroad spike of the ordinary size, which has a spoon-shaped point, and for making these two processes are required; one machine cuts off the blanks and forms the head. When the spike is still red hot, it is passed to a second machine which rolls out the point and forms the concave chamber which is a characteristic of these spikes, and which is illustrated and described in another article of this issue.

A description of the spike-making is very simple, and does not convey an adequate idea of the number of machines employed or of the magnitude of the output. This can be somewhat judged, however, from the statement that about 200,000 kegs of railroad, ship and wharf spikes is the annual product.

Track bolts are formed in about the same manner as described for machine bolts, except that the rods are heated before cutting, and the cutting and forming of the head is done in one process. Then the threads are cut, and the bolts and nuts are mated. About 90,000 kegs per annum of track bolts and nuts constitute the output in this department.

In the same department are the machines for making rivets of different sizes for bridge and structural work, and of these the output is about 130,000 kegs per annum. The smaller size of rivets are pressed from heated bars, while the larger size are first cut into suitable lengths, then heated. Rivets of the countersunk type are made in vertical dies, in which the heated blank is placed on end in the die, when a heavy hammer falls and drives it home, forming a head and countersunk taper. By another blow from the under side the finished rivet is driven out of the die, and falls over the side of the machine. The individual rivets and bolts undergo careful inspection, when they are counted and carefully packed in kegs.

One of the most interesting departments is that in which the horseshoes are made, which requires a large number of machines. The shoes are made in more than a hundred different sizes, designed both for horse and mule service, and the output is 200,000 kegs per annum.

Besides the products enumerated above, a considerable output of the work includes fish-plates and channel-bars, and of this class one is known as the "Churchill" rail joints for T and girder rails, and which will be found described in another connection. The works also turn out steel frames used by telephone companies on the top of distributing poles, to which the cables are led, and from which the individual wires are properly distributed. The material composing these frames is galvanized, and for this work there is a large vat for melting the spelter and lead, and for applying it to the metal, etc.

Not less interesting than the above processes are the methods of preparing the metal, and rolling it into suitable rods and bars preparatory to the forming of the various products. The metal consists of certain quantities of pig iron of a high grade, and every variety of scrap iron, including cast and wrought metal. The metals are assorted, and different processes are followed, according to the character of the metal in fitting it for service. After being cut to suitable sizes the pieces are carefully baled, being piled by hand, into bundles of about 2 ft. in length and 6 ins. square; then they are securely wired and are ready for the heating furnaces. Numbers of these bundles are introduced to the furnaces, and after being heated to the required temperature are delivered to the rolls, through which they pass back and forth, until they are drawn into rods of suitable size, some of them a hundred or more feet in length.

A very interesting process is that of treating the cast scrap and changing it to wrought iron. For this purpose there are many puddling furnaces, to which the metal is fed in suitable quantities, and manipulated in about the same manner as in ordinary furnaces of this character. It is interesting to note, however, that when the sulphur and other impurities are properly eliminated the pure metal is separated from the dross in globules in about the same manner in which butter is formed from the churning of cream. When suitably reduced the material is rolled into a ball from a foot to 18 ins. in diameter, when it is removed from the furnace and carried by trolley tongs to a heavy roller or squeezer, in which a large corrugated wheel revolves in a horizontal position, and which rolls the ball into the form of a cylinder, as it passes between the wheel and the inner surface of the case. It is now in shape to be introduced to the rollers, when it is formed into rods, in about the same manner as described for the bundles of scrap. The capacity of the puddling mills is 40,000 tons per annum.

The foundry department occupies a building across the yard from the rolling mills, and here are made machine and other castings, both of iron and brass, for railway use, the capacity being about 10,000 lbs. per annum. The castings for all the rolls and heavy machines employed in the works are made in this department, and the tool equipment and labor-saving devices are very complete, including almost all the appliances that are found in foundries in this character. Adjoining the foundry are the principal machine shops and forging department, in which are a number of steam hammers and all the tools necessary for turning rolls and for building machinery of every description.

In connection with the foundry department should be noted the pattern department, in which is a good complement of woodworking machines suitable for making patterns of every description. The keg-making department is also a very large and important branch of the company's works.

To facilitate the handling of material a number of the delivery tracks are elevated so that scrap, coke and coal are readily dumped, while for shipping the tracks occupy sunken ways which brings the floor of the car on a level with the shop tracks, so that goods are wheeled directly into the car.

Power is supplied to the rolls and various departments by twenty-five stationary engines of different sizes, and the works are lighted by electricity, both arc and incandescent lamps being employed, and the current is generated on the premises. In this connection is to be noted the peculiar construction of the buildings, which have high roofs and a peculiar arrangement of ventilators, which provides for a rapid circulation of air, which tends to remove the smoke and dust, and renders the works comparatively cool, considering the nature of the processes.

The business of the Diamond State Iron Company was established in 1853; the present company was incorporated in 1865. The employees number from 1200 to 1500, depending upon the demand for goods, and the mills have a capacity of 100,000 net tons per annum. The affairs of the company are under the management of George W. Todd, president and treasurer, who has been with the company for more than thirty years, having entered the service of the company as office boy. L. A. Bower is vice-president and H. T. Wallace secretary; to all of whom the writer is indebted for courtesies shown him.

The G. E. 57 B Railway Motor.

The South Side Elevated Railway, of Chicago, is using for its electrical equipment the G. E. 57 B motor. In this motor the general characteristics of all the modern types of railway motors built by the General Electric Company are preserved, and in appearance it closely resembles the G. E. motors which have recently been described in these columns.

The magnet frame of cast steel of high magnetic permeability is cast in two bowl-shaped halves, divided horizontally into upper and lowest frames, which when bolted together completely inclose and protect the armature, commutator, brush holder and field spools. Four field coils wound on insulated spools are held in place by projections on the laminated pole pieces which are bolted two to each frame, at an angle of 45 degs. from the split, by through bolts with the nuts on the outside. The top frame carries the axle and armature shaft brackets, and to the under side of these bearing caps are bolted brackets and caps being bored out to support and inclose the shaft linings.

The lower frame is bolted to the upper by four bolts, two on each side. Those on the front are hinged so that when the back bolts are removed the frame swings down, exposing the armature and field coils for inspection and cleaning. With the lower frame in this position, the lower field coils may be readily removed, while by removing the caps and gear case, the armature and upper field coils may also be removed without difficulty.

In the top frame over the commutator, a large opening allows inspection of all commutator and brush holders and removal of worn out brushes. The opening is large enough to allow the brush holder yoke and brush holder bodies to be brought up through it. It is protected by a malleable iron cover securely clamped down with an adjustable cam locking device. A smaller hand, or ventilating hole, is left on the top frame at the opposite end, and a similar hole is let into each end of the lower frame.

The field coils are of copper ribbon wound on insulated spools, coils and spools being interchangeable. The leads are brought out in such manner as to be easily removable, and, when the lower frame is dropped for inspection, disconnection of the leads inside the frame is unnecessary.

The armature is of the ironclad, hollow body, ventilating core

type. The core of soft iron laminæ is built up and securely keyed to the armature shaft, each lamination insulated from the other by a substantial coat of japan. The laminæ are clamped together by cast iron heads also keyed to the shaft. The slots are punched uniformly in the laminæ to give the assembled core smooth and uniform slots in which the armature coils may be placed without injury to them. The winding is series drum, with ninety-nine coils of three turns per coil, each coil separately formed and thoroughly insulated before application to the core. The insulating consists of specially prepared tape and cloth possessing high insulation qualities and practically impervious to moisture. The two terminals of each coil are brought directly into the commutator segments and so soldered as to properly connect the armature coils one to another and at the same time form the connections between the armature and the commutator. Any coil can be easily removed and another substituted without disturbing the rest of the armature structure. The coils are held in the slots by tinned steel wire bands and a covering of canvas securely bound in place prevents any access of carbon dust into the end windings.

The commutator has ninety-nine segments, clamped on a malleable iron shell. The diameter of the commutator is about 10¼ ins., the wearing depth 1⅛ ins. The core clamping insulation is of first quality mica built up and pressed hard and compact in steel moulds. The mica between the segments is somewhat softer in order that it may wear down evenly with the segments, which are of hard drawn copper of uniform hardness.

The two brush holders are of cast brass, each carrying two brushes which slide in finished ways and are pressed against the commutator by independent pressure fingers which give a uniform pressure throughout the working range of the brushes. The brush holders are clamped to a common well-seasoned hardwood yoke filled to keep out moisture, and bolted to the top magnet frame in such manner as to maintain the brushes parallel under all normal conditions. All the leads from the motor to the car are brought out through rubber bushed holes in the magnet frame at the front side of the motor.

The bearings are of ample proportions to insure good lubrication and long life. Those on the pinion end of the armature shaft are 8¾ ins. x 3¼ ins. The axle bearings are 9 ins long. The armature bearings are machined cast iron shells filled with babbitt metal ¼ in. thick and swaged hard into the shell to make it compact and tight. The axle bearing linings are of cast brass. All bearings are lubricated with grease and oil, the former held in grease boxes cast into the upper magnet frame. The bottom of the grease boxes and the top of the linings are slotted and the grease rests directly on the top of the shaft. Oil wells are cast in the bearing caps and felt wicks with one end on the shaft are used. Thrust collars and grease protectors are provided to obviate any access of lubricant to the motor.

The gear is of cast steel with sixty-five machine cut teeth of 3-in. pitch. The pinion is of forged steel, bored out for a taper fit on the armature shaft. It has twenty-two teeth. The weight of the motor complete, with axle, gear and gear case, is 2972 lbs.

Two New Cars

On a recent visit to the works of the Jackson & Sharp Company, at Wilmington, Del., a lot of six new cars was noted just ready for shipment. They were built for the Philadelphia & Westchester Traction Company, a new line recently constructed by Pepper & Register. The bodies of these cars are 29 ft. 6 ins. in length, with a smoking compartment partitioned off at one end. The cars have ten windows, with double sash, eight being in the main compartment. The interior finish of the cars, including the posts and wainscoting, is all in quartered oak, with the exception of the ceiling, which is of three-ply birch veneer. The seats are of the Hale & Kilburn walkover type, upholstered in rattan, furnishing seating capacity for thirty-two passengers in the main compartment and six in the smoking room. All the colors being light, comparatively, the interiors have a very inviting appearance. Electric lamps, four on each side, are attached to the ventilator stringers, which brings the light directly over the seats. The deck lights are beveled-edge chipped glass, and the register and bell cords are supported along the center of the car by straps from the ceiling, after the manner of steam car practice. The window sills are provided with adjustable caps, held in place by brass clutches, which prevent the entrance of cold air from the open spaces. The curtains are finished with Burrowes fixtures, and all the other furnishings are of high order.

The exterior is painted in Tuscan red, striped in gold and lettered in silver. The bodies are mounted on double trucks of the Peckham 14 B type, and are equipped with Christensen air brakes. A double equipment of sand boxes is provided at each end, one being under the platform, the other under the body.

Among the other cars ready for shipment were a number of single-truck cars for the Port Chester (N. Y.) Railway, which were ordered by Col. Helt, of the New Haven & Hartford Railway Company. These cars are finished in select mahogany, with birds-eye maple ceilings, and are provided with plate-glass windows, with the sash arranged to raise part way, as in steam practice. The curtains are of pantasote, with Burrowes fixtures. The car is equipped with side seats, leather covered, and tufted on both seat and back. The seats are spring-edged, and were manufactured by the Jackson & Sharp Company. The double doors are operated by the new contra-twist door fixture, which was originated by this company.

This fixture consists of a square shaft milled spirally with a contra-twist from the center outward, and which serves to hold the doors in any position, and prevents them from closing from any surging motion of the car on curves, and, best of all, they cannot get out of order. The Jackson & Sharp Company has recently enlarged its works by the addition of a brick building intended for a store room, and by a brick front to the oldest and original portion of the shop. The works are running full time, being engaged on a large number of sleeping and mail cars for steam service, in addition to the numerous street railway orders. The orders in both departments include a number of cars for export, some of those for street railway service being double-decked cars.

An Attractive Pamphlet

The M. C. Bullock Manufacturing Company, of Chicago, has recently published a pamphlet on the Willans type of engine, entitled "The Central Valve Engine." This pamphlet, though not large, is well illustrated, and the reading matter is written in a very attractive style, so that every one, even the hide-bound advocates of Corliss engines, will find much to interest them in it. On one page is given the "family tree" of the central valve engine. From it the reader notices that the first offshoots of these engines are high economy and great durability, and these two are followed by a great number of other important advantages, all of which are fully elaborated upon in the text which follows. The essential features of this engine were fully described in the last issue of the STREET RAILWAY JOURNAL.

Large Railway Switchboard in Philadelphia

Some particulars were published in the last issue of the STREET RAILWAY JOURNAL of the large switchboard in Thirteenth and Mount Vernon Streets power station of the Union Traction Company, of Philadelphia. This company is the largest single street railway property in the world and operates 450 miles of track in Philadelphia and suburbs. Some further information upon this board may be of interest.

The switchboard was planned and laid out by engineers of the Union Traction Company. The Albert & J. M. Anderson Manufacturing Company, of Boston, furnished the switches and practically all connections. It also made all connections on the board and put up the bus bars. A view of the board gives one the impression of great strength, solidity and ample capacity. It is erected across the south wall of the station in two tiers, the upper being 90 ft. long and the lower 60 ft., 15 ft. being reserved on each side for an entrance, leading to the street and repair shop on the right and to the station men's rooms and lockers on the left.

The panels are 7 ft. 10 ins. high and of white selected marble. They have a capping of 2 ft. 2 ins., also of white marble. The top of the upper tier is 20 ft. from the floor.

The board contains seventy-six feeder panels, each 18 ins. wide; four generator panels, 30 ins. wide; five tie line panels, one panel for controlling lights, one panel for recording wattmeter and negative switches, one panel for main ampere and wattmeters, two switch panels for connecting upper and lower bus bars and one spare generator panel. The switches, connections and choke coils on the board weigh upward of 14 tons and the bus bars about 7 tons, which will give a general idea of the amount of metal. The main bus bar is designed to carry 16,000 amps. The knife switches were made especially for the Union Traction Company, by the Albert & J. M. Anderson Manufacturing Company, and are of a peculiar type. The 1200-amp. double-throw switch was illustrated last month.

A disastrous fire occurred Nov. 30 at the car house of the Union Railway Company, of New York. From fifty to seventy-five cars were destroyed.

A Substitute For Salt For Removing Snow

Street railway companies, probably without exception, use salt for cleaning their rails of snow and ice because they consider this method most economical and cheapest. It has long been understood that salt as a liquid could be applied much more advantageously than in the granulated form, but in practice it is found impossible to avoid incrustations which gather on the sides and bottoms of tanks and quickly choke the pipes through which the brine is conducted to the rail. This objection has been overcome by the Fitch Chemical Company, of Bay City, Mich., which is placing upon the market a brine which is guaranteed to be without the sediment or incrustation forming properties and to be much cheaper than salt in first cost.

This brine, which the company calls "triple chlorides," is furnished to the trade in barrels and can be applied with the ordinary summer sprinkling car by making a slight modification in the discharge pipes so as to pour a single stream on each rail; or a small tank with discharge pipes may be rigged up on the front end of a motor car. For curves, crossings and switches the "triple chlorides" can be applied by hand with an ordinary sprinkling can by the man whose duty it is to keep such places clean. The triple chlorides will not freeze at 20 deg. below zero and when applied to the rail its action is more effective and more lasting than that of ordinary salt. The brine is shipped from the works in 50-gal. barrels. This composition, it is claimed, has less corroding effect on iron and copper bonds than salt, and the method will readily recommend itself to managers.

Personals

MR. ALBERT C. EMMERICK has given up his position as receiver of the Buffalo, Kenmore & Tonawanda Electric Railroad Company.

MR. JAMES DUANE LIVINGSTONE, of New York, has been elected president of the Northeast Electric Street Railway, of Kansas City, Mo., to succeed W. M. Reid.

MR. I. A. KELSEY, vice-president and secretary of the Winchester Avenue Railway Company, of New Haven, has also been elected president of the Middletown (Conn.) Street Railway Company.

MR. C. F. HOLMES, superintendent of the Metropolitan Street Railway Company, of Kansas City, Mo., has been taking an Eastern trip for his health. He returned to his home a short time ago greatly benefited by his vacation.

MR. GEORGE J. COOKE, superintendent of underground construction of the Toledo (Ohio) Traction Company, has taken a leave of absence and will spend the winter in California, where he will be treated for throat trouble.

MR. FRANK N. PHILLIPS, president of the American Electrical Works, of Providence, R. I., was married on Nov. 15, to Miss Edith R. Peck. Mr. Phillips is well known throughout the street railway field for his kindly spirit and generous hospitality, and his many friends extend to him most hearty congratulations.

COL. D. B. DYER, president of the Augusta (Ga.) Railway & Electric Company, has been appointed to the military staff of Governor Candler, of Georgia. Although of the opposite political faith from the Governor, Mr. Dyer's sterling qualities influenced the Governor to make the appointment.

MR. H. F. PARSHALL, consulting engineer of the British Thomson-Houston Company, the Dublin United Tramways Company, the Bristol Tramway & Omnibus Company and other important tramways in Great Britain, came across the water during November for a brief trip in the United States. He returned to London Nov. 30.

MR. H. H. VREELAND has been elected president of the New York Railroad Club. Mr. Vreeland had a long experience in steam railroading before accepting the position of president of the Metropolitan Street Railway Company, of New York, and has always kept up his interest in that subject. It is an interesting commentary on the close relations existing between steam and street railroading that a club composed of officials of steam railroads should select as presiding officer the president of an exclusively street railway company.

MR. L. D. MATHES, who was formerly connected with the Norfolk & Ocean View Railway, of Norfolk, Va., has recently been appointed manager of the Charleston & Seashore Railroad, of Charleston, S. C. Mr. Mathes made an excellent record at Norfolk, and the Charleston & Seashore Railroad is to be congratulated upon having secured his services.

MR. H. L. SHIPPEY, manager of John A. Roebling's Sons Company, has just returned from a visit to Europe, partly on pleasure and partly on business. In the rapid development of electrical enterprises abroad the Roebling Company has secured a large share of business, and it was partly to care for this that Mr. Shippey made his trip.

MR. ALFRED SKITT, formerly superintendent of the Madison & Fourth Avenue Railway, when it was controlled by the Vanderbilts, has been elected vice-president of the Manhattan Railway Company, of New York. When the Fourth Avenue line was leased by the Metropolitan Street Railway Company, Mr. Skitt resigned from that company and accepted the position of general manager of the lighterage department of the New York Central Railroad. While with the Fourth Avenue line, Mr. Skitt established a high reputation as a city railway manager, and his connection with the Manhattan Railway Company, it is said, is indicative of changes in the operating details of the latter.

Obituary

MR. HORACE B. MILLER, who was well known throughout the field of mechanical engineering, died at Napa, Cal., Oct. 25, of heart failure. Mr. Miller was one of the two founders and original sole proprietors of the "American Machinist," a prominent weekly journal devoted to machinery construction, and published in New York. He was born in Philadelphia in 1839, and received a naval education and served in Farragut's fleet during the Civil War. Mr. Miller was an associate member of the American Society of Mechanical Engineers from the beginning of that organization, and he was for many years a member of the Press Club, of New York.

MR. SYLVANUS M. THOMAS, treasurer of the Taunton Street Railway Company, of Taunton, Mass., and a prominent member of the Bristol County bar, died at his home on Nov. 20. Mr. Thomas was born in New Bedford in 1850. He went to Taunton about twenty-five years ago and opened a law office soon after his admission to the bar. After the purchase of the Taunton Street Railway Company by a Rochester syndicate, he became its treasurer, and he also held the same office for the Dighton, Somerset & Swansea Street Railway Company when that road was organized, but resigned this latter position about a month ago, on account of his failing health.

AMONG THE MANUFACTURERS

THE FIRM OF DARLINGTON & SHUTTLEWORTH, of Philadelphia, has been dissolved. Mr. Darlington will retain his office in the Drexel Building, Philadelphia.

THE METROPOLITAN STREET RAILWAY COMPANY, New York, has just purchased from Messrs. Wendell & MacDuffie twelve Taunton snow plows.

THE NORTHWESTERN ELEVATED RAILROAD COMPANY, of Chicago, has awarded its contract for rolling stock to the Pullman Car Company.

THE GENERAL ELECTRIC COMPANY has established a sales office in the Templeton Building, Salt Lake City, Utah. It is in charge of H. E. Chubbuck.

THE CONSOLIDATED CAR FENDER COMPANY, of Providence, sent to the trade shortly before Thanksgiving Day an attractive memorial of the day in the shape of an appropriate card.

THE BETHLEHEM IRON COMPANY, of South Bethlehem, Pa., furnished all the shafting for the torpedo boat "Davis," constructed by the Wolf & Schzwicher Iron Works, of Portland, Ore.

ELMER P. MORRIS, of New York City, reports a number of large orders received during the last month for the various supplies he handles. A number of these orders have come from foreign countries.

THE McGUIRE MANUFACTURING COMPANY, of Chicago, has been awarded the contract for all the trucks for the Northwestern Elevated Railway, of Chicago. This includes 294 trucks, and the order amounts to over $100,000. It is said to be the largest truck contract ever let for one electric elevated railway. The trucks are all to be delivered during March, April and May, 1899.

THE CONSOLIDATED CAR HEATING COMPANY, of Albany, supplied all the electrical heaters for the cars of the Union Traction Company, of Philadelphia, whose power station was described in the last issue.

THE FOSTORIA INCANDESCENT LAMP COMPANY, of Fostoria, Ohio, has opened an Eastern office in the White Building, 95-97 Liberty Street, New York City. This will also be the Eastern office of the Crouse-Tremaine Carbon Company.

THE AMERICAN VITRIFIED CONDUIT COMPANY, of New York City, has removed its office from 20 Broad Street to 39 Cortlandt Street, where it will be pleased to answer any inquiries relating to vitrified salt glazed underground and interior conduits.

THE CREAGHEAD ENGINEERING COMPANY, of Cincinnati, Ohio, is sending out an attractive card drawing attention to the Creaghead flexible brackets. The card is tastefully decorated with the United States flag and views of United States warships.

FRANCIS GRANGER, of New York City, announces that on and after Dec. 1 his office and also the New York office of the Corning Brake Shoe Company will be removed from their present address, 35 Nassau Street, to the Havemeyer Building, 26 Cortlandt Street.

SEATON M. SCOTT has opened an office at 11 Broadway, New York, as consulting engineer, and is prepared to make plans and specifications for street railway power plants and electric light stations. He will also furnish designs for special machinery, and will supervise the installation of such.

THE HARRISBURG (PA.) FOUNDRY AND MACHINE WORKS have recently secured an order from China for boilers and engines and a large amount of machinery to be used in a large woolen mill near Pekin. The mill, it is said, will be the first of the kind ever erected in China.

THE PHŒNIX IRON WORKS, of Meadville, Pa., manufacturers of engines and boilers, have furnished Laughlin & Co., of Pittsburgh, with three 300-h.p. tandem compound condensing engines and one 600-h.p. cross compound condensing engine, all of these being direct connected to generators.

THE ALBERT & J. M. ANDERSON MANUFACTURING COMPANY, of Boston, installed the large switchboard in the Thirteenth and Mt. Vernon Street station of the Union Traction Company, at Philadelphia, described in our last issue. The extent of the board and its completeness reflects great credit on the work of this company.

J. A. FAY & CO., of Cincinnati, O., who claim to be the largest manufacturers of high grade wood-working machinery in the world, have just issued an attractive folder printed in red and green, showing about fifty of their new improved machines which they have recently brought out for wood-working. The folder may be had upon application.

H. B. GAY, formerly agent at Baltimore, Md., for the Walker Company, has accepted the position of representative of the combined interests of the Walker Company and the Westinghouse Companies in the States of Delaware, Maryland, Virginia and in the District of Columbia. Mr. Gay's headquarters will be at 106 East German Street, Baltimore.

THE JOS. DIXON CRUCIBLE COMPANY, of Jersey City, N. J., has added an extension to its pencil factory 40 ft. x 90 ft., three stories high. This plant is driven entirely by electric power from generator placed in the main factory. The factory of the Dixon Company is working continuously, yet the company is behind its orders in all departments.

THE DUPLEX CAR COMPANY, of New York City, reports that the demand is increasing for the Duplex convertible car. These cars have been placed on the Mansfield (Mass.) & Easton Street Railway, the Boston & Newton Street Railway, the Norton (Mass.) Street Railway, the Concord (N. H.) Street Railway, the Bergen County Traction Company, of Fort Lee, N. J., and cars are being built for other roads.

WARREN WEBSTER & CO., of Camden, N. J., are sending out a four-page folder drawing attention to the advantages of the Webster system of steam heating. The pamphlet contains a very humorous account, written by Edgar W. Nye, of an experience with a steam radiator. The Webster system has been installed in many different cities, and hundreds of letters are being received by the manufacturers testifying to the excellent working of the system.

THE JOHN A. ROEBLING'S SONS COMPANY, of Trenton, N. J., announces that its new factory for the manufacture of rubber insulated wires and conductors is now in full operation and that it is prepared to furnish house wires, car wires, stranded conductors, lead encased power cables, submarine cables and every variety of electrical conductor insulated with rubber. The Roeblings rubber insulated wire will maintain as high a reputation as the other products of the Roeblings works.

THE AMERICAN ENGINE COMPANY, of Bound Brook, N. J., has just installed an American Ball engine and direct connected generator of 25 kw. capacity in the electric lighting plant recently built by the Porvenir Sugar Estate, a long established plantation on the island of San Domingo, W. I. It is stated that this is the first direct connected electric lighting plant to be installed on this island, and this order speaks well for the reputation for excellence of workmanship and design of the machinery manufactured by the American Engine Company.

FLOY & CARPENTER is the title of a new firm of consulting engineers which has just opened offices in the St. Paul Building, New York. The members of this partnership are well known in engineering circles. Mr. Henry Floy occupied a prominent position as electrical engineer of the Westinghouse Electric and Manufacturing Company for a number of years. Prof. R. C. Carpenter, of Ithaca, has an international reputation as a mechanical engineer. The combination of these two gentlemen makes a firm of unusual strength.

THE WATSON-STILLMAN COMPANY, of New York, is sending out its new catalogue, which contains a collection of illustrated sheets describing hydraulic tools manufactured for the special use of railways. The company thinks that this is the largest and most complete catalogue of high pressure hydraulic tools for the special use of railroads that has ever been published. The catalogue contains illustrations and very full descriptions of the Watson-Stillman hydraulic jacks, punches, benders, axle and crank pin presses, wheel bases, etc.

THE HOPPES MANUFACTURING COMPANY, of Springfield, Ohio, has issued a pamphlet describing and illustrating the Hoppes steam separators, oil eliminators, exhaust steam feed water heaters and live steam feed water purifiers. All of these devices have been on the market for some time, and have established an excellent reputation throughout the country. The Hoppes Manufacturing Company has received letters from customers all over the country stating that the separators and purifiers more than pay for themselves in a very short time.

THE BRISTOL COMPANY, of Waterbury, Conn., is sending out to the trade samples of the Bristol patent steel belt lacing. This lacing is delivered ready for application, and consists of a continuous zigzag strip of steel so proportioned as to give maximum strength with a minimum amount of material. The points are wedge-shaped, so that when driven through the belt they force the fibres aside without cutting them, and hence the ends of the belt are not weakened as when holes are punched. The lacing is made to suit all kinds and thicknesses of belting.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, of Pittsburgh, Pa., has issued a pamphlet entitled "A Modern Round House Turntable." The Westinghouse method of applying electricity to turntables should be especially interesting to railroad managers, inasmuch as it requires no change in the turntable proper other than attaching the draw-bar lug to the turntable girder. The Westinghouse turntable apparatus consists of a series reversible 10-h.p. motor mounted within a heavy cast-iron frame, having a traction wheel which rests upon the rail of the turntable pit. Power is transmitted to this wheel through double reduction gears.

THE CHROME STEEL WORKS, of Brooklyn, N. Y., have supplied a large number of their new steel wheels to the Consolidated Traction Company, of Jersey City. This wheel consists of a hard chrome steel tire, mild rolled with steel T-shaped spokes welded and dowelled into the tire and into the socket steel hubs. The spokes are welded to tire and hub in a very thorough manner, making in effect one solid piece. It is claimed that the use of this wheel does away with the necessity of frequent changes of wheels, flat spots and broken flanges and all the attendant evils. The manufacturers guarantee for these wheels three times the mileage of the best cast iron wheels.

THE UNITED STATES PROJECTILE COMPANY, of Brooklyn, N. Y., has been so rushed during the past few months

in its efforts to keep Uncle Sam supplied with convincing arguments in the recent trouble with Spain, that it has found it difficult to keep up with the demand for its patent hot-pressed pinions. Additional machinery is now being installed and the output greatly increased, so that the company is now in a position to fill all orders promptly. The products of the United States Projectile Company are used on over one hundred and fifty street railroads and are distributed from Maine to California and from Canada to the Gulf of Mexico.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has issued two new circulars, one describing special types of storage batteries for electric vehicles and the other describing the application of storage batteries to isolated plants, the particular plant illustrated being the installation of chloride accumulators in the Commercial Cable Building, New York. The first mentioned pamphlet gives instructions for setting up and using the storage battery for electric vehicles, and also gives prices for supplies and renewals. The second pamphlet contains a number of fine illustrations of the storage battery plant in the Commercial Cable Building, and gives an efficiency curve secured at this plant.

THE CROUSE-TREMAINE COMPANY, of Fostoria, Ohio, is sending to its friends a very valuable reference book for the pocket. The book contains several useful tables, rules and tests for station managers, and a complete copy of the latest rules for wiring adopted by the National Board of Fire Underwriters. In addition the book contains price list and telegraphic code, and also sizes of high grade cored and solid carbon and motor brushes which the Crouse-Tremaine Company manufactures. This company makes a specialty of cored carbons to suit any make of alternating arc lamp, to burn on any current and number of alternations, and the company claims that its products are in every respect equal to the best of imported goods.

PATTERSON, GOTTFRIED & HUNTER, of New York City, are sending out a neat memorandum book which also contains a description of the Reeves patent wood split pulley. These pulleys have been subjected to the most severe tests under all atmospheric conditions, and have been found to give perfect satisfaction under the most trying conditions. Patterson, Gottfried & Hunter are agents for this pulley. They also, in addition to their other numerous lines, are agents for the rope manufactured by A. Leschen & Sons Rope Company, of St. Louis. Rope manufactured by this company has been in use on the passenger elevators in the Decker Building, New York, since April, 1896, and is still in good condition. The owner of the building states that the ropes have lasted over twice as long as the ones previously used.

THE NILES TOOL WORKS COMPANY, of Hamilton, Ohio, has just issued its annual catalogue, which is one of the most extensive and complete trade catalogues ever issued by any manufacturing firm. It is a work of 571 pages, substantially bound in cloth covers, and is profusely illustrated. In the catalogue is presented a full line of the machine tools and appliances manufactured at the extensive works of the Niles Tool Works Company at Hamilton, and which are handled at its various warehouses and offices in the leading cities in America and Europe. The aim has been to make the catalogue complete and comprehensive, illustrating as fully as possible such machinery of every type required in the equipment of shops and factories for the manufacture of every character of work in iron and steel. A few of the very large number of the different types of machines described are goring and turning tools, lathes, planers, saws, punches, etc.

THE BROWN HOISTING AND CONVEYING MACHINE COMPANY, of Cleveland and New York, will furnish two of their extra heavy bridge tramways for handling coal at the New London coaling station for the United States navy. This plant will be built by J. W. Hoffman & Co., of Philadelphia, after plans prepared by the Brown Hoisting & Conveying Machine Company. The bid of J. H. Hoffman & Co. was accepted from among twelve others, this bid being $56,000 higher than the lowest. The award was made on account of the superior plans. The bridges installed at this plant will be 180 ft. span with 92 ft. cantilever extensions and 36 ft. projection over the front of dock. This is the fifth coaling station, contracts for which have been let by the Navy Department, and the coal handling machinery for all of them has been furnished by the Brown Hoisting & Conveying Machine Company.

GEORGE T. HANCHETT, electrical and mechanical engineer, of 123 Liberty Street, New York City, has issued a neat little pamphlet calling the attention of inventors and manufacturers to his facilities for giving expert opinion, making drawings and developing new mechanical appliances of all kinds. Mr. Hanchett is a trained machinist, having worked for some time at his trade. He is entirely familiar with the difficulties of electrical and mechanical manufacturers, and has a wide acquaintance with standard materials, shapes, sizes and costs. He is a graduate from the Massachusetts Institute of Technology, and has supplemented his college education with years of study on the subject of electrical and mechanical machine design.

WENDELL & MacDUFFIE, agents for the Taunton Locomotive Manufacturing Company, Taunton, Mass., report an unusually large snow plow business this season. The effective work of the Taunton plows during the past year has resulted in many large orders recently being received, notably the Metropolitan Street Railway Company, New York; Brooklyn Heights Railroad Company, Brooklyn; Union Railroad Company, Providence; Boston Elevated Railway Company, and in fact the largest railway systems in the country who meet with the difficulties which beset them on account of snow. The Taunton snow plow wherever it has been used has won unqualified endorsement from the executive down to the operator.

THE E. W. BLISS COMPANY, of Brooklyn, N. Y., has published a very elaborate catalogue which contains a collection of twenty views of portions of its works. A glance through this catalogue immediately impresses anyone with the enormous magnitude and extent of the business carried on by this company. At the time the views were taken the company employed over 800 men. The works are thoroughly equipped with all modern appliances and labor-saving devices, and their capacity for turning out work such as they have been fitted up to produce, it is claimed, is unequaled in America or Europe. The E. W. Bliss Company is the exclusive manufacturer for the United States Navy of the celebrated Whitehead automobile torpedoes and appliances, and one of its largest departments is devoted exclusively to the manufacture of these explosives. The Bliss punching, shearing, forming and forging machinery is celebrated the world over.

THE SWARTS METAL REFINING COMPANY, 20 North Desplaines Street, Chicago, which has built up a very extensive business in the metal refining business, is, as usual, extremely busy in all its departments. This business, under the management of Seymour Swarts, president of the company, was established in 1885 and incorporated in 1895. The company's specialties are the manufacturing and refining of high-grade babbitt, solder, spelter, ingot brass, pig tin and pig lead. It is also an extensive dealer in cotton waste. This company's business is of especial interest to the street railway manager who has worn-out trolley wires, trolley wheels, brake handles and the like to dispose of, as its business makes it possible to dispose of such scraps much more advantageously than has been possible heretofore. With a branch office in the City of Mexico, the Swarts Metal Refining Company's business is reaching out until it numbers its customers in all parts of the world.

THE HARRISON SAFETY BOILER WORKS, of Philadelphia, Pa., report the following recent sales of Cochrane feed-water heaters and purifiers: The A. I. Root Company, Medina, Ohio, 300 h.p. special; Wapakoneta (Ohio) Electric Light & Water Company, 425 h.p.; Latrobe Steel & Coupler Company, Melrose Park, Ill., 1000 h.p.; American Cement Plaster Company, Mulvane, Kan., 100 h.p.; Monessen (Pa.) Steel Company, 1250 h.p.; Texas & Pacific Railway Company, Dallas, Tex., 50 h.p.; A. & M. Moses, Natchez, Miss., 300 h.p.; Fish Bros. Wagon Company, Racine, Wis., 500 h.p.; Lawrence Limestone Co., Wampum, Pa., 150 h.p.; also recent sales of Cochrane separators as follows: George V. Cresson Company, Philadelphia, 7-in. horizontal; Campania Cervecera, Toluca, Mexico, 6-in. horizontal; Ashland (Ky.) Steel Company, 4-in. horizontal; A. A. Sanborn, Boston, Mass, 10-in. horizontal; Johnstown & Gloversville Gas Company, Gloversville, N. Y., one 3-in. and one 4-in. horizontal; Braman, Dow & Co., Boston, 8-in. horizontal; Simonds Manufacturing Company, Chicago, 5-in. vertical; U. S. Navy, 4-in. horizontal; Standard Pill Company, Whiting, Ind., three 6-in. oil-ammonia; Williamson Brothers Company, Philadelphia, 4-in. horizontal; Boston & Maine Railroad, two 6-in. horizontal; Massachusetts Institute of Technology, Boston, 8-in. horizontal; William M. Hall, North Attleboro, Mass., one 4-in. and 5-in. horizontal; Robert Megowan, Philadelphia, 7-in. horizontal; Joseph L. Ebner, Vincennes, Ind., two 6-in. vertical; Barr Pumping Engine Company, Boston, 5-in. horizontal; Beaver Traction Company, Beaver, Pa., one 12-in. and one 5-in. vertical.

ROBERT W. BLACKWELL & Co., of London, Eng., have executed within the past three years, or now have in hand, contracts as follows: In Great Britain alone, 400,000 rail bonds, 750 motor trucks, 30,000 i.h.p. in engines, 10,000 tubular steel poles, 200 miles trolley wire, insulation material, etc.; 850 special trolleys for double-deck cars, 20,000 cast-welded joints, £15,000 worth of pipe, valves and fittings, 6500 tons girder rails, etc. They have also executed further contracts on the Continent and in the Colonies involving the supply by them of half as much more material. The above has been furnished to the following electric lines, or to their principal contractors, viz.: Bristol, Dublin, Cork, Coventry, Guernsey, Brighton, Liverpool, Birmingham, Leeds, Sheffield, Middlesbrough, Glasgow, North Staffordshire, South Staffordshire, Kidderminster, Swansea, Isle of Man, Hartlepool, Portsmouth, Plymouth, Dover, Blackpool, Neath, Bradford, Norwich, Ashton-under-Lyne, Dudley & Stourbridge, Herne Bay, Walton-on-the Naze, Bolton, St. Helens, Newport, Giant's Causeway, Halifax, Paris, Marseilles, Rouen, Havre, Brussels, Liege, Jung Frau, Nijni-Novgorod, Geneva, Buenos Ayres, Barcelona, Madrid, Bilbao, Cape Town, Port Elizabeth, Brisbane, Sydney, Cairo, etc., and the Central London Railway. The branch offices of Robert W. Blackwell & Co. are at 20A Chapel Street, Liverpool, and 50 Boulevard Haussmann, Paris.

New Publications

The Development of the Central Station. By Samuel Insull. Published by Purdue University. 52 pages. Illustrated.

This is a reprint of an address delivered by Mr. Insull before the students of the Engineering Departments of Purdue University. A number of interesting curves, showing the development of the business of the Chicago-Edison Company, of which Mr. Insull is president, are contained in the book, and a large amount of valuable information about electric lighting methods is contained in this pamphlet.

Report of the Seventeenth Annual Meeting of the American Street Railway Association held at Boston, Sept. 6-9, 1898. Published by the American Street Railway Association.

The report of the American Street Railway Association for the past year contains, besides the full report of the meeting, a fine steel engraved portrait of the president, Mr. Lang, and two fine half-tone engravings of Bunker Hill Monument, which was adopted as a characteristic view in Boston on the official button this year. The report of course is complete, and the secretary deserves special credit for the great accuracy with which the large number of names of attendants at the convention is printed. No one who has never compiled a list of this kind can realize the great amount of work which the correct publication of such a list entails.

Mechanical Draft for Steam Boilers. By Walter B. Snow. 14 pages. Illustrated. Reprinted from Cassier's Magazine. By B. F. Sturtevant Company, of Boston, Mass.

This is a reprint of a lecture delivered by Mr. Snow, at Cornell University, on the subject of mechanical draught for steam boilers. Mr. Snow is a member of the engineering staff of the B. F. Sturtevant Company, and has made the subject of mechanical and forced draughts a special study. The paper contains a number of very valuable figures showing the exact saving accomplished by the use of mechanical draught, and this saving in one particular plant is given as follows: By omission of chimney and damper, $5,800; by reduction in number of boilers, $4,125; in saving of space occupied by chimney, $990; in saving of space by boilers omitted, $960, total, $11,875. To acomplish this saving, the expenditure of only $3,500 is necessary for mechanical draught apparatus; that is, the saving is nearly three and a half times the expenditure necessary to secure it. Copies of this lecture can be had on application to the publishers.

Journal of the Royal Agricultural Society of England. Volume IX, part 3, No. 35, Sept. 20, 1898. Published by John Murray, Albemarle Street, London, England.

This issue of the Journal of the Royal Agricultural Society contains a description of the trials of self-moving vehicles, held at Birmingham, under the auspices of the society. In 1897, this society attempted to hold a competition for self-moving vehicles, but as only one vehicle was presented which complied with the prescribed conditions, the race was not held. This year there were nine entries, and of these five appeared and prepared to undergo the trials. Two of these were almost immediately disabled so that there were only thre competitors, one in the light class and two in the heavy class, completing the runs satisfactorily. The Journal states that this is a considerable advance on the state of things in the previous year, but indicates that the problem of building motor vehicles capable of carrying substantial loads for considerable distances has presented difficulties which most makers have not entirely overcome.

Verbatim Report of the Second Regular Annual Meeting of the Street Railway Accountants' Association of America. Published by the Street Railway Accountants' Association.

This is the printed report of the proceedings of the Convention of the Accountants' Association, held in Boston, Sept. 6-9. It contains as a frontispiece a very fine portrait of H. L. Wilson, the retiring president. The verbatim report of the proceedings is supplemented by a list of those in attendance, and a reprint of the constitution and by-laws, a carefully prepared index and detailed index of the report and discussion of the permanent committee on a standard system of accounts. There are bound into the book a number of question blanks for the convenience of those who have problems to propose, and also a blank for application for membership. In accordance with the precedent established last year, the copies of this pamphlet are registered and are distributed only to the members of the organization. W. B. Brockway, of Toledo, secretary of the Accountants' Association, had full charge of this report while it was passing through the press, and he deserves a great deal of credit for the careful editing and the typographically clean and attractive appearance which the book presents.

Trade Catalogues

Catalogue. Published by the E. W. Bliss Company, of Brooklyn, N. Y. Illustrated.

Hydraulic Tools. Published by the Watson & Stillman Company, of New York City. Illustrated.

Circular. Published by Warren Webster & Company, at Camden, N. J. 4 pages. Illustrated.

Woodworking Tools. Published by J. A. Fay & Company, of Cincinnati, Ohio. 16 pages. Illustrated.

Wood Split Pulleys. Published by Patterson, Gottfried & Hunter, of New York City. 44 pages. Illustrated.

Machine Tools. Published by the Niles Tool Works Company, of Hamilton, Ohio. 571 pages. Illustrated.

Reference Book. Published by the Crouse & Tremaine Carbon Company, of Fostoria, Ohio. 84 pages. Illustrated.

Storage Batteries for Electric Vehicles. Published by the Electric Storage Battery Company, of Philadelphia, Pa. 13 pages. Illustrated.

Steam Separators and Oil Eliminators. Published by the Hoppes Manufacturing Company, of Springfield, Ohio. 16 pages. Illustrated.

The Modern Round House Turn-table. Published by the Westinghouse Electric & Manufacturing Company, of Pittsburgh, Pa. 12 pages. Illustrated.

List of Street Railway Patents

U. S. PATENTS ISSUED OCT. 25 TO NOV. 1, 1898, INCLUSIVE

Prepared for the STREET RAILWAY JOURNAL by THOMAS DREW STETSON

NOV. 1

Motor Driven Vehicle.—Charles T. Hildebrandt and Frank R. McMullin, Chicago, Ill. No. 613,272.

Yoke for Railway Conduits.—Fred S. Pearson, Boston, Mass. No. 613,301. Six claims.

Claim.—6. A yoke for electric railway conduits, adapted to support the slot rails and wheel bearing rails, and having the flat bottom *p;* a hollow central portion, arranged and adapted to contain the supports for the conductors; and manhole curbs flush with the surface of the roadway detachably connected to the hollow portion.

Station Indicator.—William C. Schaper, St. Louis, Mo. No. 613,320.

Car Fender.—John Sexton, Los Angeles, Cal. No. 613,325.

Suspension for Electric Railway Motors.—William Cooper, Cincinnati, Ohio, assignor to John B. Blood and Joshua Hale, Newburyport, Mass. No. 613,357.

Railroad Spike.—James R. Elliott, St. Louis, Mo., assignor of one-half to George Hermann Wilson, same place. No. 613,364.

Electric Railroad.—Charles L. Kemery, Pittsburg, Pa. No. 613,418.

Step Over Car Seat.—Charles K. Pickles, St. Louis, Mo., assignor to Samuel M. Dodd, same place. No. 613,422.

Step Over Car Seat.—Charles K. Pickles, St. Louis, Mo., assignor to Samuel M. Dodd, same place. No. 613,423.

Electric Railway System.—Louis E. Walkins, Springfield, Mass., assignor of one-half to George M. Jewett, Glenville, Md. No. 613,433.

Signal Lamp.—Charles H. Dressel, New York, N. Y. No. 613,562.

Railway Crossing Signal.—Robert M. Payne, Winchester, Tenn. No. 613,597.

Electric Railway System.—Louis E. Walkins, Springfield, Mass., assignor of one-half to George M. Jewett, Glenville, Md. No. 613,612. Two claims.

Claim.—1. In an electric railway system, the car track rails, intermediate conductor rail sections *b*, corresponding conductor rail sections *b'* near and outside of one of the track rails, and a continuous guard, interposed between the conductor rail sections *b'* and the adjacent track rail which is extended above the top of said sections *b'*, feed and return wires having wiring-in connections respectively with the intermediate and outlying conductor rail sections.

Mechanism for Operating Vehicle Doors.—Morris S. Shipley, Cincinnati, Ohio; Caleb W. Shipley, administrator of said Morris S. Shipley, deceased. No. 613,650.

Nov. 8

Guard for Open Cars.—Charles H. Fogg, Hyde Park, Mass. No. 613,672.

Life Saving Apparatus for Street Cars.—Hosea W. Libbey, Boston, Mass. No. 613,691.

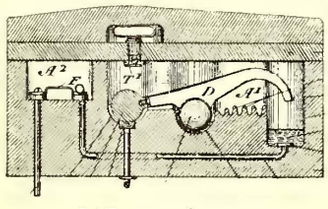
Electric Railway.—James F. McLaughlin, Philadelphia, Pa. No. 613,708. Nine claims.

Combined Car Brake and Fender.—Harry J. Raisch, San Francisco, Cal., assignor to Barton Josephus Parker and George X. Wendling, same place. No. 613,719. Six claims.

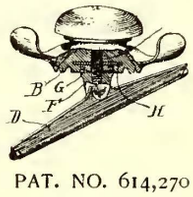
Claim.—6. The combination with the crank shaft, *G*, and connecting piece, *C*, pivoted to the crank arms thereof, of brake and track shoes supported wholly by the connecting piece and adapted to be adjusted at an angle relative to each other, and a fender extending between and carried between the shoes.

Electric Railway.—William M. Brown, Johnstown, Pa., assignor to the Johnson Company, Lorain, Ohio. No. 613,794. Eleven claims.

Claim.—11. In an electric contact box, in combination, a cavity, a recess therein containing a heavy liquid, a second recess containing a liquid conductor in connection with one side of the circuit, a third recess containing one terminal in connection with the opposite side of the circuit and another terminal in connection with the conductor section, and a movable connector comprising



PAT. NO. 613, 794



PAT. NO. 614,270

an end portion normally resting on the first mentioned terminal, a central portion floating in said heavy fluid, and its other end portion normally above the said conducting fluid, but out of contact therewith.

Railway Track.—Carl A. Sundstrom, Philadelphia, Pa., assignor of one-half to William Johnston, same place. No. 614,036. Two claims.

Claim.—1. In a railway, the combination with the ties and the rails secured thereto, of the continuously disposed longitudinal inclined plates located at the inner sides of the rails, and their upper ends bearing against the tread flanges of the rails, and the lower ends bent at an angle to the upper part and resting on the ties.

Compressed Air Locomotive.—Samuel M. Vauclain, Philadelphia, Pa. No. 614,041. Four claims.

Claim.—1. The combination in a compressed air locomotive, of a storage reservoir, an auxiliary reservoir connected thereto, a reducing valve in the said connection and a hot water drum inclosing the said auxiliary reservoir.

Nov. 15

Intermittent Electric Surface Conductor.—Franz Burger, Fort Wayne, Ind., assignor of three-fourths to Henry M. Williams, same place. No. 614,082. One claim.

Car Propulsion.—William M. Farrar, Hoboken, N. J. No. 614,095. Seven claims.

Track Groove Cleaner.—Thomas A. L. Moore, Richmond, Va., assignor of five-eighths to Samuel T. Atkinson and Drury Samuel Hardy, same place. No. 614,122. Ten claims.

Claim.—10. In a rail groove cleaner, the combination with a car, of hangers pendent from the bottom thereof, a rock shaft mounted to oscillate and to slide longitudinally in said hangers, arms projecting rearwardly from said shaft, rail groove cleaning plows carried by said arms, springs on the shaft between the hangers and arms to normally hold said arms and plows in operative position, an operating lever connected with the rock shaft and projecting forwardly therefrom, an operating shaft on the car platform, a yielding connection between the operating shaft and front end of the lever, and a latch device to hold the operating shaft and front end of the lever elevated.

Electric Switch Mechanism for Electric Railways.—John M. Murphy, Torrington, Conn., assignor of two-thirds to David F. Halsted, New York, N. Y., and William M. Keepers, Newark, N. J. No. 614,124. Five claims.

Claim.—3. In an electromagnetic switch mechanism for electric railway systems, the combination, substantially as described, of a main line circuit, a local or energizing circuit, electromagnets having windings in both the local and main circuit, an armature switch lever, an adjustable connection joining such lever with the local circuit, said connection being arranged to become disconnected from the lever when such lever is moved by the local or initial energy in the magnets, and contacts in the main line adapted to be electrically joined by the lever as it is drawn over by the initial energy of the magnets, as specified.

Switch Shifting Mechanism for Electric Cars.—Jeremiah P. W. Roach, Concord, N. H. No. 614, 133. Two claims.

Fare Box and Register.—Frank B. Wagner, Cleveland, Ohio. No. 614,147. Fifteen claims.

Claim.—1. In a fare box and register, in combination, a case composed of two separable sections, lugs carried by one section, and spring catches carried by the other section and adapted to engage with said lugs, mechanism for releasing said catches, a seal, and a seal breaking device operated by said catch releasing mechanism.

Electric Car Truck.—Edward Cliff, Newark, N. J. No. 614,161. Seven claims.

Rail Joint Attachment.—Daniel N. Hurlbut, New York, N. Y. No. 614,171. Two claims.

Trolley.—Francis A. Le Court, Rockport, Mass. No. 614,208. Three claims.

Insulated Supporter for Electric or Other Wires.—Charles K. King and George A. Mead, Mansfield, O.; said Mead assignor to the Ohio Brass Company, of Ohio. No. 614,270. Three Claims.

Claim.—3. In a support for trolley wires and the like, a clamp, an insulator washer provided with a recess, means for attaching said insulator washer to said clamp, and a locking washer arranged in said recess and bearing respectively against said insulator washer and said clamp, whereby the parts are locked and prevented from working or jarring loose.

Trolley Controller.—John Dolan, Dayton, Ohio. No. 614,321. Six claims.

Claim.—1. In a trolley controller, the combination with the trolley rope, of a guideway on the car-roof arranged longitudinally of the car and provided with one or more pulleys and slotted as described, of a sliding block hollowed out to contain one or more pulleys, and having one end of the rope secured thereto, a spring secured at one end to the block and at its opposite end to a bracket on the car roof, a catch projecting from the upper side of the block and through the slot in the guideway, a latch device supported upon the guideway to engage said catch, and means engaged by the trolley rope and operated by an upward pull on the rope for raising said latch.

Cable Grip.—Julio Frigard, Carthagena, Spain. No. 614,380. Seven claims.

Transom Sign.—Peter M. Kling, St. Louis, Mo. No. 614,397. One claim.

Electric Switch-Operating Mechanism for Railways.—Louis E. Walkins, Springfield, Mass., assignor of one-half to George M. Jewett, Glenville, Md. No. 614,412. Six claims.

Track Sanding Apparatus.—John H. Watters, William R. Howdon, and William A. Jacobs, Anniston, Ala. No. 614,413. Five claims.

We will send copies of specifications and drawings complete of any of the above patents to any address upon receipt of fifteen cents. Give date and number of patent desired. The Street Railway Publishing Company, Havemeyer Building, New York.