Street Railway Journal

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THE TWIN CITY RAPID TRANSIT COMPANY

A STUDY IN FINANCIAL AND OPERATING POLICY

The remarkable rise in the market value of the stock of the Twin City Rapid Transit Company, of St. Paul and Minneapolis, during the past year has attracted much attention to that property, not only on the part of stock exchange speculators, but street railway managers. A study of the system which could make such a showing will be of considerable interest at this time. It often happens that in the manipulations on the stock exchange the quotations of the stock rise far beyond its intrinsic value as an investment, and the market value of the stock is not always, by any means, an indication of its true value. But a recent survey of the street railway situation in the Twin cities, made by a representative of the STREET RAILWAY JOURNAL, seems to show that the rise in value of Twin City Rapid Transit stock is founded on something more solid than bull rumors on the stock exchange, and that the physical and financial condition of the property is such as to make an account of the financial policy and methods of operation which has led up to such a satisfactory condition of value to all street railway owners and operators.

WASHINGTON STREET AND HENNEPIN AVENUE—THE OLD AND THE NEW IN ELECTRIC CARS

The Twin City Rapid Transit Company, as is generally known, controls all the street railway lines in Minneapolis and St. Paul, the two interurban lines between the two cities, and also an interurban line running from St. Paul by way of White Bear Lake to Stillwater, a distance of 20 miles from the center of one city to the center of the other, making 251 miles in all. Franchises are such that this company is given a practical monopoly of the streets of St. Paul and Minneapolis for street railway purposes during the life of its charter, which expires in 1941. Like many other companies, this is a consolidation of a number of local street railway lines.

The St. Paul and Minneapolis lines were among the first large city systems to be electrically equipped, consequently, when the Twin City Rapid Transit Company was formed in 1891, the rolling stock and track were, of course, in anything but a desirable condition. At that time improved enclosed motors were beginning to come in, and the importance of heavy track construction was also beginning to be apparent. How to meet the expense of the general reconstruction and renewal of equipment, without increasing the company's liabilities by issuing more bonds or stock, was the problem which confronted the management. About the time the reconstruction of the system was begun came

the panic of 1893, which, however, did not show itself in full force as affecting the earnings of this company until 1894, 1895, 1896 and 1897. During all this trying period the management was boldly putting the money earned back into the property in the shape of betterments of a permanent character, with little or no returns to the stockholders, and it is now having the satisfaction of seeing its policy vindicated by the excellent financial condition which the company is in, having paid last year 4 per cent on its preferred stock, with every prospect that this can be continued and increased, even with the large expenditures for improvements that are contemplated. The earnings from 1878 to 1901 show some very peculiar variations, as can be seen by the accompanying Table I., giving the gross passenger earnings and increase for each year over the previous year.

Table I.—Passenger Earnings, 1878–1901

Year	Gross Passenger Earnings	Per Cent	Year	Gross Passenger Earnings	Per Cent
1878	$65,157.60	....	1890	$1,383,865.82	43.76
1879	87,005.07	33.53	1891	1,814,739.86	31.13
1880	111,085.21	27.68	1892	2,136,657.52	17.74
1881	178,298.93	60.51	1893	2,164,925.31	01.32
1882	279,501.27	56.76	1894	1,981,705.64	—08.46
1883	399,725.84	43.01	1895	1,964,772.65	—00.09
1884	478,009.87	19.59	1896	2,037,934.80	03.72
1885	519,291.00	08.64	1897	1,982,785.20	—02.78
1886	666,295.79	28.31	1898	2,145,092.95	08.19
1887	824,481.78	23.72	1899	2,476,879.75	15.47
1888	980,470.41	18.92	1900	2,814,205.10	13.62
1889	962,645.28	—01.82	1901	3,150,497.85	11.95

In 1899 came an increase of 15 per cent over 1898, and for the last three years there has been a good increase each year, that for 1901 being 11.95 per cent over 1900.

Table III.—Bonded Debt and Preferred Stock.

1st Mtg. Minneapolis & St. Paul Sub.	$500,000	5%	$25,000
1st Mtg. Minneapolis	250,000	7	17,500
2d Mtg. Minneapolis	600,000	6	36,000
1st Cons. Minneapolis	4,150,000	5	207,500
1st Mtg. St. Paul	680,000	6	40,800
Cable Cons. St. Paul	3,708,000	5	185,400
General Cons. Bonds	1,000,000	5	50,000
Preferred Stock	3,000,000	7	210,000
	$13,888,000	5.56	$772,200

From this table it is seen what effect the panic of 1893 had, and how long its effect lasted. There was a marked decrease in earnings in 1897 over 1896, due, in part, possibly to an increase in the use of bicycles for business purposes.

Table IV.—Items Reduced to Motor Car Miles and Hours

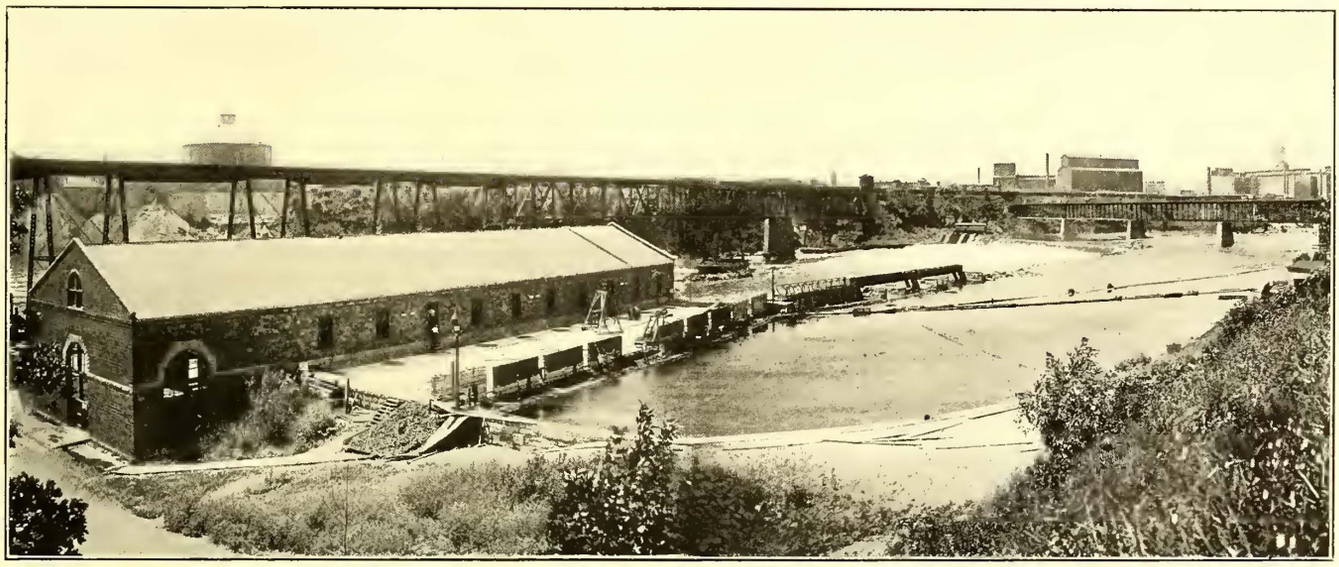
	1901			1900			
		Motor Miles	Motor Hours		Motor Miles	Motor Hours	+ or — %
	$	$	$	$	$	$	$
Gross Passenger Earnings	3,150,497.85	.2733	2.30	2,814,205.10	.2475	2.04	+11.95
Miscellaneous	23,478.00	.0019	.02	25,150.68	.0022	.02	— 6.65
Total Earnings	3,173,975.85	.2752	2.32	2,839,355.78	.2497	2.06	+11.79
Expenses.							
Maintenance Way & Structure	85,989.88	.0074	.06	61,086.45	.0053	.04	+40.77
" of Equipment	179,768.43	.0156	.13	159,834.60	.0141	.12	+12.47
Operating of Power Plants	217,946.98	0189	.16	170,661.74	.0150	.13	+27.71
Car Service	646,692.36	.0561	.47	641,195.90	.0564	.46	+ .86
General Expense	149,798.10	.0130	.11	156,472.35	.0138	.11	—04.27
Legal	22,999.92	.0020	.02	22,999.91	.0020	.02	
Injuries and Damages	97,139.91	0084	.07	82,948.61	.0073	.06	+17.11
Insurance	15,116.12	.0013	.01	9,489.55	.0008	.01	+59.29
Total Operating Expense	1,415,451.70	.1227	1 03	1,304,689.11	.1147	.95	+ 8.49
Net Earnings from Operation	1,758,524.15	.1525	1.29	1,534,666.67	.1350	1.11	+14.59
Int. on Debt & Dividends Pfd. Stk	757,637.57	.0657	.55	737,875.13	0650	.53	+ 2 68
Taxes	119,000.00	.0103	.09	91,200.50	.0079	.07	+30.48
Total Int. Chgs, Taxes, Divs., etc.	876,637.57	.0760	.64	829,075.63	.0729	.60	+ 5.73
Surplus	881,886.58	.0765	.65	705,591.04	.0621	.51	+24.99

Table II.—Statement for Ten Years.

	Yearly Statements									
	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
	$	$	$	$	$	$	$	$	$	$
Passenger Earnings	2,136,657.52	2,164,925.31	1,981,705.64	1,964,772.65	2,037,934.80	1,982,785.20	2,145,092.95	2,476,879.75	2,814,205.10	3,150,497.85
Miscellaneous Earnings	50,922.42	24,231.89	21,972.72	24,030.79	21,282.77	26,335.78	25,623.06	45,914.10	25,150.68	23,478.00
Total Earnings	2,187,579.94	2,189,157.20	2,003,678.36	1,988,803.44	2,059,217.57	2,009,120.98	2,170,716.01	2,522,793.85	2,839,355.78	3,173,975.85
Maintenance of Way and Structure	108,060 79	98,930.65	66,606.77	58,069.49	62,738.27	76,876.57	73,837.27	33,820.00	61,086.45	85,989.88
Maintenance of Equipment	211,264.28	217,381.77	126,349.90	103,537.87	121,845.98	130,576.21	131,368.30	165,364.44	159,834.60	179,768.43
Operation of Power Plants	226,986.70	229,357.67	161,374.85	154,103.73	156,764.47	133,828 58	129,805.69	147,467.12	170,661.74	217,946.98
Car Service	656,264.99	624,456.77	474,537.17	474,246.17	480,384.67	469,232.93	497,413.34	602,691.79	641,195.90	646,692.36
General Expense	130,207.93	105,088.73	75,141.69	80,073.17	77,042.70	94,457.35	95,884.29	105,855.79	156,472.35	149,798.10
Legal Expense	13,786.15	18,614.53	17.037.75	14,925.02	19,275.70	18,701.20	23,442.38	21,999.92	22,999.91	22,999.92
Injuries and Damages	51,503.79	97,436.16	106,813.90	80,890.99	65,587.07	72,000.00	58,492.63	72,910.64	82,948.61	97,139.91
Insurance	20,514.15	18,965.70	16,685.15	13,637.96	11,519.64	6,407.54	6,148.24	6,862.67	9,489.55	15,116.12
Total Operating Expense	1,418,588.78	1,410,231.98	1,044,547.18	979,484.93	995,158 50	1,002,080.38	1,019,392.14	1,156,972.37	1,304,689.11	1,415,451.70
Net Earnings from Operation	768,991.16	778,925.22	959,131.18	1,009,318.51	1,064,059.07	1,007,040.60	1,151,323.87	1,365,821.48	1,534,666.67	1,758,524.15
Taxes	54,064.48	51,143 69	52,938.69	49,071.11	58,170.42	66,469.05	64,214.11	71,905.69	90,300.50	119,000.00
Interest on Debt	474,360.18	611,490.58	686,022.40	701,767.94	626,356.73	625,833.81	593,600.07	556,337.19	534,025.13	547,637.57
Total	528,424.66	662,634.27	738,961.09	750,839.05	6 4,527.15	692,302.86	657,814.18	628,242.88	624,325.63	666,637.57
Surplus Applicable to Dividends	240,566.50	116,290.95	220,170.09	258,479.46	379,531.92	314,737.74	493,509.69	737,578.60	910,341.04	1,091,886.58
Dividend on Preferred Stock					79,534.00	79,604.00	119,854.00	187,553 34	204,750.00	210,000.00
Dividend on Common Stock								375,250.00	450,300.00	600,400.00
Total Dividends					79,534.00	79,604.00	119,854.00	562,803.34	655,050.00	810,400.00
Transferred to General Surplus	240,566.50	116,290.95	220,170.09	258,479.46	299,997.92	235,133.74	373,655.69	174,775.26	255,291.04	281,486.58
Per Cent Total Operating to Total Earnings	64.85	64.42	52.13	49.25	48.33	49.88	46.96	45 76	45.95	44.60
Per Cent Total Operating to Total Increase Taxes	67.31	66.76	54.77	51.72	51.15	53.18	49.92	48.71	49.16	48.35

The company has always kept very complete records as to all details of operation, and to any street railway man or investor these figures have been willingly thrown open for inspection and comparison. Auditor J. F. Calderwood, ex-president of the American Street Railway Accountants' Association, and one of the men most influential in the establishment of that organization, ranks second to none in the matter of keeping detailed accounts in such shape that information of value can be quickly obtained from them. Vice-President C. G. Goodrich, who has had charge of the shaping of the policy of the company, has always made good use of the figures which Mr. Calderwood, by his thorough accounting methods, has been able to furnish. One of the secrets of the successful management of this company has been the thoroughness of the accounting system which has enabled those in charge to determine exactly how the money was being spent, and in what way improvements

could be made. The detailed statements as to earnings and operating expenses can be found in Table II., which gives the various items for the years 1892 to 1901. A careful study of this table is necessary to a full understanding of the situation. It might be mentioned that in the eight years previous to 1901 the liabilities of this company have been increased only 5 per cent, while the gross earnings have been increased 45 per cent. In other words, such improvements and enlargements have been made that 45 per cent more business was taken care of in 1901 than was handled in 1894, and this with only 5 per cent increase in the capitalization upon which interest should be paid. It will be noticed in Table II. that there has been a steady decrease in the percentage of operating expenses to the total earnings, and this in spite of the reconstruction that has taken place, which will be mentioned in detail later, and which has been charged directly in as operating expense.



VIEW OF DAM AND HYDRAULIC PLANT AT ST. ANTHONY FALLS

To enable a better understanding of Table II., the statement of funded debt and fixed charges in Table III. is necessary. There is in addition to this common stock issued

TABLE V.—ITEMS REDUCED TO MOTOR MILES, &C.

	1901				1900			
	Cents per M/M	Dollars per M/HR	Per Cent Earnings	Cents per Rev. Pass.	Cents per M/M	Dollars per M/HR	Per Cent Earnings	Cents per Rev. Pass.
Maintenance of Way & Structure	.74	.06	2.71	.14	.54	.04	2.15	.11
Maintenance of Equipment	1.56	.13	5.66	.28	1.40	.12	5.63	.28
Operating of Power Plants	1.89	.16	6.87	.35	1.50	.13	6.01	.30
Car Service	5.61	.47	20.37	1.03	5.64	.46	22.58	1.13
General Expense	2.47	.21	8.99	.45	2.39	.20	9.58	.48
Total Operating	12.27	1.03	44.60	2.25	11.47	.95	45.95	2 30
Net Earnings	15.25	1.29	55.40	2.75	13.50	1.11	54.05	2.70
Fixed Charges	7.60	.64	27.62	1.39	7.29	.60	29.20	1.46
Surplus Earnings	7.65	.65	27.78	1.36	6.21	.51	24.85	1.24

to the amount of $15,010,000, making liabilities $111,147 per mile of single track.

In Table IV. the receipts and items of operating expense are reduced to a motor car mile basis, from which comparisons can be made with other roads, and in Table V. some of the items are given in motor car miles and motor hours with relation to the gross earnings, and per revenue passenger. Having now a general survey of the situation, it is in order to take up the various details which go to make up the equipment and management of the property.

TRACK

The foundation of all successful operation is good track. The company having been under the same management from the beginning until the present time, has not attempted to get cheap track work for the sake of a temporary fine showing to the directors and stockholders, but has laid the best track the state of the art at the time has suggested. It has been constantly at work since its organization in 1891 improving its track, and new track, when laid, has been of as permanent construction as could be put down. At the time the company was organized there were miles of track in the two cities that were not needed at the time, and the cities have been gradually growing to a size commensurate with the mileage. There has, therefore, been no attempt to build extensions, but simply to maintain and relay the track already down. There are now 251 miles of track in the city and interurban systems. Of this 76 miles have cast-welded joints. Twenty-five miles of the construction on paved streets is an 80-lb. T-rail, 7 ins. high, laid without ties, with a concrete beam under each rail. These concrete beams supporting the rails are 15 ins. wide x 8½ ins. deep. The track is held to gage by tie-rods 10 ft. apart, the flangeway for the wheels is made with granite block toothing in asphalt streets, and brick in brick-paved streets. For those cities which bar the use of the T-rail in paved streets, Minneapolis streets are a splendid example of the advantage of this rail. For unpaved streets the standard construction is an 80-lb. T-rail, A. S. C. E. standard, as used on steam roads. Most of the rest of the track is 56-lb. and 60-lb. rail.

The life of a cast-welded joint T-rail on concrete as laid in paved streets, of course, is not known, but that it will exceed anything used heretofore in street railway practice seems certain. Being laid on concrete without the use of wooden ties, the track will not go down by the rotting of ties, and the joints being cast-welded will wear no faster than the adjoining rail. The question then seems to be how long it will take the car wheels to reduce the cross section of the rails to a point where it cannot be used. As there is no tram or flange on a T-rail, as there is on the girder rail, the life of a T-rail must be considerably longer than a girder. Having put its track in permanent shape, the company is, of course, in position to operate much more cheaply than if the track renewals had been made on the basis of getting the cheapest work possible. This Mr. Goodrich assigns as one of the reasons for the company's satisfactory annual reports for the last three years.

ADOPTION OF LONG CONVERTIBLE CARS.

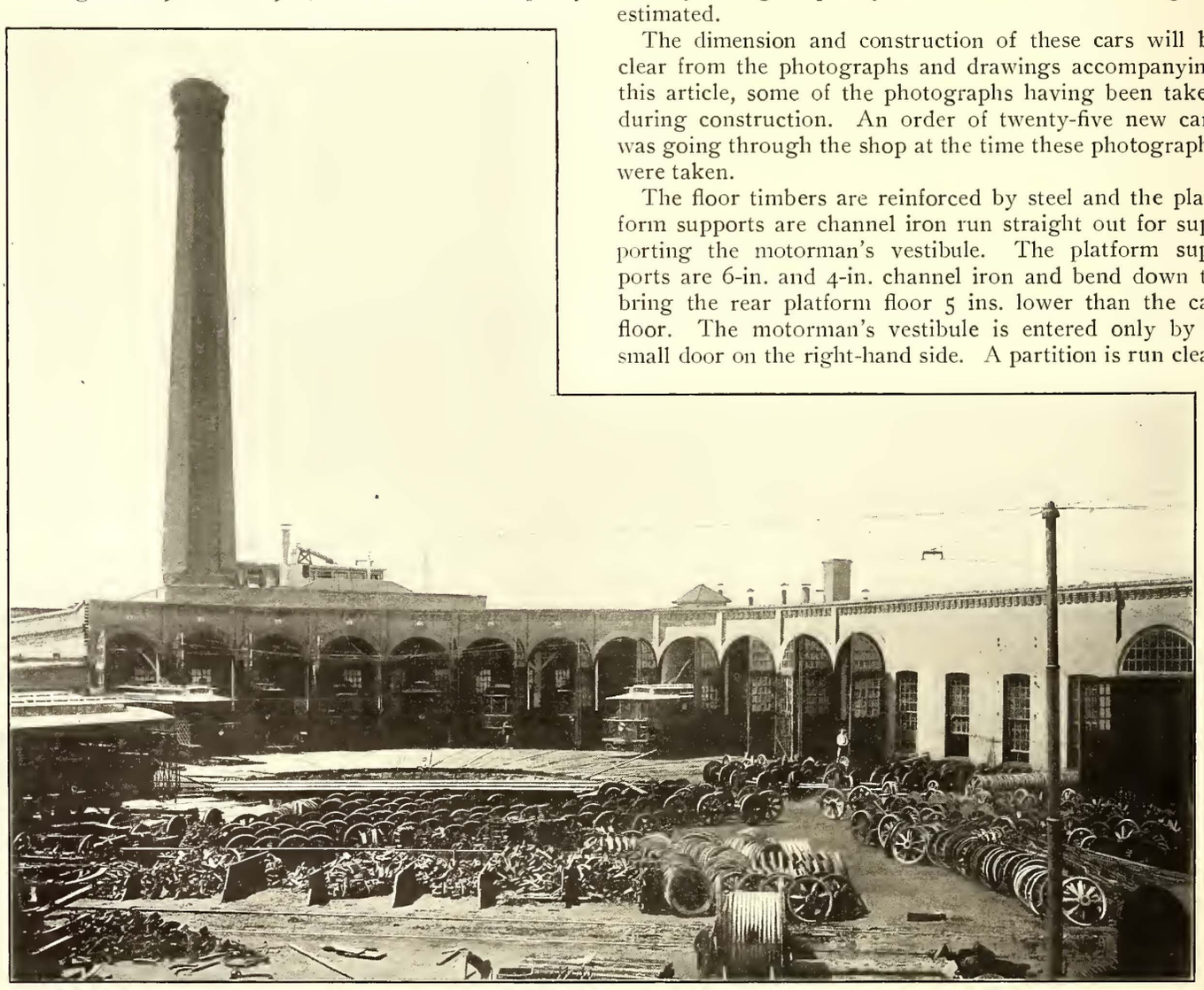
This company early appreciated the advantages in economical operation, maximum service with given investment and public preference for long double-truck sum-

mer and winter cars. All new cars are of this type, and the single-truck open and closed cars with old motor equipments are gradually being relegated to the reserve list. There are 225 long cars out of 600 motor cars.

The double-truck cars are used for the regular service as much as possible with the single-truck in, all ready for rush hours and special occasions. The total double-truck mileage for 1901 was 7,031,957; the single-truck motor-car mileage was 4,497,536, and the trailer was 1,362,681, making a total car mileage of 12,892,174. All calculations are based on the total motor car mileage of 11,529,493. The reduction in amount paid for conductors' and motormens' wages for 1901 from 1900, due to increase in capacity of motor cars and decrease in use of trailers, is shown by the following:

	1901	1900	Per cent. decrease from yr. previous
Conductors' wages	$249,705.10	$260,685,79	4.21
Motormen's wages	238,206.59	241,583.15	1.40
Excess conductors to motormen.	$11,498.51	$19,102.64	39.81

The adoption of long double-truck cross-seat cars has had its effect on the earnings as well as reducing expenditures and doing away with the necessity of keeping a double equipment of car bodies for summer and winter. Whatever may be said in favor of the ordinary open car for warm pleasant weather, it is certainly not an ideal conveyance in rainy weather. There are also many occasions when the open cars are on the road in spring and fall and on cool evening, that this type is not comfortable



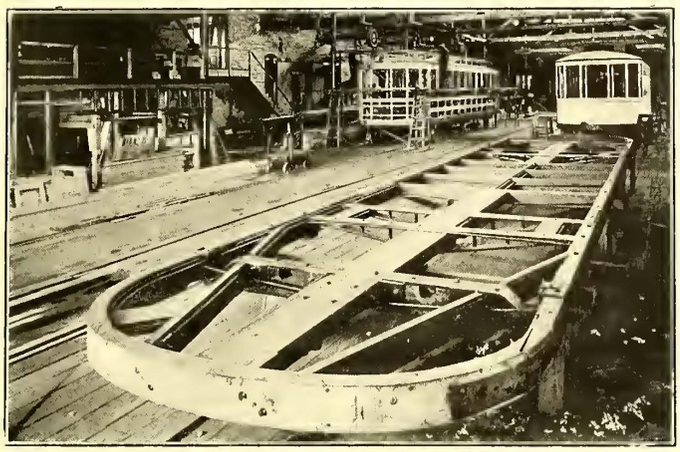
ROUND HOUSE FOR CAR REPAIRS

The present cars can be converted from open to closed by simply raising the windows. Aside from the greater comfort and public preference for the long easy-riding double-truck cars, it has been found that, whereas the traffic formerly fell off on rainy days with open cars, it now increases. This shows that with the ordinary open cars the people who formerly walked short distances or did not venture out at all now take the cars in more than sufficient numbers to counteract the depressing effect of bad weather on the revenues. In the Minneapolis climate the desirability of having a car that is closed along the floor line on cool summer evenings, and that can be closed entirely during temporary cold weather, is not to be lightly estimated.

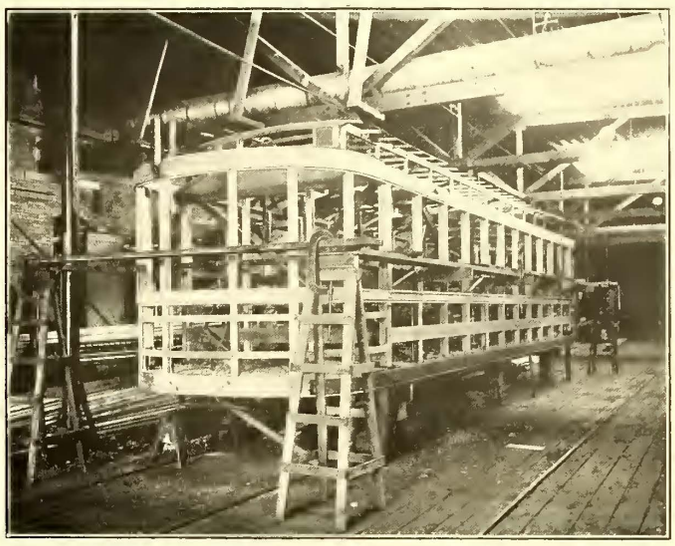
The dimension and construction of these cars will be clear from the photographs and drawings accompanying this article, some of the photographs having been taken during construction. An order of twenty-five new cars was going through the shop at the time these photographs were taken.

The floor timbers are reinforced by steel and the platform supports are channel iron run straight out for supporting the motorman's vestibule. The platform supports are 6-in. and 4-in. channel iron and bend down to bring the rear platform floor 5 ins. lower than the car floor. The motorman's vestibule is entered only by a small door on the right-hand side. A partition is run clear across the front end of the passenger compartment between the motorman's vestibule and the balance of the car. The cars are heated with Baker hot water heaters, and the heater is placed in the motorman's vestibule, it being part of the motorman's duties to keep fire in the heater. The cars are remarkably well warmed and are as comfortable, ordinarily, as any steam railroad coach. During the coldest weather double windows are put on, which, of course, greatly aid in keeping the cars warm. In summer the windows are taken out entirely and the same car used as an open car. A peculiar feature, and one that helps in keeping the cars warm, is that there is no opening of any kind in the floor of the car; further than this, it is of double thickness, a layer of cheap pine being put underneath the main hardwood floor. The floors are smooth without the usual grooves. The front part of the car has cross seats

and the rear part side seats, to facilitate exit during the rush hours. To reach the rear platform three steps are required and another step of 5 ins. from the floor of the platform. The motorman can ordinarily keep his vestibule closed and warm, but to avoid opening windows to turn switches two very small trap-doors are put in the



FRAMING OF CAR FLOOR



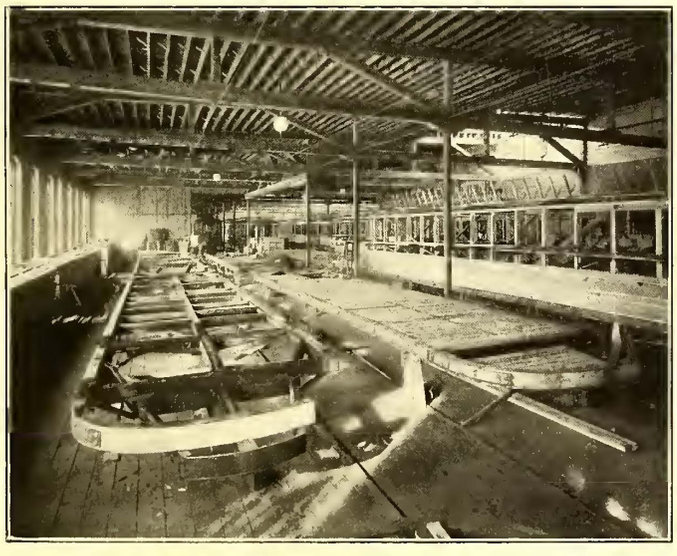
FRAMING OF CAR BODIES

motorman's vestibule, through which he can put his switch hook to turn switches; it being, of course, necessary that he stop very nearly over the switch tongue.

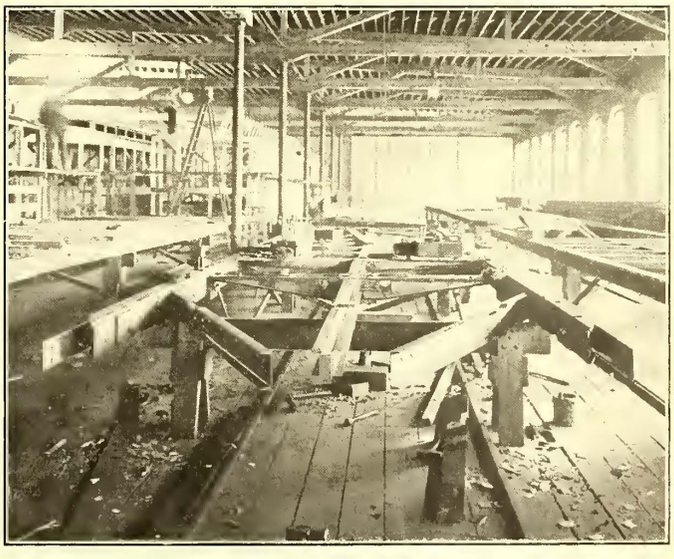
These cars are all being built by the company in its extensive shops at Thirty-First Street and Nicollet Avenue, Minneapolis. The cost of these cars is admitted to be considerably more than what cars of equal capacity could be purchased for, but good workmanship and low repairs, rather than low first cost, are aimed at.

Some experiments have been made in splicing old cars together to make long cars, but the result was not satisfactory because of the narrowness of the old cars and the general lack of stability above the floor line.

The standard truck and motor equipment is Brill 27-A



REAR PLATFORM SUPPORTS



FRONT PLATFORM SUPPORTS

trucks on which are mounted four G. E.-67 motors. For suburban and interurban lines the same cars are used, but four G. E.-57 motors are put on to give the increased capacity required by the high speeds. The weight of one of these standard city cars with four G. E.-67 motors is 40,370 lbs. Interurban cars with air brakes weigh as high as 46,720 lbs.

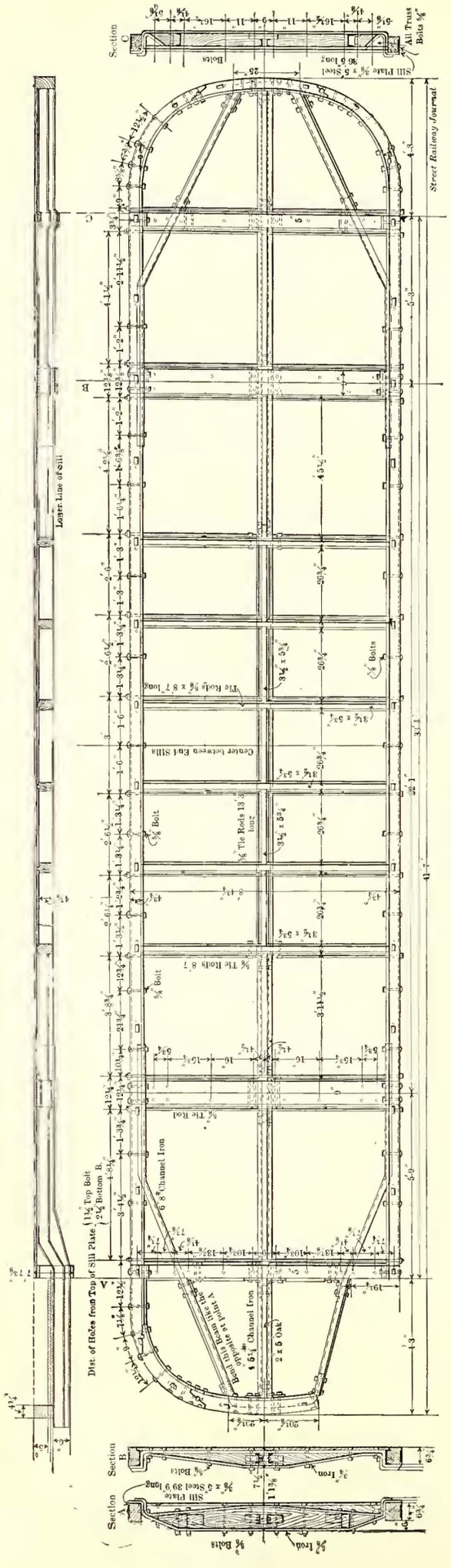
POWER CONSUMPTION AND MAINTENANCE DATA

The power used in car operation in kilowatt-hours per motor car mile for 1901, by months, is as follows:

	Kw hours		Kw hours
January	2.80	July	2.85
February	2.80	August	3.02
March	2.89	September	3.19
April	2.81	October	3.31
May	2.86	November	3.43
June	2.97	December	3.38

The relative mileage of single and double truck cars has already been given. These figures are from the alternating current switchboard of the water-power plant and the direct current switchboard of the steam plants. The greater part of the power being generated from water, a large percentage of these figures includes the losses in alternating current distribution and conversion as well as the losses in the direct current feeders. The average speed of cars on all divisions for the year was 8.45 miles per hour.

The company still has in use, at rush periods, some of the oldest motor equipments. Very complete records, of course, have been kept of the maintenance of the different kinds of motors. Table VI. gives the cost per motor mile for each of the five types of motors in use. In this table, column I., is the total cost of maintenance obtained by



FLOOR SPACE OF STANDARD DOUBLE-TRUCK CAR

dividing the cost of maintenance of each motor by the mileage of that motor. It should be remembered that all of the figures in this table are on the cost of individual motors, not for a car equipment of two or four motors.

TABLE VI.—MOTOR MAINTENANCE.

TYPE OF MOTOR.	Col. I Total Cost per Motor Mile.	Col. II Cost in Armature Room.	Col. III Cost Armatures Alone
G. E. 67	$.0008	$.0002	$.0001
G. E. 57	.0014	.0006	.0002
W. P. 50	.0033	.0017	.0004
Sprague	.0039	.0015	.0008
S. R. G.	.0055	.0046	.0026
Average	$.0023	$.0011	$.0042

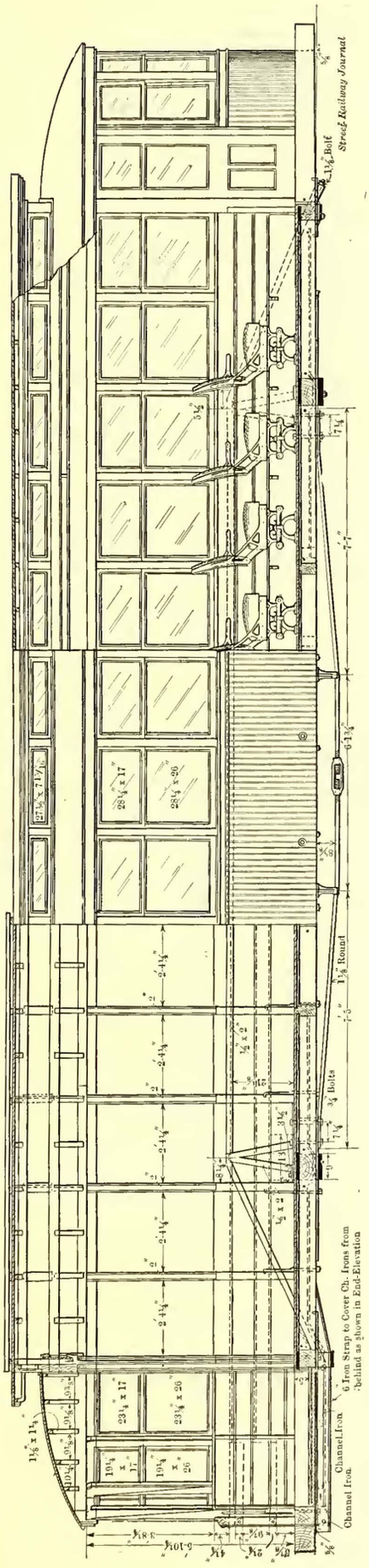
Column II. is the total cost for a motor mile of maintaining a motor taken from armature room reports. These figures include not only repairs to armatures but field coil repairs and any defect of an electrical nature which would cause a motor to be sent to the armature room.

Column III. is the cost per motor mile for armature repairs alone. The figures in column II. subtracted from those in column I. will, of course, be the cost of general repairs outside of the purely electrical ones. A report of this kind is of the greatest value in determining how long it will do to hang on to old equipment before throwing it away and buying new equipment which can be maintained more easily. Of course it must be remembered in this connection that the G. E.-57 and G. E.-67 motors are relatively new, as they are the motors with which all new cars built are being equipped. The S. R. G. repairs seem to be all out of proportion to the others. Looking back on the situation, one cannot help thinking that it is very fortunate that some wise man did not get hold of these comparative figures on Sprague and S. R. G. repairs in the early days when the single-reduction motor was first coming in to argue that the single-reduction motor was a mistake and a step in the wrong direction. Similar arguments are made to-day regarding apparatus which is right in principle and which marks an attempted advance over previous types, but which lacks perfection of details necessary to a successful competition with older apparatus.

POWER AND POWER PLANTS

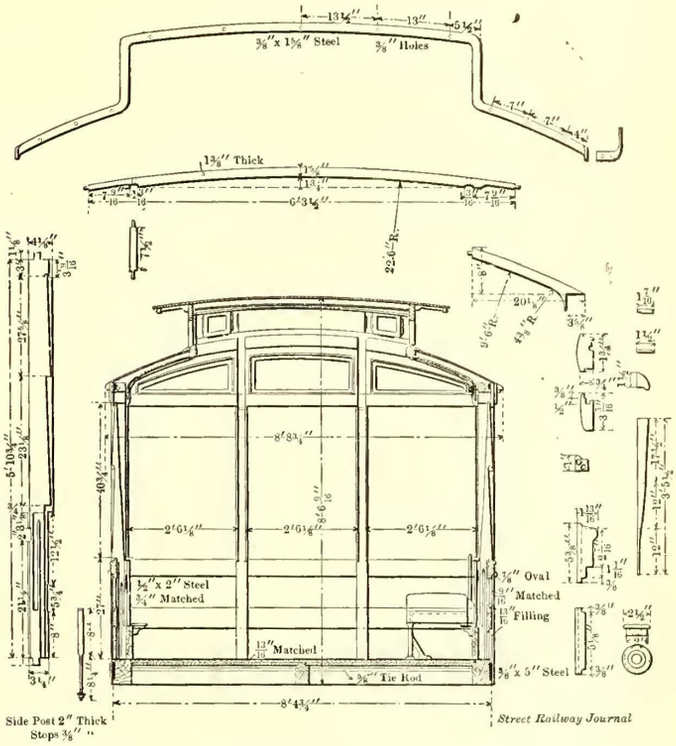
On account of the high price of coal in Minneapolis and St. Paul power has always been expensive when generated in a steam plant. For the past three years, however, a considerable portion of the power used has been generated by a water-power plant at St. Anthony Falls, in Minneapolis. This plant has been fully described in the STREET RAILWAY JOURNAL of May, 1898, and Aug. 11, 1900. It is owned by the Pillsbury-Washburn Company and leased by the street railway company, and a rental is paid based on the power available for use from day to day. Under the terms of the contract the street railway company pays for what power is actually being used by the water-wheels plus the horse-power of the water wasted over the crest of the dam. To determine the power used the recording wattmeters on each generator are read each hour, and the readings thus obtained reduced to horse-power with the efficiencies of the generators and turbines deducted are taken as the horse-power of the water passing through the turbines for that hour. The crest of the dam forms a weir by which the waste water can be measured. The average horse-power available is the figure upon which the rental is based.

Previous to the building of this plant, power was furnished by steam plants in St. Paul and Minneapolis. As



ELEVATION, PARTLY IN SECTION, OF STANDARD DOUBLE-TRUCK CAR

the power supplied by the water-power plant has usually been a little short of that necessary to operate the system the old steam plants have had to supply the peaks of the load. Two steam plants are also maintained on the Still-water line. The cost of steam-power has, of course, been high under such circumstances, as the steam plants have not been operated under the most advantageous condi-



TRANSVERSE SECTION AND DETAILS OF STANDARD DOUBLE-TRUCK CAR

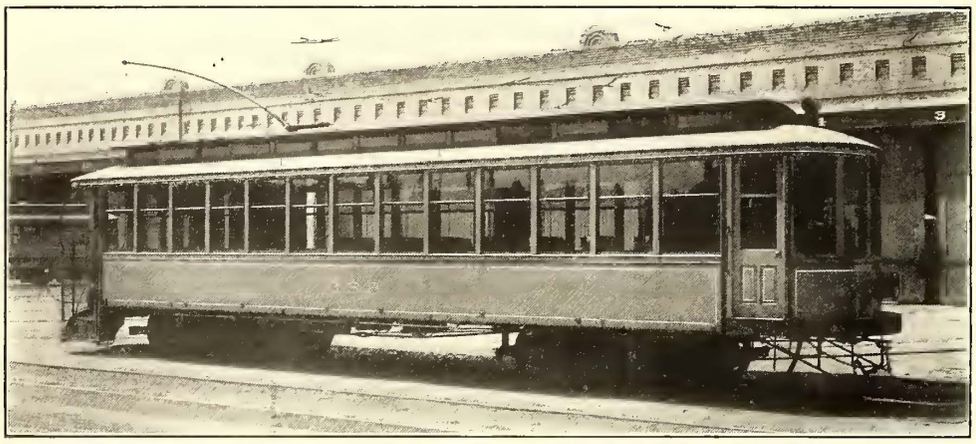
tions. An inspection of the costs of power per kilowatt-hour, from month to month, of course shows that this cost increases as the load on the steam plants decreases. Nevertheless the figure on total cost of power, including both water and steam power, averages low, and the cost of that part of the power furnished by steam is remarkably small considering the conditions.

The cost of all power, both water and steam, for the year 1901 averaged $.0066 per kilowatt-hour. The cost of steam-power was $.0138 per kilowatt-hour and the cost of water-power $.0051. The cost of labor for water-power was about 10 per cent of the total.

The water-power plant contains ten 1000hp. water-wheels. Eight are direct-connected to General Electric 3450-volt, three-phase generator. Two are direct-connected to direct-current 650-volt generators. The 3450-volt, three-phase current is taken to two sub-stations in Minneapolis. For transmission to St. Paul it is raised by step-up transformers to 12,000 volts and conducted by paper-insulated underground cables to two St. Paul sub-stations.

This company, in common with the majority of other large street railway companies, is at present short of power during rush hours because of the great increase in travel, which has exceeded all expectations. The enlargement of power facilities is therefore being taken up on a comprehensive scale, and it has been decided to start the building of an alternating current generating plant adjoining the water-power plant at St. Anthony Falls. This plant will generate at 3450 volts, three-phase, and can be operated in parallel with the water plant, allowing the water-wheels to run with a constant full load and making the steam engines do the greater part of the regulation. A

3500-kw three-phase General Electric generator has been ordered, to be direct-connected to a vertical Reynolds-Corliss engine to be made by the Allis-Chalmers Company. This generator is of the revolving field fly-wheel type and the specifications require that it shall operate twenty-four hours at rated load with not more than 30 degs. C. rise above engine room temperature, and that at the close of such a test it will stand 50 per cent overload for 1 hour without more than 42½ degs. C. rise above engine room temperature, the construction being such that with an engine room temperature of 25 degs. the insulation will not be injured by the rise named. The Reynolds-Corliss engine to drive this generator will be compound condensing with cylinders 46 ins. and 94 ins. by 60-in. stroke, running 75 r. p. m. The building will be laid out to contain six units of this size with necessary boilers, though it can be extended indefinitely. Six Babcock & Wilcox boilers have been ordered with coils for superheating steam, and it is the expectation to superheat about 120 degs. Each boiler has 5500 sq. ft. of heating surface and is nominally rated at about 550 hp.



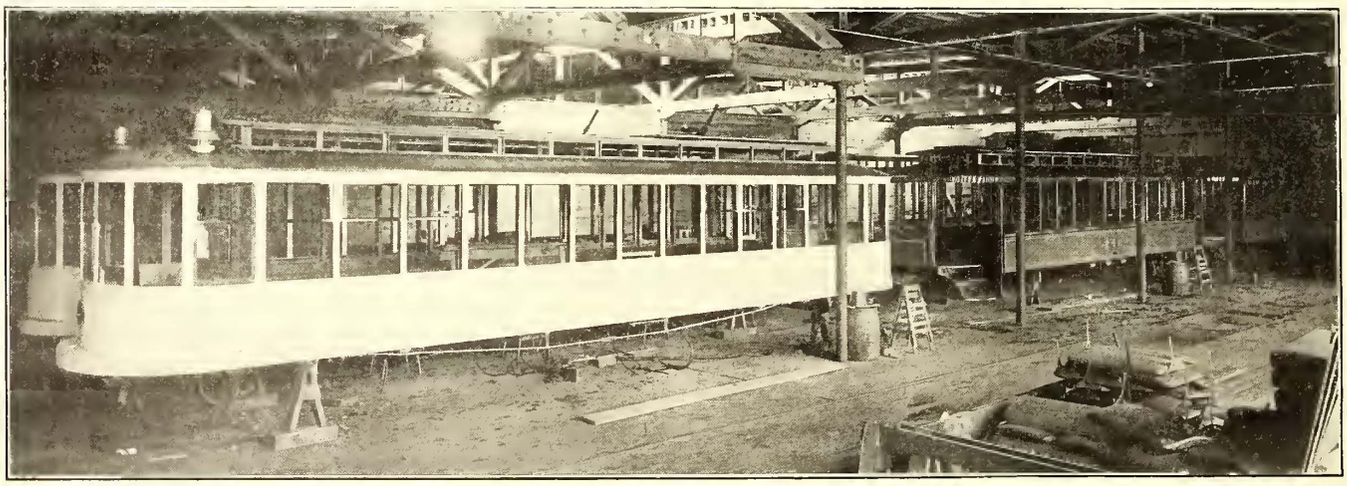
STANDARD CAR, TWIN CITY RAPID TRANSIT COMPANY

The location of the power house will make the fuel-handling problem easy. It is to be on the shore of the river immediately under the edge of a solid rock bluff. A railroad siding from the Minneapolis & Western Railway will be run along the edge of the bluff and coal unloaded into coal cars running around the boiler room roof and dumping into hoppers directly over the boilers. Sargent & Lundy, of Chicago, are consulting engineers for the new power plant, and F. S. Pearson, of New York, has also been called in consultation.

One interesting point in connection with the enlargement of power generating and distribution systems is that one sub-station will be put in each city instead of the two now maintained. While the direct-current proper required is greater with but one sub-station it is calculated that the saving in attendance and the reduction of fluctuations in load, together with the better opportunity for a given capacity of storage battery to take care of fluctuations, if located at one central point, more than compensate for this.

The present water-power plant has two sets of bus-bars. One of these sets will be extended into the new steam plant for connection in parallel with the steam-driven generators.

A neat method of calibrating all the instruments on the generator panels at the water-power plant is in use. The panels are so arranged that by removing the fuse blocks at the bottom of each the generator is disconnected from the panel. Disconnection from the bus-bars is also accomplished by opening the switches. Then with about twenty minutes' work, by means of flexible leads, the panels are all connected in series. One generator is then started up and furnishes current to a water rheostat through the series of eight alternating current switchboard panels. The load on the generator operating is adjusted to about that usually carried on each generator, and the errors on the various indicating and recording wattmeters are noticed, and allowance made by changing of constants for any changes that may have occurred. Each wattmeter is cleaned just before this test. The comparison is, of course, made with a standard wattmeter in series with the eight switchboard panels.



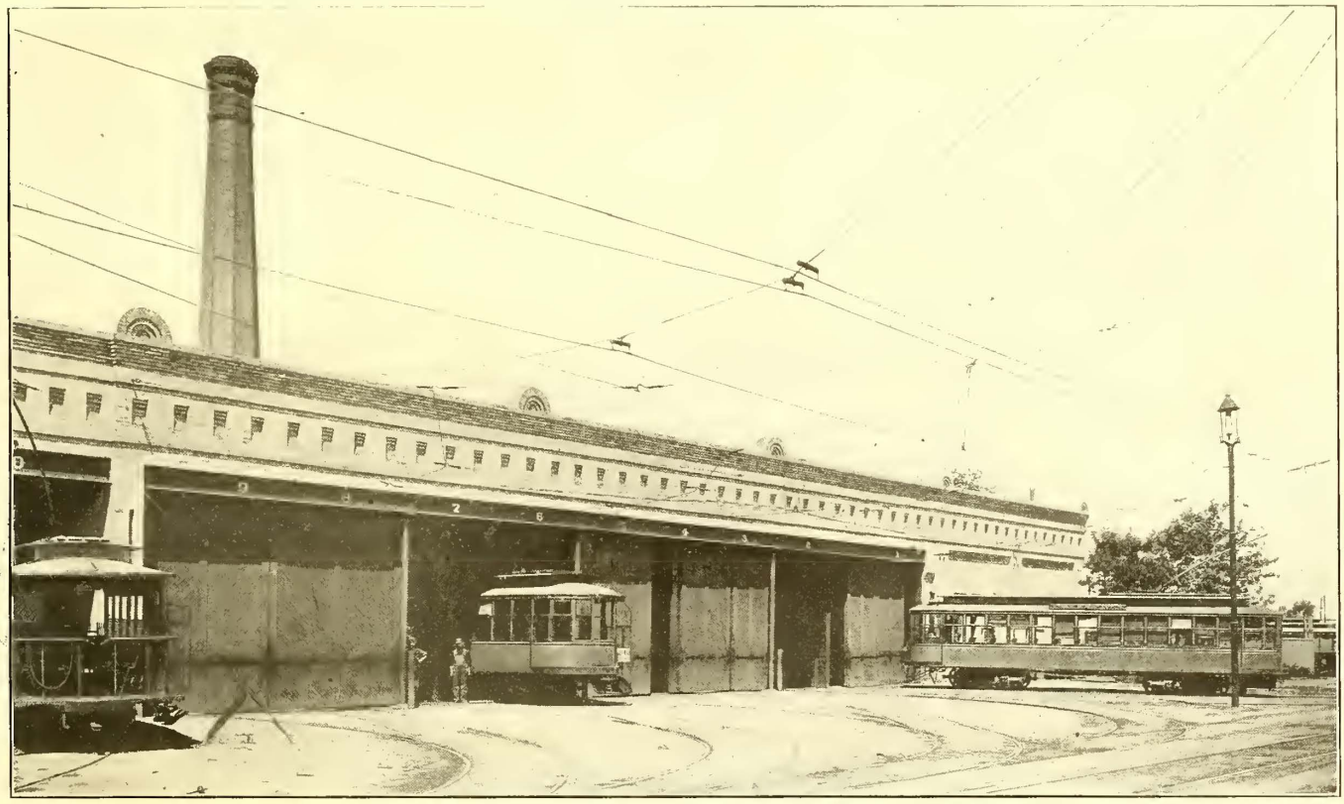
CARS IN PAINT SHOP

ACCIDENTS

In the matter of injuries and damages, the company is necessarily under greater expense than one operating over a less scattered territory. It is necessary to keep claim agent departments in both Minneapolis and St. Paul and this increases the expenses somewhat over what it would be if one claim department could attend to the entire system, but the latter is found to be impracticable on account of the local conditions, as St. Paul claim agents can deal better with St. Paul people and Minneapolis claim agents with Minneapolis people. That is, it is found to be a good policy to have claim agents identified with the local inter-

ests of the cities in which they work because, as is generally known, there has been considerable rivalry between these two cities in the past. However this may be, it will be seen from Table II. that there has been a marked decrease in the percentage of cost of injuries and damages to the gross earnings; this is due to greater care on the part of trainmen and skill in handling the damage cases, and a large slice was also cut off the amount paid for damages at the time what is known as "the Minneapolis gate" was put on nearly all the cars.

The time this change came is very evident in Table II., where the injuries and damages dropped from $160,813 in 1894 to $80,890 in 1895 and $65,587 in 1896, there being no great change in the gross earnings in these three years. The Minneapolis gate, which is probably known to most street railway men over the country, having since been adopted on the Metropolitan Street Railway at Kansas City, is a gate opened and closed by the motorman, the idea being that the car shall be closed against entry or exit at all times except when at a dead standstill. The motormen have orders to open the gates only when cars are standing still. At all other times they are closed. The gates open outwardly and are controlled by a system of rods and levers running from the motorman's vestibule to the rear platform. At the time the gates were adopted, an inspection of the accident account revealed that a considerable percentage of the costly injuries were due to passengers attempting to leave or board the car while the car was in motion. While these accidents were, strictly speaking, not accidents for which the company was responsible, the claim is usually set up in such cases that the motorman started the car just as the injured person was stepping off and that the conductor gave the starting signal too soon. Such cases form an uncomfortably large percentage of the total number of cases. The adoption of gates which are closed at all times except when the car is standing, has immediately shut off a great bulk of this class of accidents. There are a few stop accidents at the present time, however, as an inspection of the accident statistics shows, and the experience at Minneapolis would seem to demonstrate that where gates of this kind are used special precaution should be taken to see that motormen do not fall into the bad habit of starting the car before the gates are closed, otherwise more serious accidents than those that the gates are intended to prevent may happen. There is, of course, a constant temptation for the motorman to turn on the current before closing the gates in order to save a fraction of a second in time for each start; while this saving of time may be desirable, it would seem that it is hardly worth the risk involved, especially with an outwardly opening gate which can catch alighting passengers. Many questions have been asked, from time to time, as to how the use of gates in Minneapolis affected the schedule speed. Many managers have asserted that the scheme is entirely impracticable in their cities because there are a large number of men who will get off the car before it stops and allow it to proceed before coming to a full stop, thereby saving time for the car and allowing a higher schedule speed than could otherwise be made. Experience in Minneapolis does not seem to bear this out. Vice-President Goodrich states that the use of gates not only does not decrease the schedule speed, but allows better time to be made. This, he says, is because the motormen bring their cars promptly to a standstill when they must stop at a crossing rather than bringing them up to a crossing at a low rate of speed expecting that they may possibly not have to come to a stand. It is a custom among some motormen and conductors for the conductor to give a late bell when an active-looking man is to get off, with the expectation that the motorman will not have to bring the car to a dead standstill. In such a case the motorman will reduce his speed considerably and drift along, expecting to get a go-ahead signal about the time he reaches the crossing. If he does not get it, he may drift along a few feet farther and then stop the car, which wastes more time than had he made a prompt stop. At least this is the theory by which the rapid schedule time made by cars equipped with gates is accounted for.



THIRTY-FIRST STREET CAR HOUSE

Figures on accidents on all divisions of the Twin City Rapid Transit Company for 1901 were as follows:

Passengers carried	63,009,957
Passengers per accident	20,003
Cost of accidents per passenger	$.0020
Total motor car miles	11,529,453
Motor car miles per accident	3,660

These are also approximately the proportions on the interurban lines which are included in the above averages, except that on all divisions the cost of collisions was about 50 per cent of the total cost of accidents, and of this 50 per cent one-half is chargeable to the interurban line between St. Paul and Minneapolis—a figure which it is hoped to reduce by the use of air brakes on the interurban cars. On the Minneapolis & St. Paul Suburban Railway, which is an interurban line from St. Paul to Stillwater, 20 miles, the accident figures for 1901 were as follows:

Passengers carried	3,322,044
Passengers per accident	28,018
Cost per passenger	$.0008
Motor car miles	650,289
Motor car miles per accident	4,655

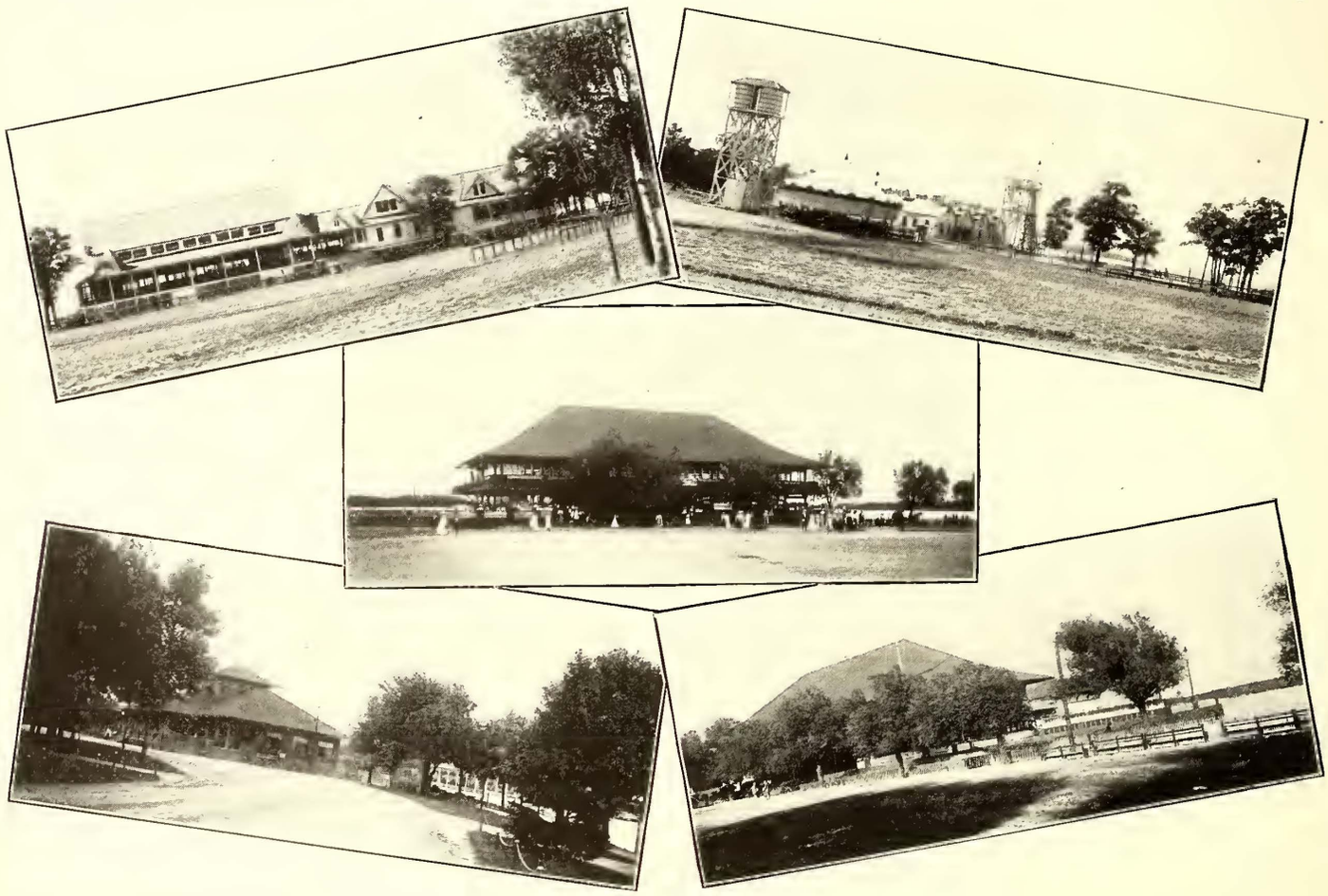
OPERATING FIGURES OF THE ST. PAUL-STILLWATER INTERURBAN LINE

Reliable figures on the operation of interurban electric roads are of special value in these days when there is such great activity in the building of such roads and when it is often hard to get figures based on conservative and experienced management.

The line from St. Paul to Stillwater is 20 miles in length. It is divided into six sections, a charge of 5 cents being made for each section, or 30 cents for the entire trip from St. Paul to Stillwater.

The following are the figures on operation for 1900, those for 1901 not having been completely tabulated at present writing. A half-hour service is given on this line the year round, but a heavy summer business is done taking people to Wildwood. The average number of cars in operation per day of eighteen hours was 5, and the car mileage was 602,269.

	Per car mile
Passenger earnings	$.2242
Miscellaneous earnings	.0024
Total gross earnings	$ 2266
Maintenance, way and structures	$.0051
" equipment	.0133
Operation of power plant	.0403
" " cars	.0386
General expense	.0175
Legal "	.0017
Injuries and damages	.0059
Insurance	.0014
Total cost operating per motor car mile	$.1238



VIEWS IN PARKS OF THE TWIN CITY RAPID TRANSIT COMPANY

PLEASURE RESORTS

There are three large resorts on the Twin City Rapid Transit Company's system. Two of these are parks maintained by the park commissioners, and one of them a resort maintained by the company. In Minneapolis Lake Harriett is the great amusement center, and is located on the southwestern edge of the city. Como Park and Lake, in St. Paul, is located on one of the interurban lines between the two cities, and on account of its convenient location gets many pleasure-seekers. Wildwood, on the St. Paul and Stillwater interurban line at White Bear Lake, is maintained and operated entirely by the company. At Wildwood which was formerly a rather tough resort, a transformation has taken place since this company took hold of it, and it is now maintained along the same lines that the public parks of Minneapolis and St. Paul are kept by the park commissioners. No objectionable people are allowed on the grounds, and the resort is as suitable for ladies and children as are any of the public parks. There are, of course, however, more miscellaneous attractions, such as merry-go-rounds, bowling alleys, switchback railways, etc.,

at Wildwood than at the public parks. At the Como and Harriett resorts expensive bands are engaged each season, the cost of such bands sometimes running as high as $2,000 a week. When such bands play at the public parks, a bonus is usually obtained from the park commission to cover part of the expense. The company keeps its accounts in connection with parks and pleasure resorts just as it would if it were an outside party running these places. All expenses, car fare of bands, etc., are charged as if paid for in cash.

At Wildwood large bath houses have been built, and an antiseptic laundry for quick washing and drying of bathing suits. The admission to the amusement hall at this place is 10 cents. Bowling alleys cost 30 cents per game.

ORGANIZATION

As seen from the accompanying chart of organization the vice-president is the hub about which the various departments center. The general manager has charge of everything pertaining to operation or equipment. The

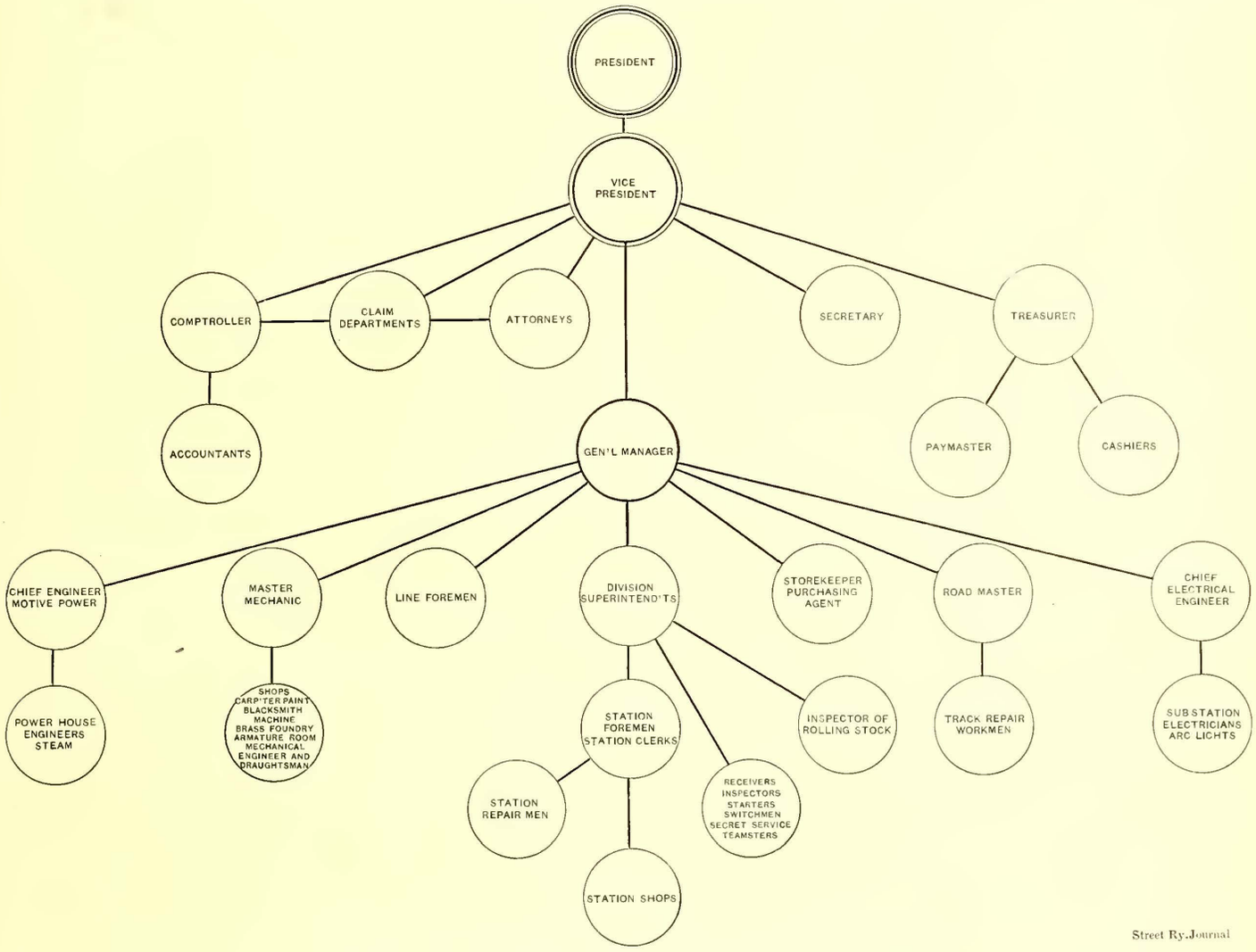


DIAGRAM OF ORGANIZATION, TWIN CITY RAPID TRANSIT COMPANY

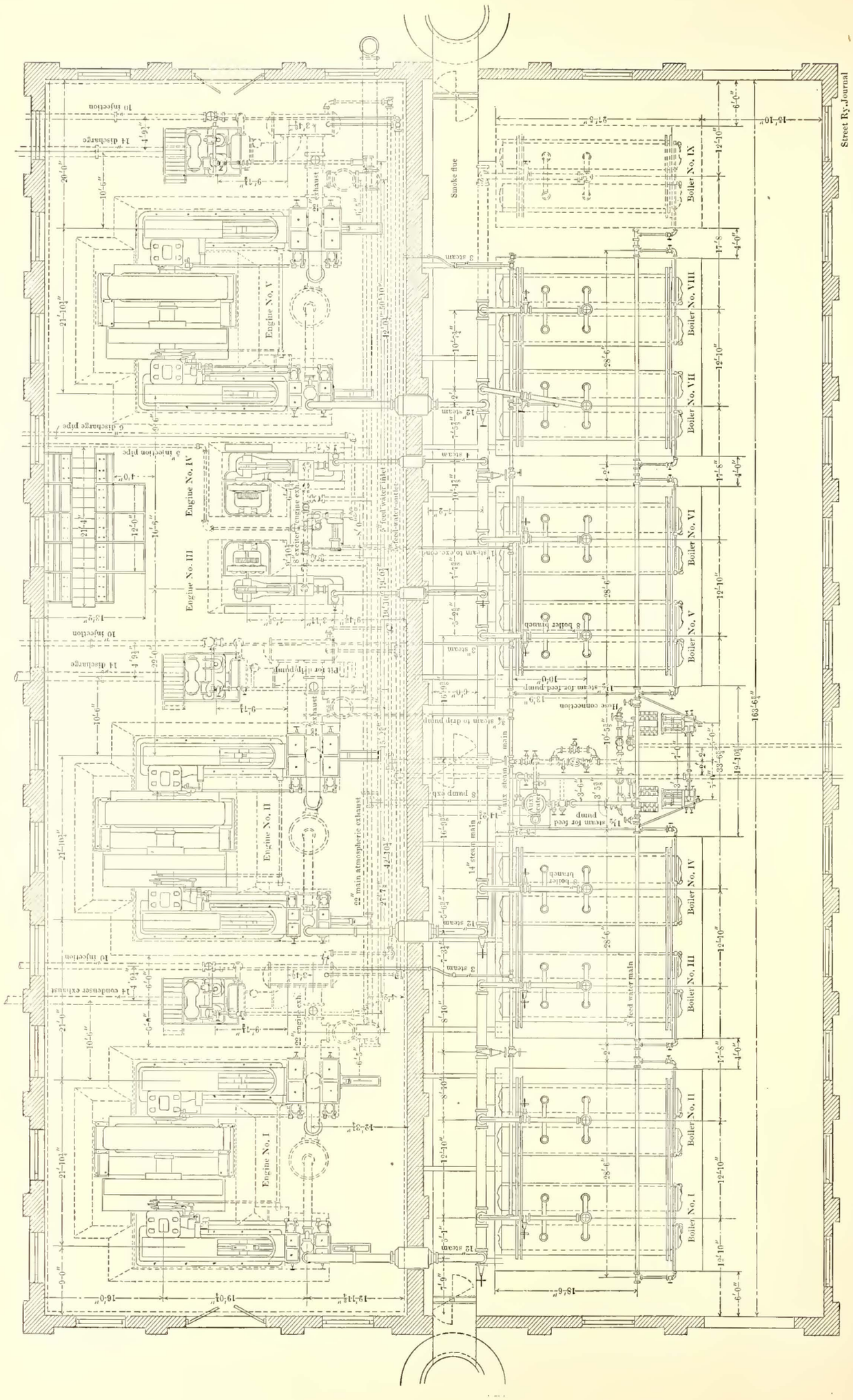
There is always an interesting question in connection with pleasure resorts, as to whether the company is running ahead or behind in maintaining them. After keeping its expense accounts according to the method above outlined, this company, during the summer season of 1901, found that its pleasure resorts had cost it $4,292.24 over and above all money received from concessions and bonuses from the park commissioners. This is such an insignificant figure in comparison with the amount of business done in carrying people to these pleasure resorts that there is no doubt as to the money expended on these places by the company being well spent. At Wildwood, traffic, of course, could be kept with a reasonable degree of accuracy. The deficit at Wildwood in 1901 was $1,265.27. The traffic at Wildwood during the summer season of 1901 was as follows, carried out in dollars and cents:

June	$7,496.27
July	12,676.18
August	13,299.52
September	6,896.83
Total	$40,368.08

claim department is not put under operation, as it is considered that a better compromise between operating expediency and legal policy on various matters can be obtained by having operation and claim departments separate, and reporting independently to the vice-president, who can decide points of policy in connection with the claim department after considering all sides of the question.

As said before, the principal officers of the company have been the same for the past nine years: Thomas Lowry, president; C. G. Goodrich, vice-president, secretary and treasurer; J. F. Calderwood, auditor; W. J. Hield, general manager. The other officers and department heads are: R. L. Costigan, purchasing agent; G. Brigger, superintendent Minneapolis division; D. S. Smith, superintendent St. Paul division; R. C. Taylor, master mechanic; Edward Scofield, electrical engineer.

During the storm of Feb. 17 a larger amount of snow fell in many districts in the East than in any other storm during the last twelve years. Yet, though the service on some roads was impeded, it was not more so than on neighboring steam railroads.



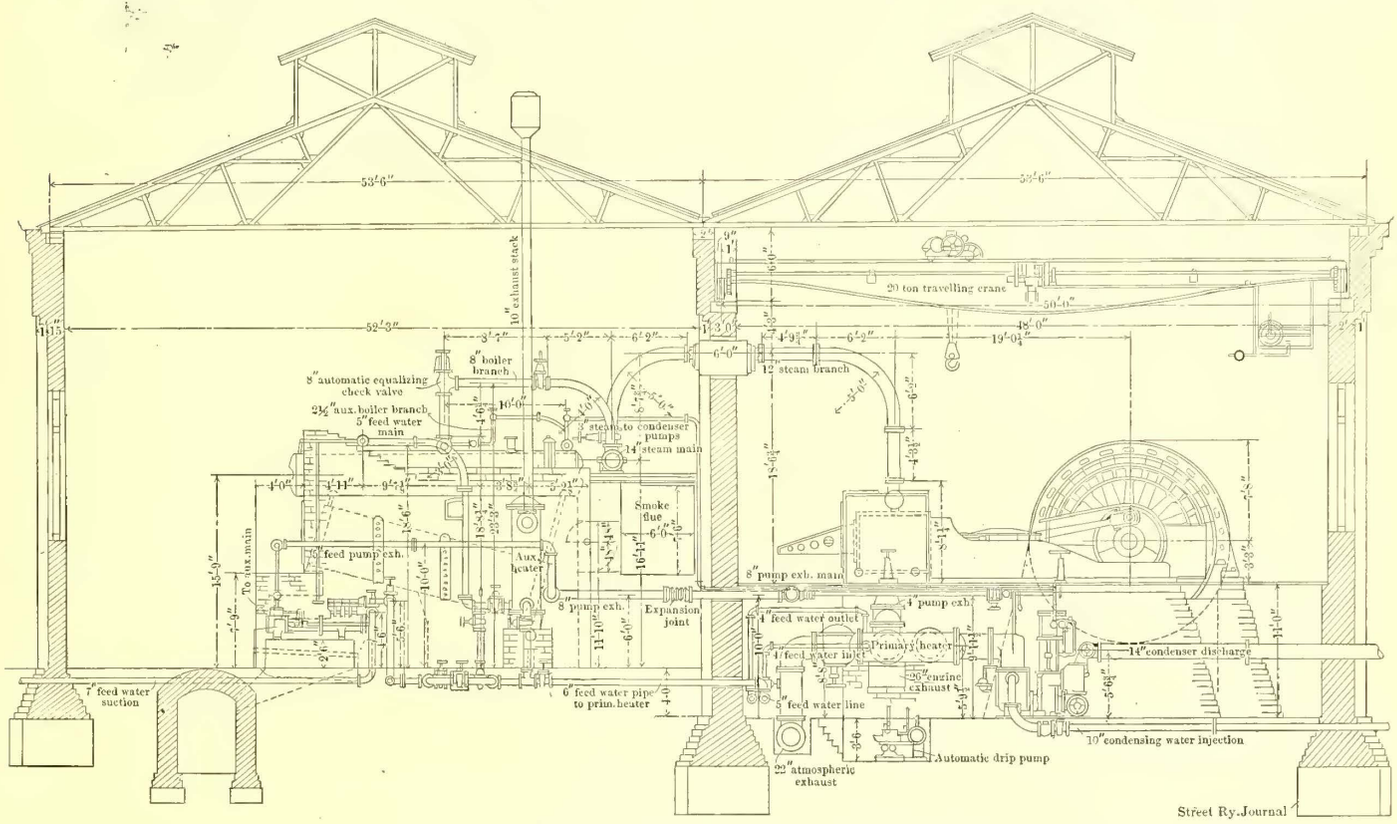
PLAN OF POWER STATION FOR TOKIO ELECTRIC RAILWAY

Electric Railway Equipment for Tokio

The Tokio Densha Tetsudo Kabushika Kwaisha, which is the largest street railway company in Japan, and which operates some 22 miles or more in that city, has just given contracts for an extensive electrical equipment which it is expected will be in operation early in 1903. The orders were placed recently by Mr. Enyo, chief engineer of the Tokio company, and financial arrangements have been made through the Japanese house of Mitsui & Co., of New York, whereby that firm guarantees the payment for the machinery. The polyphase system of distribution at 6600 volts will be used.

The power house, which measures, inside dimensions, about 164 ft. x 102 ft., contains space for three 1800-hp engines, each directly connected to a 1200-kw. General Electric generator. The engines are being supplied by McIntosh, Seymour & Company and are of their horizontal, cross-compound, condensing type; the cylinder dimensions are 30 ins. and 62 ins. x 42-in. stroke. Two small engines, each directly-connected to a 100-kw. generator, form the exciting plant. There are eight boilers, each of 350-hp capacity, built by the Babcock & Wilcox Company. The pumps comprise three condensing outfits, two feed pumps and three small equipments to be utilized for drainage and oiling purposes and are to be manufactured by the International Pump Company. Four Wainright heaters will be used in the station. The Morgan Engineering Company, of Alliance, Ohio, will build a 20-ton overhead electric crane.

The car bodies will be manufactured in Japan, but will be mounted on No. 8-B. trucks built by the Peckham Manufacturing Company, to be equipped with Sterling brakes. The number of the trucks already ordered are 250 and they will be fitted with double motor equipments of the G. E.-54 type. In addition to the generators, the General Electric Company will supply six 400-rotary converters of 360 volts alternating, and 550 volts to 575 volts direct-current, and eighteen 150-kw transformers of 6000-300 volts. The General Electric Company will also supply the switchboards for the generating station and sub-stations.



SECTIONAL ELEVATION OF TOKIO POWER STATION

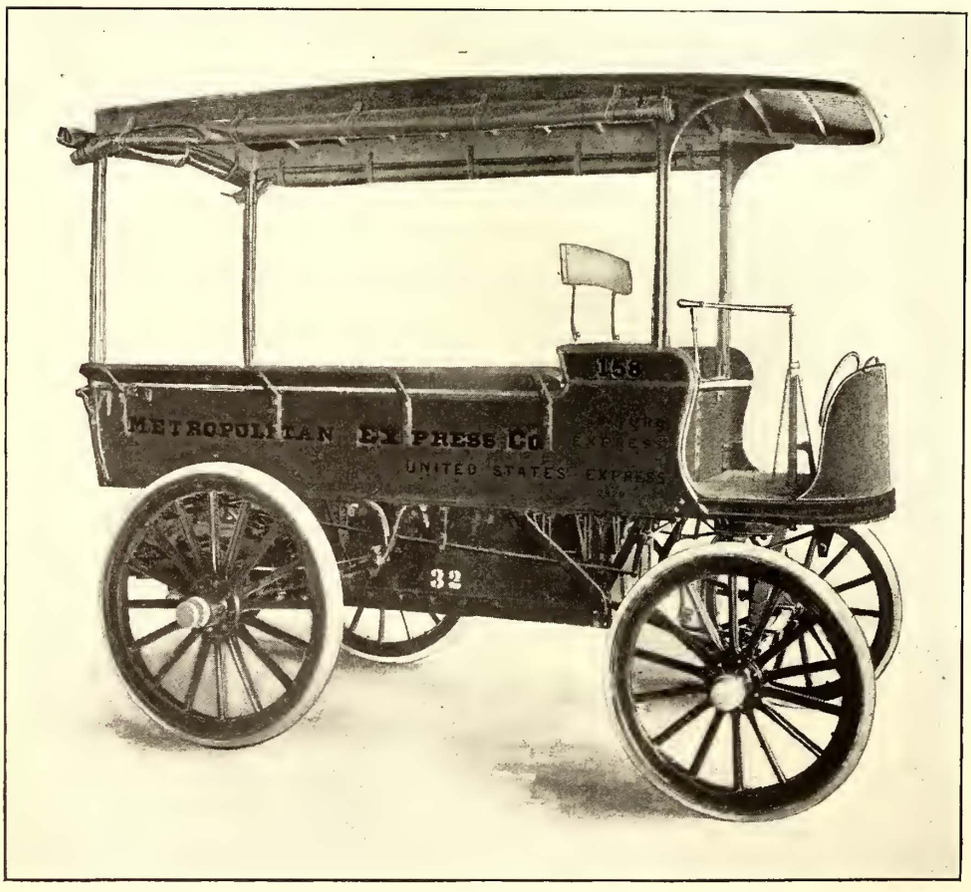
The Metropolitan Express Company

The express service which was started on the lines of the Metropolitan Street Railway Company about six months ago has proved very successful. The first cars which were used in the service, it will be remembered, were the old Third Avenue mail cars with some changes made in their construction to better adapt them to the express business, but since that time twenty long double-truck cars have been added, which have greatly increased the facilities of the company. A number of automobile express wagons have also been put in operation in connection with the delivery system, which now has in all about 130 wagons in service. Both of these are illustrated in the accompanying engravings. The new cars have two doors on the side and are considerably larger than those formerly employed. They are fitted with the standard overhead trolley as used on the lines around White Plains, New Rochelle, Yonkers and other towns in the southern part of Westchester County, where a large amount of deliveries are made, and are also equipped with a modified type of the plow used by the Metropolitan Street Railway on its conduit lines. This plow is so arranged that it can be removed from the slot at one of the "hatches" and placed out of the way under the car. This enables the express company to use the same cars on any part of the lines of the Metropolitan Company and other companies in and above the Borough of Manhattan.

The delivery wagons, of which there are fifteen, are used for the local delivery business, the cars being employed only for transportation over long distances. These wagons have curtains on the side which can be lowered in the wet weather, but ordinarily these curtains are rolled up, as shown in the illustration of the wagon herewith. The

wagons are equipped with two 2½-hp motors, and are capable of developing a speed of about 12 miles per hour. The batteries, which are placed in a box under the wagon floor, have a capacity of 35 amp. at 90 volts for about 3½ hours, but in ordinary service the wagon runs 35 miles with one charge. The charging is done at the stations of the New York Transportation Company, until recently known as the New York Electric Vehicle Transportation Company, which has complete control of the operation of these vehicles.

DOUBLE TRUCK EXPRESS CAR



AUTOMOBILE DELIVERY WAGON

The financial arrangements of the Metropolitan Express Company with other local companies have been most successful, and the plans as originally made by the officers have been carried out in a manner satisfactory to all concerned. The United States Express Company has given over to the Metropolitan Express Company all of its delivery business above Fifty-Ninth Street, and this district now has a much better service than ever before. The Century Express Company, which is now nothing but a name, has had its business largely increased in all lines since its absorption by the Metropolitan Express Company. This is especially true of the lower parts of the city, and everything points to the realization of the hopes of the management when the new venture was started. The conditions in New York are such that a rapid express service of this kind is highly desirable, and by operating during such hours as the tracks of the Metropolitan company are comparatively free no interference with the passenger traffic occurs.

Another Electric Road for Mexico

The City of Mexico is to have an electric traction system, in addition to the one now in operation in that city. Recent advices from Mexico state that a concession has just been granted by the government to an enterprise styled the Mexican Traction Company, of which John L. Moylan is president, for the purpose of building and operating an electric traction system to run between the Mexican capital and Tacubaya, one of its suburbs. The length of the road will be about 8 miles. The company absorbs the project of Señor Miranda y Marron, who in 1898 was granted a franchise with a view to connecting the eastern part of the city with Tacubaya, but who only constructed a small portion of the line. Ninety-pound rails are to be used. The whole system must be built inside of eighteen months.

Joint Construction and Wheels in Philadelphia

The use of the "composite" or cast zinc joint, invented by the engineers of the Union Traction Company of Philadelphia, and described in the STREET RAILWAY JOURNAL for April, 1901, has proved so successful that the company is installing a considerable number of these joints. A section and side elevation of this joint, reproduced from the issue of last April, are presented herewith in Fig. 1, but some modifications have been made in the method of applying this joint, as the result of the experience of the last nine months.

As will be remembered, this joint is made up of two angle-plates, which are made to fit the web of the rail closely and overlap the base, except that a space of about 3-16 in. is left between the head and the base of the rail and the flanges of each of the angle-plates; the angle-plates are then riveted through the web of the rail by twelve 1-in. rivets, set up by a pneumatic riveter, and the intervening space is poured with zinc. The company has equipped about 12 miles of new track with these joints since spring. Of course, the time in which they have been in use is not long enough yet to determine their value, but

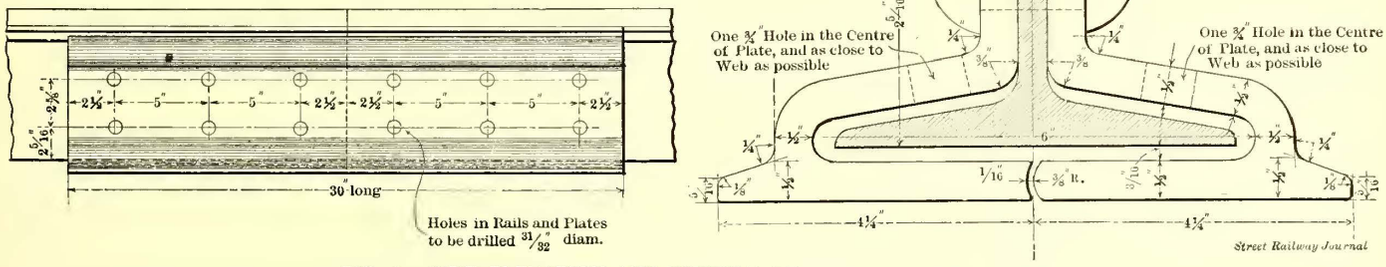


FIG. 1.—SIDE ELEVATION AND SECTION OF NEW CAST ZINC JOINT

the service given by hardened center special work constructed in this manner, that is, with the wearing parts held in place by zinc, indicates that in point of durability the joint will be satisfactory. Certainly, so far as smoothness in riding and electrical conductivity of the joint are concerned, the experience with it has been most satisfactory.

The apparatus now being used to melt the zinc is carried on a wagon built especially for the purpose and weighing, complete with equipment, about 5000 lbs. A view of this truck complete with fuel oil burners, compressor and crucible, is shown in Fig. 2. The crucible, in which the zinc is melted, has a capacity of about 300 lbs. of zinc, and is heated by a fuel oil burner supplied with air under a pressure of about 15 lbs. per square inch, supplied by a small motor compressor. The crucible is swung at the end of the truck so as to be always level. Forming part of its back is a pocket, which is also heated from the main flame, and which is large enough to hold three ladles; these ladles have a capacity each of from 20 lbs. to 25 lbs. of zinc, and one ladleful is ample to pour a joint, as the amount of zinc required is about 15 lbs. It is proposed, however, in future work to substitute electric melters in place of the spherical oil melter shown in the engraving. This will greatly decrease the weight carried on this particular truck.

A second wagon carries a motor compressor and complete sand-blast apparatus for cleaning the ends of the rail before casting, burners for heating the ends of the rails preparatory to casting, and sheet-iron forms for pouring the metal. Two Christensen air compressors are used for operating the sand blast, and are capable of supplying about 100 cubic feet of air per minute. This wagon is shown in Fig. 3.

METHOD OF APPLYING THE COMPOSITE JOINT

The joint is applied to new track immediately after the rails are placed on the ties and before the rails have been surfaced or spiked. After the material has been distributed, both the plates and the ends of the rails for a distance of about 18 ins., including the lower part of the head and both sides of the base, are thoroughly cleaned by the sand blast mentioned above and shown in Fig. 3. The appearance of the rail ends and plates after the application of the sand blast is well shown in Fig. 4. The plates are next placed on the rails and

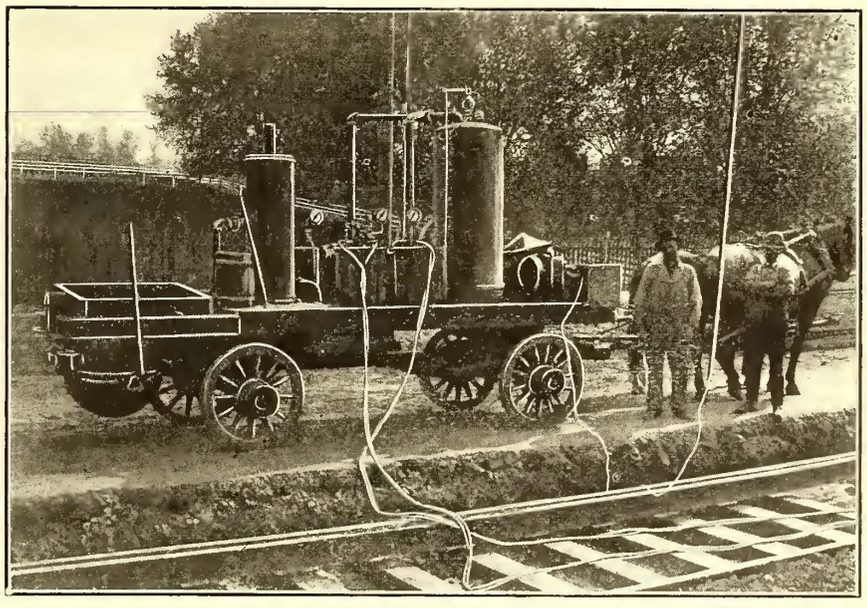
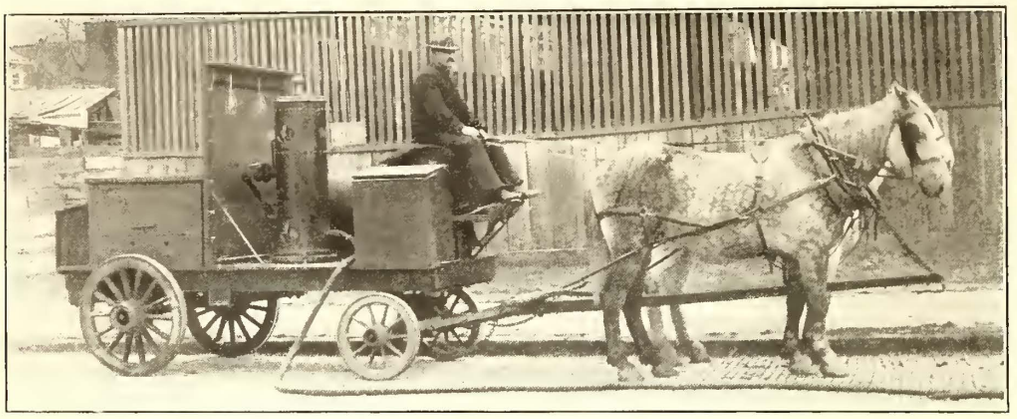


FIG. 2.—ZINC CASTING TRUCK COMPLETE, WITH BURNERS, COMPRESSORS AND CRUCIBLE

are held in place by steel drift pins, placed, one in each end of the plate. A steel straight edge is then laid



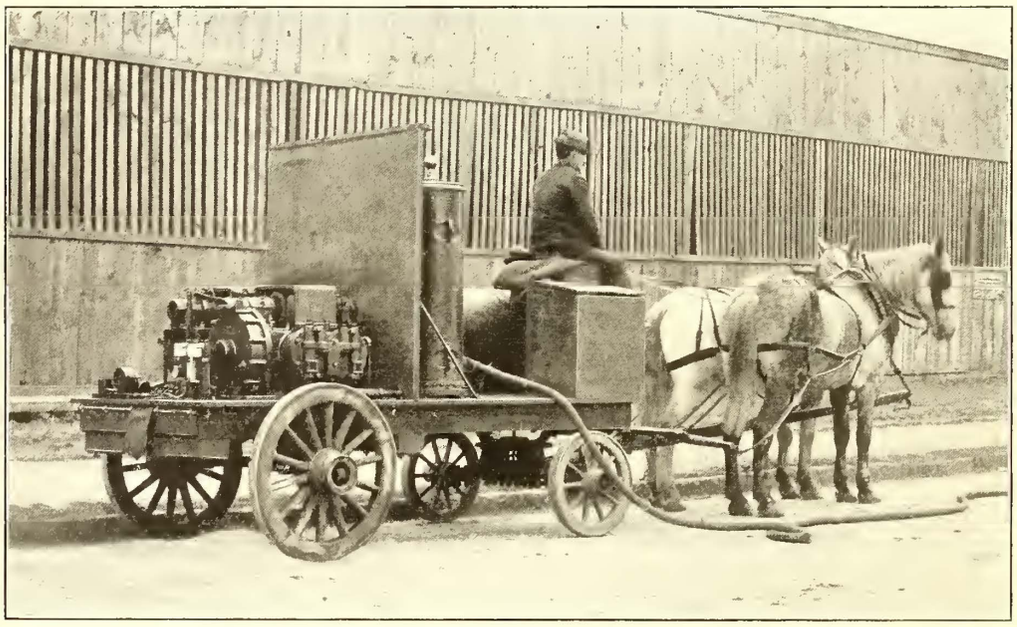


FIG. 3.—SAND BLAST TRUCK, WITH AND WITHOUT COVERS REMOVED

on the rail and the head and base of the rail are brought to a uniform surface by inserting wedges between the plate and the tram, or the plate and the head. These wedges are driven up with a light hammer until the

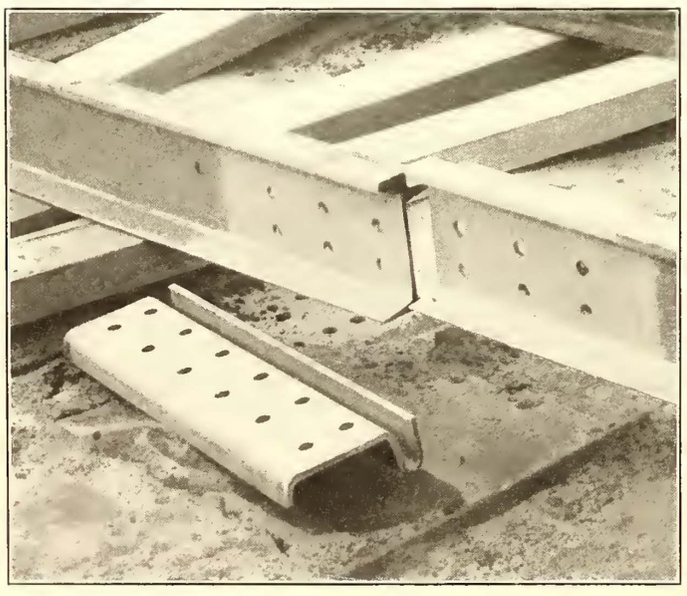


FIG. 4.—APPEARANCE OF ENDS OF RAILS AFTER BEING CLEANED

straight edge has a continuous bearing. The plates are then held in place by four temporary bolts while the usual bolt holes are being reamed to 1 1-32 ins. by a portable pneumatic reamer (see Figs. 5 and 6).

Several types of reamers have been tried for boring out the rivet holes. The employment of compressed air for the sand blast suggested the use of a pneumatic reamer, and this has proved in many particulars more satisfactory than an electric reamer, as with the latter a flexible shaft has to be employed, and, owing to the large amount of power transmitted, some troubles have developed through the breaking of this shaft. The compressor used is of the Christensen make, driven like that on the sand blast by current from the trolley wire and furnishes air at 85 lbs. pressure. The appearance of the joint reamed with four temporary bolts in place is shown in Fig. 7.

After the holes are reamed out the steel rivets are inserted. Twelve 1-in. rivets are used to each joint and they are upset by the pneumatic riveter shown in Fig. 8, and which is handled by two men. The compressor used is shown in the engraving with the forge for heating rivets. This is hauled by hand from joint to joint, but when carried any distance is carried in the construction wagon, Figs. 9 and 10.

Fig. 9 shows the apparatus

FIG. 6.—PNEUMATIC REAMER AT WORK

boxed up, and Fig. 10 with the apparatus removed. After the angle-plates are riveted up, the joint is heated

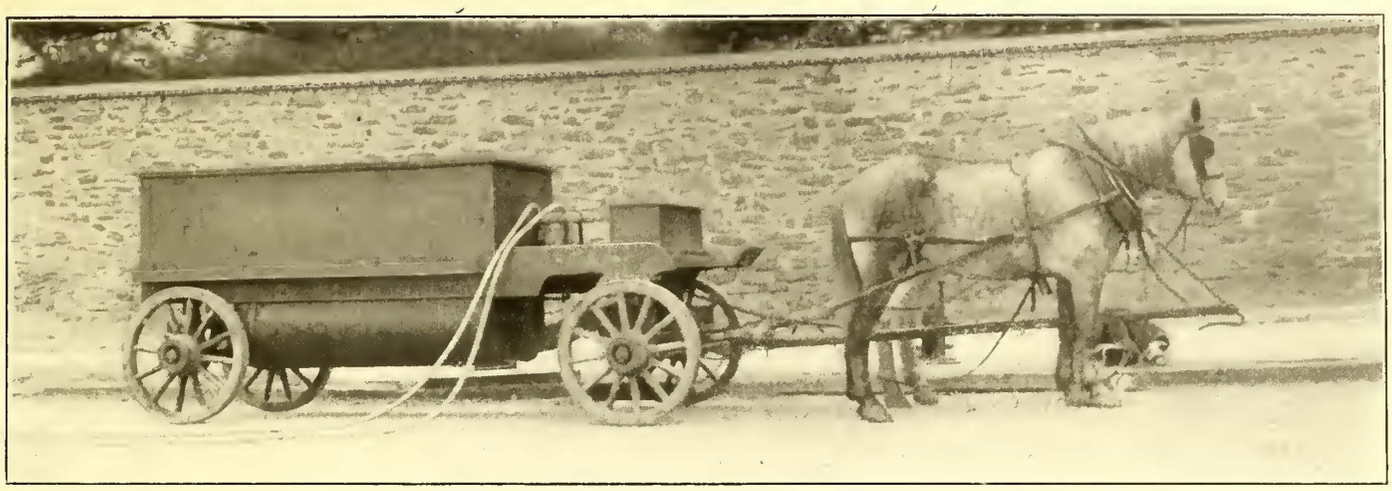


FIG 5.—COMPRESSING APPARATUS FOR PNEUMATIC REAMER

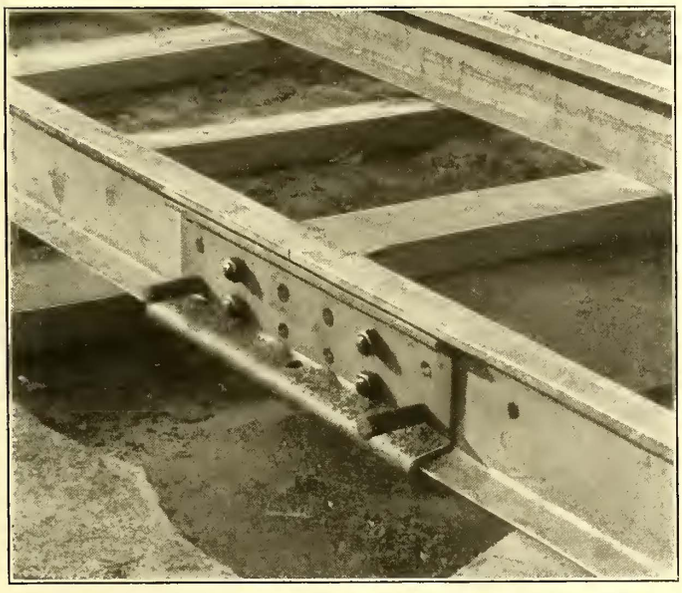


FIG. 7.—JOINT REAMED READY TO BE RIVETED

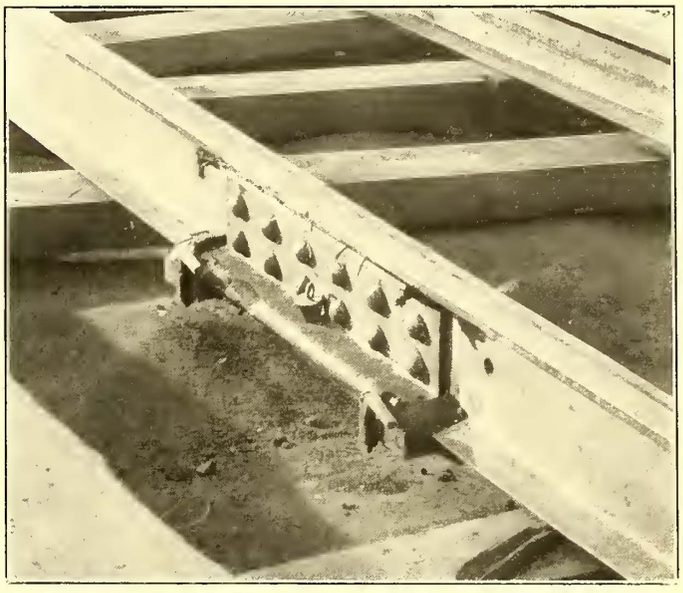


FIG. 12.—JOINT CAULKED WITH ASBESTOS

by means of the two fuel-oil burners; before doing this, however, the holes in the angle-plates through which the zinc is later to be poured and the spaces at the ends of the plates are temporarily caulked with pieces of asbestos cloth, as shown in Figs. 11 and 12, so that no soot will enter the space between the rail and the plates. The lower portions of the plates are then warmed to a temperature of about 300 degs. F. by fuel-oil burners operated by the portable compressor shown in Fig. 2, and already described. The joint is now ready for pouring. The zinc is poured through a ¾-in. hole in the center of the lower portion of the plate (at the place shown by the iron plug in Fig. 13), and also by means of dams underneath the head and tram of the rail. The dams used are made of aluminum castings padded with asbestos cloth, and are well shown in Fig. 13. Views of completed joints are given in Figs. 14 and 15, one being of the inside, the other of the outside, of the rail.

The present cost of the zinc joint is somewhat higher than it would be in case rolled angle-plates were used in-

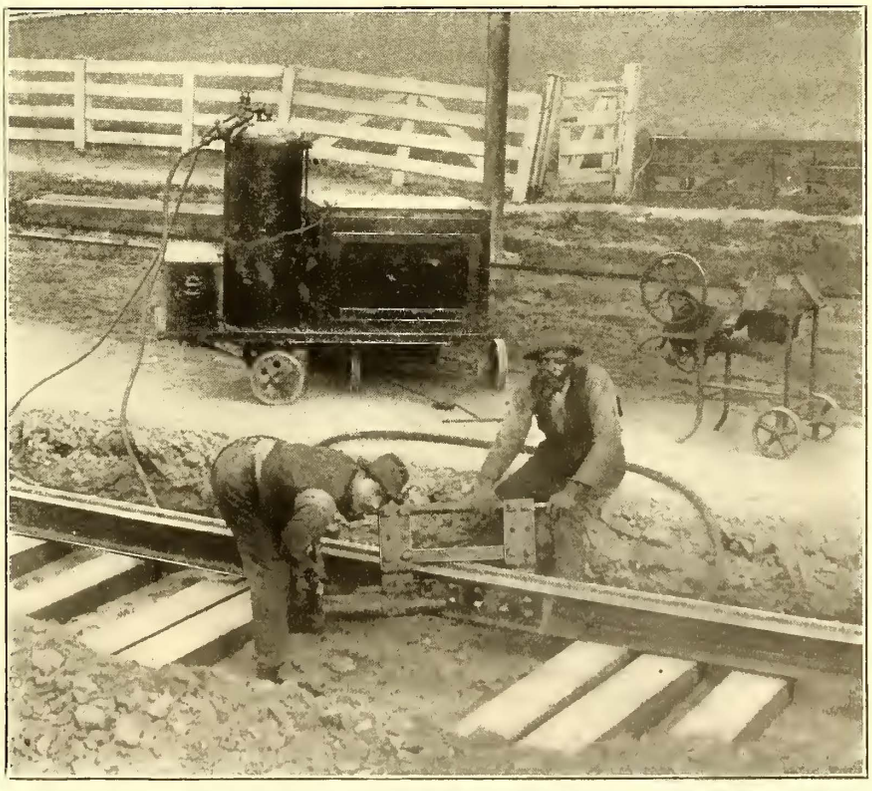


FIG. 8.—PNEUMATIC RIVETER AT WORK

FIG. 9.—COMPRESSING APPARATUS FOR PNEUMATIC RIVETER

stead of drop-forged. The company has not yet commenced the employment of rolled plates, however, as the managers wished to determine the exact value of the joint before going to the expense of ordering a set of rolls.

DISTRIBUTION OF MEN APPLYING RIVETED JOINT PLATES

A track-casting gang consists of fourteen men and one boy, divided about as follows:

Sand Blast Wagon, 2 men.
Reamer Wagon, 3 men.
Riveting Gang, 3 men and 1 boy.
Molders, 2 men.
Melting Wagon and Burners, 4 men.

A gang of this number will cast about forty joints in a day of ten hours. The total cost of labor per joint is $1, and the total cost of zinc, including waste, is $1. This estimate is based on the total cost of applying 2000 joints, and of course does not include the cost of plates, rivets, etc. If these were added the cost of the joint would probably be in excess of $5 per joint. The company's engineers believe that the joint is superior to cast-welded joints, for they consider that in the latter the rail is affected by the intense heat of the molten iron, while in the new joint a temperature of only 300 degs. is required. This has no effect on steel. At the same time the joint is considered to be as durable in service and more easily applied than the cast-welded joint, especially to deep rails

RIVETED JOINTS

During the last year, and before the design of the zinc joint described above, the

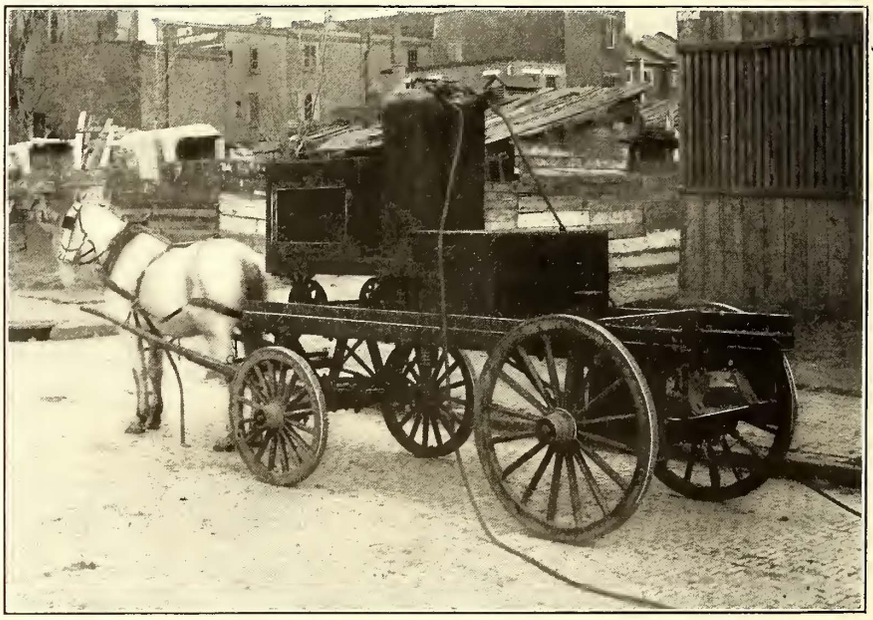


FIG. 10.—COMPRESSING APPARATUS FOR PNEUMATIC RIVETER

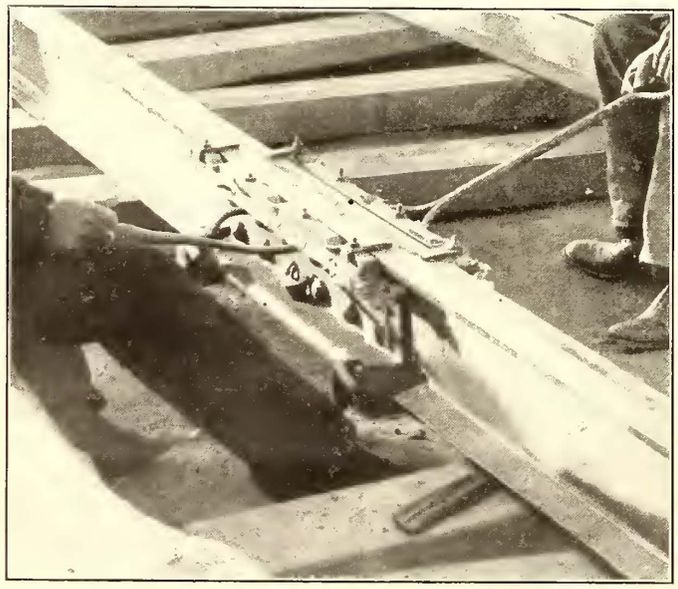


FIG. 13.—JOINT CAULKED READY FOR CASTING

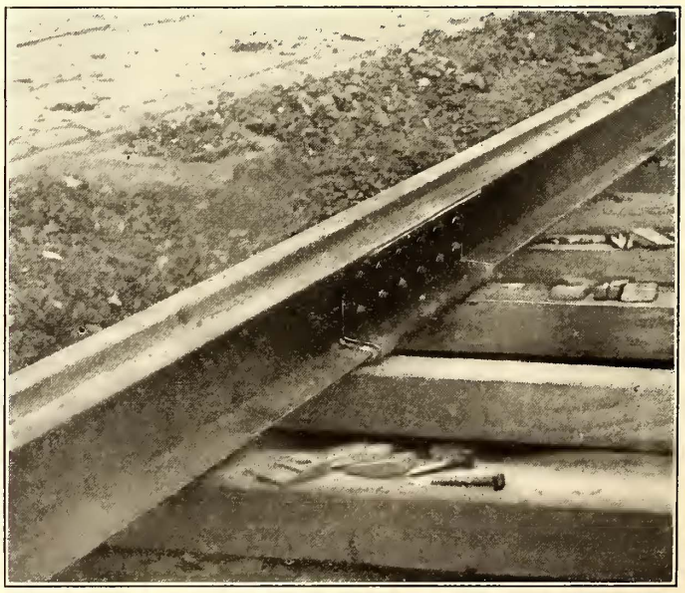


FIG. 14.—COMPLETED JOINT, INSIDE VIEW

company installed a number of riveted joints. These joints were illustrated and described in the STREET RAILWAY JOURNAL for April, and were made up of fish-plates 30 ins. long, without top and bottom flanges, and held in place by twelve ⅞-in. rivets. Some of these joints have been in use for about a year, and so far have given satisfaction.

SPECIAL WORK

The company's standard special work and appliances were fully described in the December issue of the STREET RAILWAY JOURNAL. In this article it should have been stated, however, that a number of the most important patents on the articles described and illustrated are now

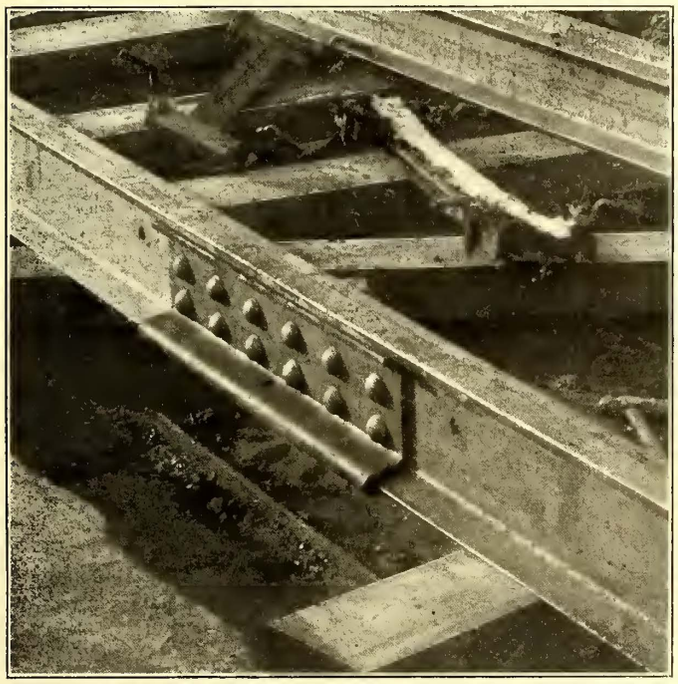


FIG. 11.—JOINT WITH ASBESTOS FOR CAULKING

owned by William Wharton, Jr., & Co., Incorporated, the well-known special work manufacturers, who are furnishing these articles, as well as large amounts of special work in general, to the Union Traction Company.

CHROME STEEL WHEELS

Fig. 16 shows a new type of car wheel with which the company is experimenting. The rims of the wheel are made of chrome steel and the centers are of ordinary cast iron. With this method of construction the wheels do not weigh more than the ordinary wheel. The rim is attached to the center by means of cast zinc, which is run into an annular opening between the rim and the center, 3-16 in. in diameter at the ends and ⅜ in. in diameter in the center. The cross section of the zinc annulus or ring, as shown in the engraving, is such as to bind the tire to the center. When the rim or tire wears out it is the intention to renew it without renewing the center, which can be done without removing the latter from the

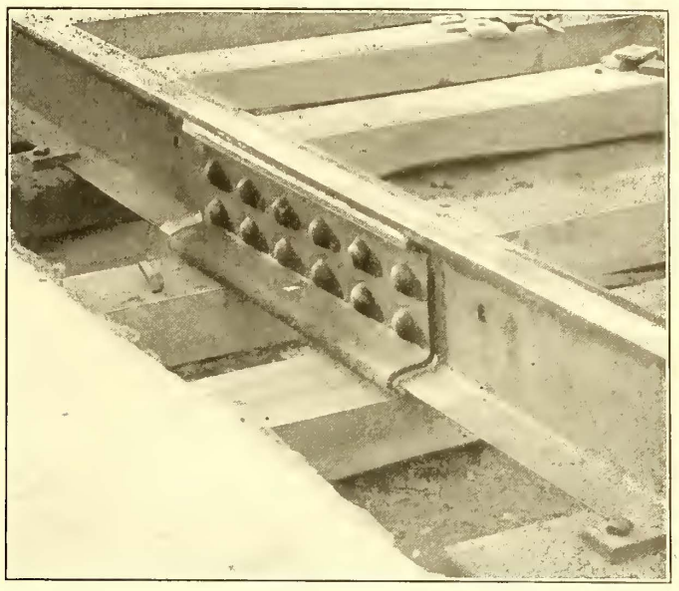


FIG. 15.—COMPLETED JOINT, OUTSIDE VIEW

axle. The invention has been patented by C. B. Voynow, who is connected with the engineering department of the Union Traction Company, and eight of these wheels are in use. They have not been running a sufficient length of time to enable the company to determine their wearing qualities, as compared with that of cast iron.

Fire at Brooklyn

The repair shops of the Fifth Avenue elevated division of the Brooklyn Rapid Transit Company, of Brooklyn, N. Y., located at Thirty-Sixth Street, were destroyed by fire on Feb. 20. The fire is said to have started in the engine room of the machine shop. It spread rapidly, extending to the car yards, where many cars were stored. Ten cars are said to have been completely destroyed, and it is reported that twenty others were damaged by the flames. A switch tower was also destroyed. The Union Depot, from which are operated the Bath Beach, Bensonhurst and Ulmer Park cars, and where the elevated cars run down an incline to the surface, is directly opposite the machine shops. The loss is placed at $125,000.

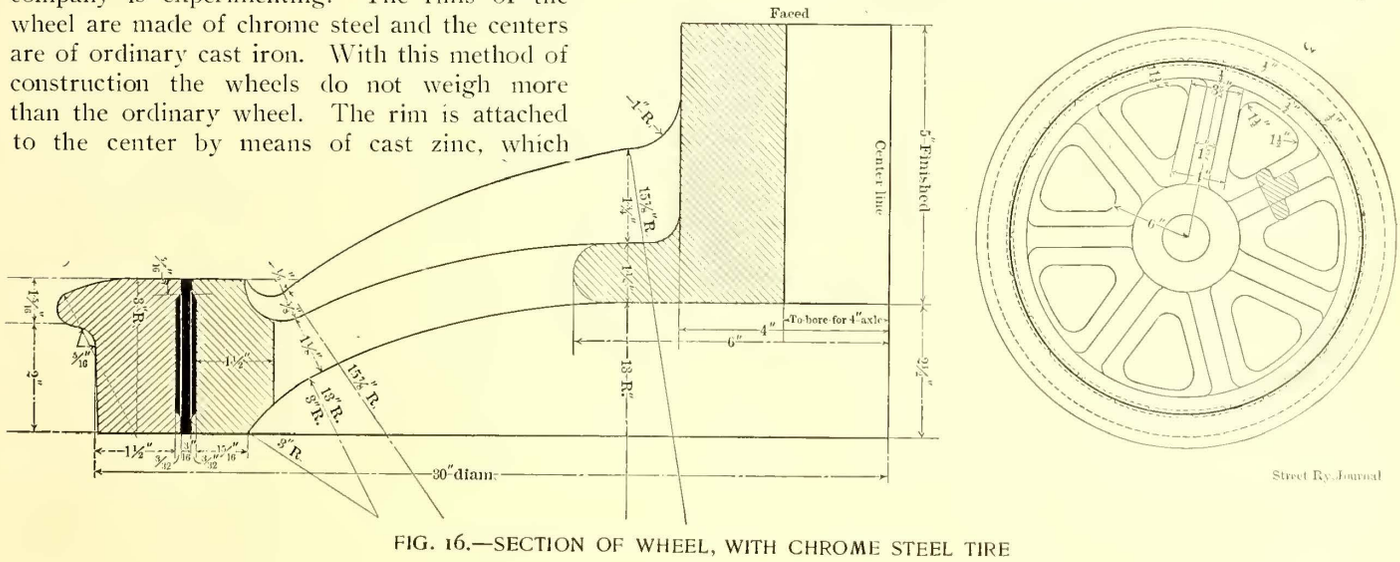


FIG. 16.—SECTION OF WHEEL, WITH CHROME STEEL TIRE

The Double Trolley Trackless Motor Car

BY MAX SCHIEMANN

The advantages of the "trolley omnibus," or "trackless car" system, which it is the purpose of this article to describe, over the ordinary electric car, lie in the fact that such a line is very much cheaper to construct, so that it is often possible to make a short road of this kind pay, especially when it is an extension or a spur to an ordinary trolley line, where the traffic would not warrant the construction of a regular trolley road with rails. Thus, a road of the "trackless" kind can be built and equipped for from $4,000 to $5,000 a mile, exclusive of power station, and can be put on a paying basis from the day it is opened, as the cars can be run only as frequently as the traffic demands.

FIG. 1.—END VIEW OF TRACKLESS CAR

The first electrically operated trackless motor car was shown in actual operation at Vincennes Park during the Paris Exposition, and was of the French Lombard-Gerin type. During the spring of 1901 the same company installed a similar service at Eberswalde. This system provides for a double overrunning trolley with a flexible cable, by which the current is led down to the top of the car.

In the system which I propose to describe the construction of an ordinary overhead electric track road is retained as much as possible, so that a trackless road may be transformed at any time into an ordinary track road without any change in line construction. The current is collected from the trolley wires by a specially constructed contact shoe and pole with ability to swing out at the side somewhat similar to that of the Dickinson system. The car is not at liberty to move about as freely in this system as by the French plan already mentioned, but as most streets along which these cars are designed to operate are not wider than from 20 ft. to 25 ft., and as they are not usually crowded, it seems sufficient to allow for a 10-ft. deviation to each side from the center of the road. Fig. 3 and Fig. 4 show how this side contact is made. Experience has shown that this amount of side movement is quite sufficient for allowing the car to pass by another vehicle, which is also shown in Fig. 3 and Fig. 4.

The fact that no track is needed for such a road restores all parts of the highway to general traffic, and the ease of dirigibility of the cars permits them to follow the ordinary rules of the road.

A road of this type has been installed in the Biela Valley, in Germany, between Königstein-a.-E. and Königsbrunn, and was opened on July 10, 1901. The road carries passengers as well as freight between all the intervening towns. During the year 1902 it is proposed to extend the line to the beautiful summer resort "Bad Schweizermühle," which is 11 km (8½ miles) distant, and situated 270 m (890 ft.) above the towns mentioned.

Fig. 1 shows a passenger car with a somewhat unsymmetrical front construction, while Fig. 2 shows a side view of the same car with a small freight trailer attached. This motor car was built by Siemens & Halske, of Berlin. The local freight service can be carried on very economically, because connection can be made with factories and storehouses without requiring any special construction. It is only necessary to branch off a double trolley line from the nearest pole, which is far simpler than the construction of a track siding, which frequently is out of the question.

The speed of the passenger cars is 12 km, or 8 miles, per hour, and of the freight cars from 8 km to 10 km per hour. In Fig. 4 is shown how one motor car passes another. The one car has to remove its contacts from the wires while the other is passing. This eliminates all switches. Fig. 5 shows the arrival of a car at the road terminal.

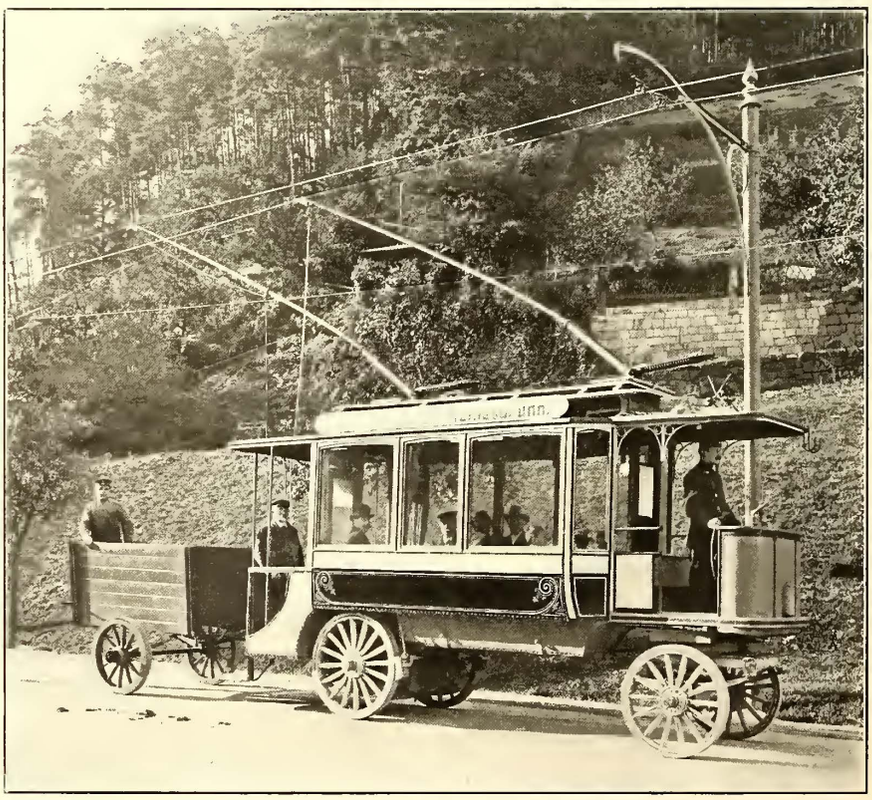


FIG. 2.—PASSENGER CAR AND TRAILER

The first problem to be solved was the choice of a serviceable contact shoe, as a sliding contact was considered preferable to a wheel. The Dickinson contact, which is in use considerably in England, was not acceptable in its ordinary

form, as contact was not always assured when the shoe pressed against the wire from the side. I therefore adopted a shoe which was swiveled around a vertical as well as horizontal axis. The long contact surface is filled with a soft, well-conducting material, so as to lessen the wear on the trolley wires. There are, furthermore, recesses in which a fat of considerable consistency is put which helps to lubricate the contact shoe. By means of a specially constructed spring the entire surface constantly bears against the wires. The shoe is easily placed against the wire by means of a rope and a guiding fork surrounding the shoe.

The trolley pole, together with the mainspring, is movable about a vertical pin, so that the contact shoe and the car are always parallel. The distance between the trolley poles is 50 cm (1 ft. 7½ ins.), the same as between the wires. Along the length of the car the poles are separated by a distance large enough to permit them to be turned around without their bases touching each other.

The car body is of symmetrical construction, and being similar to ordinary street cars, can be easily turned. In reversing it the trolley poles need not be removed from the wires, as the car can be backed. The line construction is but slightly different from the standard method. Figure 8 wire and mechanical clips are used. The insulators are kept at a uniform distance apart by wrought-iron braces, which insure a uniform distance between trolley wires. The same insulator can be installed at curves as well as on straight sections. In case it is desired to branch off from the main line, a similar two-wire line is built, which is connected to the main line. The car contacts are simply taken from the main line wires and transferred to the branch line wires.

The springs on the car must be carefully designed, for too strong a spring makes riding very uncomfortable, while too weak a spring causes the contacts to jump away from the trolley wires whenever there is great unevenness in the roadbed. The problem was carefully studied, and a combination of spiral and flat springs was finally adopted.

The car wheels have a diameter of 1 m (39 ins.) and 1.1 m (43 ins.), and a width of tire of 9 cm (3.5 ins.) and 10 cm (3.9 ins.). The gage is 1.5 m (59 ins.). Two motors operate the car, and the gear reduction is 1.8 to 1.

The car seats eighteen persons, and six more can stand on the rear platform. The front platform is for the motorman only, so that his attention is not diverted. The interior is lighted by six incandescent lamps, and a strong headlight is attached to the front dashboard. There is one incandescent lamp on the front platform and two on the rear.

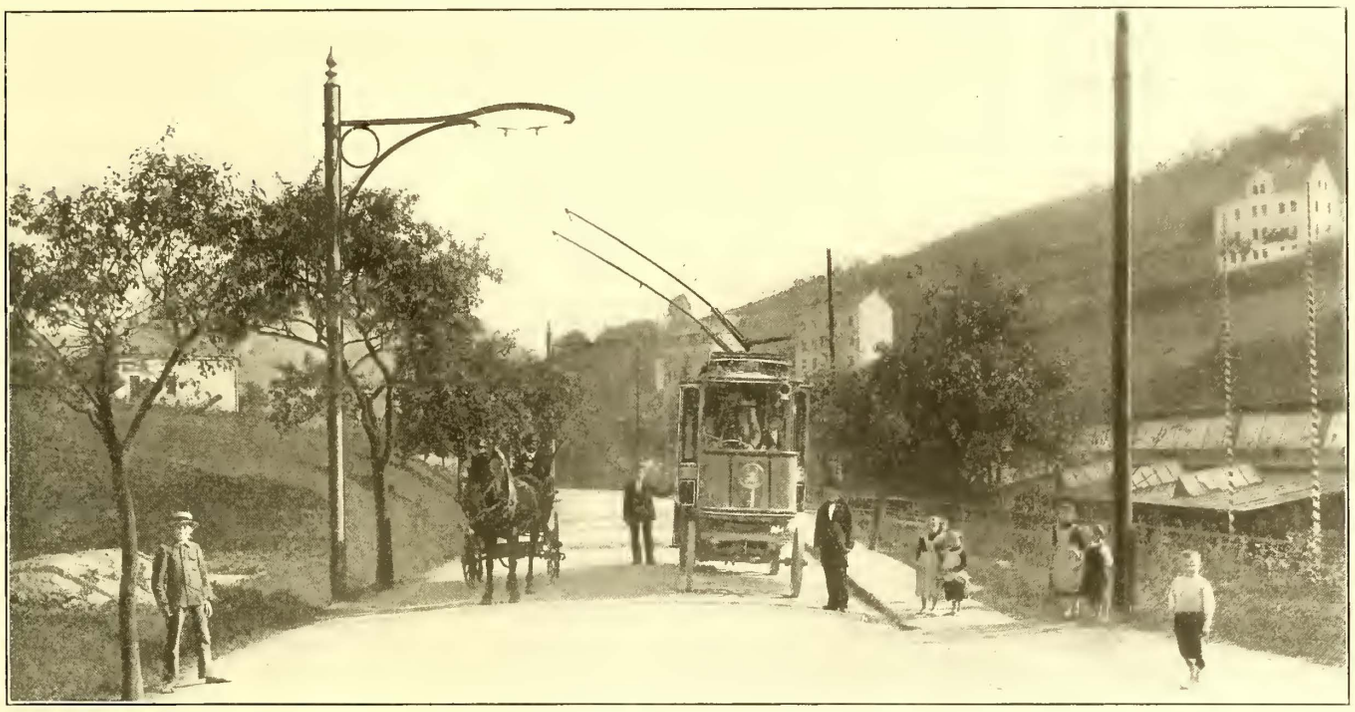


FIG. 3.—CAR PASSING VEHICLE ON ROAD

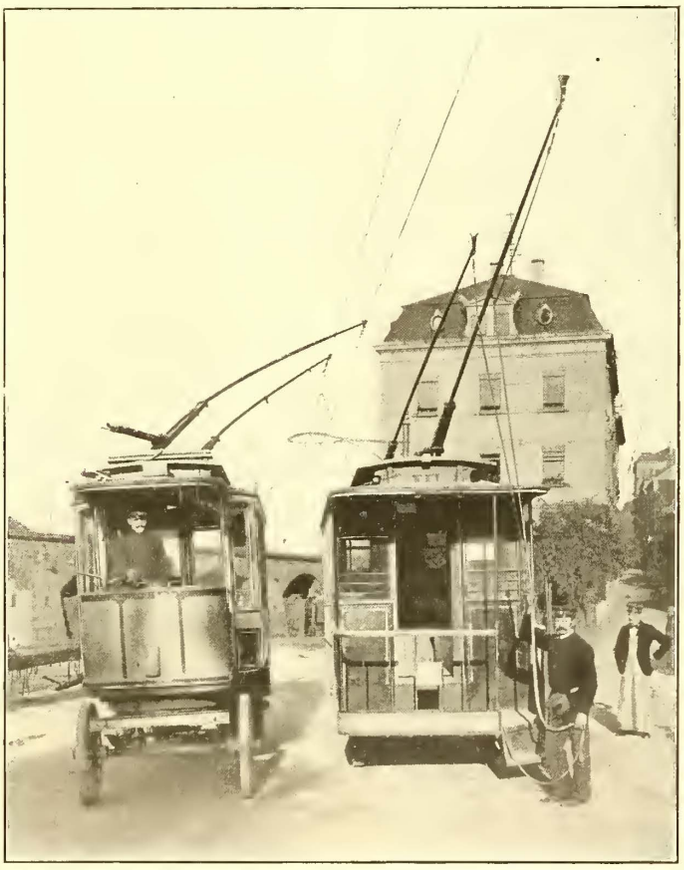


FIG. 4.—TWO CARS PASSING BY REMOVING POLES OF ONE CAR FROM OVERHEAD WIRES

The car is steered by the turning of the entire front truck. Balls are inserted between the rings separating the movable truck and the car body, so that there is rolling friction in-

stead of the customary sliding friction. This makes it possible to steer the vehicle with ease while it is moving, with one hand and a wheel which is 60 cm (23 ins.) in diameter. The mechanical brake acts only on the two rear wheels, in

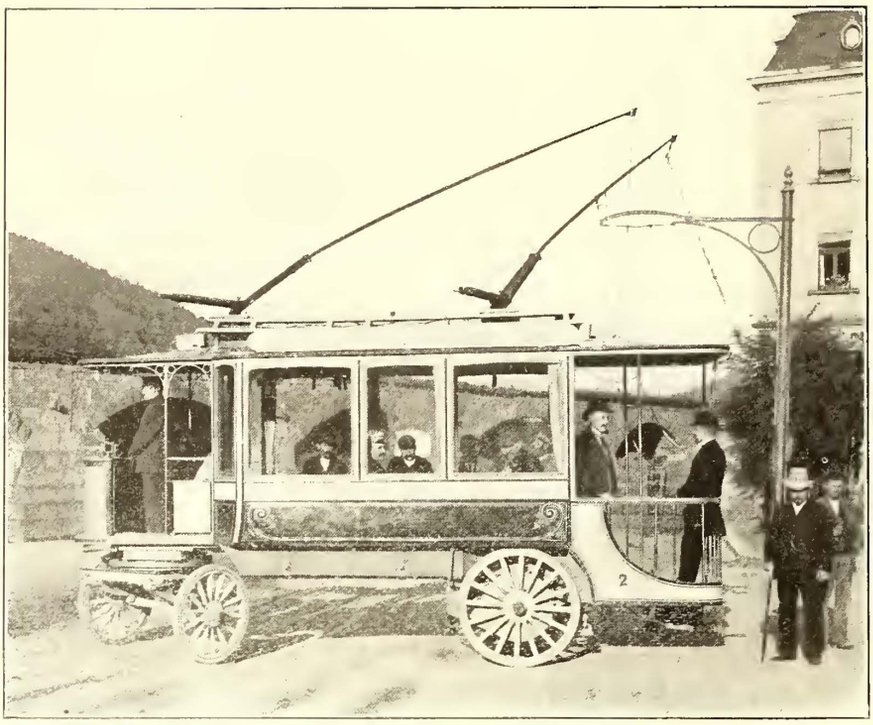


FIG. 5.—CAR AT TERMINUS TURNING AROUND

front of which the sand tubes are located. Generally the electrical short-circuit brake is used, which acts simultaneously on all four wheels, and can be operated with greater ease by the motorman, because it is brought into

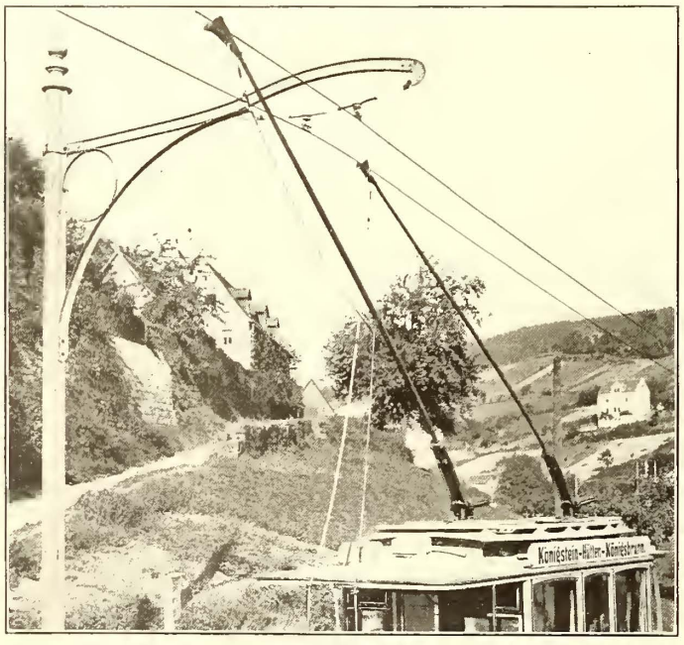


FIG. 6.—VIEW OF CURRENT COLLECTORS USED

action by moving the handle of the controller. In this way the entire adhesion of the car is utilized for braking, which is essential for perfect safety along slippery roads.

By means of the controller the car may be made to run forward or backward, and the speed is varied by series parallel connections of the motors. The current is led down to roof lightning arresters, fuses and automatic circuit breakers, which can be easily reached by the motorman.

On the line in operation there is an average grade of 2.5 per cent, which has many curves, but it is well built. Measurements show that the tractive resistance is about 25 kg per metric ton (25 lbs. per 1000 lbs.), according to the condition of the road, or about twice as much as a trolley car. The car can descend the 2½ per cent down grades without the use of current. No more power is required on curves, however, than on straight track, and in this respect the vehicle is more economical than the trolley car. The actual current consumption on this road per ton mile after a three months' trial was shown to be practically double that required on a track road. This extra current, however, cost only about one-tenth as much as the track and its bed would cost in the form of interest, sinking fund and depreciation. This shows a clear advantage for the trackless system on roads of very light traffic in spite of the greater current consumption. Where the traffic is heavy the track road is always more economical.

The figures cited above are so favorable that the projectors of roads for light traffic may well take into consideration the construction of trackless roads. In fact, the results obtained on the Bielathal road are far more favorable than had been anticipated. The possibilities for a road of this kind are of course more favorable where electric power from an existing railway or lighting station is available.

Improvements at Pittsburgh

The Pittsburgh Railways Company, of Pittsburgh, Pa., in accordance with its plans for the improvement of the street railway system to which it succeeded on Jan. 1, has recently made some important announcements. As previously noted the sum of $2,000,000 was voted in order that the company might carry out, untrammeled, the improvements that were deemed necessary. The announcements that have recently been made show that a large new power station is to be built, and that 200 new cars are to be added to the equipment. The new power house is to be located on Brunots Island, and will be 400 ft. x 200 ft. The plan is to begin construction work as soon as the condition of the ground will permit, and it is expected that part of the apparatus will be ready for operation by Jan. 1, 1903. Already contracts for the boiler and engine equipment have been let. Six Rice & Sargent engines, aggregating some 20,000 hp, are to be installed, and the contract for supplying them has been awarded to the Providence Engineering Company. The Babcock & Wilcox Company has been awarded the contract for boilers, aggregating 10,000 hp. Several of the present plants now in operation will be retained as auxiliaries. The car contract is for 100 cars, and they will be larger than any of the open cars now operated by the company. There will be seats for eighty-four people, the seats running crosswise. The present open cars in use seat forty-five to fifty people. The cars are to be equipped with power brakes. The specifications call for deliveries to be made in May, and the cars will be distributed on all lines. Contracts for the 100 new closed cars are to be let at once.

The Electrical Equipment of the Providence, Warren & Bristol Railroad

The section of the New York, New Haven & Hartford Railroad known as the Providence, Warren & Bristol Branch has recently been equipped with the overhead trolley system, and the trains are now run over it by electricity. This line extends from Providence to Fall River, with a branch road at Warren running out to the town of Bristol. The road from Providence to Warren, ten miles in length, and from Warren to Fall River, also about ten miles, is double track, the branch road running out to Bristol, four miles, being single track. The electric service has now been in operation for about a year, a temporary power house having been constructed which has supplied it with current. The new main power house of the company is now, however, almost completed, and the temporary engine and dynamos upon which the operation of the road at first depended are now used only during the peak of the load. No new branches have been constructed, the line, with the exception of more frequent stops, being run on the same general plan as when operated by steam locomotives.

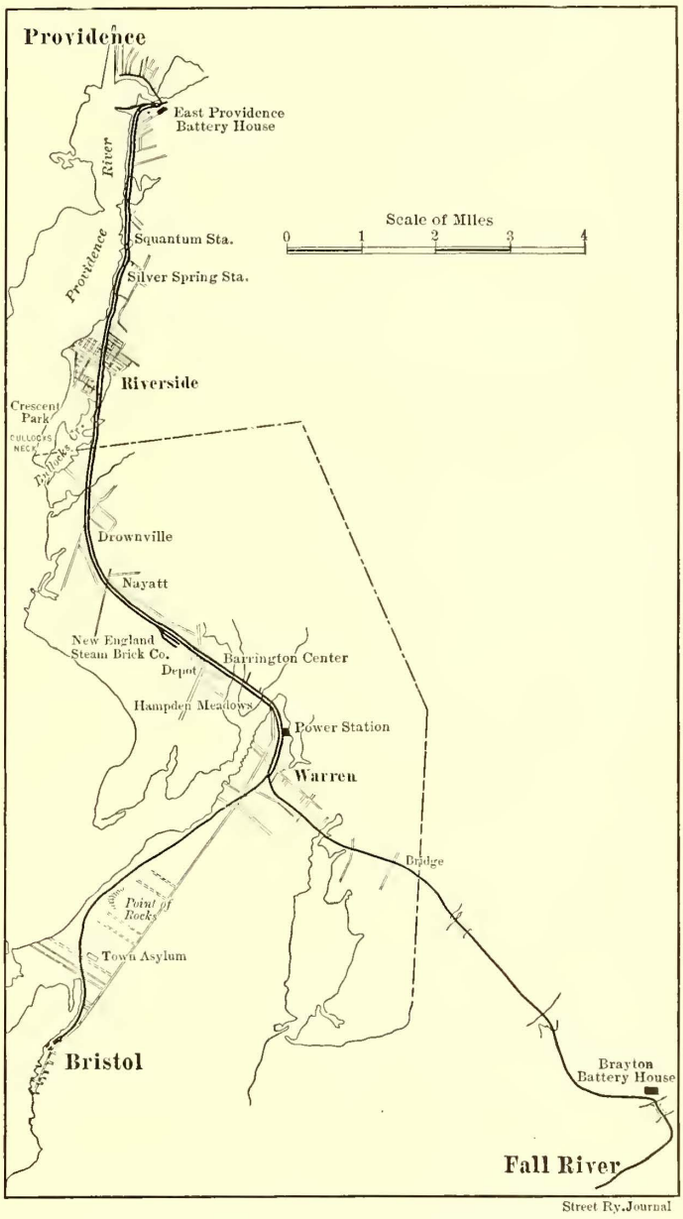
POWER HOUSE

The new power house is a handsome brick structure, situated in Warren, almost exactly half-way between the two termini of the road. The generating equipment will consist, when completed, of two 850-kw, 625-volt generators made by the General Electric Company, of Schenectady, N. Y., direct connected to two cross-compound condensing Greene engines made by the Providence Engineering Company.

The switchboard is situated at the side of the power house, a recess being provided behind so that the switchboard stands out free from the wall, and access to all its parts can be had with great facility. The boiler house adjoins the engine room and has a stack 115 ft. high. The boiler equipment consists of ten 200-hp Bridgeport return-tubular boilers, arranged in two batteries, with a passageway containing the feed-pumps between. All of the boilers are arranged with steam jets in the fire-box for burning "sparks," this fuel being obtained from the engines of the New York, New Haven & Hartford Railroad, and costs only the expense of hauling to the power station. The coal bunkers are arranged at the back of the boiler house,, a separate wall being built immediately behind and along the entire width of the building, which gives a large storage capacity. Tracks are run to the top of this pocket by an easy grade at the side of the building, and the coal cars can be pushed directly above the storage bin by the electric cars of the company. The boilers face the back wall of the boiler room, in which openings are provided a short distance above the floor for access to the bottom of the coal bin, and the firemen have only to carry the fuel from one side of the space in front of the boilers to the grates. Two Snow duplex feed-pumps, 9 ins. x 5½ ins. x 10 ins., are used. The water is generally obtained from the town supply, although the company has a 180-ft. well on its premises adjoining the power station. All the steam piping is "extra heavy." Between the boilers and the main headers curved leads are used made of copper pipe which enter the headers from the bottom. These copper leads are made extra large, and the center line of the engine cylinders are above the water line in the boilers, preventing all possibility of a syphoning action, so that no separators are required. A platform runs along the header, giving access to the valves in both header and leads. The boiler pressure is 120 lbs. The Holly gravity system is installed on the boilers.

The condensers were made by the Dean Brothers Steam Pump Works, Indianapolis, Ind., and are of the jet type. They are placed in the basement close to the engine foundations. The condensing water is taken from the bay back of the power station by a 14-in. pipe. This pipe is about 500 ft. long, 286 ft. being on the land and the remainder stretching out to a square wooden crib made of piles and slats which protects the suction head. This pipe is supported on piles at each joint, the length of the sections being 12 ft.

The boiler room was constructed and the boilers were



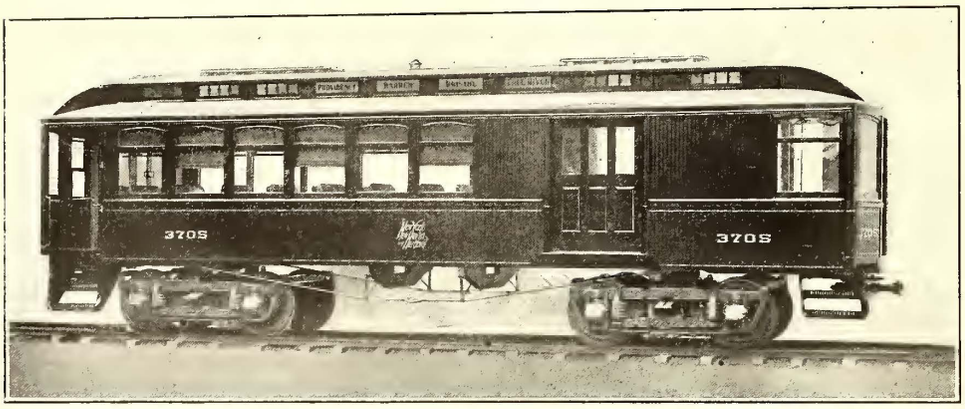
MAP OF PROVIDENCE, WARREN & BRISTOL BRANCH

installed in time for supplying steam to the temporary power station, which was built adjacent to the foundations of the present structure. This temporary power station contains two 500-kw, 550-volt generators made by the Westinghouse Electric & Manufacturing Company, and belted in tandem, with one belt running over the other, to an old mill engine purchased by the company for this temporary service. As stated above, this temporary plant is now only used as an auxiliary to the new plant during the peak of the load. The two plants are not run in parallel, but each supplies separate districts. The feeder system is divided into four sections, so that those nearer the power station, on the main line and the Bristol branch, may be

run on the 550-volt generators during the periods of heavy load. The power station is helped out at this time also by two storage batteries, one placed at each end of the line. These batteries are of 800-ampere-hours capacity each, and consist of 250 G-11 cells made by the Electric Storage Battery Company, of Philadelphia. One is at East Providence, and the other at Brayton, near Fall River.

CAR HOUSE

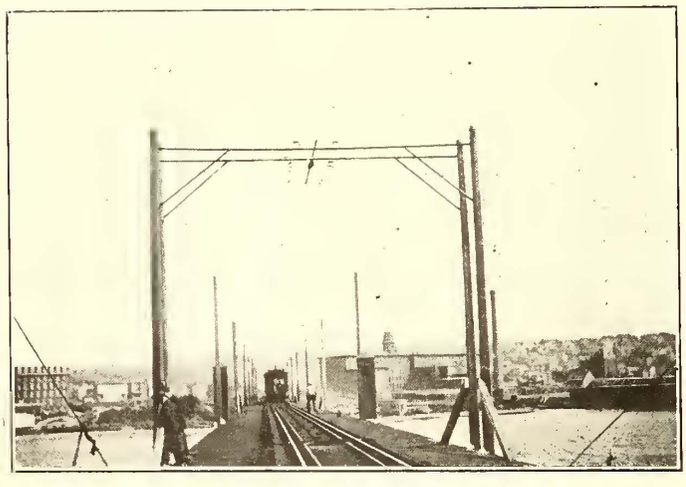
The car house is located in Warren, near the power station, and is likewise constructed of brick. There are seven tracks running into the car house, the eastern portion of which is partitioned off and used as a repair shop. The shop is provided with a transfer table made by the Taunton Locomotive Works, of Taunton, Mass., and with the necessary equipment for making ordinary repairs on the trucks, motors, controllers, etc., of the rolling stock. Hooks are suspended from the ceiling by means of which either end of the cars can be jacked up and the trucks rolled from under; and a pneumatic hoist is provided for handling heavy parts.



STANDARD COMBINATION BAGGAGE CAR

CARS

The rolling stock of this branch of the road consists, in all, of forty-six cars; of these twenty-four are passenger coaches, used as trailers, and nine are combination baggage and passenger cars. Besides these are two combination baggage, express and mail cars, containing three compartments, each keeping the different departments entirely distinct, and one New Haven standard 70-ft. passenger coach, equipped with motors. The cars were furnished by the J. G. Brill Company, of Philadelphia, and the Osgood Bradley Car Works, of Worcester, and are all equipped with Brill trucks. The motor cars are equipped with a modification of the standard Brill twenty-seven truck, having the side bars slightly shortened at each end, so as to conform to the designs of the cars which were made in the offices of the electrical engineer of the New York, New Haven & Hartford Company. A somewhat lighter truck is used on the trailers. The cars are equipped with General Electric motors, type G. E.-51, which are nominally rated at 80-hp. There are four motors to a car. All of the baggage and combination cars are motor cars, there being but a few of the passenger cars which can be used independently. The train service is mostly made up, therefore, of a combination baggage car and one or two passenger trailers. The motor cars are each equipped with two trolley poles, the trolley bases being made by the General Electric Company, and known as the No. 6 type. Each motor car is also equipped with cow-catchers at each end under the platforms in front of the truck, not shown in the cut. The electrical equipment is also double-ended, a controller being placed at each end of the motor cars, so that they can be run in either direction. The vestibules have but one door each, so that access can be had to the car at the rear end from the outside of the track only. One side of the vestibule is occupied by a motorman's compartment. All cars are equipped with Van Dorn couplers and Bliss gates. There are three steps at each vestibule, so that passengers can alight at points where there are no station platforms. Each car is supplied with eighteen electric lamps, nine on each side of the monitor, placed in horizontal sockets, and receiving their current from the motor car by flexible electric connections.



FALL RIVER BRIDGE

The seats are of the well-known walk-over type, and were made by the Heywood Brothers & Wakefield Company, of Wakefield, Mass., and the Hale & Kilburn Manufacturing Company, of Philadelphia. They are covered with red plush. Underneath are placed cylindrical electric heaters made by the Gold Car-Heating Company. All cars are equipped with air brakes made by the Christensen Engineering Company, of Milwaukee, Wis., and operated by a motor compresser placed in a box under the motor car. The motor cars are equipped with whistles and gongs, the latter being used when approaching the stations.

The car illustrated is one of the Brill combination baggage and passenger cars. Its length over all is 40 ft., and over end posts, 31 ft. 6¼ ins. The width over sills is 8 ft. 4 in., and the height of the body from under side of sill to top of roof, which is of the steam-car type, is 9 ft. 1¼ ins. The passenger compartment is 18 ft. long. The car body weighs, without equipments, about 20,000 lbs. The inside finish is mahogany, and the glass in the windows is double thick French.

The type of wheel used on these cars is 36 ins. in diameter, having a 15-16-in. flange and a 3-in. tread. The wheels are of cast-iron construction, and were made by Barnum Richardson, of Salisbury, Conn. The tread of the wheels is made somewhat wider than in ordinary interurban service, as the same amount of play is allowed between the flange and the rail as is ordinarily provided in steam railroad operation. This gives a wheel which is impossible to operate on city tracks, the edge of the tread overhanging too far to escape injury from the pavement.

TRACK AND OVERHEAD CONSTRUCTION

The roadbed has gravel ballast, and the rail is 78-lb. T, A. S. C. E. section. The rails are bonded by Washburn & Moen crown pin bonds, placed under the rail. Two bonds are used at each joint of 200,000 circ. mils each, the leaf type of bond being used. The trolley wire is No. 0000, round, made by the Coe Brass Manufacturing Company, Ansonia, Conn., and is suspended from 15-in. trolley ears. The trolley wire is fastened to the ear by being gripped by the lips of the ear and soldered thereto. Both span wires and bracket construction are used, the overhead material, with the exception of the trolley wire, being manufactured by the Ohio Brass Company and supplied from the Pettingell-Andrews Company, of Boston. In the bracket construction short malleable iron supports extend down from the bracket, to which the wire supporting the wire trolley ear insulator is attached. As the road runs on its own right of way, is not run in close proximity to buildings, and wooden poles are used, but one insulation is employed between the trolley wire and the ground. There are no strain insulators, therefore, in the span wires.

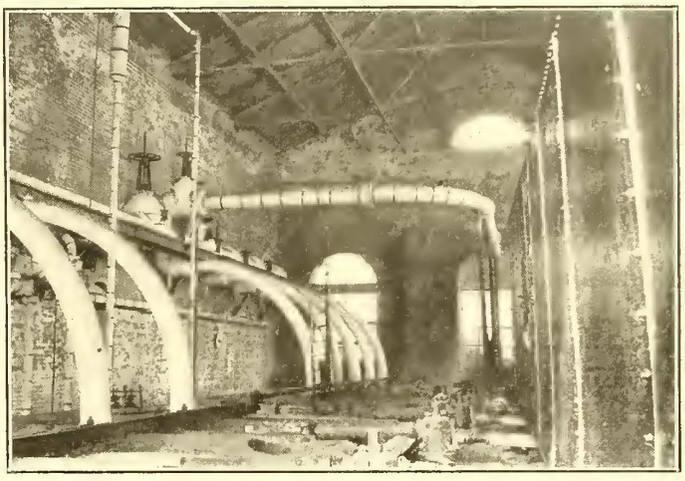
At the incline which has been constructed to the coal storage back of the boiler house a novel form of bracket has been installed, which was made from the designs of the railway company. This consists of a double arm made of two angle-irons riveted together at the outside end, and separated at the pole. This is bolted to each side of the pole and held in a horizontal position by a guy wire from the end of the arm to the top of the pole. One of the angle-irons is made longer than the other, and this extension is bent over downward. Between the extremity of this bend and an eye-bolt in the pole is stretched the short horizontal wire supporting the trolley ear. This type of bracket has proved so successful that an order has been given for a number to be installed along the main line.

DOUBLE TRACK CONSTRUCTION

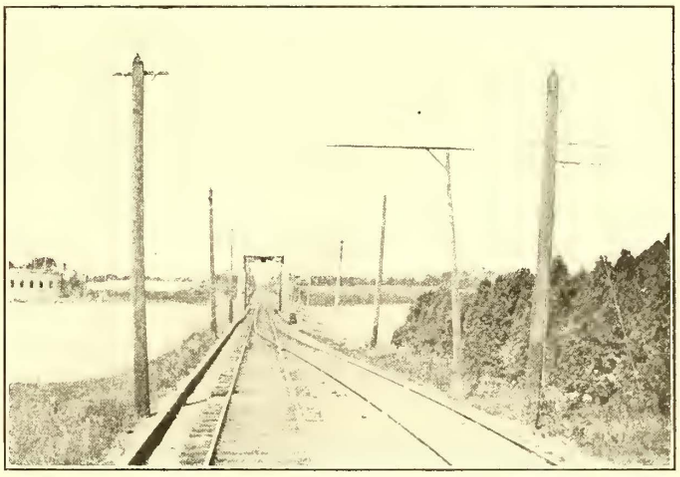
OPERATION

The New York, New Haven & Hartford Railroad is now operating over the Providence, Warren & Bristol branch 112 trains and single cars every day to and from Providence. This service is both local and express, and the time of running between Providence and Fall River has been reduced two or three minutes, although the number of stops has been greatly increased on the local trains. The running time between Providence and Fall River on local trains, making twenty-six stops, is 45 minutes, and for express trains, making seven stops, is 33 minutes. The old steam schedule between Providence and Fall River was 48 minutes for local trains with fourteen stops and no express trains were operated. On the Warren & Bristol branch the express trains now do on a schedule of six minutes what formerly took seven, and the local trains make four intermediate stops, which before were not on the time table, on a seven-minute run.

The old stations of the railroad company are used, but a number of stops at road crossings have been added. At all important grade crossings there are stationed men who operate the crossing gates, as in the old steam railroad days. At all other crossings where electric alarm bells were formerly operated there is no provision made for safety other than the vigilance of the motorman and his control of his train. Between Providence and Fall River the fare, which formerly was 50 cents, has been reduced to 20 cents. The road is divided into four sections, a five-cent fare being taken by the conductor after the line of each section has been crossed. Tickets are sold for the convenience of passengers, but no reduction is made in price. Each car has its own conductor, and besides the motorman there is an extra brakeman on every train. The fares are registered as collected on a register made by the New Haven Car Register Company, of New Haven, Conn. The cars are provided with a bell rope which, when pulled, operates a whistle in the motorman's compartment on the platform in the same manner as the signal whistle in the engine cab of the steam trains is blown.



BOILER ROOM ABOVE BOILERS



CROSSING A SINGLE TRACK BRIDGE

The work of electrically equipping this branch was carried out by the electrical department of the New York, New Haven & Hartford Railroad, of which Colonel N. H. Heft is the chief, the plans for the power station and line construction being prepared in his office. R. E. Wade is the resident engineer in charge.

The Brown System of Discipline as Used in Elmira

A great deal has been said and written about the Brown system of discipline as employed on steam railroads, and its value on properties of this kind has been so marked, according to the testimony of steam railroad operators, that it has been adopted by practically every large steam railroad line in the country. Briefly, the system as employed on steam railroads consists in abandoning the old plan of lay-offs, or suspending an employee for several days, or a week or longer, as a penalty for the infraction of some rule of the company, and instead continuing the man at work, but making a record of the offense. Such a record, if kept in a systematic manner, soon determines the usefulness of the man in the service of the road, and if a study of it shows that the poor service is apt to continue the man is discharged. In other words, this is the final and really the only penalty used in the Brown system of discipline. It can be said in its favor that the experience of practically every large steam railway system in the country is that lay-offs form the worst possible method of disciplining from the standpoint of both the company and the employee, because they usually stand in the way of the employee giving good service after he returns to his position. The reason for this is that unless the person who has been "laid off" has a good-sized bank account, he gets behind in his domestic payments and cannot make up the lost time after he gets back to his position. His creditors worry him, he gets careless, and finally gets into a frame of mind where he does not care whether he keeps his position or not, so that a poor employee is made out of what might have been a good one.

The "record" which is used as a substitute in the Brown system for the lay-off is kept in various ways. As employed on some roads, it is simply a series of brief entries in a book of each employee's good and bad deeds, so far as they relate to the service, and as they are brought to the attention of the management, and if the offenses predominate or assume such a large proportion of the whole number of acts recorded that the man's services to the road do not seem worthy of continuance, he is discharged. Other companies employ a modification of the system in which certain acts, both good and bad, are rewarded or penalized by a certain number of merits or demerits, and from the sum of these different markings, as shown by the record book, a man's desirability and standing as an employee is gaged by the management.

The Brown system as recognized by the cardinal principle of avoiding the lay-off as a punishment and confining the discipline to a certain number of warnings, with discharge as an ultimate contingency, is employed by many street railway companies in this country. Most of these companies, or certainly those who have expressed an opinion one way or the other on the results of this system, speak in favor of it and report that it is also popular with the men. The most common method of applying the system is to keep an individual record of each employee with written memoranda as to the actions, good or bad, which relate to his efficiency, and from this record the manager governs himself as to reprimands and discharges for each employee. When a book is kept in this way a common method is to indicate either all of the meritorious acts in red ink or to distinguish a certain class of faults in red ink so as to make it easy quickly to read and understand the record.

Of course this system, though better than depending entirely upon the superintendent's memory, has the disadvantage, first, that the memory of the manager still plays an important part in the summing up of a man's performances for a year or several years previous, unless the memoranda made are so explicit as to cover all of the important facts as to each act recorded, and second, because the natural tendency is to put down only the offenses, so that a man has comparatively little chance, except through immunity from accident, to increase his standing. Nevertheless, the system, as just outlined, is practically as complete as that used on a great many, if not on all, steam railroads, and is properly known as the Brown system. Modifications of this system, however, have been introduced on several street railway properties with the idea of establishing a more accurate rating for each man, and one which can be expressed numerically and which would be a criterion of the value of his services as compared with those of the other employees. This, as will be seen, is a radical step in advance of a rating depending entirely upon a mental summary of the man's record as shown in a book of memoranda. In the latter a man's prejudices or preconceived opinions, or his feelings at the particular time are apt to affect his judgment, no matter how conscientiously he may desire to act in an unbiased way. Moreover, the judgment of most men is apt to be governed largely by their impression of recent acts rather than by the previous good or poor work on the part of the person whose record is being judged. On the other hand, a numerical rating for each employee, with definite rules to guide the superintendent in establishing the rating, such as it is the purpose of this article to describe, avoids many of the disadvantages of the "mental summary" plan. In the first place, it eliminates largely the possibility of favoritism, conscious or unconscious. A list of all the possible cases which might happen is prepared and judgment is passed upon them by all the leading officers of the road, who fix the relative number of points of merit or demerit for each act. This eliminates the judgment of foremen, inspectors and starters, who simply report the acts. It also prevents hasty or snap judgment on the part of the management of an employee's offense. In the second place it produces legitimate competition among the employees to increase their respective ratings. As they know that their standing depends entirely on their own efforts each tries to do his best in operating skilfully the apparatus under his charge, in gentlemanly deportment and in tidiness in dress. If properly administerd, the charge of rigidity cannot properly be brought against the numerical system, for, while certain merit and demerit marks have been assigned to specific acts, the manager is guided only, not bound down by them.

Particulars were published in the Street Railway Journal for September, 1901, and November, 1897, of the methods used in this merit system of rating employees in New Orleans. Another company which has gone very thoroughly into this plan, and with marked success, is the Elmira Water, Light & Railroad Company, of Elmira, N. Y. The history of the use of this system in Elmria dates back to about four years ago, when it was first put in operation on the West Side Street Railway of Elmira by W. W. Cole, who was then general manager of the company. When C. F. Uebelacker assumed the management of the Elmira Water, Light & Railroad Company a conference was held, the rules and regulations were revised, and a more complete system of merits and demerits was put into effect, based upon the one then in use, and upon Mr. Uebelacker's experience at New Orleans. Since Mr. Cole assumed control of the consolidated lines of Elmira, these rules and regulations have been again revised, and some few changes made in the merits and demerits.

Briefly stated, the system consists in giving each street railway employee at the beginning of each

year, or if he commences his service with the company during the year at the beginning of his work, a rating of zero. Each man can then increase this rating by efficient service or the performance of different meritorious acts, for which a special number of merit marks has been assigned; or his rating is debited by a certain number of merit marks if he infringes certain regulations of the company. Each man is promptly notified of any additions or subtractions to his rating, and a record is kept of all such merits or demerits in a book especially ruled for the purpose. Each record is added up at the end of every month and the amount is carried over to the next month, except at the end of the year, when all the men commence again at zero. The page of the record book on which a man's record is kept is open at all times to his inspection, or if he requests it a transcript will be made of the record and given to him, but no employee is allowed to see the record of any other employee. The record made by each man, not only during one year but during previous years, is considered in case of promotion, as it is understood that the men having the best record are most likely of advancement. On the other hand, if a man's record falls below one hundred demerits at any time he is liable to discharge. This rule is not absolute, but is of course subject to the discretion of the general manager who takes the past records of the man under consideration. If on looking over these past records, he finds that the employee is on the whole a desirable man, but has been unfortunate for certain reasons, the man may be retained in service for a time on probation to see if he can build his record up; thus a man might have a very bad accident which would give him enough demerits at once for a discharge, but if during the previous two or three years he has had a clean record he is given a chance to reedeem himself. On the other hand, if his past record has been continuously poor, he would be discharged at once.

There are employed on the street railway system of the Elmira Water, Light & Railroad Company about 140 men in winter and 200 in summer. A man whose merits and demerits stand about even is considered to have a fair record. One whose account stands at from 25 to 50 merits to his credit is considered to have a good record; above that he has an excellent record. At the end of the year the man who stands the highest is given a week's vacation with full pay, his name is also placed on the bulletin board with the number of merits he has received during the year, and this is, of course, a high honor. In addition, as already stated, a high standing is given weight when a question of promotion is being considered.

Having now outlined the theory of the system, it will be of interest to take up the actual working of it. There are six actions on the part of both motormen and conductors which the company consider warrant immediate discharge; these are disloyalty to the company, false statements, intoxication, dishonesty, gross ungentlemanly conduct and failure to report accidents. With motormen accidents are divided into three heads, "to persons," "to cars," and "to vehicles," and each of these divisions is further subdivided into "serious," "medium" and "slight." This makes nine divisions, or counting "accidents, no injury," ten divisions for accidents, to which, in the motormen's classification, no specific penalty is attached, this being left entirely to the judgment of the general manager, who decides upon the culpability of the employee. As will be seen, these are not considered prima facie cause for censure, but "failing to report accidents" is considered a heinous offense.

The following is the official list of the demerits and merits applied to various offenses and meritorious acts:

CONDUCTORS. DEMERITS.

IMMEDIATE DISCHARGE

(1) Disloyalty to Company.
(2) False Statements.
(3) Intoxication.
(4) Dishonesty.
(5) Gross ungentlemanly conduct.
(6) Failing to report accidents.

ACCIDENTS	Demerits.
(7) Serious injury	80
Persons: (8) Medium	60
(9) Slight	40
Accidents, no injury	5

DOUBTFUL HONESTY

(10) Detective reports (1st, 2d and 3d) each	10
(11) Short register	10
(12) Bunching fares	20
(13) Ringing up fares when an officer boards the car	20
(14) Doubtful reputation (notes)	
(15) Register not turned	2
(16) Shorts and overs, each fare	2

GENERAL

(17) No change when leaving station	10
(18) Refusing to assist on special occasions	15
(19) Not being in full uniform when on duty	1
(20) Recommending unworthy men for employment	1
(21) Untidy condition of dress—cap on back of head, soiled linen	1
(22) Bad judgment on special occasions	
(23) Disobeying oral orders from officers	60
(24) Smoking on car	5
(25) Allowing newsboys to ride on step, or more than one at a time	1
(26) Missing car:	
First time	12
Second time	20
Third time	40

OPERATION OF CARS

(27) Trouble with passengers	20
(28) Backing car to receive passengers	8
(29) Giving bells too quick	4
(30) Untidy condition of car	2
(31) Back headlight burning	1
(32) Not announcing routes, streets, transfer points, etc.	1
(33) Leaning against door conversing with passengers inside car	1
(34) Unnecessary conversation while on duty	1
(35) Reading while on duty	1
(36) Not giving proper signals	2
(37) Not answering signals promptly	1
(38) Not flagging crossings properly (trips)	40
(39) Not turning in collections the trip they are made	50
(40) Conversing with employees of another road while car is in motion	8
(41) Minor injuries to equipment	1
(42) Insufficient number of names of witnesses in accident cases	10
(43) Incomplete accident reports	5
(44) Failing to immediately inform officers of company of accidents	10
(45) Failing to hand in accident reports before leaving barn	10
(46) Handing in incompetent trip sheets	1
(47) Failing to hand in memo. reports	1
(48) Failing to hand in conductors' reports	1
(49) Failing to hand in time reports	1
(50) Letting boys change trolley	4

CONDUCTORS: MERITS.

SKILFULLY AVOIDING ACCIDENTS TO PERSONS

	Merits.
(1) Holding persons on car who want to jump, while drunk or crazy	8
(2) Warning persons not to jump	2

REPORTS

(3) Mentioning points where company is losing or gaining traffic	5
(4) Reports as to best speed of cars to please patrons	1
(5) Suggestions as to best number of cars to run	1
(6) Suggestions as to when to put extra cars out	1
(7) Suggestions as to what passengers say in regard to service given	2
(8) Suggestion as to best method of advertising	1
(9) Suggestion as to faults in advertising	1

	Merits.
(10) Suggestions as to bulletins	1
(11) Suggestions as to schedule	1
(12) Suggestions as to improvements in equipment	1
(13) Suggestions as to faults in equipment	1
(14) Suggestions as to change in blank forms	1
(15) Reports as to dissatisfaction of patrons	2
(16) Reports of approval of patrons	2
(17) Complete and perfect accident reports	2 and 4
(18) Reports of defects in equipment noticed while operating car	1
(19) Reports of defects, or blockades, etc. (to inspector)	1
(20) Complete and perfect trip sheets, memo. reports and conductor's and motormen's reports in regard to defects in equipment	1
OPERATION OF CARS	
(21) Judicious assistance to passengers	1
(22) Careful information to passengers	1
(23) Adjustment of shades and windows to please passengers.	1
(24) Assistance to ladies and children in boarding or alighting from car	1
(25) Kindness to aged and infirm persons	1
(26) Collecting pass books which are recalled, requiring fare	2
(27) Collecting transfers at points other than transfer points, requiring fare	2
(28) Collecting fare from children over five years of age	2
(29) Removing cars or wagons	2
(30) Pulling derailed car onto track	2
(31) Repairing trolley	1
(32) Assistance in minor road repairs	1
(33) Particularly valuable assistance in road repairs	2
GENERAL	
(34) Recommending good men to the service	1
(35) Working overtime	1
(36) Securing names and addresses of witnesses who saw accidents	4
(37) Assisting injured persons, vehicle or car	2
(38) General efficient service per week	1

MOTORMEN: DEMERITS.

IMMEDIATE DISCHARGE

(1) Disloyalty to company.
(2) False statement.
(3) Intoxication.
(4) Dishonesty.
(5) Gross ungentlemanly conduct.
(6) Failing to report accidents.

ACCIDENTS (DEMERITS DISCRETIONARY)

Persons: (7) Serious injury. (8) Medium. (9) Slight.
Cars: (10) Serious injury. (11) Medium. (12) Slight.
Vehicles: (13) Serious injury. (14) Medium. (15) Slight.
(16) Accidents, no injury.

	Demerits.
GENERAL	
(17) Refusing assistance on special occasions	12
(18) Missing car, first time	12
(19) Missing car second time	20
(20) Third time	40
(21) Disobeying oral orders of officers	60
(22) Recommending unworthy men to the service	1
(23) On duty not in full uniform	1
(24) Bad judgment on special occasions	
(25) Untidy condition of dress	1
Cap on back of head	1
(26) Soiled linen	1
(27) Smoking on car	5
REPORTS	
(28) Failing to hand in motorman's report	1
OPERATION OF CARS	
(29) Not coming to dead stop at steam crossings and at other points indicated in the rules	80
(30) Going across steam crossing without being properly flagged	20
(31) Allowing unauthorized persons to run car	20
(32) Leaving car before it stops	20
(33) Neglecting to pick up passengers	20
(34) Running by crosswalks	10
(35) Not shutting off current at electric crossings and circuit breakers	10
(36) Allowing anyone on front platform, except as authorized.	8
(37) Running over the road faster than is mentioned in bulletins	8
(38) Not stopping at stop signs	8
(39) Stopping on electric or steam crossings	20
(40) Front headlight not burning	8
(41) Unnecessary conversation with other employees	8
(42) Running almost up to a crossing before stopping	5
(43) Running within two poles of car ahead (250 feet)	4
(44) Starting car without proper signal	20
(45) Looking around while car is in motion	4
(46) Conversation while car is in motion	4
(47) Running car with hands off brake controller	2
(48) Not running slowly through water	2
(49) Not stopping when car in opposite direction is stopped or slowing	
(50) Running on more than four or five points in curves	2
(51) Feeding car too fast	2
(52) Not answering signals promptly	1
(53) Running ahead of schedule time	3
(54) Running behind schedule time	1
(55) Minor injuries to equipment	1

MOTORMEN: MERITS.

SKILFULLY AVOIDING ACCIDENTS TO PERSONS

	Merits.
(1) When a person steps from a secluded position onto track 45 feet ahead of car	10
(2) When a person is prevented from stepping onto track by motorman's seeing person, ringing gong and slowing up	5
(3) When motorman sees persons, comes to dead stop and tells him to get off of the track	2
AVOIDING ACCIDENTS TO CARS	
(4) When another company's crew is reckless	2
AVOIDING ACCIDENTS TO VEHICLES	
(5) When a cart is driven across the track from a secluded position 45 feet ahead of car	2
(6) When driver is prevented from crossing track by motorman's seeing car, ringing and slowing up	1
(7) When motorman sees cart, comes to dead stop and tells driver to get off track	1
REPORTS	
(8) Mentioning points where the company is gaining or losing traffic	4
(9) Reports as to best speed of cars for safety	1
(10) Reports as to what passengers say in regard to service given	2
(11) Suggestion as to best number of cars to run	1
(12) Suggestions as to when to put out extra cars	1
(13) Suggestions as to best methods of advertising	1
(14) Suggestions as to faults of advertising	1
(15) Suggestions as to bulletins	1
(16) Suggestions as to schedule	1
(17) Suggestions as to improvements in equipment	1
(18) Suggestions as to faults of equipment	1
(19) Reports of dissatisfaction on the part of patrons	1
(20) Reports of approval from patrons	1
(21) Reporting bells off, line defects, etc	1
OPERATION OF CAR	
(22) On exact schedule time at station points (per week)	1
(23) Coupling cars (towing in disabled cars)	1
(24) Removing carts or wagons	2
(25) Pulling derailed car onto track	2
(26) Fixing trolley	1
(27) Taking charge of car on special occasions	1
GENERAL	
(28) Recommending good men to the service	1
(29) Working overtime	1
(30) Assistance in minor repairs	1
(31) Especially valuable assistance in case of trouble on the road	2
(32) Securing names and addresses of witnesses who saw accidents	4
(33) General efficient service	1

The demerits are nearly self explanatory. The system of merits, however, calls for certain explanations, for instance in regard to suggestions for improving service. It should be stated in explanation of this that the company holds a meeting once a month of all the employees of the company at which various topics connected with the operation of the road and technical matters are discussed. At these meetings the men are encouraged to make sugges-

tions as to the cars or other apparatus, the operation of the road, etc., which they think will be of interest to the company, and if these suggestions are good, merits are given accordingly. The men are also encouraged to give such ideas to the manager or superintendent at any time, and this increases the men's interest in the road. In some respects the Elmira Water, Light & Railroad Company is more advantageously situated for receiving and acting upon such suggestions than most railway companies, from the fact that the company not only owns the street railway system in Elmira, but also the water, the electric and gas lighting systems of the city, and the suggestions for which merit marks are given can apply not only to the railway but also to the other services. Thus, if a conductor or motorman notices a hydrant out of order, or sends a customer for gas, or if a motorman notices an arc lamp in which the carbon is burned out, or one which does not give good light, he reports it on his return trip, and information of this kind if valuable to the company is credited to his merit account. In other words, the men receive merit credits for information which will help in other departments besides their own.

Every report of this kind is written, as the company does not depend upon oral reports. The men are also encouraged to notice and report neglect of duty, etc., which come under their notice as well as points of merit. Thus if a motorman is careless, passing a switch without noticing it, the conductor reports him, and as the men know that little things of this kind are noticed they tend to become more careful of such things, as they all count in their reports. The men in the water and lighting departments of the company are not under the merit system.

As already stated, the ratings given in the accompanying table are by no means arbitrary; for instance, if a certain employee is reported for the same offense more than three times he is usually called into the office and receives more demerits for the second or third repetition of the same offense than he did for committing it first, and if he still persists in doing the same thing he might be discharged, although the rating given for the offense in the table was comparatively a minor one. On the other hand, if the meritorious act was performed under particularly commendable circumstances the employee would be given a larger number of merits than called for on the schedule. For instance, if a conductor jumped from his car and stopped a runaway horse he might be given 75 or 100 merits for such an act. Such a case happened at one time in Elmira, when a conductor stopped his car, ran ahead and stopped a horse which was running toward an open drawbridge. For this he was given 100 merits. In the case of collision a man would usually be marked for lack of judgment; in some cases, however, he might be marked merits even in case of a collision. Thus, if a runaway horse or car were coming directly toward his car and he saw that an accident could not be averted, but by reversing his car he succeeded in saving it from a worse accident, he would get merits for his action. "Shorts" and "overs" are considered by the company a mark of carelessness, and the conductor making this error is given two demerits for each fare he has failed to register in this way. Sometimes amusing errors occur, which could hardly be punished by any other system of discipline, as for instance recently when a passenger offered a conductor for fare a Columbian half dollar. The conductor looked at it for some time, then returned it to the passenger and said: "Take this back and give me good money. You can't work off any World's Fair medals on me." The conductor got one demerit for not being posted about the official coins of the country.

To assist the employees in following the rules of the company, the management has issued a small pocket edition of the regulations used which defines clearly all his duties, and a copy of which he is always required to have in his pocket.

Reports on the service are received not only from inspectors and in the ways already stated, but also from the general public. The fact that the system is in use is generally known in Elmira, and as the people know that the employees are interested in making good records, the company finds that good service is reported just as quickly and as often as bad service by letter or in the daily papers. With a road of this kind in a small city a great many residents of the city are stockholders in the company, and are of course interested in its operation and in the system of merits employed, so that they assist greatly in the maintenance of a system of this kind.

Of course it might be argued that where weight was given to outside communications, particularly on good conduct, there would be a chance of an abuse of the system through efforts made by men to increase their standing by appealing for letters to outside sources. The only answer to this is that a management can judge pretty well in a city of the size of Elmira the value to be placed on gratuitous commendations and can easily determine whether they are spontaneous or the result of wire pulling. Certainly no such abuse has been discovered to any extent. On a system of this kind, also, managers are personally acquainted with all the employees and can gage pretty accurately the value of the service given by each man. In the case of an accident, where the motorman or conductor is called to the office for investigation, and thus is absent from his work for several hours or half a day, and it is found that he was not to blame for the accident, he is allowed his pay for that period and the demerits, if any are given him for carelessness or any other cause, are all the punishment which he gets for the offense. It might also be said in connection with the subject of accidents, that when each motorman turns his car in at night he is obliged to report on the condition of the car and to state if any of the apparatus is out of order. These reports are made out with a regular affidavit, which is sworn to before a notary public in the office of the company. The same is true of all accident reports so that in the case of an

Notification No.....

ELMIRA WATER, LIGHT & R. R. CO.,

RAILROAD DEPARTMENT

Elmira, N. Y.....190....

Mr.....

Dear Sir:

The company would call your attention to the following report in regard to your work:

Date.....190.... Time.....M.

Place .....

Car No..... Line.....

.....

.....

.....

.....

.....

Any explanation you may wish to make will be considered if you will call at the Superintendent's office at.....M.

.....190....

CHARGE

Rule No.....

Merits.....

Demerits.....

Signed,

.....

Superintendent.

FIG. 1.—NOTIFICATION BLANK

accident if the employee claims later, or testifies in court that the apparatus was at fault, the affidavit may be of use.

Two forms are used in this system of record. The first is that shown in Fig. 1, which shows the notification blank

Their address.....
Why did you leave?.....
Who was your previous employer?.....
His address.....
Other references.....

134

Name ..... Badge No. ..... Pay Roll No. .....
Age ..... Married ..... Date Employed ..... Application No. ..... Date Left ..... Reason Left .....
Address ..... Changed to ..... Changed to ..... Changed to ..... Changed to .....

RECORD. Transferred to Page .....

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
	Charge D. M.	Charge D M	Charge D. M.	Charge D. M.	Charge D M	Charge D. M.	Charge D. M.	Charge D. M.	Charge D. M.	Charge D M	Charge D M.	Charge D M.

FIG. 2.—HEADING OF PAGE FROM RECORD BOOK

used by the Elmira Water, Light & Railroad Company. As already stated, about 140 men are employed on the railroad system, and about one-third of this number gets a notice of some kind on this blank each week showing the number of merits or demerits given, and stating the circumstances and reasons. A carbon copy of this blank is kept in the office of the company, and the employee is given the opportunity of offering any explanation he may wish to make to the superintendent. Fig. 2 is a copy of the heading of the page used in the record book. As will be seen, the heading of the page gives the name, address and other particulars of the employee. Below this information are a number of ruled lines where the date, number of charge and number of merits and demerits are recorded for each month. The form of application blank and that used for recording accidents are also given.

In securing employees the company is very particular in looking up references. Before being accepted for service the employee has to file an indemnity bond for $200 with the company, and the company prefers to have individuals for the indorsers of this bond rather than a liability insurance company. Many of the employees of the company naturally come from the agricultural districts, and the experience of the company shows that such men usually make better employees than those whose early life has been spent mainly in the cities, as they are used to working out in all kinds of weather, while the city bred man does not usually have the constitution to stand that kind of life. It usually takes longer for the former class of man to become adept, but in the end he usually remembers his instructions better and seems to take a greater interest in his work.

ELMIRA WATER, LIGHT & RAILROAD COMPANY,
RAILROAD DEPARTMENT.

APPLICATION.

PENAL CODE.—Section 570. A person who obtains employment, or appointment to any office or place of trust, by color or aid of any false or forged letter or certificate of recommendation, or of any false statement in writing, as to his name, residence, previous employment or qualifications, is guilty of a misdemeanor.

Applicants for the position of Motorman or Conductor on the Elmira Water, Light & Railroad Company must answer the following questions in their own handwriting:

What is your full name?.....Age.....
Are you married?.....
Residence .....
How long have you resided at the above address?.....
Previous residence.....
Trade or occupation.....
Do you own real estate or personal property?.....
How long have you been out of employment?.....
To what extent are you in debt?.....
Do you use intoxicants in any form?.....
Have you ever been addicted to the use of intoxicants?.....
By whom were you last employed?.....
How long were you in their employ?.....
Their address.....
How long were you in his employ?.....
What are the highest wages you ever received?.....
Who recommended you to this company?.....
Their address.....
Were you ever employed on any horse or electric railroad in this or any other city as Driver, Motorman or Conductor? If so, state which.....
State where so employed.....
State how long employed.....
State why you left.....

I promise and agree, if employed, to obey the rules and regulations of the Company and faithfully discharge the duties entrusted to me.

.....

STATE OF NEW YORK,
COUNTY OF CHEMUNG, CITY OF ELMIRA. ss:

I.....

being duly sworn, do say that the foregoing questions, answers and statements, together with the statute therein set forth, being part of Section 570 of the Penal Code, have been read by me, and that said answers and statements by me made and subscribed are in all respects true.

.....

Subscribed and sworn to before me this.....day of.....190....

.....

.....

We do hereby certify, that we are well acquainted with .....and represent and guarantee him to be honest and capable for Motorman or Conductor, and in consideration of his employment in either position, and one dollar paid by the ELMIRA WATER, LIGHT & RAILROAD COMPANY, the receipt whereof is hereby acknowledged, we jointly and severally undertake and agree to indemnify, save and bear harmless, the said Company from all loss or damage up to two hundred dollars, which said Company may sustain, or be put to, by reason of any disobedience, neglect of duty, or any act or violation by said .....while in its employ.

.....

.....

ACCIDENT REPORT No.....

INSTRUCTIONS TO CONDUCTOR AND MOTORMAN.

In case of accident, however slight, in connection with, or near your car, to persons or property, you will at once render all necessary assistance, and immediately obtain the names and residences in full of the persons injured, and all witnesses on or near the car (if the conductor omits this important duty, he will be suspended until he finds them); then make a written report on this form, filling up all blanks. This report is to be signed by the motorman as well as by the conductor, and delivered at the office of the company, and approved by the general manager or superintendent. If two cars are concerned in the accident, both conductors must report in detail.

Give no account of an accident to any person other than the general manager of the company, or the person designated by him.

.....Line. .....I.....
Date of Accident.....I....I.... at.....
o'clock.....M. Place of accident.....
(Fill in the names of streets nearby, and mark exact spot at which accident happened, with arrow showing direction.)
No. of Car..... Open or closed.....

..... Conductor.....
Condition of car..... Draw bars.....
Brakes ..... Brake rigging.....
If collision occurred, state in what direction other vehicle was going and whether vehicle was open or closed.....
Did Motorman ring gong?..... If so, how long a time before accident .....
Weather was pleasant, cloudy, rainy or foggy; warm, hot or cold.
Rails were dry, wet, slippery or icy.
(Draw a line through condition of weather, temperature, and condition of rails.)
How far did car move after accident?.....

PERSONS INJURED.

Name..... Age (about).....
Residence..... Occupation.....
Extent of injuries.....
Name and address of doctor employed.....
The injured person was taken.....
Property injured..... Extent of injuries.....
Witnesses .....
.....
Residence .....
.....

HOW ACCIDENT OCCURRED.

At time above named our car was proceeding.....
wardly on..... Street,
.....at the rate of.....miles
per hour, and when at point shown above.....
.....
.....
Was accident due to want of care on part of injured?.....
Was accident due to want of care on part of any other person?
If so, how?.....
Was car in motion before and at time of accident?.....
State all that was said and done by you and the person injured or owner .....
.....
.....
.....
.....
.....
(Have Motorman write all he knows about the accident.)
.....
.....
.....
.....
Signatures:
.....Conductor.
.....Motorman.
Approved.....Gen'l Mgr. or Supt.

STATE OF NEW YORK, ss:
COUNTY OF CHEMUNG.

On this.....day of.....in the year 19...,
before me, the subscriber, personally appeared.....
....., to me personally known and known to me to be the same person described in and who executed the foregoing report, and being by me duly sworn, did depose and say that he has read the said report before signing the same and knows the contents thereof, and that all of the said report is true to deponent's own knowledge.

.....
Notary Public.

It is stated that the managers of the State railroads of Sweden are investigating the advisability of equipping the railroad lines with electricity, and a recent newspaper article announces that private concerns are interested in the matter. It is reported that the board of managers of the Falen-Vesterdalarnes Railroad Company has sent to the government a petition for the gradual adoption of electric locomotives, instead of steam engines, throughout the whole country, and the utilization of water-power. This company stated that a Swiss concern will furnish the rolling stock; that a Swedish concern will supply the power, and that it is prepared to furnish the railroad line necessary to carry out experiments with the Huber system. It is estimated that $27,000 will be required to carry out the experiments, and the government has been asked to appropriate this sum.

Improvements at Steubenville, Ohio

The Steubenville Traction & Light Company, which owns and operates the entire street railway system in Steubenville, Ohio, has just completed between 11 and 12 miles of new track and roadbed, new car house, repair shop and other important improvements. The new car house covers a floor area of 14,000 sq. ft. The structural iron for it was supplied by the Columbia Bridge Company, of Pittsburgh, the erection being in the hands of local contractors. The construction of this new car house was made necessary by the additions which the company has made recently to its rolling stock.

Twenty new cars have just been purchased. Part of them were built by the Laclede Car Company and part by the American Car & Foundry Company, Jackson & Sharpe plant. All these cars are equipped with Westinghouse motors, and the interurban cars are fitted with Christensen air brakes.

The power station has also been considerably enlarged and a new boiler house has been built. Three Stirling boilers aggregating 900 hp have been installed, and are equipped with the Green Engineering Company's chain-grate stokers. Worthington pumps are used, and the new steam piping was installed by the Pittsburgh Valve, Foundry & Construction Company.

Additions have been made to the electric lighting equipment in the station by the installation of one 150-kw and one 100-kw compensated type, G. E. alternator, two multipolar Brush arc generators and one bipolar Western Electric generator. A. B. lamps have been installed on all the city lighting circuits, and G. E. alternating-current lamps for indoor arc lighting; about 48 miles of new lines have been constructed this summer.

The new traction machinery consists of one Westinghouse compound-wound, direct-current, railway-type engine generator of 250-kw capacity, and a 410-ihp Westinghouse engine; also one 300-kw Crocker-Wheeler generator and a 400-hp Corliss engine. A 1200-hp stack has been constructed by Adam Weber Sons, of New York City, and the pipe-covering contracts were awarded to the H. W. Johns Manufacturing Company. A storage battery consisting of 252 chloride accumulators has also been installed by the Electric Storage Battery Company. This plant is to be located at Stanton Park, and the building which is to contain it is now being constructed by local contractors. Aluminum feeders of 795,000 circ. mils are used.

The new railway lines already referred to consist of a 1-mile extension within the city limits of Steubenville and 11 miles of track, forming connections with Toronto, Jeddo, Costonia and Alikanna, with the first-named city as its terminus. About one-half of this road is through private right of way, the balance on the County Boulevard.

The company also owns an attractive pleasure ground called Stanton Park, and has added a number of attractions to the property, which now include a roller coaster, built by the Ingersoll Brothers, of Pittsburgh; a 50-ft. merry-go-round, operated by an electric motor; five bowling alleys, shooting galleries, Dehhewamis Lake, waterfalls and 80 acres of woodland, etc. The Casino building, now being erected, will consist of a dancing floor 80 ft. x 100 ft., with 20-ft. porches overlooking the Ohio River, dining-room, kitchen, refreshment booths, etc.

A collision between two Brooklyn Bridge trains caused a three-hour suspension of traffic on that structure Feb. 24.

The Function of Small Roads

BY DR. LOUIS BELL

This discussion is not intended to be technical nor to appeal entirely to those who are directly engaged in the operation of street railway systems. It is aimed at the fellow who is benefited by small roads; at the public that lives off the line of the splendid interurban electrical lines, which have been so numerously built during the last few years.

One of the commercial vices common among our countrymen is the habit of estimating the importance of any enterprise by the size of its bonded indebtedness. Judged by this criterion, the small electric road is beneath the contempt of any up-to-date financier. Only a few years ago the writer happened to have his clutches upon the franchise of a small electric line joining a minor city with an important freight terminus. The road had a freight franchise, and, although only three or four miles long, with no reasonable prospect of extension, its paying properties were beyond reasonable doubt. Laying the proposition before a banker who was a personal friend, it was met frankly and calmly with the statement that it did not pay to handle a proposition of that size quite irrespective of its merit as regards earning dividends. Continuing, my friend, the banker, frankly stated that his business was not the operation of electric properties, however good, but the placing of securities, and where there were few securities to place the matter lacked that interest which would inspire him to take it up except as a matter of personal accommodation. The writer saw the point and promptly closed the interview. Eventually the franchise was taken up by persons who thought "in thousands" instead of in millions, and carried through to a successful conclusion.

It is to this class of road that this article pertains; its character; its functions; its possibilities as a business enterprise, and as an integral part of the life of the community.

It is sometimes hard for the projector of a railway line to realize that it cannot become a great thoroughfare for the freight and passenger traffic of the nation. Similarly it is hard for a citizen of a small town in New England, or the Middle States, or the great West to sit calmly down and reach the conclusion that the community of which he is a member cannot reasonably be expected to equal New York or Chicago in population or commercial interests. Putting such hopes aside as visionary, it is hard for him to realize that most small towns cannot in the nature of things grow rapidly or reach any considerable size in the near future. From the inability to recognize this fact comes a certain hesitation in undertaking enterprises of a size commensurate with the importance of the work to be done.

We often think of the Eastern States as well developed from the standpoint of the electric railway builder, and yet even in the older and more thickly settled parts of the country there are scores, if not hundreds, of towns from two or three to ten or fifteen thousand inhabitants, where there is an opportunity for a carefully constructed small road, of good-paying powers from the standpoint of the man who puts his money into the enterprise.

It is a common saying among street railway men that street railways in towns below a certain size do not pay and should not be undertaken. Experience has very clearly shown that the revenue derived by a street railway per head of population increases very rapidly with the size of the city, on something the same principle that the number of calls per subscriber in the telephone system rises with the population of the place. Granting the truth of the street railway proposition, it, nevertheless, remains a fact that the road which will not pay as a street railway can frequently be made to pay as an intertown railway, or as a connecting link between a town and better railway facilities. The commonest function of the small road is to join a village community with the rest of the world, either with other villages en route to the city or with points upon railways otherwise inaccessible.

As to the character of such roads, one has to get one cut according to the cloth. As a rule franchises for such enterprises must of necessity, and generally do, contain the rights of transportation of freight. If one counts up in detail the freight which goes into and out of a town of two or three thousand inhabitants, the aggregate amount of the year reaches surprisingly large figures. Most towns of this size have railway facilities, but very frequently several communities, aggregating four or five thousand inhabitants within a distance of a very few miles, are not blessed with railway facilities, and in such cases practically the whole freight traffic of the community can be handled at a good profit over a short and cheaply constructed electric line. The number of such communities is far greater than one not familiar with the facts would be disposed to think. Even in Massachusetts, which has been as thoroughly worked over by railway corporations as any State in the Union, about one town in eight is without a railway station, and probably one town in six, or even five, is without a reasonably good connection between the railway and its center of population. If a road can be built without unreasonable expense, so as to serve in half a dozen miles an aggregate population of four or five thousand people, the chances are that it can be made to pay; not in the sense which urban street railways pay dividends upon securities jacked up to the largest possible figure, but in the sense in which an investor would consider himself well paid in any commercial enterprise in a similar community.

The essential point in making a success of a small road is to drop out of mind all visionary ideas of abnormal growth in the future. Growth often may come, and when it comes is thoroughly welcome, but it is a bad thing to which to pin one's faith in such cases.

At present rates of interest on investments, it does not take a very heavy traffic to pay expenses and interest on an investment of forty or fifty thousand dollars, and if the road is economically built and equipped, such an amount is sufficient to do considerable building in rural districts. It is quite unnecessary to put down 90-lb. tram rails for a road of this kind, or to run 40-ft. double-truck cars, or to run them at high rates of speed. What is necessary is reasonably quick, frequent and cheap communication between the termini. Light rails and light roadbed may oftentimes be used with entire success, even when they would obviously be insufficient for a road under ordinary circumstances. It must be remembered that the wear and tear on the rails and roadbed depend on the amount of traffic that yearly passes over the line. Where this traffic is light the wear and tear is also light. Rails which would not last ninety days under heavy urban traffic would last almost as many years under the wear and tear received from a rural road. This immunity from wearing out does not, however, extend to the cars. The rolling stock is not a good place to skin in building a small road. While the cars do not have to make high speed, they have, as a measure of economy, to be kept pretty steadily in service, and will often make as great a mileage per day as the cars upon a large system; consequently, the policy sometimes pursued in equipping little roads of buying second-hand equipment which has been cast out of larger systems is in the long run poor economy. As far as the moving stock is concerned, it must be thoroughly good.

It is an easier matter to design the power station for a

city road than it is to lay out a proper equipment for a two-car five-mile rural line. Small power stations are notoriously uneconomical. This is because small engines and generators are less efficient than large ones, and more particularly because the variable character of the load in a small road is peculiarly unfavorable to economic generation of power. Beyond this, the item of attendance in a small plant becomes relatively very large if reckoned on the kilowatt-hour basis. In some instances a friendly electric light station may come to the rescue and be glad enough to get a bit of power production to eke out its day load, or a mill using water-power within easy striking distance of the proposed line may furnish an available source of power, which would otherwise be somewhat more costly to produce; but in the last resort a small power station can be built and operated with a better degree of economy than is generally supposed. At the present time it is possible to get small engines giving a very much better result in steam consumption than even the large machines of a few years back. It is probable that the improvement in such small engines has been considerably greater than the improvement in large engines, and in the future this difference will be still further accentuated. Throughout the natural gas regions explosion engines are entirely feasible sources of rather cheap power, although a few years ago operating a small railway station by such means would have been considered to be, and would in fact have been, impracticable. In the Eastern States water-power, as has already been intimated, affords, perhaps, the best standby for small roads. The writer personally knows of instances where little electric railways, through fortunate proximity to power plants, have been able to obtain power at a price less than the actual cost of power in many considerable urban stations. Such aid is by no means generally attainable, but where it can be had the problem of power supply is at once solved.

The distributing system on little roads is, or may be, of the simplest character, the largest proportion of them being handled simply by the trolley wire, so that the feeding system is about the last thing the organizer of such an enterprise need worry about.

The writer is quite well aware that these commendatory suggestions concerning small roads may be met by the statement that such roads have frequently failed to pay, to which the retort courteous is, in the Yankee form of a question, to pay on what basis? If a short line of the character here under discussion is promoted—in the ordinary sense of that word—and shuffled around until it finds someone who, for a large consideration, will place its securities among those who know little or less of the needs of the community in which the road is to be built, it will probably come to grief. If, in addition, it be shuffled off by the promoter on to a contractor who builds with an eye to construction profits only, and perhaps leaves the roadbed carpeted with mechanics' liens in the hands of enraged Italians, as has occasionally happened, the road would also doubtless come to grief. If, on the other hand, it is built as a local enterprise, with the co-operation of the community which it is ultimately to benefit, built for cash, and economically operated, there is no excuse for failure to pay a reasonable return on the investment, particularly since in working on this basis the prospects of the road can be taken very accurately into consideration. The effect of the successful carrying out of such an enterprise upon the community is beneficial in a degree that can hardly be overestimated. Every town touched by such a road comes into closer relation with its neighbors, and with nearby cities reached by steam connections, and the event is almost certain to be felt in the increased valuations of property along the line.

The whole effect of getting nearer to one's neighbors, of forming part of a large community bound by ties of common interest—instead of being sequestrated in a small one—is very great in stimulating business and waking up a community to the possibilities of greater prosperity. All through New England, at least, there are regions where the summer business is considerable; in fact, no small part of the business of a community depends on that brought in by summer colonists. The effect of easier communication stimulating this particular source of revenue is very great. A country town which is brought within easy distance of railway connections becomes possible as a summer resort, where otherwise it would be impossible. No small number of roads have been built already to deal with the purely summer traffic, but this particular feature of the matter, the stimulation of summer business, simply in virtue of easy communications, has hardly received the attention which it ultimately will prove to deserve. Sooner or later many small lines of the kind here described may grow extensions, until the original line becomes a part of what possibly may become a system of considerable length. The more communities thus linked, the greater, on the whole, will be the business per mile of line attainable. Yet the economical construction and administration of national lines is a thing which very generally will determine the financial possibilities of extension.

The writer is perfectly well aware that these little enterprises have not been favored in the past, and have been looked on with even concealed scorn by those engaged in larger problems of transportation, but one cannot forget the country out of which urban prosperity is built, and the more closely the country comes into touch with the largest centers of population the better, both from a financial and civic point of view. The best kind of help in this case is self-help. A stimulus that comes from within a community is pretty certain to have some good reason for existence, and there is good reason to believe that local enterprise can find a very suitable and reasonably remunerative field in this small railway work.

The steam railroads, the history of which might be read with profit by everyone interested in electric roads, have passed through stages of development very similar to those which electric roads are passing through at the present time. Save between large centers, trunk lines depend for their traffic on connecting lines that reach out for business and these, in turn, on branches and small roads of various sorts, form a sort of drag-net to gather in the freight and passenger traffic of the country traversed.

The little electric road, insignificant as it seems, has a proper place in the general system of transportation, and if this presentation of some of its possibilities may serve to direct attention to its place in the economy of traffic the purpose of this paper will have been well served. The transportation business in this country is no longer upon an 8 per cent or 10 per cent basis, and opportunities for small enterprises need not be sniffed at, especially by those who cannot command the resources to cope with larger ones. Keep an eye out, therefore, for the small electric road. Not everyone projected may prove feasible, but now and then one will prove an exceedingly good investment.

The Council of Miamisburg, Ohio, is said to have adopted a unique method of determining the speed of electric cars and trains passing through the town. The city ordinance calls for a speed of 6 miles an hour, and the report from that city states that a man who can walk at this gait has been employed to keep tab on the cars and trains. He walks along the track, and in event he cannot keep up with the object in question, he reports to the Council.

Steel Street Car Wheels

BY W. L. WRIGHT.

There is a great prejudice in America in favor of the cast iron chilled wheel. Cast iron has shown itself capable of a great mileage. It can carry the heaviest loads with safety. Loads of about 15,000 lbs. per wheel are not beyond its capacity. On steam roads such wheels easily average 60,000 miles, while it is not uncommon for individual wheels to greatly exceed this.

On street railways guarantees of 40,000 miles for the life of a cast iron wheel are common and individual wheels go to 70,000 miles and upward even in pretty severe service. Sand and grit, constant applications of the brake and the fact that on the street car the wheel is a driver are some of the reasons for the difference in length of life in the two lines of service.

On steam roads the steel wheel, especially that with a cushioned center, has made a phenomenal mileage. A pair of Allen's first paper wheels, if we remember rightly, had made nearly 600,000 miles when they were retired from service. Steel wheels on steam roads make mileages often running up into the hundreds of thousands.

The cast iron wheel has one bad feature, the lack of strength at the root of the flange. Cities demand grooved rails. The grooves are usually so small that only an insignificant flange is possible. To obtain the necessary endurance to wear, the chill must be made very deep. While the iron itself is tough and strong it is liable to crack when chilled and subjected to heavy strains. The flange, when warm, and when made small enough to run properly in the standard grooved rails, is too weak for long service.

Naturally steel is the material to which we turn for a solution of the problem. Steel wheels were tried years ago under street cars. It was a surprise to all concerned, when the steel that could make such records as we have mentioned was often worn out after 12,000 or 14,000 miles of service. The metal had a surplus of strength, but was too soft to stand the grit and the constant use of the brakes. Maker after maker of rolled steel tires tried his hand and in the end give it up. It is now pretty well settled that no steel which is soft enough to be rolled or forged has sufficient hardness to stand street railway service.

It is now some five years since the last experiments of this kind were made and the unfortunate manufacturer gave up the idea. The wrought tires would sometimes make 25,000 miles, but as a rule the flanges became either thin or sharp long before the metal was gone from the tread. When they escaped undue wear the flanges became too deep to run and as there was little metal left in the tread they were not worth turning.

A cast steel wheel was the next attempt at a solution. These wheels promised well. They could be made almost as hard as the chill of cast iron and so had ample endurance. One curious feature was often developed. A steel wheel much softer than cast iron would not, when skidded, develop as large a flat spot. It was also found that flat spots often ground themselves out in service. It proved two interesting facts. First, that hardness was not the only quality needed in a street railway wheel, and, second, that toughness was in many respects a more valuable feature than hardness alone. This latter fact is one which the cast iron wheelmakers understand also.

In the manufacture of steel wheels certain difficulties arose which have not been altogether overcome. First, there was great cost. A steel wheel must, of necessity, at the present day, be quoted at about three or four times the figure asked for cast iron; secondly, there are difficulties of manufacture. A wheel made entirely of steel had a great deal of shrinkage. It was rarely round and not often true. Many times it would come from the mould resembling the rim of a hat. For good results in mileage it had to be so hard that it could not be turned. Grinding to a proper figure was out of the question on account of cost. Then boring the hub was another problem that was not easily answered. Different makers solved this problem with fair degrees of success.

Steel is not an easy metal to handle when it is being put into a mould. It will "pipe" and blow holes of various kinds will appear. For no apparent reasons one part will be porous while another will be perfectly solid. These faults have been encountered by all who have used steel castings. The steel wheelmakers had troubles of their own. When there were pipes they were pretty sure to run around the tires and then a large section of flange would quietly drop off. If there was a blow hole it would commonly come where it would produce a flat or a crack across the rim. All these troubles came to the built-up wheels with the additional fault that the parts sometimes became loose.

Many of these troubles have been overcome. Perhaps all of them may be gotten rid of by a little more practice. The efforts to get rid of them have cost hundreds of thousands of dollars, and the successful steel wheel is not yet in the market. Yet there is no street railway man who has tried steel wheels who does not seem to have faith that some one will one day invent a successful steel wheel and put it on the market. They have such a superabundance of strength that they inspire confidence. A steel flange $\frac{1}{4}$ of an inch thick is ample in strength for all the work it is required to do. If it could only wear, it would have plenty of room in the smallest groove that any pig-headed committee of aldermen ever compelled a long-suffering engineer to place in a street.

If other things are right, a steel wheel could make 200,000 miles, coming out only three times for turning. Such wheels would be cheap at three times the price of cast iron.

An ideal wheel would seem to be one with a cast iron center and a cast steel tire welded upon it. The difficulty in such a process is to make a perfect weld between the two parts. The casting of a tire true and round is another problem which has not yet been solved. At least it has not been solved commercially with a steel as hard as is necessary for street railway wheels.

A rolled tire surface treated and put on to a center of cast or wrought metal appears to be one way out of the difficulty which has not yet been attempted. It would be expensive to make, as the scheme involves much machine work. Whether a hardening process is feasible for a product no thicker than a tire is uncertain. The question in every case finally assumes a simple form. Will the cost of any given wheel be approximately the same, or less, per thousand miles run than that of the cast iron wheels now in service? Steel wheels may and do have many important advantages over cast iron in the way of strength and safety. A steel wheel might have a much greater mileage between the times when it would be necessary to true it up than the cast wheel. It might not be as easily flatted. But all these advantages would not be considered of sufficient value to induce the railway managers to give a greatly increased price per thousand miles of service.

Those who have kept close watch of steel wheel experiments may wonder why nothing has been said in regard to the steel chrome and manganese steel wheels. The reason is a simple one. These wheels, so far as we know, are not in the market. Difficulties in the manufacture have

delayed introduction. A considerable number of chrome steel wheels are still in service and the thoughtful engineer is keeping watch of them most carefully. One of these days their mileage records will make very interesting reading. There may be a few manganese wheels still in service, but of these almost nothing is known.

In the meantime the field is open. The demand for a hard, tough, durable wheel that will stand abuse is one which has not yet been met. The roads need such a wheel, and what is more, they are fully awake to the necessity for it. It is one of the few wants in the railway world which is not pretty well supplied. The market is ready for the manufacturer. He will not have to create a demand; all that he will have to do is to prove that he has the article. Whether this ideal wheel will be of chilled iron or of some entirely new type time alone will determine, but at present the chilled iron wheel certainly seems to be in vastly greater favor than anything else which has been tried.

Profit-Sharing on the Columbus Street Railway

The Columbus (Ohio) Street Railway Company adopted a system of profit-sharing with its employees in July, 1899, under which the first quarterly dividend was payable Aug. 1, 1899. On Feb. 1, 1902, the tenth quarterly profit-sharing dividend was paid, therefore the experience of the company with this system of just dealing with employees now covers a period of two and one-half years. In describing this system, *Public Policy*, in a recent issue, says:

"The profit-sharing dividend is paid on total amount of wages earned during a quarter at the same ratio of per cent as is paid to stockholders on their holdings of preferred stock, payable quarterly and on the same date as to stockholders. To be entitled to this dividend, employees must have worked six months continuously prior to a dividend-paying date. If an employee leaves the service of the company within three months prior to dividend-paying date he forfeits any participation in that quarter period.

"The ten quarter profit-sharing dividends aggregate $40,000, making a quarterly average of $4,000. The number of employees at the present time is 500, therefore each employee has received a cash dividend of $8 per quarter, or $24 per year, which, capitalized at 4 per cent, represents an average yearly wage of $600. This wage, for dividend purposes, has been equivalent to an investment of $600 in the preferred stock of the company.

So far as can be learned by careful inquiry, the professions of appreciation, of harmonious relations between employees and management, expressed by directors and stockholders, is fully shared and reciprocated by the employees. We think that here is a satisfactory demonstration that fair treatment is a good investment, and that the money paid out for profit-sharing dividends is not an expense to stockholders nor a burden upon the public, but a new creation resulting from a more perfect utilization of the economic factor of self-interest. Absence of friction and immunity from strikes has been worth more than $40,000 to the stockholders during the two years and one-half of the existence of the profit-sharing experiment in the earnings of their business. It has been worth more than $40,000 to the employees in their earnings of wages. A strike of but thirty days would cost each side much more than the total amount of the profit-sharing dividend for the entire two and one-half years.

That the results secured are satisfactory is shown by the resolution adopted at the last annual meeting: "The stockholders express their appreciation of the efficiency of employes and gratification at the pleasant relations prevailing between them and the management."

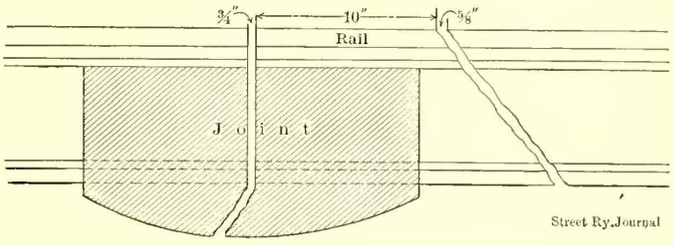
CORRESPONDENCE

Peculiar Break in a Cast Welded Joint

Kansas City, Mo., Feb. 4, 1902.

Editors Street Railway Journal:

During the recent cold snap a 9-in. rail on the Metropolitan Street Railway of this city pulled in two in a very unusual manner. The track is laid on an old fill, and the street is paved with asphalt outside and between the tracks. The joints are 200 lb. cast-welded. The track has been down over two years and no break has occurred in that



PECULIAR BREAK IN CAST-WELDED JOINT

vicinity before. Upon examination, the rail was found to be broken in two places, 10 ins. apart. As will be seen from the sketch which I enclose, the joint is broken clean through. The other break is a rather ragged one, running back under the rail 8 ins. Both breaks look fresh and there are no signs of crystallization. The short section of rail with its part of the joint was found to be entirely free at both ends, but the concrete held it so firmly in place that for several days one could hardly tell by the riding of the car that it was passing over a broken rail. The question that has not yet been solved is, "What caused the rail to break in two places so close together?" I will thank anyone for a reply through the Journal.

W. O. Hands.

Life of Car Wheels and Car Parts in Newcastle

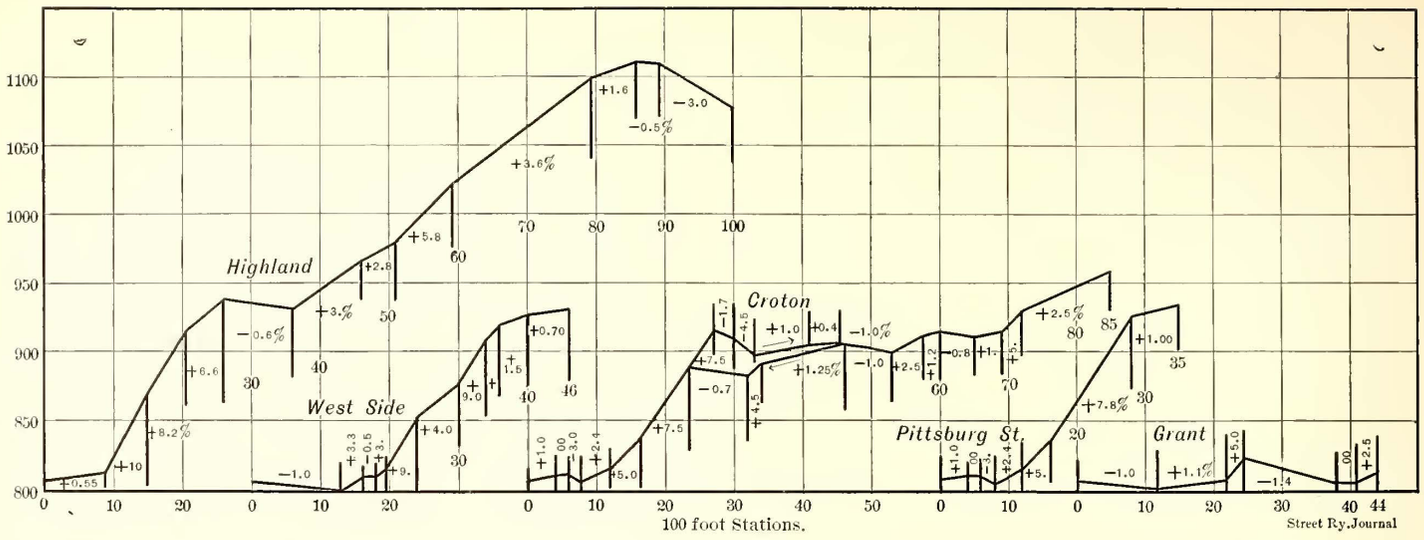
NEW CASTLE TRACTION COMPANY

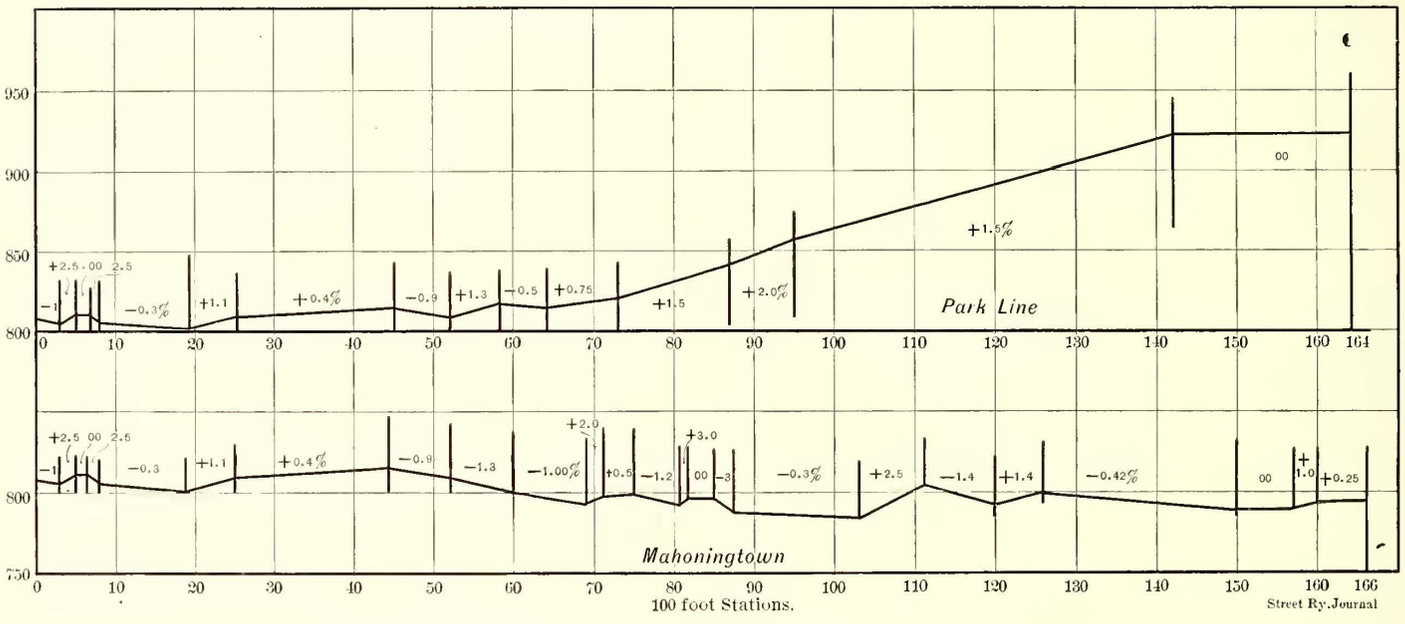
Editors Street Railway Journal:

I send herewith some statistics of cost of maintenance of rolling stock, together with profiles of roads over which cars are operated, and tables showing the mileage, etc., for the different years. The lines designated as Mahoningtown and Highland form one division; lines Grant and Pittsburgh another division; lines Croton and West Side another division, while the line designated Park is a division by itself. The car miles run on these divisions are as follows:

	1900	1901
M. & H.	352,975	333,917
C. & W. S.	181,008	151,965
G. and P.	85,690	85,833
Park	138,505	132,310

All profiles have a common zero at the junction of all the lines. Wheels and brake-shoes give the longest mileage on the Park division and the shortest on the Croton and West Side. This is accounted for by the flat grades of Park line and the steep grades of the Croton and West Side, respectively. The variation in mileage of wheels and brake-shoes between 1900 and 1901 is due to several causes, viz.; more stops, slower speed, requiring application of brakes on flat grades, where it was not necessary before, and a slight variation in the composition of shoes. The shoes of 1901 were softer. It appears that a soft shoe





PROFILES OF DIFFERENT DIVISIONS OF NEW CASTLE TRACTION COMPANY

Mileage and Other Data	1900—Range			1901—Range		
	Monthly Average	Maximum	Minimum	Monthly Average	Maximum	Minimum
Car mileage	63,182	July, 83,668	Nov., 51,596	58,502	July, 78,554.9	Feb., 46,145
Kw hours	83,887	Jan., 110,150	Sept., 54,140	76,006	Dec., 98,495.0	Sept., 60,900
Kw hours per car mile	1.327	Feb., 1.94	July, 0.966	1.18	Dec., 1.78	July, 0.93
Brake shoe mileage	6,550	15,937	2,590	4,810	12,840	1,940
Carbon brush "	4,043	12,082	2,085	5,280	13,420	2,162
Trolley wheel "	3,836 8	5,529	2,182	3,080	10,658	864.5
Armature bearing mileage	14,580	41,277	7,319	12,560	36,412	4,820
Wheels	26,734	51,117	*13,231	23,328	31,395	12,608
Number of renewals made during year	No. During Yr.			No. During Year.		
Motor bearings	38	Per cent. of total in use ..	30	58	Per cent. of total in use	46
Fuse boxes and blocks	21	" " "	50	10	" " "	25
Lamps	115	" " "	50	105	" " "	48
Gong hammers	11	" " "	14.5	8	" " "	12
Register cord	1,002.5	" " "	32	959	" " "	31
Contact fingers	223	" " "	25	251	" " "	29
Lights, glass broken	155	" " in cars	25	84	" " "	14
Bolts used	580	" " "	.03	555	" " "	3
Armatures changed { Repaired	57	" " in use	68	59	" " "	70
Armatures changed { New						
Pinions used	59	" " "	69	55	" " "	65
Gears "	12	" " "	14	11	" " "	13
Shoe hangers	35	" " "	16	46	" " "	22
Journal grease	1,598 lbs.			1,560 lbs.		
Gear "	1,010 "			999 "		
Track "	4,100 "			3,500 "		
Sand used	124 tons			94 tons		

* Except 1 pair.

wears the wheel more than a hard one so long as the material in both remains the same.

Variation in carbon brush mileage is no doubt due to better care of the armatures and commutators, together with better adjustment of the brush-holder springs.

Trolley wheels make a small mileage on the Park line and a large mileage on the Grant and Pittsburgh. This is probably accounted for by the fact that the Park service is variable and irregular, cars being run out of the house on a moment's notice without the trolley wheels being oiled,

Car Mile and Kilowatt Hours In Newcastle

	1900			1901		
	Car Miles	Kw Hours	Average	Car Miles	Kw Hours	Average
Jan.....	61,278.9	110,150	1.797	51,742.0	85,735	1.66
Feb....	55,267.6	107,240	1.940	46,145.4	80,400	1.74
March..	60,387.4	110,150	1 831	50,378.5	75,515	1.50
April...	58,530.3	83,180	1.421	49,600.0	65,080	1.30
May....	66,352.0	82,200	1.239	56,078.8	63,770	1.13
June....	79,945.6	80,000	1.00	66,384.0	70,765	1.07
July	83,668.0	80,885	0.966	78,554.9	73,265	0.93
Aug....	81,163.0	82,770	1.019	74,463.5	80,200	1.075
Sept....	52,285.1	54,140	1.035	56,662.9	60,900	1.08
Oct.....	54,369.5	62,135	1.140	54,427.4	70,300	1.28
Nov....	51,596.5	70,390	1.364	55,614.5	87,645	1.59
Dec	53,337.6	83,190	1.560	58,421.7	98,495	1.78
Total.	758,181.5	1,006,430	1.32	698,473.8	912,070	1.18

Mileage of Wheels Taken Out to Date Put in in 1900 and 1901

Mileage	Cause of Removal	Mileage	Cause of Removal
26,729	Worn out	15,384	Flanges broken
38,327	"	24,692	Worn out
28,913	"	31,395	"
32,500	"	12,608	"
13,231	"	24,394	"
4,735	Button broken off axle	27,295	"
†51,117	Worn out	30,937	"
17,350	"	23,452	"
28,280	"	25,349	"
†47,032	"	13,488	"
16,734	"	23,420	"
26,589	"	23,421	"
21,439	"	12,608	Flange broken
26,143	"	31,395	Worn out
18,359	Flange broken		
21,923	Worn out	Total... 826,261	
33,095	"		
30,430	"	Aver'ge 25,039	
25,498	"		

† Run on Park Line exclusively.
Note.—This comprises about 60 per cent. of wheels taken out in the 2 years.

after having stood for a day or two, while the cars of Grant and Pittsburgh are oiled regularly. We also operate over the Park line at a much higher speed than over the Grant and Pittsburgh. The variation in mileage of trolley wheels between 1900 and 1901 is due to a depreciation in condition of trolley wires, the wires being worn at some places and a little out of line at places, and poor material in trolley wheels.

The difference in number of fuse blocks used in the years 1900 and 1901, while it does not amount to much, is accounted for by something which I consider of importance in street railway construction. When the line represented by the Highland profile was built a simple curve of 90 ft. radius was placed at station 15. During the year 1900, a car when going up would strike the curve, and as it left the curve it would jerk sideways, causing the car to bind in the rails. The fuse would be burnt out on an average of once in twenty times, and sometimes fuse-box block and all. In November we took up the curve and bent a spiral on each end and replaced it. Since that time we have not had an average of one in 400 fuses burn out at this point, and no blocks or boxes destroyed.

The table on wheel mileage shows a wide variation. We get quite a number of small flat spots on our wheels, very few of them being over ¾ in. long. These are generally ground out on the line by the motormen, but in every case it shortens the life of the wheels by considerable amount. All of our wheels wear the flange sharp and square on the gear side, and I have spent considerable time to find out to a certainty what is the cause of it. I would very much like to hear opinions on the cause of this wear from the Street Railway Journal readers.

J. M. Walker, Supt.

The Question of Double Flanges

Union Traction Company of Indiana.

Editors Street Railway Journal:

Anderson, Ind., Feb. 19, 1902.

I note an item in a recent issue relative to double flanges. I would like to ask the writer of this article how he accounts for sharp and double flanges on an equipment where the motors drive from the same side of the truck. I mean by this, when the gears and pinions are both on the right-hand side of truck, facing car. Such is the case with the road with which I am connected, and the motor equipment I speak of is two Westinghouse 50-c motors, mounted on Baldwin Locomotive Company's "M. C. B." trucks.

Flanges on these trucks will run sharp on one side and double on the other. Probably the next car in will be in the same condition, except the sharp and double flanges will be on the opposite side than with the first car, or on diagonally cross corners. Nevertheless, the truck will be in perfect trim, all right as to axle centers, journal box centers, brass centers, as well as diagonally cross-truck ends from axle centers. There is absolutely no longitudinal motion in the brasses inside of the journal box housing.

My theory is that when one wheel is 1-1000 part of an inch smaller than the other, that the larger wheel will at once begin crowding, regardless of the location in the truck of this wheel. My remedy for this (speaking of steel-tired wheels) is to take care, when returning wheels, to make a taper of $\frac{1}{8}$ in. from the throat of the flange to the outside tread of the wheels. This allows the wheels to equalize their sizes and they will run perfectly true so long as this taper remains in the tread, but just as soon as the tread is worn flat and a little smaller than the opposite wheels, just that instant they will begin crowding the rail.

Hard and soft tires have a great deal to do with this matter, as it is very seldom that a person will find two steel tires on one axle to be of exactly the same temper.

I think you will find that there is more trouble in sharp and double flanges with steel tires throughout the country than there is with chilled cast wheels. However, I would have it understood I am not an advocate of cast chilled wheels for trucks in heavy, high-speed interurban equipments. I think the steel rim should be of as even a temperature as can possibly be secured. I might add that unless the manufacturers of steel tires make these tires more evenly tempered, this trouble will never end.

J. S. Hamlin, Master Mechanic.

The South Lancashire Electric Traction & Power Company, Ltd., of Manchester, Eng., has under construction 133 miles of electric railways connecting villages between Manchester and Liverpool, and has let contracts for the complete equipment of many additional roads to operate in the village of South Lancashire.

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NOTICE.

Papers and correspondence on all subjects of practical interest to our readers are cordially invited. Our columns are always open for the discussion of problems of operation, construction, engineering, accounting, finance and invention.

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 news columns.

All matters intended for publication in the current issues must be received at our office not later than Wednesday of each week.

Address all communications to
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The seriousness of the traction problem which has developed on the Brooklyn Bridge is increasing every day. The people of Brooklyn appear to have been afflicted *en masse* with a desire to rush into print with their own pet "remedies," and the local papers are filling their columns with the most insane methods of relief. The suggestions range from laying a second track on the roadway, to be used during rush hours only, thus practically doubling the weight, to building auxiliary steel towers beside the present ones and constructing additional roadways on each side. The double-track idea is a good one, if the bridge will stand it, as it would prohibit the use of the roadways for vehicular traffic during the rush hours, and so remove a frequent cause of blockades. The ferries are still doing business and carriages and wagons could be well diverted from the bridge during the rush hours in order to benefit the remainder of the public. But on the whole the cars are not so much more badly crowded than those of other lines in the Metropolitan district between the hours of five to six-thirty in the evening, and it is not in getting the Brooklynites across the bridge that the difficulty lies, but in getting them into the cars without the daily sacrifice of clothes and tempers now experienced at Park Row, Manhattan. Here separate crowds gather, each individual group containing prospective patronizers of the same line, and await the coming of their cars, the seats, it is needless to say, being generally secured by those of greatest muscular development. The limitation in track capacity seems to us, therefore, to be the greatest cause for the now famous "jam," and this could be greatly relieved by the plan suggested by the board of expert engineers who investigated the problem some months ago and which was described at length in these pages at the time. This not only included the addition of several more loops on the surface tracks, affording accommodation for twice as many more cars of various lines, and so diverting and splitting up the various sections of the arriving crowds, but provided for an elevated extension up Centre Street, which will eventually connect with bridge No. 2. This plan, if followed, would secure material relief to the elevated trains by permitting longer trains to be run, and would allow of "magazining" extra trains on the structure before the evening rush. An improvement in the elevated service would undoubtedly attract some of the surface traffic upstairs. But for some reason Bridge Commissioner Lindenthal does not look with favor upon this scheme, and is at work perfecting others which he has promised shortly to announce. Among those which he has praised as being among the most sensible was one suggesting the operation of "shuttle" cars only across the surface tracks, much after the manner in which the elevated trains were formerly operated. We think this would not only increase the crush at the Manhattan terminal, but would produce a second and unnecessary one on the Brooklyn side, where passengers would have to transfer to their respective cars. It has even been suggested, we believe, that the city take over the bridge transportation problem and operate it as a municipal affair, perhaps going as far as carrying passengers across free in the rush hours, and this in spite of the fact that in all the authoritative reports and recommendations that have yet appeared the Brooklyn Heights Railroad Company has been commended for the able manner in which it has operated its system under the limitations prescribed by the municipal officers.

* * *

It is more than doubtful, furthermore, whether the necessity for some radical changes of the kind mentioned will cease even after the opening of the new bridge, for at the rate at which Brooklyn is growing it would seem as if every step toward improving the facilities of transportation between Manhattan Borough and Brooklyn was outgrown before it had alleviated the situation to any extent. In the meantime, Mr. Swanstrom, President of the Borough of Brooklyn, has written a strong letter to the Rapid Transit Commissioners, urging a change in the plans for the extension of the tunnel to Brooklyn under the East River from a two-track to a four-track loop, saying that a two-track tunnel would be dangerous, and would not accommodate enough passengers to relieve the congestion of traffic at the New York end of the bridge. The whole situation is in the hands of the powers that be, and will have to be settled by them. Under private ownership, we are convinced, a solution would have been reached long ago. But the authorities of Greater New York must bear in mind

that the cramped facilities between New York and Brooklyn are sending more and more New York business men into New Jersey to find there homes which they can reach in comfort, and thus the city is constantly losing a large number of citizens and the personal taxes represented by them.

Many thousands of dollars are yearly expended in improving the ground return of street railway systems, and as the disbursement of this money is very often largely guided by milli-voltmeter readings a few words concerning them will be appropriate. There is no deflecting instrument that is more likely to give misleading results than the milli-voltmeter. The potential differences which it measures are exceedingly minute, and it very often happens that a milli-voltmeter connected across these differences of potential, by reason of its low resistance, calls for a current sufficient to destroy or seriously change the pressures that it is to measure. Its resistance is so low that the resistance of its leads and contacts seriously reduce its readings. Thus it is possible for an engineer to make a survey with a carefully calibrated 6-ohm, 100-milli-volt instrument, and get certain results and an equally conscientious engineer using an instrument adjusted with equal care and having 60 ohms resistance and a 1000-milli-volt scale would obtain results often differing by 100 per cent or more, although both instruments are accurate, and both truly indicate the potential difference at their terminals. The most convenient means for making an electrical survey with a milli-voltmeter is to connect to the instrument two long leads, each of which is securely fastened to a long, pointed iron rod, which can be thrust into the ground and wedged into intimate contact with rails, water-pipes and the like.

With such a method it is essential to touch the rods together before making a measurement, for it will often be found that a galvanic or thermal e. m. f. has by some means become generated in the lead circuits themselves, and sometimes even in subsequent readings it will be found that on reversing the rods the direction of the deflection will remain unchanged, thereby showing that the circuit contains an e. m. f. which is not reversed by reversing the connections. Due consideration must also be given to the character of the reading which is obtained. The ground is often charged with earth currents, producing differences of potential of much greater magnitude than may occur from a railway return current. These currents may sometimes be mistaken for railway return currents, but can usually be identified by the steady deflection which they give and the fact that they are not well sustained. It is these earth currents which give such widely different results when tested with instruments of different resistances. An engineer who has made a great many readings of this kind states that it is not at all uncommon to find differences of potential due to earth currents as great as one volt between two points in the ground not over 10 feet apart, and sometimes sufficiently well sustained to ring a bell or rattle a telephone receiver. In such cases the steady deflection is the only way in which the source can be identified. Therefore, when measuring microscopic potentials in this way, the readings in many cases have but little quantitative value, but simply show that one point is of a higher potential than another and the direction in which the current tends to flow. Milli-voltmeter readings taken around a length of metallic conductor of any kind are much more reliable from a quantitative standpoint, and though the deflections are generally of lesser magnitude they mean a great deal more. If a metallic structure having a resistance of one ten-thousandth of an ohm has a potential of 10 milli-volts at its terminals, 100 amps are flowing therein, an amount quite large enough to receive serious consideration. In taking such a measurement the greatest care must be had to have solid substantial connections at the terminals of the conductor, for a loose, dirty connection may interpose, in series with the potential to be measured, a galvanic effect which may deflect the milli-voltmeter three or four times as much as the potential to be measured, or a bad contact which may reduce the reading fully as much. If due allowance is made for all of these considerations, a milli-voltmeter serves as a very valuable guide in specifying improvements for the ground return, but unless this is done much money will be uselessly spent, and, on general principles, would much better be put into copper bonding.

The success of any business requiring labor depends largely upon the enthusiasm of the employees and the sentiments which they feel toward their work and the management. This is particularly true in street railway operation, where the employees have more direct dealings with the public than in any other branch of electrical activity, and than in nearly any other industry. Natural ability, of course, counts for a great deal, but human nature is largely the same in all men, and the efficiency of the entire operation depends in great part upon the policy of the company toward its employees as well as that adopted by the employees toward the company. It is needless to say that in any organization of men there must be some well-recognized system of discipline, whether the association is voluntary or involuntary or whether it is formed for political, industrial or social purposes. The by-laws of a club, as well as the statutes and law courts of civic and State organizations, provide penalties for those who commit infractions of the rules which have been adopted. Any other method of government would be unthinkable, because order, discipline and penalties are inseparable terms. It only remains, therefore, in any system of discipline, to determine the best penalty to enforce for the infraction of rules.

In deciding this question three important desiderata should be borne in mind: (1) the penalty should follow the commission of the wrong deed as quickly as possible; (2) it should be proportioned to the degree of the offense; and (3) it should be of such a nature as not to injure the persons inflicting the penalty or the innocent party in the transaction. In the case of military and civil bodies it is possible to have some control over the person and property of the offender; but as in an industrial organization the ultimate penalty can only be discharge, lesser offenses must be punished by some modified form of this punishment, that is, either the "lay-off" for a specific number of days or demerits leading up to final suspension from duty. These considerations have brought around a general adoption by steam railroad companies and many street railway companies of the Brown system of discipline in a more or less modified form, in which the lay-off has been discarded and offenses against the rules of the company are penalized by warnings or other steps leading up to final discharge. There is no doubt that while the lay-off may be effective in the way of the two considerations first mentioned in the list of

essentials, it is defective as a penalty in the third specification, in that a period of enforced idleness cannot but affect a man's financial resources and stamina and thus reduce his efficiency after he returns to the service of the company. This the Brown system does not do in any of its various forms. In comparing these different forms, as all answer the first and the third requirement, their relative efficiency may be determined by the extent with which each complies with the second consideration mentioned above or the way in which the minor offenses of the employee are recorded until they have reached a total to warrant the infliction of the ultimate and only penalty.

The system of a graded standing for each employee, as adopted in Elmira, and which includes a method by which this standing can be increased by the addition of marks for meritorious actions and lowered by demerits for offenses, is described elsewhere in this issue. Considerable space is given to the details employed because they seem to have been worked out with a great deal of thought, and to have been found in practice to be most satisfactory to both company and employees. The system used in Elmira is not radically different from that which has been employed in several other cities, and the testimony from the other roads where it has been in use is equally favorable. We do not mean by this that any system of this kind can be perfect, and there are undoubtedly objections which can be urged against a numerical classification of the men according to their all-around ability. It is also very probable that the gradations for different acts, as used in Elmira, would be to some extent unsuitable for direct application in other cities, and that, as a whole, the system might have to be modified considerably if it was transplanted to other conditions, especially if the road should be very much smaller or considerably larger. Nevertheless, the numerical gradation of different offenses and meritorious acts has an advantage over the system in which the Brown system is applied entirely according to the discretion of the manager after reading over the individual records, in that the employees know the reward or penalty for each act, and that their standing is not affected by favoritism, real or fancied. By some these facts will not be regarded entirely in the light of advantages, but so far as the first is concerned it is generally admitted, we think, to be a correct principle in jurisprudence, that better results are obtained where the penalties for each offense are well known and recognized rather than when they are indefinite, and so far as the second consideration is concerned the discretion of the manager is by no means eliminated, because his judgment, while guided by the rules, is not inflexibly bound by them and he can depart from the number of merits or demerits given in the schedule, and often does so within reasonable limits depending upon the circumstances of the case. There is, perhaps, no subject in railway operation which is of more practical value than that of the handling of employees, and theoretically there seems to be no reason why exact scientific methods cannot be used in this department, as in the department of engineering.

Practical Problems of Acceleration

We have already commented somewhat at length on Dr. Hutchinson's mathematical treatise of the conditions of acceleration of electric railways and the ensuing discussions. In an intricate practical problem, like that involved in determining the complete relations of acceleration to railway service, it is difficult to include in a mathematical discussion of reasonable simplicity, all the factors of which should enter into a final solution, since the omission or insertion of certain elements of the matter may lead to obtaining diametrically opposite results from data apparently similar, as was the case with the results obtained by Dr. Hutchingson and by Dr. Dodd. But acceleration, as the railway man knows it, and as the public deals with it, is far from being a purely mathematical problem. It involves practical considerations of a highly important character which do not lend themselves to a theoretical discussion, and it is to some of the larger aspects of the question that we wish to call particular attention.

Acceleration may be approached from two entirely opposite directions, and in our opinion the commoner road is the less satisfactory. It has been not unusual to examine the conditions of acceleration from the standpoint of the energy required, and upon this basis to work out as the best acceleration that particular value which makes the energy a minimum—which calls, therefore, for the least power per train mile. As is very well known, this solution leads to high values of acceleration. Without going into the mathematical reasoning which leads to this conclusion, it is sufficient to state that inasmuch as energy spent in braking is wasted energy, a quick acceleration followed by coasting from a maximum speed to rest is likely to give small input per train mile, provided the efficiency of the motors is not affected, as in point of fact under working conditions it is not.

To carry this line of thought to its logical, or rather illogical, conclusion, an ideal case might be represented by the car as a projectile, receiving a very high initial velocity and quickly settling down to its trajectory aimed at the next succeeding station. As a matter of practice, limitations, some of which Dr. Hutchinson has pointed out, arise in the way of insufficient tractive power, too violent demand for current at starting, need of increased size of motors, and undesirability of accelerating a human load at rates beyond a rather moderate maximum. With the best modern appliances, and such refinements of control as have been developed in the multiple-unit system, it is possible to reach rather high values of acceleration without encountering these limitations in a serious form at the scheduled speeds which have so far been attempted; but electric railway operation is much more than a problem in kinetics. It is a fine art of which much has been learned from experience, and comparatively little from theory

If one examines carefully the annual expense account of a great rapid transit system, either steam or electric, it becomes at once evident that the cost of motive power is a comparatively small factor in the matter; even a considerable increase in the energy demanded for operating the system is usually more than compensated by a very moderate increase in traffic.

If an individual finds his income and expenses dangerously near to equality two courses are open: first, to retrench on the expenses; second, to build up the income. Either will lead to a more satisfactory annual balance sheet, but the latter procedure is generally regarded as leaving on the whole pleasanter conditions. As with individuals, so with other enterprises. Economy is per se an excellent thing, but results are the final test of success in commercial

enterprises—including rapid transit systems—and it has been shown by years of experience that a large, broad-gage policy reaps its reward with gratifying regularity. This is in nowise better shown than in some form of metropolitan enterprises. On the other hand, small and skimping economies frequently fail in the long run to pay, particularly where the public feels them.

The subject of acceleration is, it seems to us, best approached from the standpoint of traffic. A thoroughly satisfactory and efficient train service is the thing which should be built up. This once accomplished, the question of more or less energy consumed in securing it becomes of rather little importance. With stations at convenient intervals and a schedule that will draw passengers instead of repelling them, the commercial results will be satisfactory, and the question before the engineers is rather how to maintain such service than whether such a service is efficient or not from a purely dynamical standpoint. The engineers must then pass first, upon the possibility of the schedules' desirability in themselves, and second, upon the ways and means of getting them, relegating to the last place the mere cost of electrical energy to produce the results.

In this connection, the most sensational feature of Dr. Hutchinson's paper was his prediction that the proposed schedule of the express of the New York Rapid Transit line would prove impracticable from inability to obtain sufficient motor capacity, and that "the minimum motor capacity required of 14.9 kw per ton *is beyond the range of practical conditions.*"

When electric motors are designed for the purpose of securing rapid acceleration, and for giving high output per pound of weight during this acceleration, results are obtained enormously better than the figure given by Dr. Hutchinson. Those of our readers who followed the extremely interesting reports which have been published of the electrical equipment upon the high-speed experimental line between Berlin and Zossen will realize how far in error this statement really is, and, although the equipment in question employs polyphase motors, which may be made conspicuously light for their output, yet continuous current motors can be and have been designed coming measurably near even to the extreme figures of this experimental line.

Large motors intended for rapid transit traction are developed along lines somewhat different from the street railway practice, from which Dr. Hutchinson apparently derived his data, and there is not the slightest reason to doubt that when it comes to planning a practical equipment for the New York rapid transit work there will be found little difficulty in meeting the requirements of the schedule. This great metropolitan rapid transit problem is one which has to be approached from the side of traffic. As we have just intimated, certain things must be accomplished, and provided these things are possible they will be accomplished. The work was not undertaken with the schedule planned by mere flights in electric railroading; on the contrary, a large amount of experience has been accumulated in the larger work of past electric railroading, which have justified the assumptions which form the basis of the proposed schedule. If this schedule were, in fact, visionary, one may as well bid farewell to all dreams of electrical rapid transit for New York or any other place.

In the work already accomplished there have been few signs of nearing any limitations based upon insufficient acceleration. On the contrary, the evidence secured by experience has appeared to indicate to us that the endurance of the passengers would constitute the real limit of acceleration unless speed be gained very smoothly. That is, unless the rate of acceleration be carefully adjusted, a point can readily be reached at which the live load begins to rebel, and it is this rather than any lack of power in the motors that seems to us to define the practical maximum of acceleration.

In the matter of motor design, it must be remembered that the large machines used for heavy traction work, particularly in such a system as is proposed for New York, are better protected from the elements than in street railway practice, and hence can easily be arranged to get rid of heat vastly better than the standard street railway motors. To be sure, as motors grow larger there is more need for such immunity, but the experience of many years in design of electrical machinery has very clearly shown that improved methods of construction mean a greatly enhanced output before the heating limit is reached.

Ordinarily neither motors nor generators have to be designed with very large output per pound of weight particularly in view. When developed, however, with this as a predominating factor in the general design, the results which can be obtained are something astonishing to those unfamiliar with modern electrical methods. Nor can the large electrical locomotives made for freight haulage be taken as instances of construction parallel to that which should be adopted for rapid transit work, for the conditions of freight haulage imperatively demand great weights to secure the adhesion necessary for drawing a long and heavy train. With every wheel, or every other wheel, a driving wheel, the conditions are very widely changed, and where high speed and quick acceleration is an object, and even very high efficiency of the motors is only important as affecting weight efficiency. A continuous current motor can be pushed to a point quite near to the best which has been accomplished with polyphase motors, and this, as we have already remarked, is amply sufficient to meet the conditions imposed by the New York rapid transit problem, or any other similar one which is likely to arise in the near future. As the rapid transit systems around great cities are developed proper schedules become much more difficult to attain with steam locomotives, handicapped as they are in the matter of adhesion, and engineers will infallibly be driven to select electric motors for their preeminence in those qualities which Dr. Hutchinson has intimated they do not possess.

We are glad this discussion has been opened and we trust that it will not die out until the whole subject has been very thoroughly aired; particularly we trust that the matter will be taken up from the standpoint of traffic and its larger relations be examined in as painstaking fashion as the minor details, which at first sight seem so important.

American engineers have always been distinguished for getting at results and modifying methods to suit the requirements of necessity. We do not believe they are going to be foiled by a task so near to present practice as the New York rapid transit problem, and we venture to predict that when the long-delayed rapid transit tunnel has come into reality, it will be found not only that it is comparatively easy to reach and to maintain the proposed schedule, but that it will not be long ere a still faster schedule will be demanded.

The Great Northern and City Railway

London may be said to be the home of the deep level underground railway, or "tube," as it has come to be called in popular phrase, since the advent of the Central London Railway. A little more than eleven years ago, on Nov. 4, 1890, to be exact, the Prince of Wales, now King Edward VII., inaugurated the system of the City and South London Railway, and the section from Stockwell to King William Street was opened on Dec. 18 of the same year. This line, the forerunner of all the other tubes, has been steadily extended, and now gives good service from Clapham Common to the Angel at Islington, a distance of about 6½ miles. Only recently the extension from Moorgate to Islington was opened and a complete new service of trains was inaugurated of much improved pattern and more comfortable accommodation.

Following this underground railway came the Waterloo and City Railway, also adopting the deep, level tube system, and affording a quick method of getting from Waterloo Station, on the south side of the river and a considerable distance from the center of the city, to the very heart of the city within a few yards of the Bank, Mansion House and Royal Exchange. Then came about a year and a half ago the Central London Railway, commonly called the "Two-penny Tube," which has done even more to popularize this method of transit, following as it did one of the two most important arteries of traffic from East to West, and being replete with the most modern ideas of electric traction, and affording an amount of comfort, cleanliness and light hitherto unknown in underground railways.

The northern suburbs of London, as is well known, have increased enormously in the past ten years, and one of the lines which have been endeavoring to serve the interests of residents not only in the suburbs but also in outlying towns on the main line is the Great Northern Railway. This important railway has its main line terminus at Kings Cross, but has also facilities for bringing its tens of thousands of passengers to Broad Street in the City. All Great Northern trains, whether for Kings Cross or Broad Street, pass the well-known junction Finsbury Park, and for years it has been evident that some better and more rapid method of transportation between this junction and the city proper was imperative, the route to Broad Street being not only a roundabout one, but being absolutely inadequate for the rapidly increasing demand, especially in the busy hours of the morning and evening. A deep level tube seemed to be the solution of the difficulty, and accordingly in 1892 a Great Northern and City Railway bill was promoted in Parliament, the engineers of which were Sir Douglas Fox & Partners and Mr. James Greathead. The bill provided for a rapid transit route from Finsbury Park to Moorgate Street, as shown in the map, by means of a double tube, each section of which was to be large enough to accommodate the ordinary rolling stock of the Great Northern Railway.

Unfortunately, for certain reasons the scheme fell through for years, until S. Pearson & Son, one of the largest and most enterprising firms of contractors in the world, who have contracts for various engineering works in all parts of the world, came to the rescue and successfully reopened negotiations. In March, 1898, the firm succeeded in floating the Great Northern & City Railway, with a capital of £2,000,000, of which £500,000 are debentures, £750,000 "A" stock, both held largely by the public, and £750,000 "B" stock, most of which is held by themselves.

As it was early decided that the trains entering the new tube should be operated electrically a suitable site for the power house and for the commencement of excavating was found in Poole Street, New North Road, and the land was purchased in July, 1898. This site measures about 22,500 sq. ft., and is situated on the southern bank of the Regents Canal, which by its connection with the Grand Junction Canal connects Warwickshire with the Thames. Poole Street is just about half way between Moorgate Street and the point where the tube comes to the surface, so that with its facilities for delivering freight by canal boat, the use of the canal for condensing and feed water for the electric power station, an ideal site was secured both from the point of view of the construction of the tunnel and as a site for a centrally situated electric power house for operating the railway when completed.

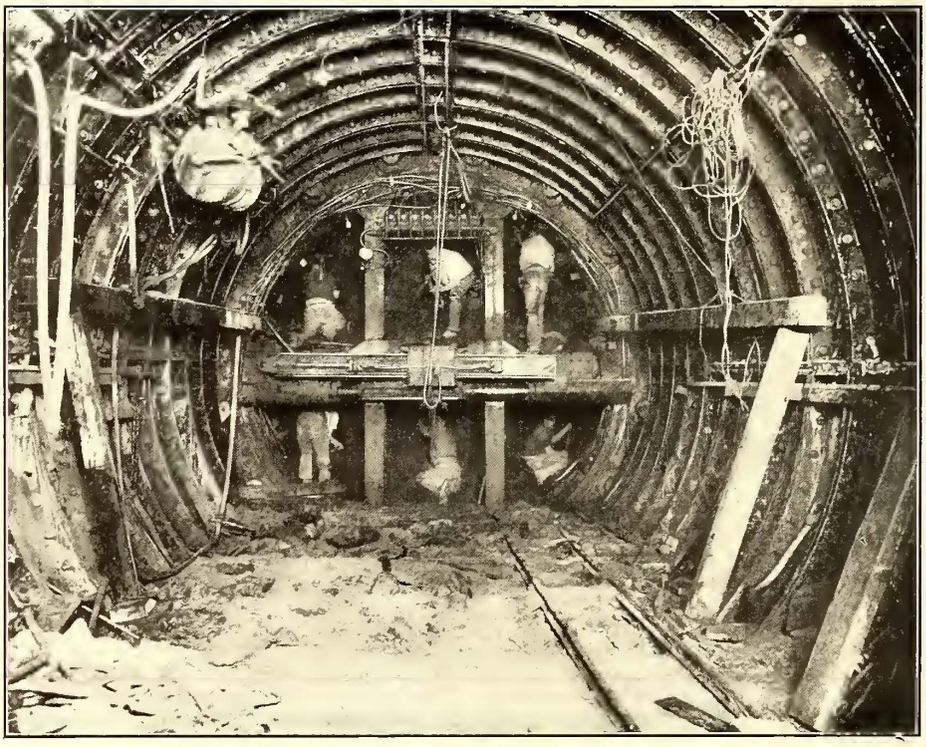


FIG. 1. VIEW INSIDE SHIELD ON STRAIGHT TRACK, SHOWING METHOD OF DRIVING

The shaft in Poole Street was sunk in October, 1898, and is situated about 20 feet from the canal bank. At the bottom of the shaft a drift was mined by hand in the ordinary way about 300 ft. long, running westward, till a point was reached in the western side of the New North Road, as it was intended that the tubes should follow the route of this road north and south. Here a large chamber was excavated, and there being two tubes, one for each set of rails, four shields 17 ft. 3 ins. in diameter were erected, each pair being set back to back and put to work, two working north and two working south. Another shaft was shortly afterward sunk at Essex Road, about half way between Poole Street and the northern end of the tube. At this point it was decided to build a station 21 ft. in diameter and 420 ft. long, and this work was accomplished by means of a large shield 22 ft. 10 ins. diameter. When the smaller shields driving the tubes from Poole Street reached the Essex Road station they were rolled through the larger

tube and then continued on their way northward toward Finsbury Park. In the meantime the other two shields continued working south from Poole Street to Old Street,

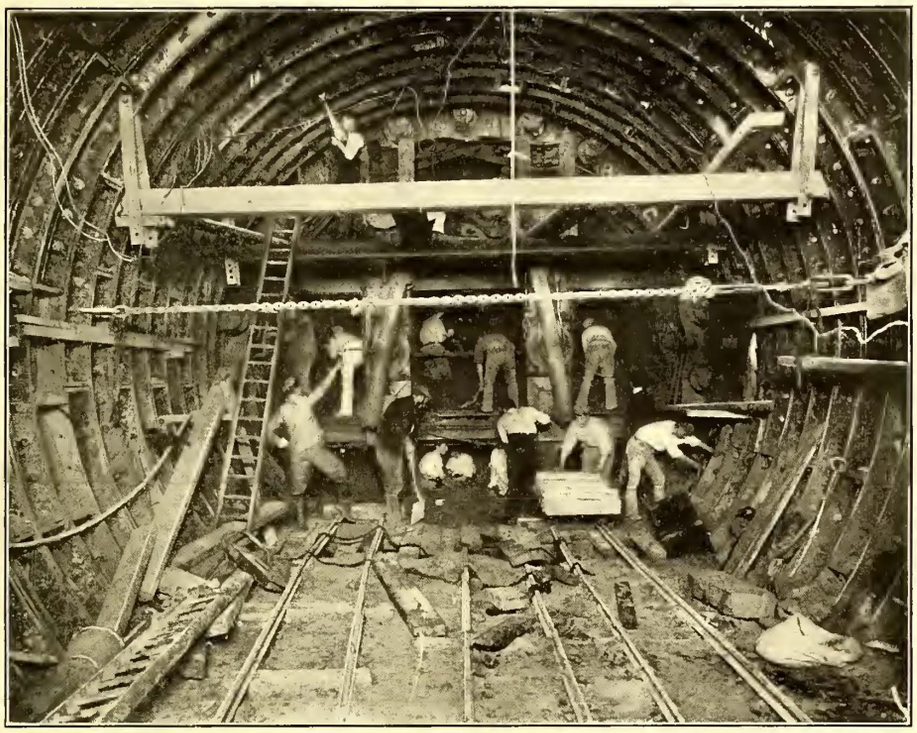


FIG. 2.—VIEW IN SHIELD USED FOR MAKING CHAMBERS FOR STATIONS

at which point another station had been decided upon and where the same method was adopted, the station tubes, 21 ft. in diameter, being first excavated after a third shaft had been sunk. Here, however, some delay in buying the land necessary took place, and two other shields were started working southward, making six shields at work at the same time for the making of the 16 ft. tubes. When the Moorgate Street station site was purchased the engineers of the work announced that they desired the two tubes of this station, which is 470 ft. long, to be 23 ft. internal diameter, so that a new shield of 25 ft. diameter had to be designed and constructed for this work.

The total length of the railway is approximately 6200 yards, the bulk of which is in tunnel. Besides the two terminal stations, Moorgate Street and Finsbury Park, there are stations at Old Street, Essex Road and Drayton Park, the last mentioned being an open station. The tunnel has a clear inside diameter of 16 ft., which is the largest tube railway which has yet been constructed, and the diameter inside the clay is about 17 ft. At first the tube, like all other tubes for similar purposes, was composed of cast iron segments 1 in. thick, of which there were eight, and a key plate in the circle, but this construction has been changed, as described below and as shown in the sectional view. The segments have a pitch or length in the direction of the tube of 20 ins., and are bolted together by five 1-in. bolts on the sides and three 1-in. bolts on the ends, the flanges of course all pointing inward, the outside of the tube next the clay being perfectly smooth. A small key plate 12 ins. wide is inserted at the top, as naturally it would be impossible to place the segments in position without such a device. So as to absolutely fill up the space existing between the outside of the tube and the clay formed by the thickness of the skin of the shield, lime in a liquid form is forced by air pressure through a small hole in each segment after the matter devised by James Greathead, thus filling every interstice and preventing any chance of subsidence. Unlike all other tube railways, however, a radical change was made in the construction of the tube after the work was well commenced, and the tube as now completed is of cast iron on the top half only, the lower half having been replaced by special Brindle brickwork 15 ins. thick, the bricks being capable of sustaining a pressure of 400 tons to the square foot. A cast iron bearer-plate is placed on the line of contact between the cast iron segments and the brickwork so as to distribute the pressure equally over the 15-in. brickwork.

With this general description of the tunnel it will doubtless be interesting to the reader to describe more in detail the special shield designed for this work and its method of operation. It is especially powerful, has far more hydraulic pushing power than is usual, and has been specially designed for this work by E. W. Moir, one of the directors of S. Pearson & Sons, in whose personal charge the whole contract has been carried out. It should first of all be said that the substratum of the Thames valley under the great city of London is composed of a material commonly known as London clay, which makes this form of tunneling peculiarly suitable. There is no rock or gravel mixed with it, so that the shields proceed from day to day with almost uniform rapidity. Above the London clay water-bearing gravel

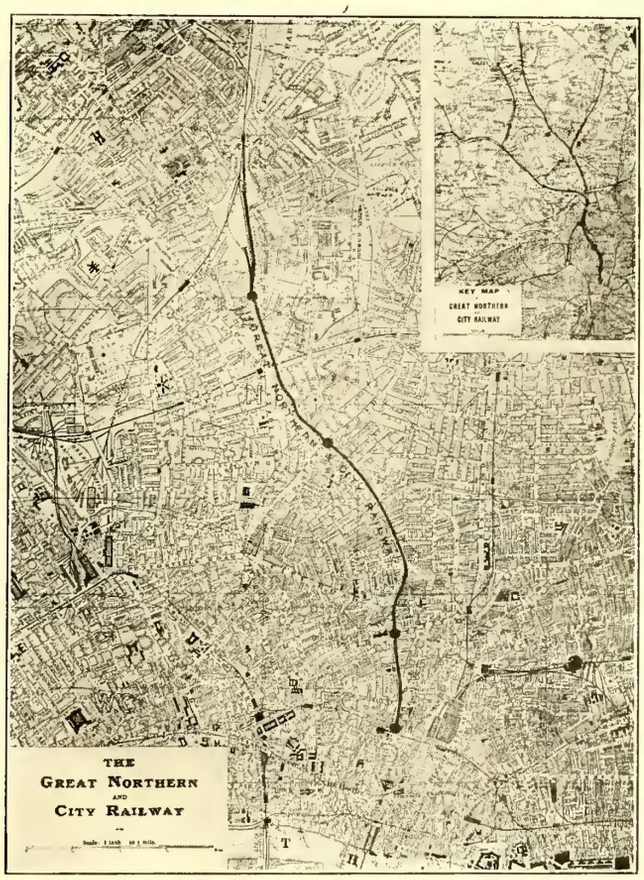


FIG. 3.—MAP OF THE SYSTEM

exists, but the blue London clay acts as a watertight partition, and no trouble has been experienced from water or gravel in the work of construction of

any of the underground tubes where careful borings have been taken in advance, as in the case of this tunnel. It is not altogether true, however, that the whole of London is situated on this blue clay, but the larger portion undoubtedly is favored in this respect. There are, however, certain localities where the clay disappears and gravel replaces it, and it is interesting to note that some of the routes of proposed tube railways encroach on these localities, so that their engineers and contractors would do well to investigate carefully beforehand, as the encountering of water-bearing gravel leads to much trouble and increased expenditure.

As there appears to be considerable misapprehension as to the exact nature of a shield, many thinking that it is a species of large boring machine or augur with rotating blades, which gradually cuts its way into the clay, perhaps it should be said before describing the shield in detail that it is really what its name implies, a shield in which men do the work of excavation, and which is pushed steadily forward by hydraulic power when the clay in front of it has been dug out and carried away. The shield is in fact a large steel cylinder like a cheese taster, open at both ends, the end next the clay being called the front or face of the shield, reinforced by cutting edges, as described further on, and the other end being called the tail, which at all times overlaps part of the completed tube, like the cap of a telescope does the body, the work of erection of the cast iron segments of the tube being carried on in the tail.

In the illustration Fig. 1 is shown a most excellent picture of a shield taken from a photograph when at work on the Great Northern & City Railway, and in Fig. 2 is shown a somewhat similar view of the large shield which was used for making the station chambers. Fig. 4 is a drawing showing in detail a side and end elevation of a shield for 16-ft. tunnels, by studying which the construction and method of operation will be readily understood. Describing the 16-ft. shield, it is composed of a cylindrical skin consisting of two $\frac{1}{2}$-in. steel plates closely riveted together, the heads of the rivets being flush on the outside, so as to present a perfectly smooth surface to the clay. This skin is made in six sections, in which form it is taken down the shaft and delivered at the point where it is to be erected, where they are firmly held together by six flush butt straps, clearly shown in our drawing. When joined together the shield has an outside diameter of 17 ft. $4\frac{1}{2}$ ins., which is exactly the diameter of the excavation to be made in the clay, and which is necessary for the making of a tube having an inside diameter of 16 ft. The length of the shield from the cutting edge to the back end of the tail is 8 ft. 9 ins., about half of this length comprising the working part of the shield and the other half forming merely the tail in which the segments of the tube are erected immediately after the shield is moved forward by means of hydraulic power. The tail overlaps, however, another half segment of the tube behind, so that the clay has no chance of pushing through into the tube except from the front of the shield where the men are at work. The front edge of the shield is reinforced by ten heavy cast steel cutting edges, which extend round the entire circle and thus prevent the shield itself from damage, and preserve it at all times in good working condition. These can be readily replaced should they be accidentally damaged.

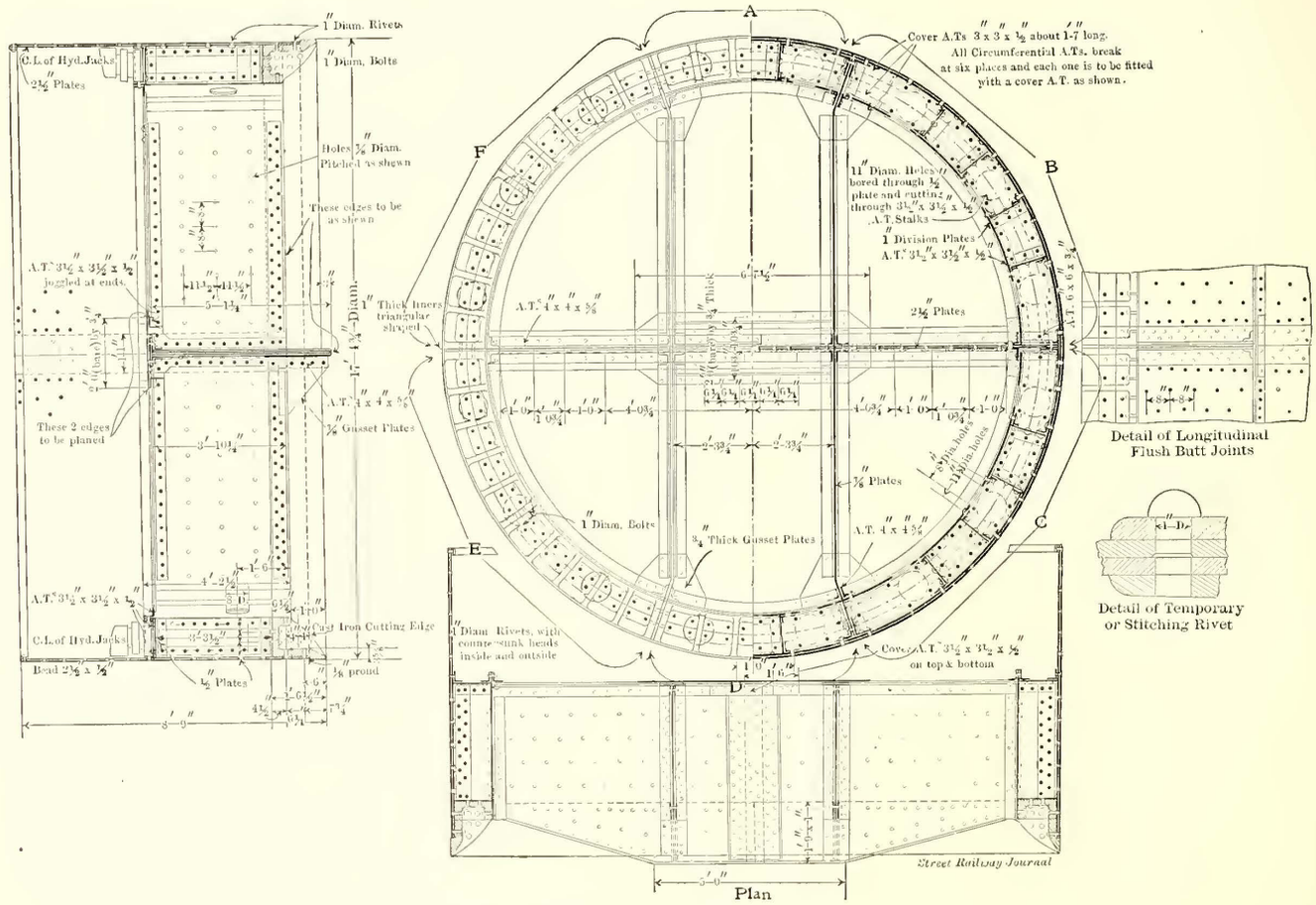


FIG. 4.—DETAILS OF SHIELD FOR TUNNELS 16 FT. IN DIAMETER

To the butt straps referred to above are attached two vertical and one horizontal bulkhead, by means of which the shield is not only strengthened, but is divided into six pockets about 4 ft. wide, thereby enabling six men to work at the clay at the same time. The horizontal bulkhead extends about a foot in front of the cutting edge into the clay, thus helping to prevent any subsidence of the clay while the men are at work. These bulkheads are strongly

reinforced with angle irons, as shown. The outer skin is also reinforced by an inner skin forming an annular space between the two skins, which is cross-girded in such a manner that a series of annular pockets is formed all the way round, but which are not seen from the front on account of the cutting edges being bolted to them. Spaced at equal intervals in these pockets are sixteen hydraulic jacks, as clearly shown in Fig. 2, which represents the

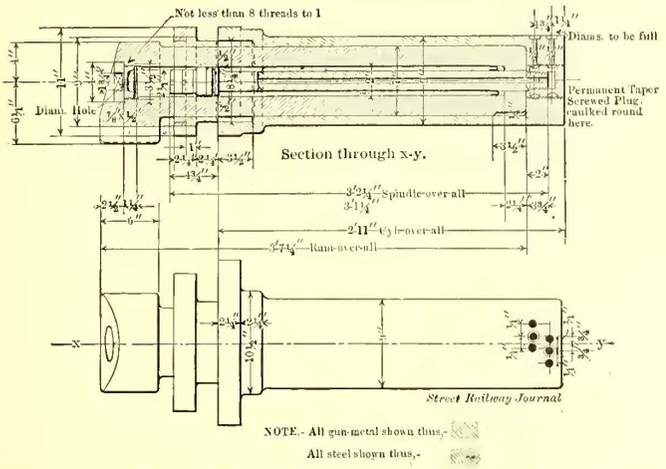


FIG7 5.—SECTION AND SIDE ELEVATION OF 7-INS. DIAMETER HYDRAULIC JACKS

shield immediately after it has been pushed forward for another ring of the iron segments, and shows the ram extended with its end close up against the last section of the tube inserted. These jacks are 7 ins. in diameter, are bored out of solid ingot steel, and are connected at the back end to the hydraulic service, the controlling valves being worked from one point on the back of the shield, and are shown in detail in Fig. 5. The pressure which is obtained is 2 tons to the square inch, and so that the jacks may be readily drawn back after they have done their work a constant pressure is allowed inside of the ram, the cylinder being so constructed as to allow of a small pressure in the opposing direction at all times and designed so that all packing can be done from the front end without moving the plunger or cylinder. A "shove" of the shield is effected when the clay in front has been excavated roughly in the center to the extent of about 18 ins., though the clay round the edges is left for the shield to break down as it is pushed forward. As will be seen, the rams exert their pressure directly on back of the cutting edge castings, while the head of the ram bears guard on the tube segments nearest the shield. As has already been said, the men when at work on the shield are in the pockets already described and work on the clay by means of pickaxes, wedges and other tools. This material is extremely hard to work with a pick, while at the same time it cuts readily with the powerful improved shields as now used. Upon being broken down or mined by the pickaxes it is shoveled from the pockets into iron trolleys brought up to the back of the shield on rails, which after being filled are hauled away to the nearest shaft by means of ponies.

For the purpose of placing the cast iron segments in position after a shove has been effected there is attached to each shield an hydraulic crane, which is generally called by the contractors an erector. This erector, shown in Figs. 2 and 4, and in detail in Figs. 6 and 7, which is the invention of Mr. Moir, who was mentioned above as designing the special shields and hydraulic appliances used, is attached to the back of the shield exactly in the center so that its arm can revolve round the whole periphery of the circle and at the same time can move outward and inward along a radial line. In other words, there are two main motions to the erector, the one a rotating motion and the other an extending motion. The rotating motion is worked by means of a rack and pinion, the rack being moved to and fro by means of two hydraulic rams whose cylinders are stationary. The rams move the rack which rotate the pinion about the main trunnion, which is situated exactly in the center of the shield. This trunnion is extended forward so as to form a box in which the extending arm slides, the extending motion being produced by another ram and cylinder which is bolted to the box. The erector rotates only half a circle in each direction and the hydraulic pressure is conveyed to it by flexible pipes.

In the 23-ft. shield the dimensions are somewhat different, the total length being 9 ft. 6-ins., and as there are two horizontal and two vertical bulkheads, nine compartments are thus provided for working in. In the annular pockets already described there are twenty-four 8-in. jacks, and in addition six platform jacks are provided so as to prevent the clay from falling in from the face while the men are working on it. It might be interesting to state here that similar jacks to these were used successfully in the construction of the Blackwall tunnel underneath the River Thames five or six years ago, that wonderful piece of work being also carried out under Mr. Moir's supervision. In the case of these larger shields two erectors are provided instead of one, each erector doing half the work. The work of the construction of the tunnel is proceeding day and night, and a maximum speed has been attained of erecting 44 rings of the segments, completely bolted to-

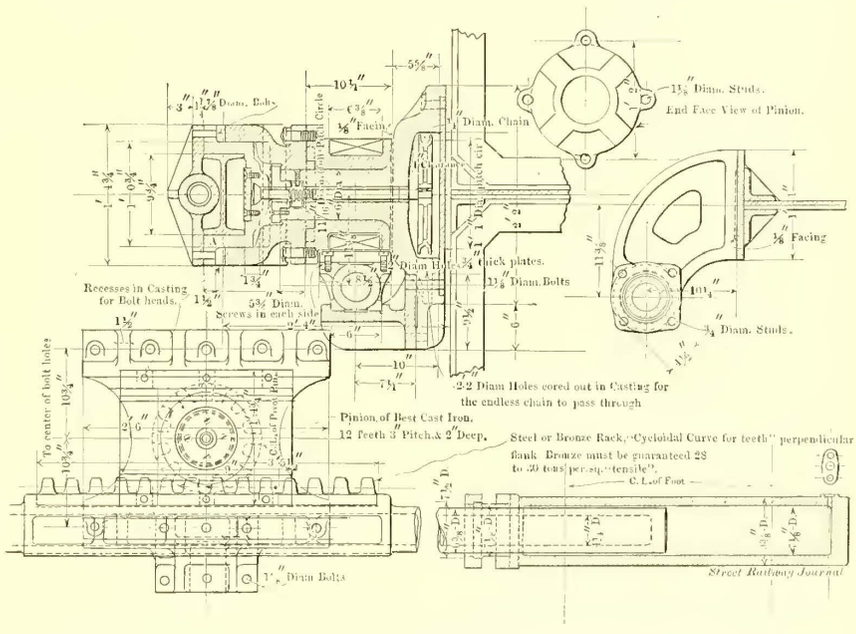


FIG. 6.—DETAILS OF HYDRAULIC ROTATING APPARATUS FOR ERECTOR

gether and grouted, during a week of five and a half days. This does not represent naturally the average speed, but all the tunnels have been driven in a little over two years.

About three-quarters of a mile from Finsbury Park terminus the tunnel comes to the surface, and from that point to Finsbury Park the line again descends, and the present terminus will be directly under the present Finsbury Park station of the Great Northern Railway. At the end of the tunnels will be located the necessary repairing shops, car sheds, cleaning sheds and sheds for storing the trains during the slack hours of the day.

It is interesting to note the importance which electricity

has played in the construction of this railway, and that this branch of applied science has rendered the undertaking far less formidable than it might have been in earlier days. Indeed, it is doubtful whether it would have been at all possible to drive the shields to such distances and at such a rate if the electric light had not been available, for the atmosphere would have become so vitiated by the use of any other illuminant that ventilation would have become at least an interesting problem, perhaps a difficulty, and a source of considerable expense, while the working of

The manner in which these depots were arranged was highly creditable to the skill of the contractors, for on a space of not more than 36 ft. x 56 ft. the whole of the plant, consisting of at least fourteen shaft-driven units for driving three different tunnels at the same time, was installed, while provision was made for dealing with all the materials for building the tunnels and removing the spoil without causing any inconvenience in some of the busiest parts of London.

A substantial wooden structure was erected in the base-

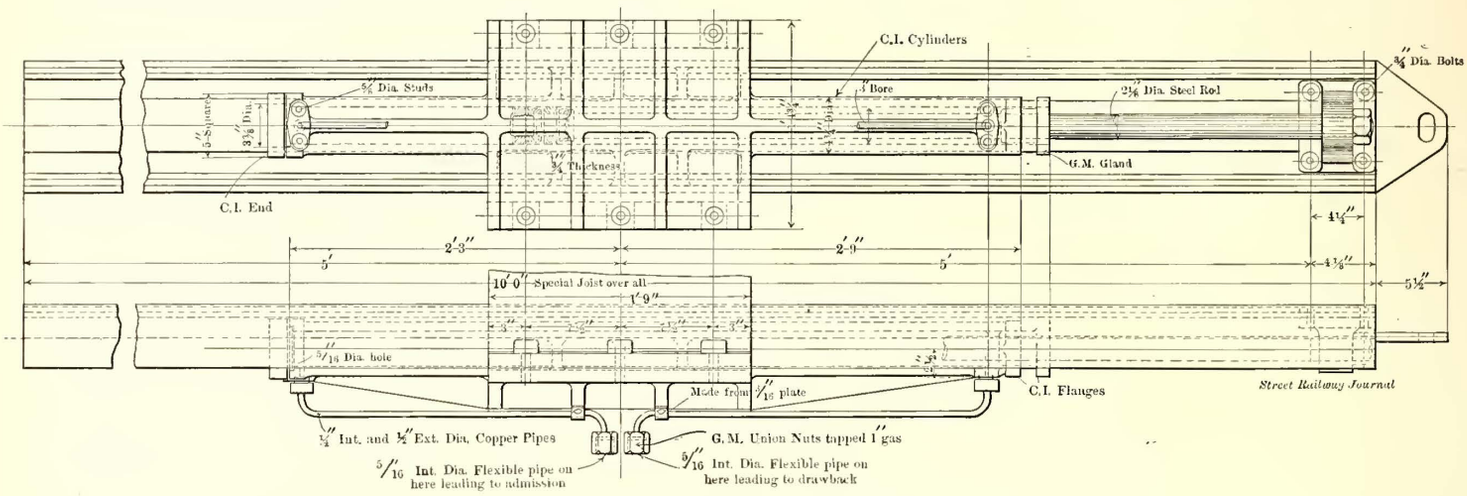


FIG. 7.—HYDRAULIC CYLINDERS AND GEAR OF ERECTOR

the traffic through the tunnel would, no doubt, have been seriously impeded by the lack of such a luxury. It is not in the matter of lighting alone, however, that electricity has been found so serviceable, for electric motive power has been applied to haulage, winding, pumping, air compressing, hydraulic plant, sawing, mortar mixing and fanning, etc., on a large scale, some of the depots being run entirely by electrically driven plants. As a proof of the reliability of this method of working the contractors state that one of their depots was run continuously for six weeks, Sundays included, without a hitch, while at other times the running time was invariably from Monday morning to Saturday night.

For the supply of electric power agreements were entered into with the local electric supply companies. The mains were slung on insulators from the roof of the tunnels, and consisted of a specially made single-braided, copper-stranded conductor, untinned, the single braiding serving to prevent the pointers from short-circuiting when working at the top of the tunnels.

Incandescent lamps at short intervals were found amply sufficient for working the traffic in the 16-ft. tunnels, but for special work in station tunnels, passages, shields, stages, etc., a very much larger allowance was necessary, and the flexibility of electric lighting was found to be one of its greatest advantages in these cases. Arc lamps, except in one or two cases, were not found very suitable for underground work, but they were extensively used on the gantries and yards at the various depots.

For the electric motive power it was very wisely decided to have the motors as far as possible all of the same size, and interchangeable. The size adopted was 30 hp and Westinghouse 4-pole type motors were put down to drive a line shaft from which the necessary hydraulic, air, winding, fanning, pumping and other plants for working the depot were driven by means of belting.

Motors were run upon loose pulleys and put on to the shafting according to the demand for power. Thus the maximum economy was attained by keeping the motors as fully loaded as possible.

ment, in which was situated all the driving machinery. The top floor carried a portable steam crane which could plumb the roadway and deal with the material required in the tunnel by lowering it down a portion of the shaft reserved for its use, and also formed the landing stage for the

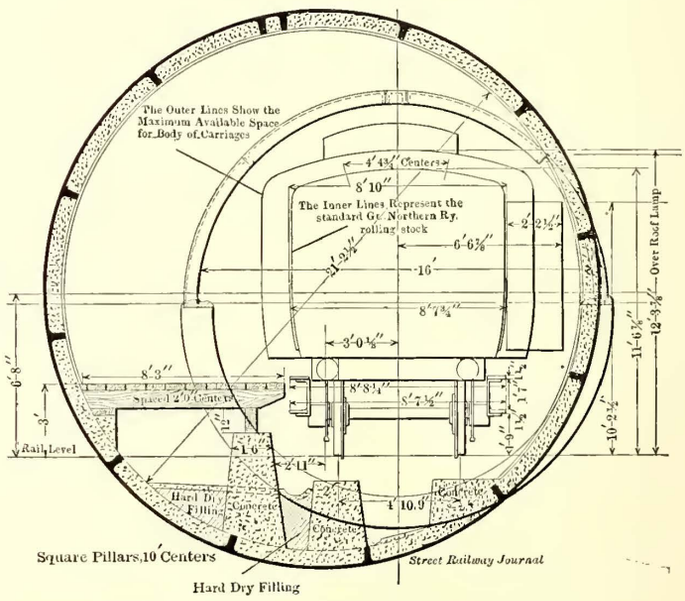


FIG. 8.—SECTION OF TUNNEL AND STATION

spoil wound from the bottom of the shaft, the cages being suspended from a pit-head superstructure and operated by the winding gear situated with the other machinery in the basement. The spoil was shot from the skips into bins served by roads leading from the cages, and carts on the ground floor were served from these bins by suitably controlled shoots worked by the carters as required.

The depth of the shafts varied between 60 ft. and 90 ft., and the winding was done very satisfactorily by belt-driven Lidgerwood hoists with friction gear, the cage being wound above ordinary flap keps and then lowered away on free barrel to rest upon them.

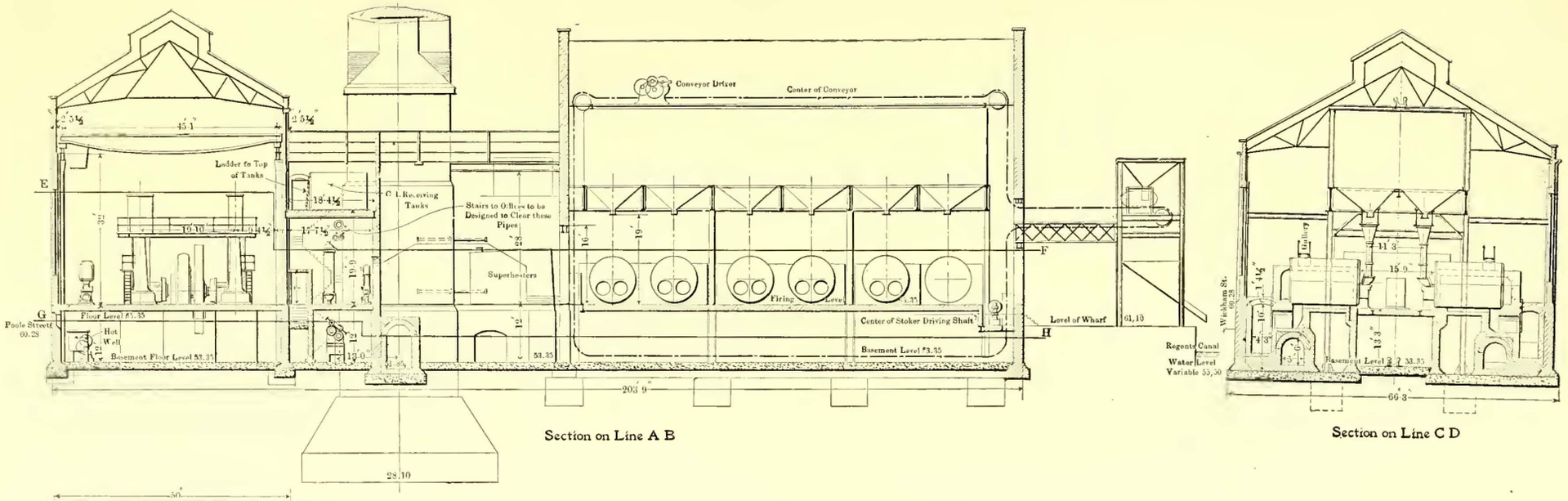
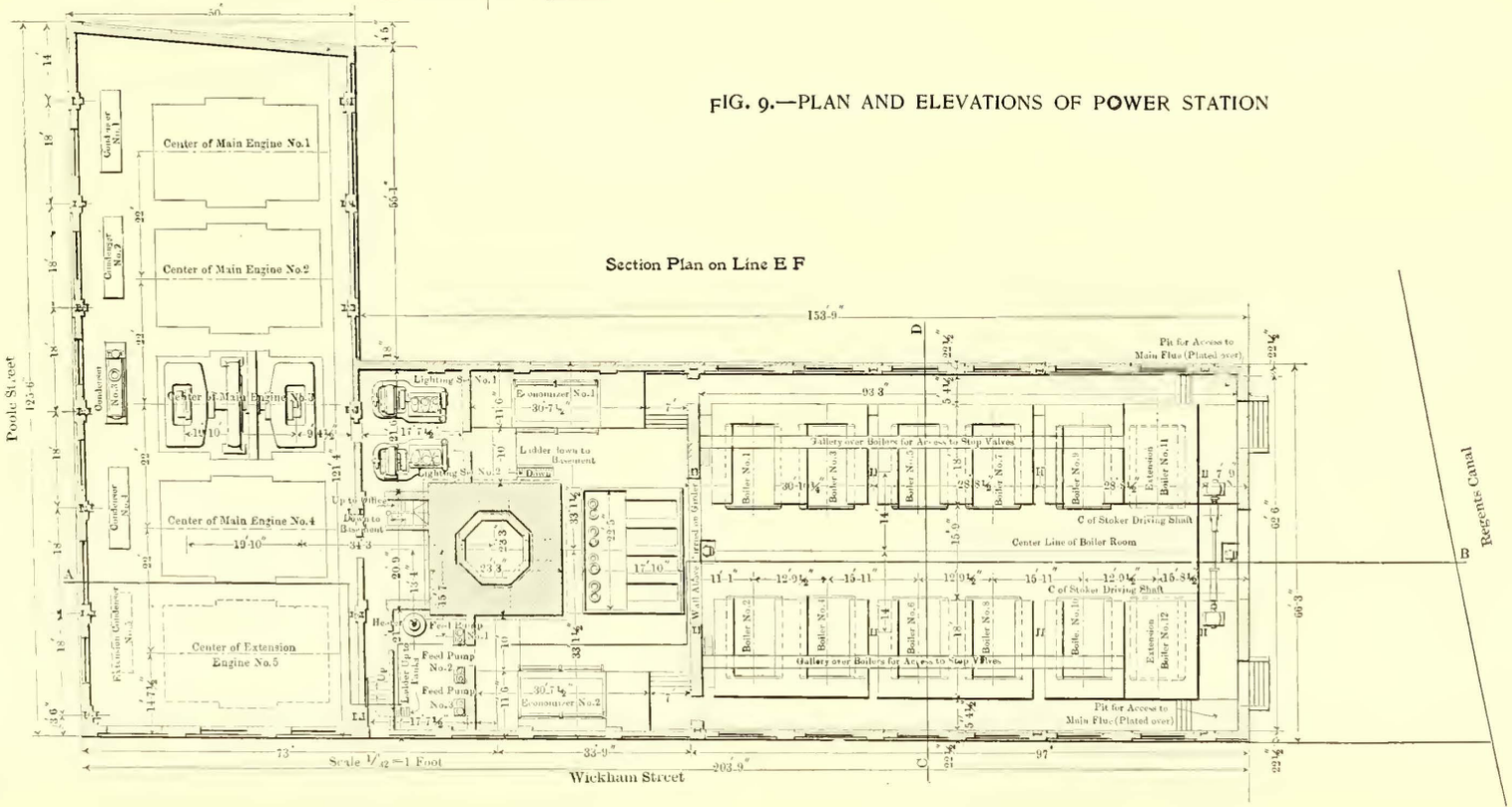


FIG. 9.—PLAN AND ELEVATIONS OF POWER STATION



The hydraulic power for working the shields was delivered by a system of piping with valves at a convenient place in the tunnel for controlling the supply to the various points.

The stores were situated near this distributing point and communication with the engine room, offices, shields, etc., was effected by means of telephones, which when the tunnels got through were connected up with all the other depots, thus forming a complete system enabling communication to be established between the head depot at Poole Street and any part of the railway.

The purpose of this article being to describe briefly the method of making a tube railway it is not the intention to describe fully the electrical equipment, but a few words regarding the generating station and electrical equipment will be found interesting, and it is thought in a later issue it will be possible to describe this work more in detail.

The space for the power house in Poole Street, which has been previously referred to, is very limited and it has been difficult to get plant of the horse-power necessary into the space available. Six thousand horse-power was necessary, and that amount is being provided for, the general arrangement being shown in Fig. 9. The engines, four in number, are being built by John Musgrave & Son, Ltd., of Bolton, who have already attained a high reputation for supplying engines for electric traction work. They are of the vertical marine compound type, and each engine will be capable of driving a normal load of 1400 ihp, and an emergency load of 1875 ihp. The cylinder dimensions are 27 ins. and 52 ins. x 42 ins. stroke. The valves are of the Corliss type, placed in the cylinder covers. The main governor is

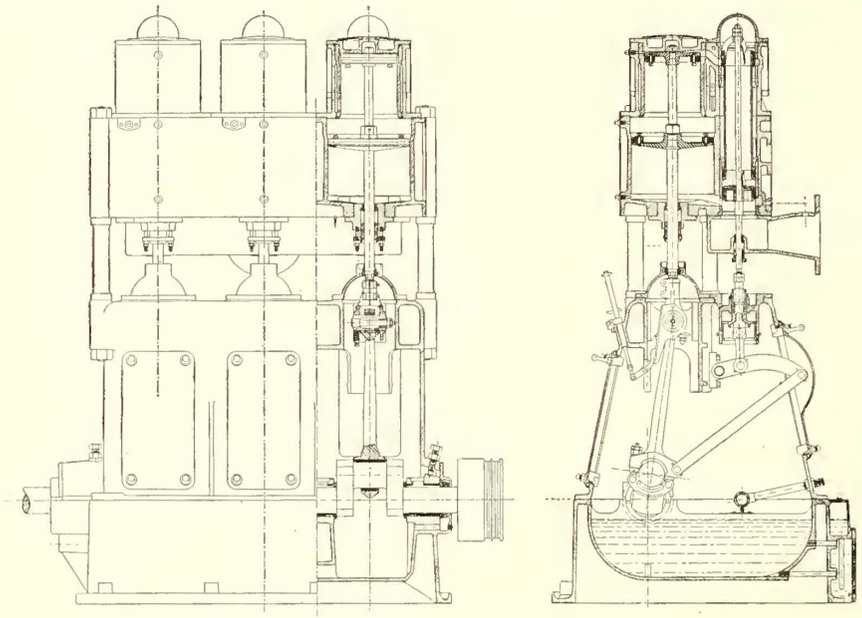


FIG. 11.—SECTIONS OF AUXILIARY ENGINES

coupled direct to the high-pressure cylinder valve gear, and will regulate the speed of the engine to 3 per cent from full load to no load, if thrown off suddenly. In case of accident to the main governor there is an emergency governor to each engine which comes into action when the engine gets 5 per cent above normal speed; this governor then rises and closes the valve, which is placed in the steam pipe so that the engine cannot run away. The engines are also made in such a manner that either cylinder can be used without the other, so that they can work the high-pressure cylinder only to atmosphere or condensing, or low-pressure cylinder only to atmosphere or condensing, or compound, non-condensing or condensing. The fly-wheel is 19 ft. in diameter.

The auxiliary engines are two in number, and of the Davey-Paxman "Peache" high-speed, three-crank vertical compound type. Each engine has three high-pressure cylinders, each 11 ins. in diameter, and three low-pressure cylonders, 16 ins. in diameter and 10-in. stroke. Each engine is capable of developing 171 B. hp as normal load, 214 B. hp as an overload for two hours, and 262 B. hp as

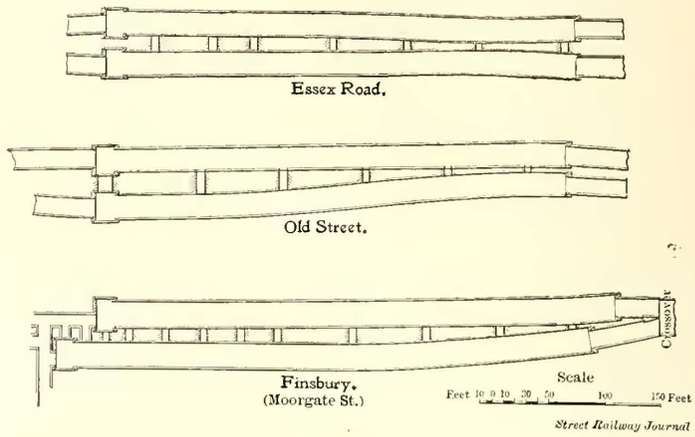


FIG 10 —PLAN OF STATIONS

a momentary overload, running at a speed of 375 r. p. m., and with 150 lbs. steam at engine stop-valve.

In connection with the above plant, Davey, Paxman & Company, Ltd., of Colchester, are supplying ten of their well-known "economic" steam boilers, each of which is 14 ft. 6 ins. long by 9 ft. 9 ins. in diameter, and is fitted with two flues, each 3 ft. 2 ins. in diameter, each being provided with two circulating tubes. There are 138 smoke tubes, 3¼ ins. in external diameter, fitted in each boiler. The heating surface is about 1890 sq. ft., and grate area 41 sq. ft. The working pressure of the boilers is 160 lbs. per square inch; hydraulic test, 260 lbs. per square inch. Each boiler will evaporate 11,200 lbs. of water per hour. The boilers are fitted with Vicars' mechanical stokers.

Surface condensers, coal conveyors, economizers, water-softening plant and all the accessories for a first-class modern condensing plant are being installed, and the whole is contained in buildings of steel framework with brickwork paneling between. The smokestack is 205 ft. high, with an inside flue of 10 ft. diameter, and it is built of yellow stocks. It is octagonal in shape and rests on concrete foundations built into the London clay.

The electric generators, which are of 800 kw each, are being supplied by the British Thomson-Houston Company, of Rugby, who are also supplying the railway motors.

The storage capacity for coal above the boilers amounts to over 1000 tons, and as the power house is built close to the Regents Canal already referred to the unloading of coal is greatly facilitated. Provision is also made for other necessary stores. The distributing system is very simple, as the generators deliver their current directly to the insulated conductor rails at a pressure of 575 volts. These rails are placed one on each side of the track and are composed of steel channel, supported on earthenware insulators and forming an insulated return. The transmission losses will be low, the power house being about midway on the line, and as direct current is used there will be no loss due to the use of sub-stations. Electric elevators are being put in at the various stations, and these are being supplied by Easton & Co., of London.

The cars for this line are of two kinds, motors and trailers, which will be worked in trains of seven cars, each made up of three motor cars and four trailer cars per train. The trains will each weigh about 200 tons when normally loaded, and will consist of seven coaches in all, of which three—the center and two end ones—will each be equipped with two motors.

In over-all dimensions and in seating capacity the cars are practically identical, but the motor cars are to have

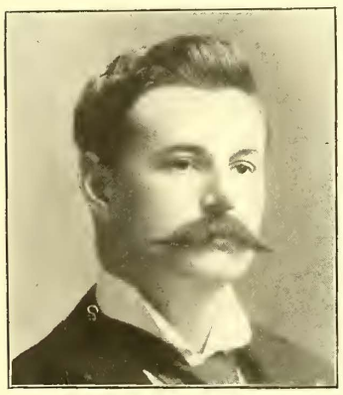
SIR DOUGLAS FOX

SIR WEETMAN PEARSON

vestibuled platforms, while the platforms of the trailer cars are to be provided only with wrought-iron railings and gates similar to the cars in operation on the Central London line. The cars will be equipped with Westinghouse brakes. The main dimensions of the cars are as follows:

Total length over platforms, 49 ft. 6 ins.
Width over panel at window belt, 9 ft. 4 ins.
Total overall height when mounted on trucks, 12 ft. 2 ins.

In cross section the cars are designed to comply with the Great Northern Railway loading gage, which will enable their being worked in connection with the rolling stock of the above road should it be found convenient or necessary to do so. The seating capacity of the cars is seventy-three passengers, and the seats are arranged crosswise of the car, with room for three passengers on one side and two on the other. In construction the cars are to have steel under frames, with the usual buffers, couplers, etc. The upper framework will be principally of teak; the interior finish will be of the McGuire make, with cast-steel frames, and the wheels either of Mansell or Kitson pattern. The platform entrances of the cars will be closed by gates similar to those on the Central London Railway. The rolling stock has been supplied by the Brush Electrical Engineering Company, of London, and the Electric Railway and Tramway Carriage Works, of Preston.



E. W. MOIR

The trains will be operated on the motor car system, using the electric train control system of the British Thomson-Houston Company, which is similar to that which is being used by the Manhattan Elevated Railway, of New York City. The motors will also be of the same type as on the New York elevated roads, i. e., the 66 motor. As both this system and motor were fully described in the STREET RAILWAY JOURNAL for October, 1901, the reader is referred to that issue for full particulars. On the Great Northern & City line the trail cars are not equipped with master controllers, but where the conditions require it every coach of a train, whether a motor car or a trail car, may be thus equipped, so that the train may just as readily be operated whether there is a trail car or a motor car at the front. The approximate weight of apparatus required for each trail car is 100 lbs.

As has already been stated, the engineers for the work are Sir Douglas Fox & Partners, whose resident engineer on the works is D. Hutchinson. The contractors, who also promoted the line, are S. Pearson & Son, Ltd., London, the president of which company is Sir Weetman Pearson, Bart., M. P. E. W. Moir, M. Inst. C. E., one of the directors of the company, has had special charge of the work from the beginning, and, as has already been stated in several places in this article, is the inventor of the new improved shield with which the work has been accomplished, the hydraulic erector attached to the shield, and many of the special appliances necessary for the successful completion of the work. Mr. Moir has been most ably assisted by Mr. Basil Everett and Mr. Halden, while in the electrical work he has had the assistance of R. P. Brousson, who has had valuable previous experience in the electrical equipment of the Central London Railway, and has been given entire charge of the erection of the power station and the complete electrical equipment.

To all of these gentlemen and to the very efficient staff under them the STREET RAILWAY JOURNAL is very much indebted for the foregoing details and for the numerous drawings and photographs which they have kindly furnished for the illustrations.

Disruption of Freight Service at Dayton

The city officials of Dayton, Ohio, have taken action on the matter of unloading freight within prescribed limits, and the result is that the various electric railway companies will be forced to establish a central freight and passenger station, or else withdraw from the freight business. The Council of Dayton recently established limits within which the traction companies were not permitted to unload freight. For a time the roads paid no attention to the rule and the police have recently taken a hand. The Dayton & Xenia Traction Company, operating two lines to Xenia, has discontinued its freight service, as it was found impracticable for shippers to meet the cars at distant city points, especially as it would be necessary to maintain two stations. The Dayton & Troy Traction Company and the Dayton & Western Traction Company have entered into an agreement with the Southern Ohio Express Company whereby the latter will collect and deliver express matter for these roads. This plan will be of great advantage to shippers, and will obviate the difficulties caused by the city's ruling that cars must not be unloaded inside of a large district in the center of the city. The Dayton, Springfield & Urbana Railway transports its freight to and from Springfield Street; the haul is a long one, but the business is heavy enough to warrant the move. The Southern Ohio Traction Company has paid no attention to the ordinance, and continues to unload freight near the postoffice. How long it will be permitted is a matter of conjecture. The Dayton & Northern is the only road not interfered with, as its freight station is located on the levee and does not interfere with traffic. The action of the city in so interfering with the freight service has worked not only to the detriment of the companies engaged in transporting freight, but also to the business interests; and business men are loud in their denunciations of a policy that tends to the disruption of a service which has been of immense value to them.

The Camps Bay, Cape Town & Sea Point Tramways

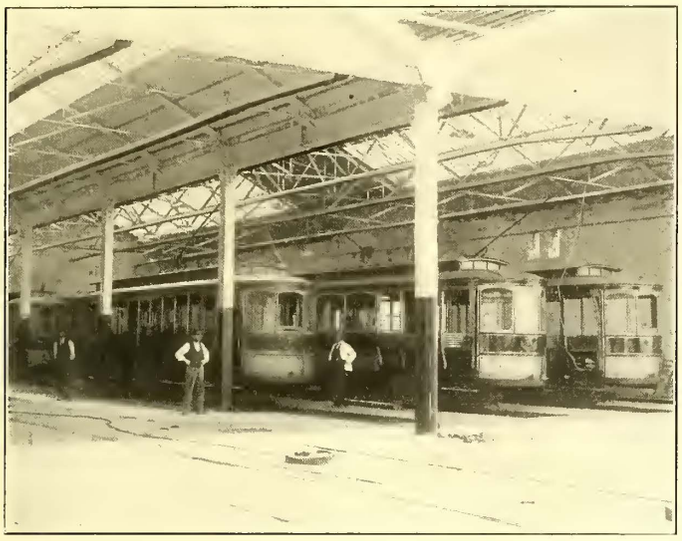
During the past two years probably no place in the world has been more constantly in the public mind than Cape Colony and its capital, Cape Town. Cape Town itself is a most progressive city, has a fine harbor and extensive docks, and in Table Bay has one of the most perfect natural anchorages in the world. Even at normal times it is a busy place where people of all nationalities may be met on their way to and from the goldfields of South Africa, but the present war has caused a ceaseless activity difficult to imagine by those who have not witnessed it. Being the principal base for the military operations, its resources and capabilities have been taxed to their utmost. A considerable percentage of the dock space has been entirely monopolized by the soldiers, who have also had the railways under their control. This, of course, has all tended to increase the difficulties of carrying on any form of construction work. Not only has labor been very scarce, but the delivery of many of the materials has been most difficult. Some of the ships having these on board have been in the harbor months before obtaining a berth. However, notwithstanding these and other drawbacks, an electric tramway system comprising 9 miles of what is probably the most difficult trackwork in the world, with the possible exception of the Gorge road at Niagara Falls, has recently been completed near Cape Town.

The construction and equipment of the line has been carried out in accordance with the act of Parliament dated Oct. 20, 1899, entitled the Camps Bay tramways act. The company which undertook to build the road under this act is known as the Camps Bay, Cape Town & Sea Point Tramways Company, and it is to the enterprise of this company that the districts owe these lines, which are now completed. As will be understood from the title of the road, the system is in reality an extension of the existing Cape Town Tramways, although pioneered and worked by a separate company.

The main route may be described as semi-circular. For the purposes of this description it may be well to commence at the Round Church, Sea Point, on the southwest of Cape Town. Junction is made at this point with the existing tramway, and from there the line commences to ascend, gradually at first, but within the first mile an altitude of nearly 300 ft. is attained, and grades of 1 in 12, or 8.33 per cent are encountered. Continuing southward, Upper Clifton is reached, and from here a magnificent view of Camps Bay and the range of mountains known as the Twelve Apostles is obtained. From here a gradual descent brings the traveler past the old Toll House to Camps Bay, where the track leaves the center of the roadway and is laid on land purchased by the company along the side of the Victoria Road for a distance of nearly three-quarters of a mile until the power house is reached. The land on which this portion of the tramway is laid forms part of the Brighton estate, which was purchased by an-

GENERAL VIEW OF PART OF ROUTE, ASCENDING GRADE

other company with the object of developing the land as a building estate, making roads, laying sewers and building hotels and residences. At present Camps Bay has practically no population, but with the development of the

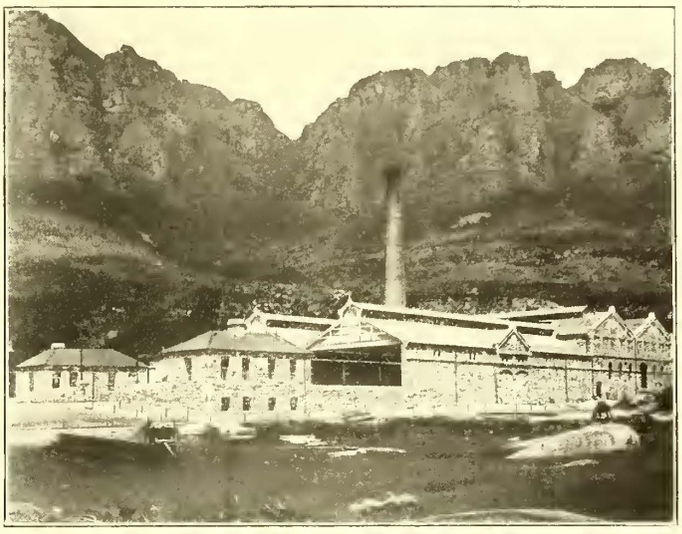


CAR HOUSE

estate and a cheap and rapid means of reaching Cape Town its natural advantages will undoubtedly make it in the future the finest residential and seaside resort in the whole of South Africa.

Passing the power house the tramway leaves the existing roadway, and is laid on the estate before mentioned. Following a new roadway which has recently been made for the purpose the most southerly point of the tramway is reached at Oudekraal, near the aerial tramway which conveys the materials to the new reservoir now being constructed on Table Mountain, and from here it turns in a northeasterly direction, still following the new roadway, until the highest point of the tramway is attained at Kloof Nek. The altitude here is nearly 800 ft. above sea level, and one of the finest views in the Colony is obtained. To the south lie Camps Bay and Oudekraal; to the north, Cape Town, Table Bay, and, in the distance, the Blue Berg Mountains; on the west is the Lion's Head, and on the east Table Mountain. The new road ends at Kloof Nek, and again the tramway is laid along the center of an existing roadway known as the Kloof Road. The route here, as regards grades, is the heaviest on any part of the system. The average grade from the Kloof Nek to the terminus at Burnside Road, a distance of a little over 1¼ miles, is slightly steeper than 1 in 12. This is exceeded in places, there being grades of 1 in 9 for short distances. Passing down the Kloof Road, the northern terminus at Burnside Road in the municipality of Cape Town is reached. Junction is here made with the Cape Town tramways. The distance from the Round Church at Sea Point is roughly 7 miles.

In addition to the main line, there are two other short sections, one running down Queen's Road, Sea Point, to the Sea Point Railway station, with a branch to the Sea Point terminus of the Cape Town Tramways, and the other section forms a junction with the existing Cape Town Tramways in Orange Street, passing along the whole length of Upper Orange Street, past De Waal Park and the Molteno Reservoir to the Orangezight estate, which,

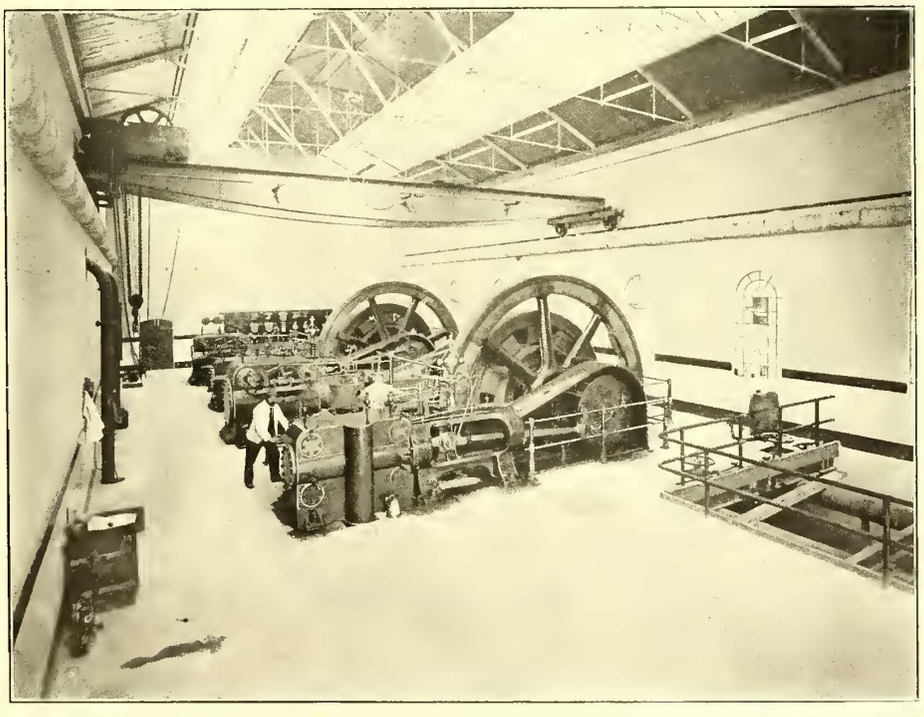


POWER STATION

like the Brighton estate at Camps Bay, is the property of a company whose object is to develop the estate.

EARTHWORK

The earthwork, which it was necessary to undertake before the actual work of construction could be commenced, was of a very heavy nature. In addition to the new roadway which had to be constructed, more than 75



INTERIOR OF POWER STATION

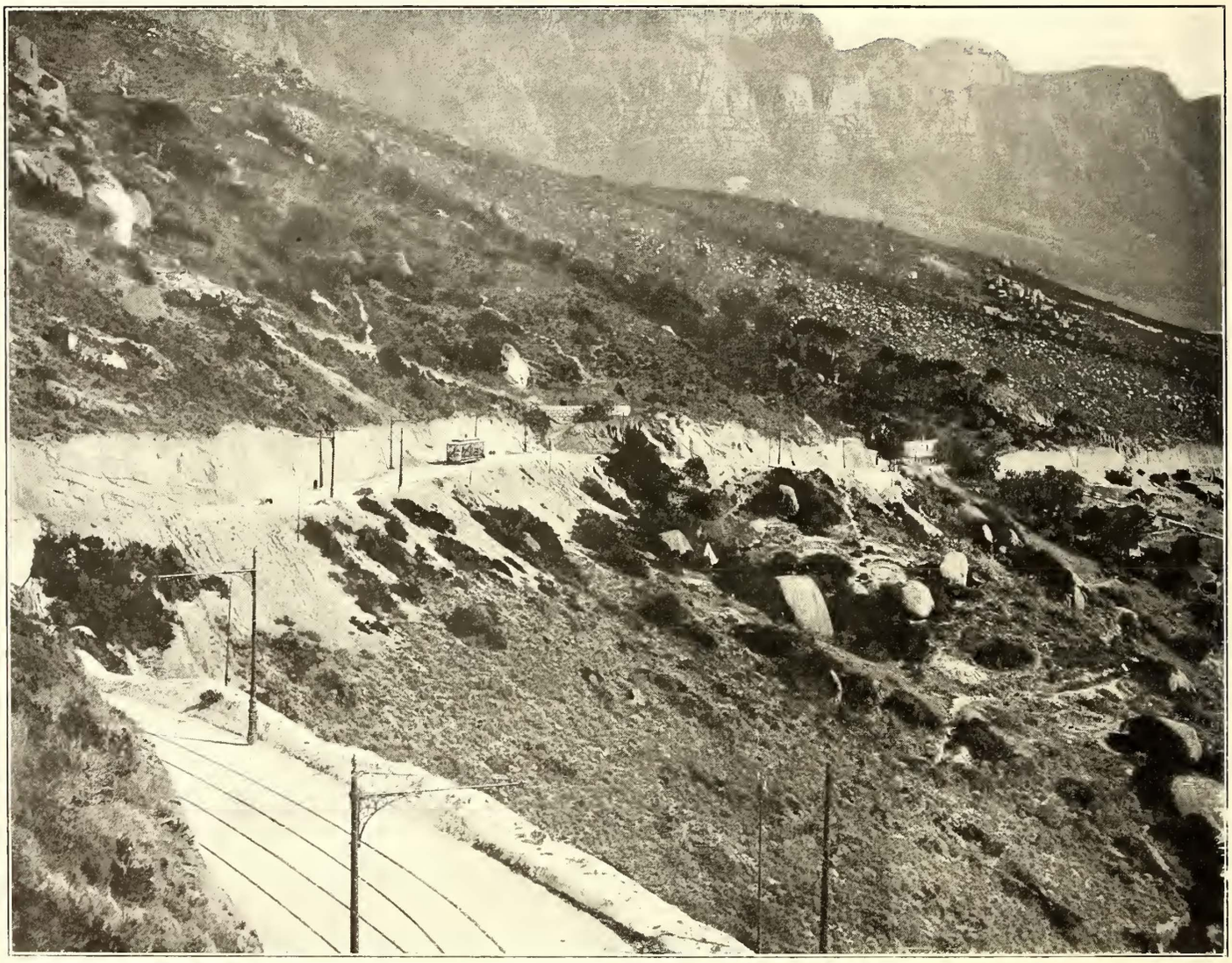
per cent of the existing roads had to be widened and graded. The nature of the ground throughout rendered excavation difficult and expensive. In places a clayey soil was encountered containing innumerable boulders of various sizes; the larger ones it was necessary to blast and split up into smaller pieces before they could be removed. In other places a decomposed granite in all stages of decomposition was met with, that which was most decomposed being negotiated with much labor by means of

picks and shovels; that in the first stages of decomposition it was necessary to blast, but the most difficult of all was that which was only half decomposed, it being too hard for getting with a pick and too soft and elastic for satisfactory blasting, many of the charges blowing out without loosening the mass. In comparison to the amount of earthwork to be done, the proportion of blasting necessary was very great, the majority of rock encountered being a very hard blue granite, which as a building stone is equal to any Scotch granite. The bulk of the rock blasted was again broken up, and formed an excellent stone for concrete and road ballasting. The decomposed granite was found to be an excellent material for surfacing the roadways, for which purpose a considerable quantity was used.

Along the new road many culverts were necessary to carry off the great quantity of water which rushes down the precipitous slopes of Table Mountain after the heavy tropical rains known to the Colony. Additional culverts were also necessary along the existing roads to thoroughly protect them from the heavy rains. During the wet season the damage done to the roads is considerable, owing to the non-absorbent nature of the ground. Provision has to be made for carrying off most of the rainfall by frequent and capacious drains and culverts. Should by any chance the culverts become blocked the consequences might be serious. Massive retaining walls were also constructed consisting of dry stonework laid in courses. On the new road these were of exceptional strength, measuring from 6 ft. to 10 ft. thick at the base, and from 20 ft. to 25 ft. in height, crossing the deep sluits or water courses on the estate.

TRACK CONSTRUCTION

Permanent-way construction was commenced in September, 1900. The gage of the tramway is 4 ft. 8½ ins., similar to the Cape Town Tramways, over whose lines running powers have been obtained. Girder rails weighing 90 lbs. to the yard have been used. These are laid on a concrete foundation, a strip of concrete 6 ins. deep and 18 ins. wide, composed of 5:1 Portland cement, being laid under each rail. Karri wood paving has been laid for a width of 1 ft. 10 ins. on each side of the track, and a 9-in. toothing course along the inner side of each rail. The rail-joints are each bonded with two No. 000000 S. W. G. (a trifle larger than No. 0000 B. & S.) "Neptune" rail-bonds. Special cast steel points or switches 8 ft. 8 ins. long and 1 in 9 crossings have been used.



ANOTHER VIEW, SHOWING TRACK AND CAR ON HILL SIDE

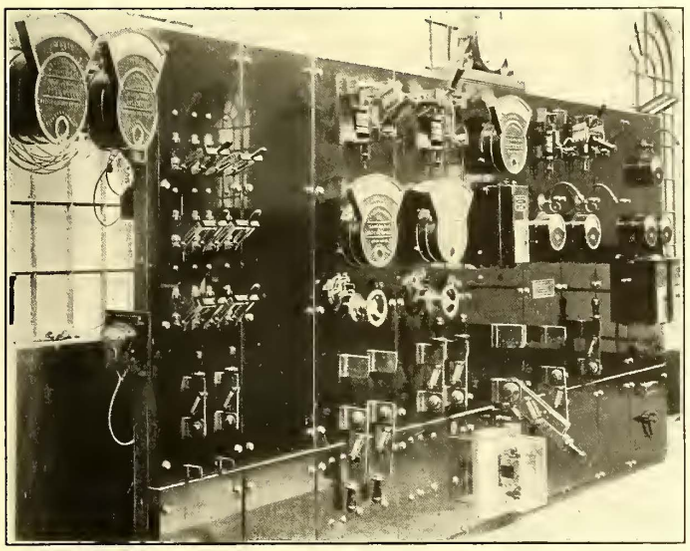
OVERHEAD EQUIPMENT

The side wire system has been adopted. The poles are of mild steel tapered from 7 ins. at the base to 3½ ins. in diameter at the top, with ornamental base castings, brackets, etc., which, although not elaborate, have a pleasing effect, and contrast favorably with the plain poles on the existing Cape Town Tramways. The height of the trol-

ley wire is 18 ft. 6 ins. above rail level. The arms vary in length from 6 ft. 6 ins. to 15 ft., according to the width of the road, and the average distance of the furthest trolley wire from the center of the track is 10 ft. Owing to the number of curves, it has been found necessary to run the trolley wire partly on one side of the road and partly on the other, to allow of the poles being fixed in the most suitable positions. As many of the curves are of very sharp radii, it will be readily understood that the wiring of these required considerable care to avoid the use of a large number of poles or the angles of the trolley wire being too acute. There is very little tangent on the route, and it is undoubtedly one of the most tortuous and heavily graded systems ever equipped on the overhead system. The trolley wire used is No. 0 B. W. G. hard-drawn copper.

GENERATING STATION

The generating station and car house is situate at Camps Bay, almost at the extreme south of the system. This position was chosen as the most suitable, owing to its proximity to the sea, from which water is drawn for condensing purposes; also to the fact that a continuous supply of fresh water for boiler feed is obtainable from a spring, a small stream flowing therefrom down Table Mountain.



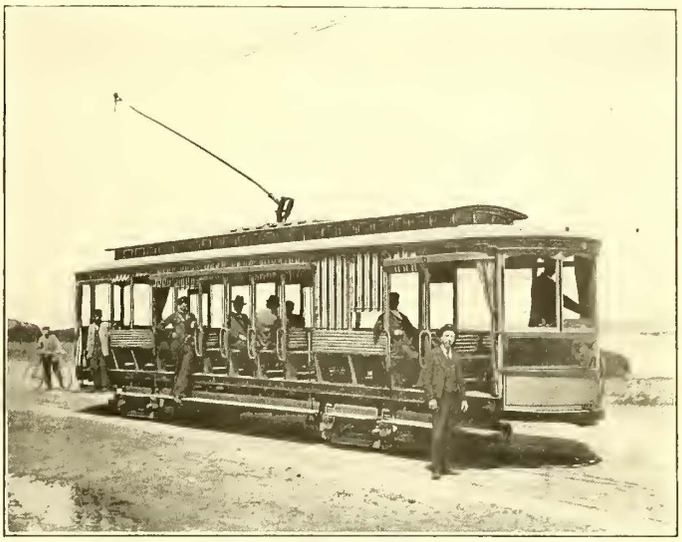
SWITCHBOARD

Its position is fairly central, being near the apex of a triangle formed by the two branches of the system.

The engine-room is 94 ft. x 42 ft., and consists of two floors and a condenser pit. An overhead traveling crane, arranged for hand-power and capable of lifting 10 tons, runs the whole length of the engine-room, and has a lift of 16 ft. The boiler house is 94 ft. long x 43 ft. 5 ins. wide. The car house, which is also part of the same buildings, is 136 ft. long x 94 ft. wide, with eight lines of track, four of which have pits running their entire length. At the entrance to the car house are offices, messroom and stores.

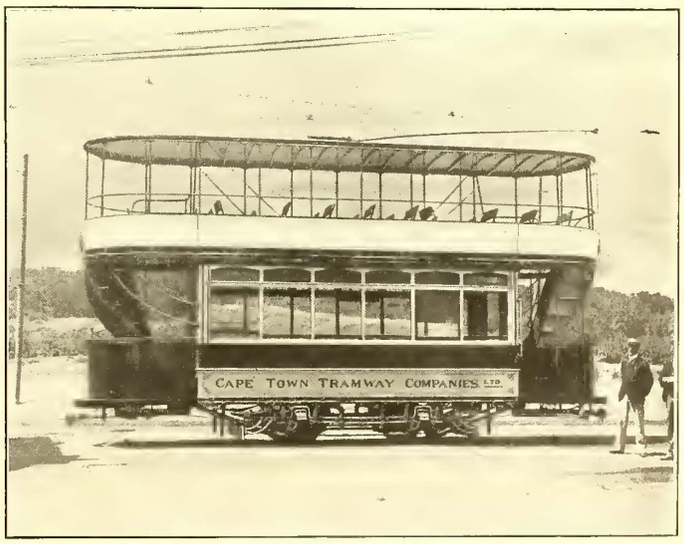
The generating plant consists of two direct-coupled 400-kw sets. The engines are of the cross-compound type, capable of developing 720 brake-hp with a steam pressure of 150 lbs. at the cylinders when running at 90 r. p. m. The main shafts are 19 ins. in diameter, and on these the generators and fly-wheels are keyed. The latter are 18 ft. in diameter, and weigh about 24 tons. The cylinders are fitted with Corliss automatic valve gear. The contractors for the whole of the plant and equipment were Dick, Kerr & Company, Ltd., London. The generators were built for them by the English Electric Manufacturing Company, Ltd., Preston, at whose works they were put through a most severe test by the engineers of the company, Alfred Dickinson & Company, Birmingham, who were highly satisfied with the way in which their specification had been met.

The switchboard consists of nine panels, of which three



DOUBLE TRUCK OPEN CAR

are generator panels, three feeder panels, one a station panel, one a lighting panel and one a leakage panel. Two of the generator panels only are in use, the other being a spare panel. Each is fitted with a positive and negative quick-breaking switch capable of carrying 1000 amps., a magnetic circuit breaker and an ammeter reading from zero to 1200 amps. Two of the feeder panels are in use, the other being held in reserve. Each is fitted with an automatic circuit breaker of the same type as those used on the generator panels, an ammeter reading up to 500 amps., and a quick break switch for connecting feeder to bus-bar. The main station panel is fitted with a main ammeter reading up to 3000 amps., on which the total output of the station is constantly shown, and a recording wattmeter. It is also fitted with a recording voltmeter with a working pressure of 550 volts. The leakage panel contains all the instruments necessary for testing for leakage, etc. The

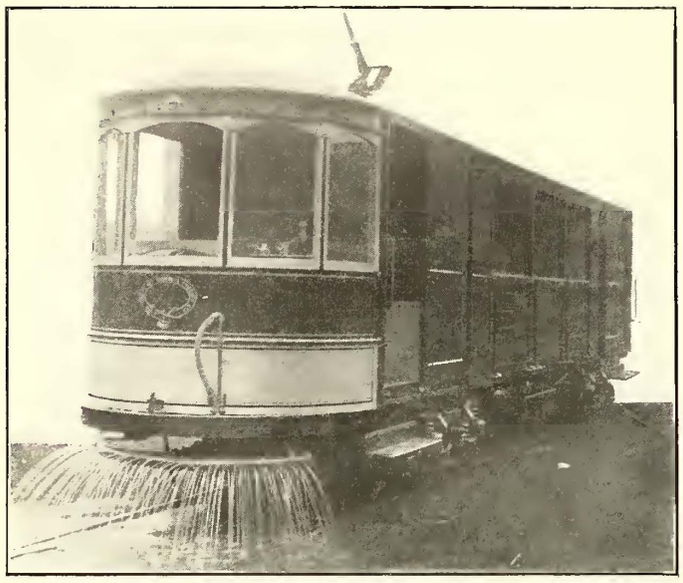


DOUBLE-DECKED CAR USED IN CAPE TOWN

lighting panel is arranged for six 50-amp. double-pole circuit switches, with fuses and throw-over switches.

In the condenser pit are two surface condensers with combined air and circulating pumps. These are of the Admiralty type manufactured by the Wheeler Condenser

Company, specially adapted for using sea water. The sea water is supplied to the condensers by means of large cast-iron pipes, which are carried well out beyond low-water mark. To avoid the danger of seaweed being drawn up into the condensers the suction pipe has been intercepted on the shore by a pump built in concrete carried



END VIEW OF SPRINKLER AND FREIGHT CAR

well down below low-water level, which is easily kept clear.

In the boiler house are two water-tube boilers, each with a heating surface of 3654 sq. ft., and capable of evaporating 12,000 lbs. of water per hour under normal conditions. Each boiler is fitted with a dead-weight safety valve and a spring valve set to blow off at 160 lbs. pressure. The boilers are fed by means of two compound non-condensing duplex feed pumps working at a pressure of 160 lbs., and capable of delivering 24,000 lbs. of water per hour against a boiler pressure of 160 lbs. Before being pumped into the boilers the feed-water is passed through a fuel economizer containing 288 pipes fixed in the main flue. The chimney stack is 125 ft. in height and 5 ft. inside diameter at the top. A work shop is equipped with the necessary machine tools for the purpose of carrying out repairs, viz.: a large screw-cutting lathe, wheel lathe, wheel press, drilling machines, grindstone, smiths' hearth and fan, the whole being driven by an electric motor.

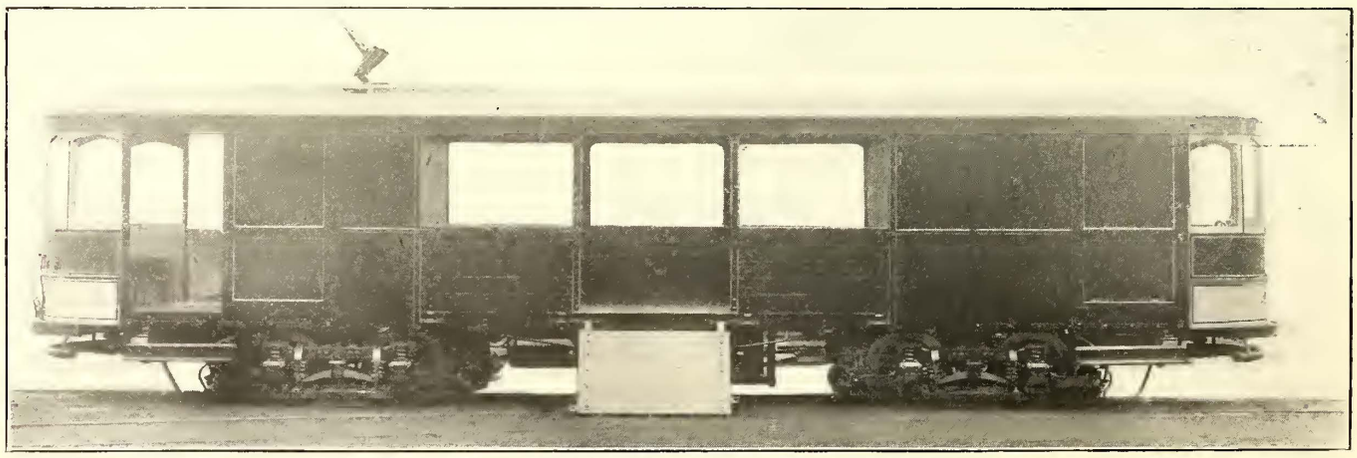
FEEDERS

The feeder cables are laid underground. They are lead-covered and insulated with paper and vulcanized rubber, and are placed in cast-iron troughs 18 ins. below the surface and surrounded with bitumen. The main cables are laid in half-mile sections, and at the junction of each section a feeder pillar is placed, in which the cables are connected to a bus-bar, and from thence to the trolley wires in the usual manner.

ROLLING STOCK

The cars are, in general, of the single-deck double-truck type, part being ordinary cross-bench open cars, and part are of the combined type. The former have a seating capacity of sixty-five passengers, and the latter of fifty-four. The length of car is 40 ft. 3 ins., width 7 ft. 6 ins., and height inside 8 ft. They were built for Dick, Kerr & Company, Ltd., by the Electric Railway & Tramway Carriage Works, Preston, and shipped to Cape Town completely finished, the only work to be done before they could commence to run being to mount them on the trucks, connect the wiring and fix the trolley poles. So popular has Camps Bay already become that the company expects that the present equipment of cars will shortly be found too few to cope with the traffic. The car bodies are mounted on double trucks, each truck being equipped with two motors, one on each axle. The motors are of the four-pole type, each of 25 brake-hp, so that each car is capable of developing 100 brake-hp, this having been considered necessary to effectually cope with the heavy grades on the system. The brakes have also received very careful consideration, three brakes having been fitted, viz.: a hand-brake, with a brake-block on each of the eight truck wheels, an air-brake acting in conjunction with the hand-brake, and an auxiliary or shoe-brake. In addition to these, it is also possible, by throwing over the reversing switch, to convert the motors into generators, thus enabling them to act as a powerful emergency brake. The cars are to be operated from either end.

Two of the accompanying engravings show a side and end view of a sprinkler car also built by the Electric Railway &



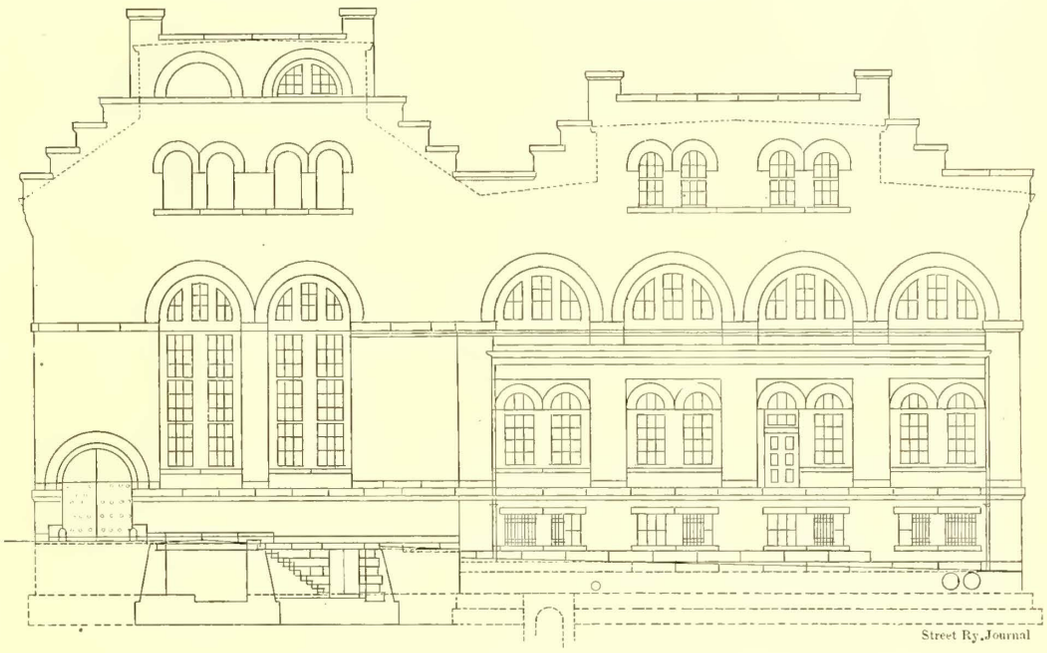
SIDE VIEW OF COMBINATION SPRINKLER AND FREIGHT CAR

Tramway Carriage Works for this road. As will be noticed, the sprinkler is a novel type, in that it combines the properties of a sprinkler and a freight car. The tanks for holding water are at each end of the body over the trucks, while the ample cab and vestibule at the end provide plenty of room for the motorman. The water is received through an inlet in the forward end of the car. The sides of the central compartment are hinged, and can be swung down, allowing plenty of room for the largest baggage, and even cattle. The car is mounted on double trucks like the rest of the equipment.

An engraving of a single-truck, double-deck car used by the Cape Town Tramway Companies, Ltd., is also shown on the preceding page.

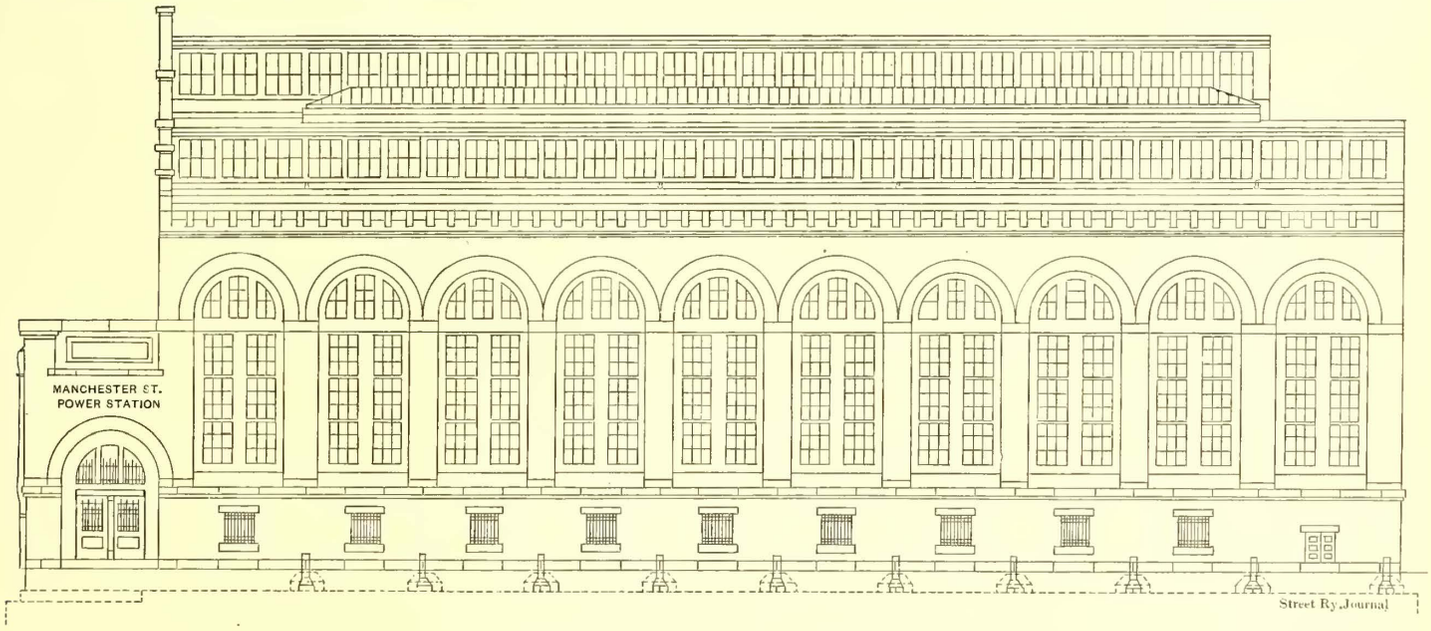
Design for a Power Station in Providence

The extensive urban and interurban roads in and between the towns of Providence and those adjoining have been so rapidly developed in the last few years that the present power supply has become entirely inadequate. For a long time the management has been proposing to enlarge its power-generating facilities, but it has been the misfortune of the engineers to be held up in many ways. It was at first proposed to enlarge the plant on Perry Street, but owing to the fancy price which was placed on the adjoining property by the company's neighbors, who thought that the railway company was obliged to extend in this manner, the proposition was abandoned and a new location selected on Manchester Street, entirely distinct, though near to the old station. The lot which the company has obtained for this purpose is a fine piece of dock property on the Providence River, with every facility for obtaining coal, condensing water, etc., at hand. Owing to the fact that the buildings on the surrounding docks are rather old and inflammable, every precaution against danger from fire will be taken in the construction of the building, but in other respects the situation is an ideal one for the purposes of the company, and one of the most up-to-date plants for the economical production of electric power has been designed and is now under construction.



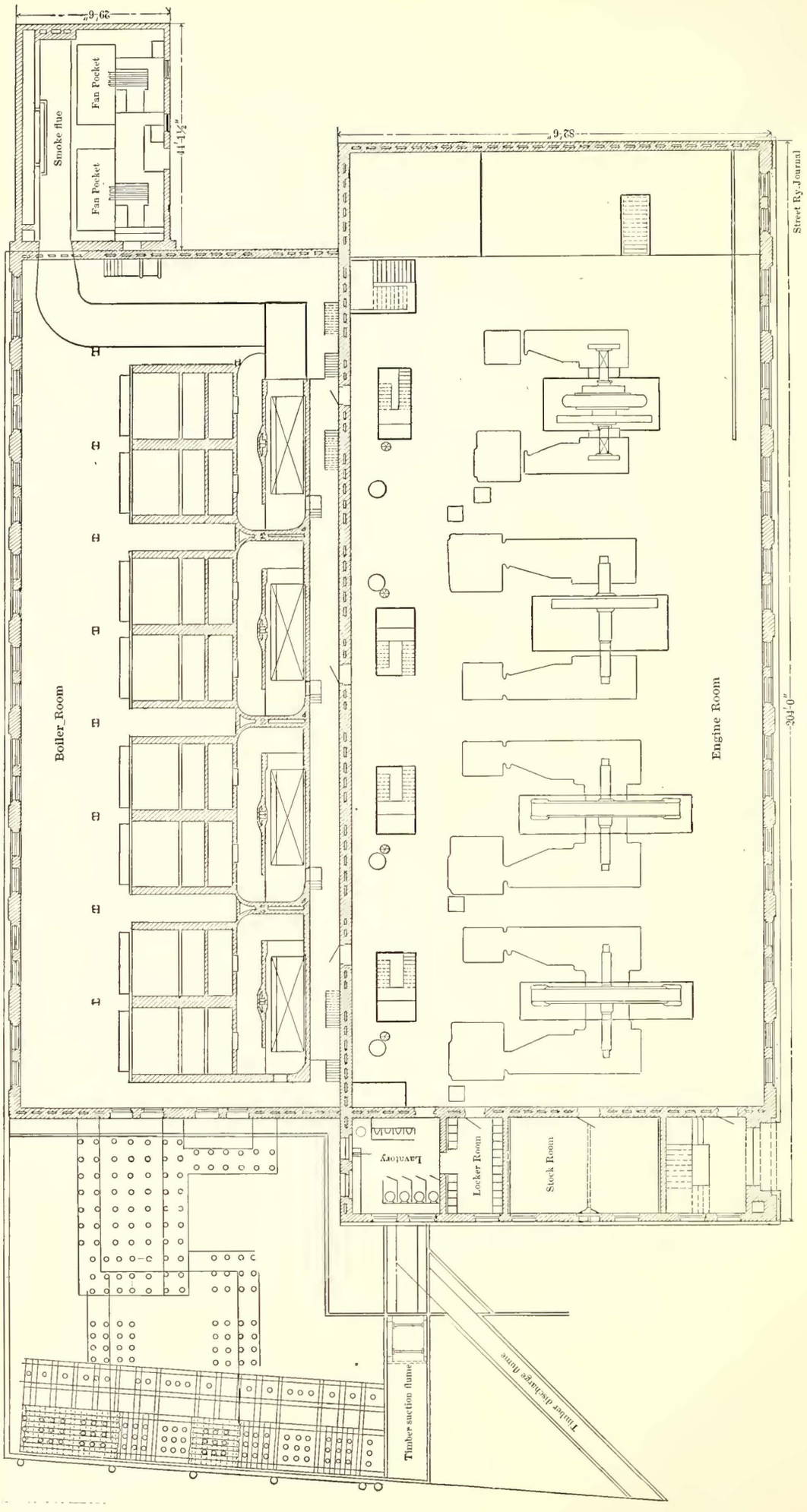
END ELEVATION OF POWER STATION

The accompanying engravings, which were made from the working drawings of the company, give a very good general idea of the exterior and interior of the station when completed. As will be seen from the most cursory glance at these drawings, the engineers of the company have incorporated in their designs the most approved modern methods of steam generation and utilization, and in about a year from this date, or at the outside a year and a half, the Rhode Island Suburban Railway Company and its allied lines will have at their command power facilities for the most efficient operation of the system. The contracts for the building have been let by the company and the foundations are already nearly completed. Those for the steel skeleton work for the superstructure have been placed with the New England Structural Company, of Boston, who will erect the frame of the building during the next six months. The contract for the erection of the remainder of the superstructure, which will be of the first quality red brick with granite trimmings, has been awarded to Horton & Hemenway, of Providence, and will of course immediately follow the erection of the steel superstructure.



SIDE ELEVATION OF POWER STATION

The foundations are composed of about 5500 piles, supporting a monolithic mass of Portland cement concrete 4 ft. thick, the piles and concrete being surrounded by a wall of sheet piling made up of hard pine timber 6 ins. thick, splined, and driven to a depth of 40 ft. below the surface. The contract for this foundation work was placed with F. E. Shaw, of Providence, last September, and, as stated above, is nearly finished. The strata underlying



PLAN OF POWER STATION, SHOWING FOUNDATIONS OF COAL HANDLING TOWER

the power station is made of about 13 ft. of filling material, 26 ft. original soft shore mud, 3 ft. or 4 ft. of a harder strata, composed of sand and gravel, and then a varying depth of fairly stiff clay overlying hardpan. The foundation piles driven vary from 50 ft. to 60 ft. in length, and are driven well into the clay. It is expected, although there is a large strata of soft material beneath the building, that the sheet piling will prevent any vibration.

Beneath the foundations of the building are constructed two water conduits, of sufficient size for a man to walk through, to furnish water for condensing purposes and to discharge the water after it has been used. These conduits extend to the channel of the Providence River. Under the building these waterways are made of concrete; between the building and the river they are timber flumes. A screen chamber is placed in the intake. There are also foundations for the coal-hoisting tower, which will be erected at the water's edge upon the wharf. These are shown in the plan of the station at the river end of the boiler room, although they are, of course, at a considerably lower level than that of the rest of the plan shown in that engraving.

The building has been designed so as to have a massive appearance, indicative of its purpose, and the architectural treatment has been in extremely good taste. The steel framework, which will weigh

about 1300 tons, will support the various floors and roof, and also the coal pocket above the boiler room. The floors will be composed partly of steel trough flooring, carrying concrete with granolithic surface, and partly of steel beams, supporting what is known as expanded metal floor construction. The coal pocket will be lined with expanded metal and concrete construction, and also have a granolithic surface, with steel-framed and masonry-arched end walls. It is supported on 48-in. steel plate girders.

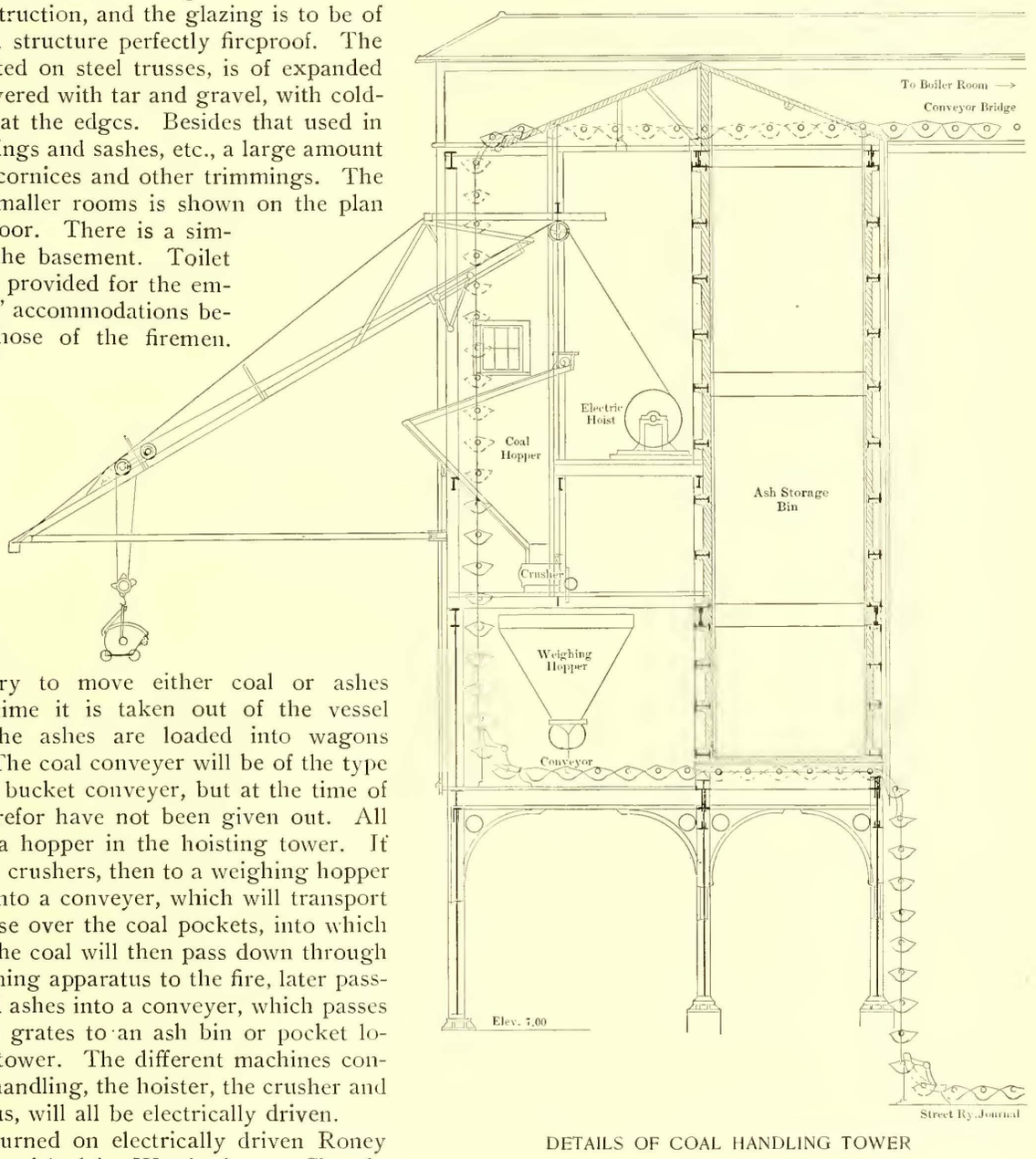
The doors and the windows, including frames and sash, will be of copper construction, and the glazing is to be of wired glass, making a structure perfectly fireproof. The roof, which is supported on steel trusses, is of expanded metal construction covered with tar and gravel, with cold-rolled copper gutters at the edges. Besides that used in the doors, window casings and sashes, etc., a large amount of copper is used for cornices and other trimmings. The arrangement of the smaller rooms is shown on the plan of the engine-room floor. There is a similar arrangement in the basement. Toilet and locker rooms are provided for the employees, the engineers' accommodations being separate from those of the firemen. The plan shows the position and size of the stock room, etc., on that floor. Lighting is effected by means of large skylights and monitors in the roof.

There will be installed a system of coal-handling machinery, so that it will not be necessary to move either coal or ashes by hand from the time it is taken out of the vessel at the dock until the ashes are loaded into wagons to be carried away. The coal conveyer will be of the type known as the gravity bucket conveyer, but at the time of writing contracts therefor have not been given out. All coal is dumped into a hopper in the hoisting tower. It will first pass through crushers, then to a weighing hopper to be weighed, then into a conveyer, which will transport it into the power house over the coal pockets, into which it will be dumped. The coal will then pass down through spouts and over weighing apparatus to the fire, later passing out as cinders and ashes into a conveyer, which passes along underneath the grates to an ash bin or pocket located in the hoisting tower. The different machines connected with this coal handling, the hoister, the crusher and the conveyer apparatus, will all be electrically driven.

The coal will be burned on electrically driven Roney mechanical stokers, furnished by Westinghouse, Church, Kerr & Company, New York. The gases from the fires will be conducted through flues either directly through or over economizers made by the Green Fuel Economizer Company, Matteawan, N. Y., so that the heat in these gases may be utilized to heat the feed-water. Provision has been made and foundations constructed for the erection of a stack 300 ft. high and an interior diameter of 16 ft., but at first there will be erected a mechanical draft plant with a steel stack 10 ft. in diameter which will extend only a short distance above the roof of the building. This mechanical draft plant consists of two fans 14 ft. in diameter, and two engines for driving the same, and they can be operated independently or together to provide necessary draft. It is expected that the stokers will practically do away with the smoke nuisance. The apparatus of this plant will be supplied by Westinghouse, Church, Kerr & Company.

The boilers, eight in number, are arranged in four batteries of 1000 hp each. They are of the water-tube type, and made by the Babcock & Wilcox Company, New York City. Gleaner feed-water heaters will be used in addition to the economizers, and Worthington feed-pumps supply the boilers.

The steam piping was contracted for by the General Fire

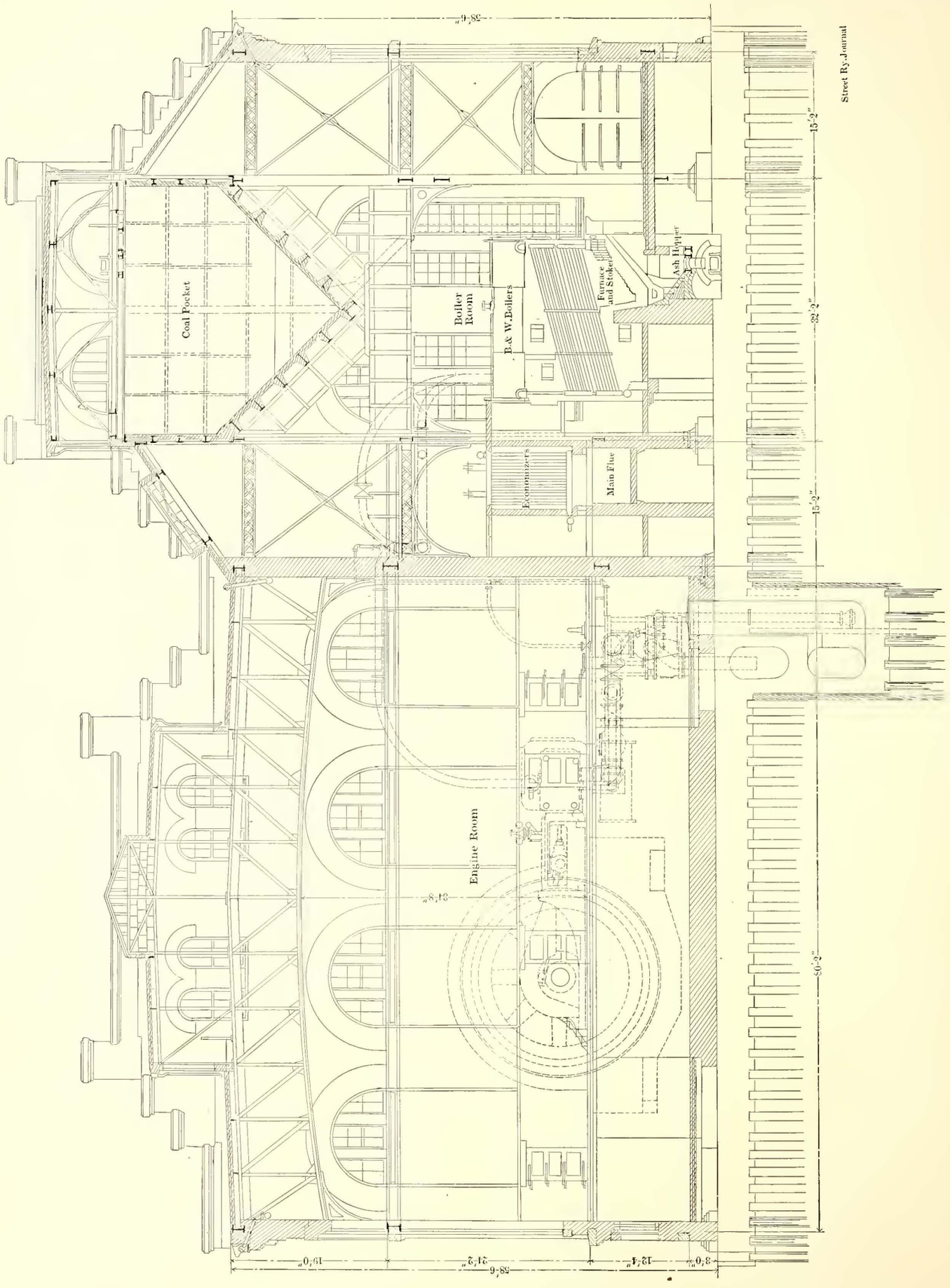


DETAILS OF COAL HANDLING TOWER

Extinguisher Company, of Providence. The plan shows the general layout of this piping system, which is made of lap-welded Bessemer steel pipe, in no place less than ⅜ in. thick. The flanges are welded on and corrugated copper gaskets are used throughout. The valves will be furnished by the Chapman Valve Manufacturing Company, of Indian Orchard, Mass. Before being erected each section of piping will be tested under 500 lbs. hydraulic pressure. The Holly gravity return system and steam loop will be installed to return condensed steam to the boilers. The free exhaust pipes are of the spiral riveted type.

The engine room will contain four direct-connected units, three of which are new and the fourth now in operation in the Eddy Street station. This will be removed to

the new power house after it has been sufficiently completed to carry the load. The engines for the generators have been constructed by the Filer & Stowell Company, has cylinders 28 ins. and 54 ins., with stroke of 48 ins. The engines will be run condensing, Blake condensers having been ordered. These engines are so arranged as to go

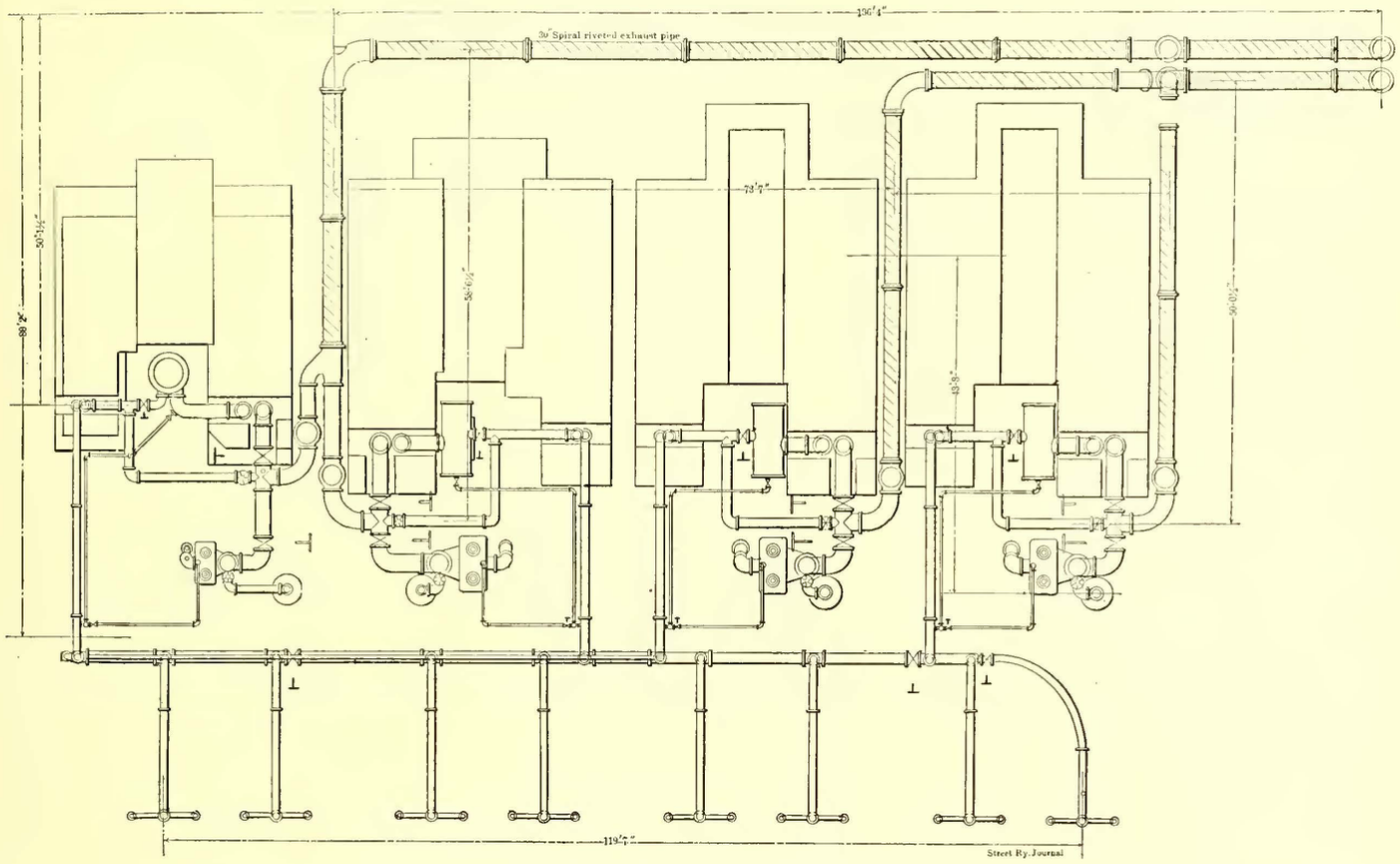


CROSS SECTION OF POWER STATION

Milwaukee, Wis., and are of the horizontal compound type. The three new engines have cylinders 32 ins. and 64 ins., with stroke of 54 ins. The other engine directly opposite each battery of boilers, and the steam piping and condenser piping connections are of the shortest possible length. The three new generators will be of

1500 kw capacity, and together with the one which it is proposed to move from the old to the new house, which is of 1250 kw capacity, make the full complement for the new house. These generators are all constructed by the General Electric Company, of Schenectady, N. Y., which will also provide the new switchboard, etc.

It is proposed to erect and put in operation under temporary housing a portion of this plant previous to the completion of the building structure. Nearly all of the machinery has been delivered, and it is hoped that this can be done within a very few months. The company owns sufficient land at the back of the station to enable the duplicating of the equipment in future, at the same time using the proposed stack, which will then be in the center of the building. The general features and details of the plant, including foundations, superstructure and coal handling, have been designed in the office of George B. Francis, chief engineer of the Rhode Island Suburban Railway Company.



GENERAL PLAN OF STEAM PIPING

The construction of the Kalgoorlie Electric Tramway, which is to connect Kalgoorlie and Boulder, Australia, has been begun. All material to be used in building the line is on the ground, and the purpose is to rush the construction work. The company now has a car house under way, but will not erect a power station, arrangements having been made with the Kalgoorlie Electric Lighting Corporation to supply power.

The Senate of New York has passed the Pennsylvania Railroad Tunnel bill, which permits the city of New York to grant a franchise to the Pennsylvania Railroad to tunnel the East and North Rivers from the Jersey shore and maintain terminals on Manhattan and Long Island, and adds that the city shall receive a reasonable annual compensation and that the period of revaluation shall not be longer than twenty-five years.

Meeting of the Executive Committee of the A. S. R. A.

The executive committee of the American Street Railway Association held its first meeting since its election at the Cadillac Hotel, Detroit, on Monday, Feb. 24, 1902. There were present the president, H. H. Vreeland; first vice-president, Charles W. Wason; second vice-president, Elwin C. Foster; third vice-president, H. M. Sloan; secretary and treasurer, T. C. Penington, and the following members: Walton H. Holmes, of Kansas City, Mo.; Daniel B. Dyer, of Augusta, Ga.; T. J. Nicholl, of Rochester, N. Y., and George W. Dickinson, of Seattle, Wash. The only absentee was John A. Riggs, of Reading, Pa., who was detained by pressure of business. The committee was met by J. C. Hutchins, vice-president of the Detroit United Railway Company, who conferred with the committee in relation to the plans for the fall convention. His assistant, A. A. Stanley, general superintendent of the United Company, was also present.

The treasurer presented a full and complete report of the finances of the association, the salient feature of which was the excellent condition of the treasury, which showed cash in bank $11,081.29, and a present membership in the association numbering 187. Mr. Penington reported that twenty-five new members joined the association during the past year, while seventeen retired, leaving a net gain of eight.

One of the suggestions considered by the committee was that the association arrange for an information and general investigation bureau for the benefit of the members. This had been requested by several members of the association, but, after full discussion of the subject, the committee decided that it could not properly take action on this matter, as the policy of the association was that such subjects be referred to the individual members for decision. A proposal was also made to change the method of renting floor space in the convention hall, but the committee

unanimously decided that the present plan be continued without change.

After luncheon an inspection was made of the Light Guard Armory in Detroit, which had been suggested as a place for holding the convention proceedings and the display of exhibits.

Upon convening, it was resolved that the armory be selected for such purpose, and that Wednesday, Thursday and Friday, Oct. 8, 9 and 10, 1902, be adopted as the meeting dates, with a reservation that Thursday, Oct. 9, be set apart especially for the exhibition of supplies, and that no regular proceedings be held on that day. The time for holding the annual banquet was also fixed upon as the evening of Friday, Oct. 10, 1902, at the Cadillac, which hotel was also selected as the headquarters of the association.

On motion of Mr. Holmes, it was resolved that the standing committee on rules be appointed by the president. The committee was also unanimously of the opinion that the topics and papers to be read should hereafter be assigned directly to members of the association, and not to special officers of the different corporations. Seven subjects were selected and the following designations made:

1. "Registration of Transfers," Cincinnati Traction Company, of Cincinnati, Ohio.
2. "Benefit Associations," Metropolitan Street Railway Company, of New York.
3. "Discipline of Employees by the Merit System," Metropolitan Street Railway Company, of Kansas City, Mo.
4. "Transportation of Light Express and Parcels," Detroit United Railway Company, of Detroit, Mich.
5. "Steam Turbines and Rotary Engines," Boston Elevated Railroad Company, of Boston, Mass.
6. "Signals for Urban and Interurban Railways," Union Traction Company, of Anderson, Ind.
7. "Settlement of Damage Claims," Chicago City Railroad Company, of Chicago, Ill.

On motion of Mr. Foster, the secretary was directed to write members urging the attendance of their representatives under such instructions that their presence in the convention hall at the discussions should be obligatory.

After the business meetings of the committee were concluded, Mr. Hutchins, of the Detroit United Railway Company, acted the part of host to the visiting members of the committee at a delightful dinner at the Detroit Club, and afterward during a pleasurable visit to the Yontodago Club.

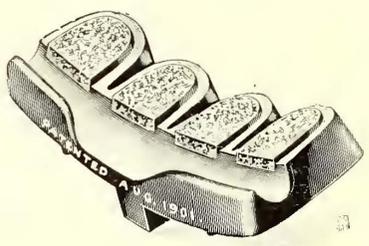
The armory hall selected for the meetings has ample space for the exhibits and meetings of the association, and is within easy riding distance of the Cadillac and other leading hotels of Detroit. It is understood that the local committee is arranging very pleasurable social features for the entertainment of the visiting delegates in October, and, as Detroit is a very attractive city, particularly during the early autumn, ample opportunity will be given for many enjoyable excursions.

The Electric Fountain Company of America

The well-known firm which formerly went under the name of the Darlington Electric Fountain & Supply Company has been reorganized and incorporated under the laws of Delaware as the Electric Fountain Company of America, the new company taking over the entire business which has been built up by Frederic W. Darlington, formerly the head of the old company and now the president of the new one. Mr. Darlington's familiarity with the fountain business is well known to all street railway men whose attention has been directed toward improving street railway parks or pleasure resorts by the addition of that entertaining feature, the illuminated fountain, and it has been largely due to his skill and energy that the electric fountain has the position as an attraction that it now holds. Besides the design and construction of illuminated and other types of fountains, the large factory which the company intends to build will have a sufficient capacity for the supplying of all kinds of specialties in hydraulic apparatus, such as fire nozzles, automatic valves, etc. It is understood that the company not only has options on several patents in the fountain line, but that Mr. Darlington is now at work upon several ingenious improvements. Among these may be mentioned an attachment whereby musical effects can be produced in combination with those of light and water. The company is already on a good financial footing and it intends to erect in the near future the manufacturing plant which will be necessary for carrying on its business. Among those of other consulting engineers, the services of Luther Stieringer have been secured, and his reputation as an expert designer of artistic effects guarantees all work with which he is in any way connected. The offices of the Electric Fountain Company of America are in Philadelphia.

A Remedy for Flat Wheels

Every railway manager is familiar with the expense attendant upon the repair of flat wheels. The maintenance account of the rolling stock of a road always has a large item which is devoted to the repair of this most annoying and inevitable effect of wear, and the device shown in the accompanying illustration has been perfected with the idea of remedying to as great an extent as is possible the troubles following the development of a flat spot on the wheels. The greatest source of expense is of course in removing the wheels from a car and eliminating the flat by grinding the wheel down; but a not less objectionable feature of this process is the temporary throwing of the car out of commission, a very serious obstacle to satisfactory operation on many roads whose car equipment is not of sufficient size to render the disabling of three or four a matter of inconsiderate proportions. The device illustrated, which will be seen to differ but slightly in outline from an ordinary brake-shoe, is made by the Car Wheel Trueing Brake Shoe Company, of Buffalo, N. Y., and contains in its face three insets of carborundum, one of the hardest substances known to the mechanical arts. After many experiments with abrading materials of all kinds, including emery, corundum, etc., it was found by the company that the most efficient grinding results were obtained by the use of pure carborundum, and this substance was accordingly adopted. The company states that it has secured the exclusive right from the manufacturers of carborundum to use it for this class of work, so that this will be the only shoe having carborundum abrading blocks. These insets are so formed that when pressed against the surface of a rotating wheel an even grinding action is produced which trues the wheel up to its original shape no matter in what condition it may be before the application of the device. The insets of carborundum, as will be seen, are placed sufficiently far apart and are of an advantageous shape to allow all dirt and grindings from the wheel to escape freely, so that there is no possibility of the surface of the carborundum blocks being prevented from coming into close contact with the tread of the wheel being trued.



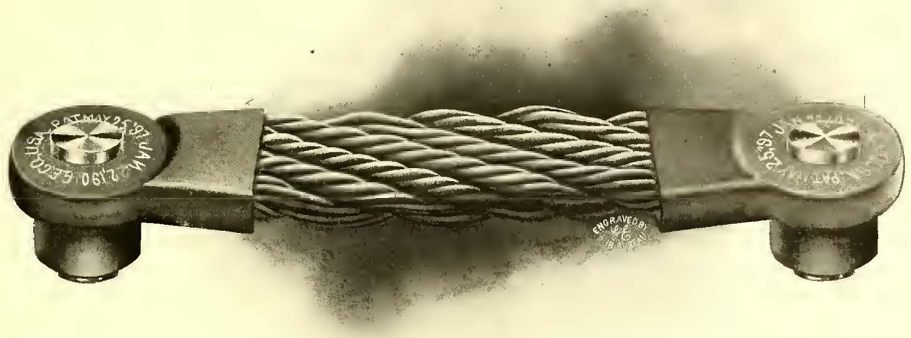
WHEEL TRUEING SHOE

The manner of using this ingenious piece of apparatus is extremely simple. The car under which a flat wheel has developed is run over the pits of the car house long enough to remove a pair of ordinary brake-shoes and substitute a pair of those containing the carborundum blocks. It is then put back into service and every time that the motorman applies his brake the wheel is partially ground. As soon as the flat has disappeared, which depends upon the class of service upon which the car is being used and the frequency of the stops and grades, the car is again run over the pits and the original brake-shoes replaced. It is, of course, desirable to always use the grinding shoes in pairs so that the two wheels on one axle may be of the same diameter at all times. One pair of shoes can be used again and again, the number of flat wheels which they will correct being, naturally, largely dependent upon the state of the wheel when the device is applied.

The G. E. Rail Bond

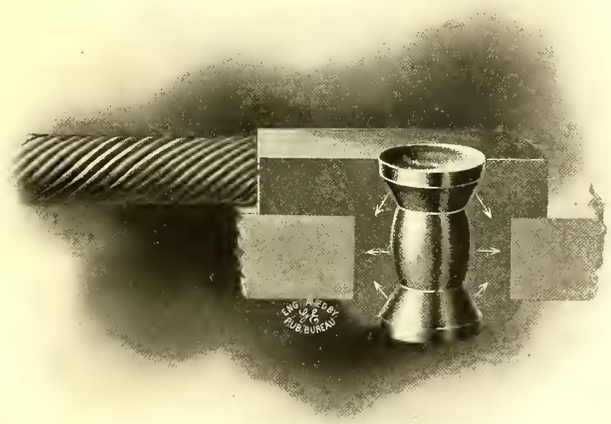
The rail bond which the General Electric Company manufactures, as shown in the accompanying illustrations, differs quite materially from any bond that has heretofore been placed on the market.

The terminals are made of the best grade of copper, in the center of which is cast a steel spool having two tapered heads, the center of which is nearly straight with a slight bulge in the center. This steel core projects ⅛ in. beyond each end of the terminal. In the course of manufacturing the bonds, the terminals are treated in such a manner as to harden the heads of the steel core, allowing the center portion to remain soft, so that when this steel pin is compressed either by hydraulic or an ordinary screw press the steel heads are brought down flush with the terminals. The center portion of the steel pin expands 1-10 of an inch, forcing out the copper which surrounds it with enormous pressure. When the terminal is placed in position and is expanded, the copper is pressed against the walls of the hole in the web of the rail with such force that it is impossible for any moisture to get between the copper and the steel. The outside surface of the terminal does not change its position nor elongate when placed in the web of the rail and compressed by the expansion of the steel pin. The contact is therefore maintained uniform during the operation of expanding the terminals, which is a point that does not exist in any other type of bond.



SIDE VIEW OF BOND

STEEL SPOOL



VIEW OF BOND TERMINAL

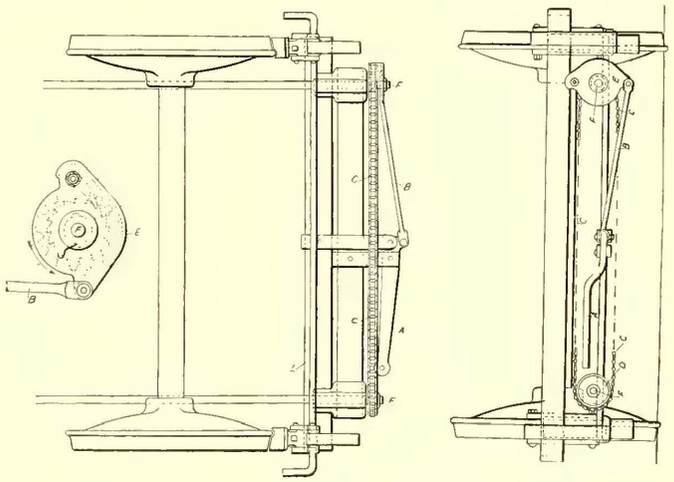
The flexible portion of the cable of this bond is cast-welded into the terminals by a process which melts the ends of the cable into the terminals, making a uniform and absolute contact at this point. The cable is so constructed as to allow the greatest amount of expansion and contraction without crystallizing or breaking off the wires.

This bond can be applied in any of the well-established ways, and in fact is susceptible to some applications which other bonds are not. It can be used in the splice bar as a protected type in the base of the rail, or around the splice. It is made in any length for cross bonding in either solid or flexible cable, and is manufactured in lengths of 4 ins. and longer with terminals of standard size.

Automatic Brake Adjuster

The accompanying engravings show an automatic brake adjuster invented by John E. Angerer, formerly of the Jackson & Sharp Company, of Wilmington, Del., now of the Electric Tramway & Carriage Works, of Preston, England. The device, though applicable for both steam and electric service, was designed especially for electric cars, and has for its object the automatic taking up of the slack caused by the wearing away of the brake-shoes. At present this slack is taken up by hand, and this requires frequent adjustment to insure safety.

In the engravings Fig. 1 shows an end view of the sprocket sheath or casing to be described later; Fig. 2 shows a plan, and Fig 3 an end elevation of the truck. In these engravings A is the ordinary brake-lever used in putting on the brake which is connected in the usual way, except that it has a rod, B, which is connected to the sprocket casing, E. Within this casing is a sprocket wheel mounted on a nut on the end of the brake-rod, F, which is threaded, and which extends from end to end of the car. The brake-rods, of which there are two, are of the pattern ordinarily used, except that the nut for the adjusting of the brake-shoes is tightened up automatically.



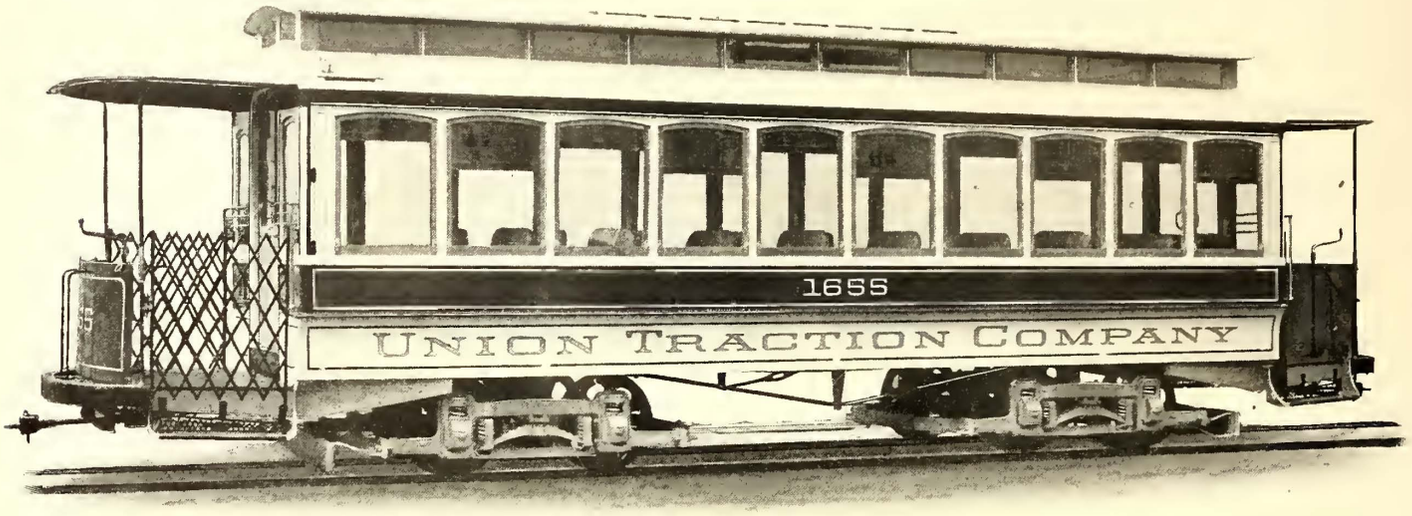
FIGS. 1, 2 AND 3.—AUTOMATIC BRAKE ADJUSTER

The operation of the device is as follows: When applying the brake, the lever, A, is pulled outward, which causes the connecting rod, B, to move the casing, E, in the direction of the arrow. Should the lever, A, from the wear of the shoes, travel further than a given distance, the casing, E, is rotated far enough to allow the pawl (Fig. 1) to travel more than the length of a tooth in the ratchet wheel When the brake is released, the springs which draw the lever back will rotate the casing, E, into its original position. Thus, the pawl will rotate the ratchet wheel, tightening up the nut on the rod, F, to the extent of the angular motion of one tooth. The result is that when the slack on the brake-shoes is greater than a certain amount, it is automatically taken up; and as there is a similar arrangement at each end of the car, and as the motion on the nuts of one brake-rod are transferred to the nuts on the other rod by the sprocket chain, the slack is taken up equally on both brake-rods.

The device has been installed on some 600 cars of the Liverpool electric tramway, and is being handled in this country by George H. Angerer, of Wilmington, Del.

Cars for the Union Traction Company, of Philadelphia

An order for fifty cars from the J. G. Brill Company, Philadelphia, for the Union Traction Company, of Philadelphia, is nearing completion. For several years this type of car, the features of which originated with President Jno. B. Parsons, of the Union Traction Company, has been very popular in Philadelphia. The new cars differ slightly in dimensions from those already in use, and have lower window rails; otherwise they are the same.



STANDARD DOUBLE TRUCK CAR, PHILADELPHIA

The cars are 37 ft. long over the crown pieces and 7 ft. 8½ ins. wide at the sills. They are provided with ten single-sash windows on each side and the monitor decks are wide and high. The car is extra well protected against the severest weather by the fact that the windows, being stationary, are weather-stripped. A simple locking device operated with a key controls the windows and permits them to be easily removed. Two bronze guard bars are placed across the lower portion of each window as the rail is very low and roller curtains shield the passengers from sun and rain when the window sashes are removed. Thus in summer a car is provided which is unusually open and cool, and has the advantage over an open car with side entrance of greater safety where the speed is high, and of less danger to alighting passengers.

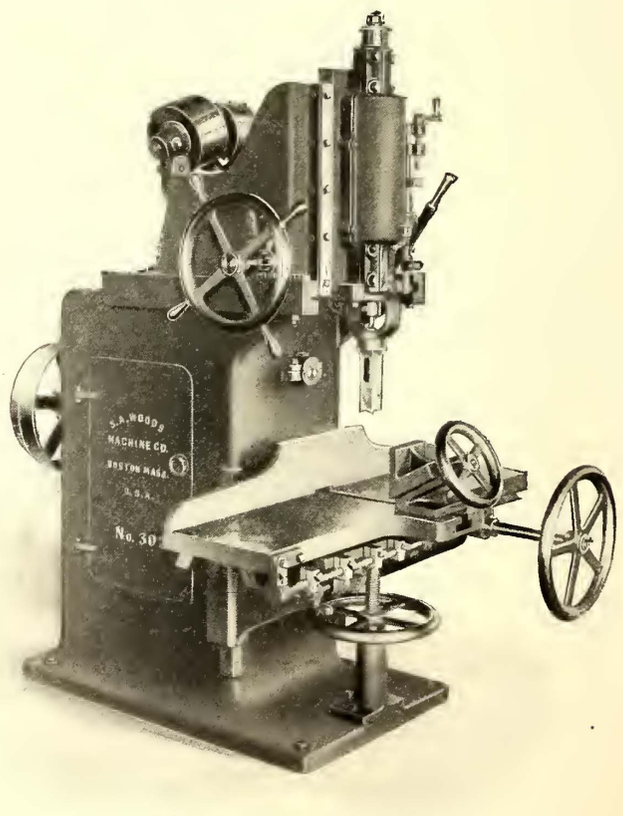
Ash panels are used in place of veneer in the sides of the car. A metal-covered projecting guard-rail protects the panels from the glancing blows of vehicles. The timbers of the dropped platforms are reinforced with angle-irons. Brill angle-iron bumpers protect and strengthen the crown pieces. The inside finish is of silver ash, and the ceiling of three-ply veneer, decorated with silver.

There are sixteen reversible cross seats with metal ends sufficiently high to prevent seated passengers from occupying aisle space. Four longitudinal corner double seats leave ample space at the doors.

The cars are fitted with Brill Dedenda alarm gongs, Brill radiating draw bars, and Brill ratchet brake-handles, and are mounted on Brill 27-G trucks.

A New Wood-Working Tool

The accompanying illustration shows a view of a new mortising machine which has recently been perfected by the S. A. Woods Machine Company, of South Boston, Mass. As will be seen by a glance at the engraving, the new machine has a most compact and serviceable appearance, the various parts giving an impression of strength and durability that will recommend them to all who use this class of tool. The advantages of a hollow chisel mortiser over other types need not be dwelt upon here, as all superintendents of car shops or wood-working plants of any kind have fully realized the great saving in power and time which is obtained by this class of apparatus. Among the features of the new machine to which especial attention might be directed are the patent lay-out stops for laying out mortises, an improved stepped bearing for taking up the end thrust of the spindle and assisting in its support, which always operates in a bath of oil and consequently maintains its easy-running qualities, a new device for instantly changing the depth of mortise, and a novel clamping arrangement for locking the chisel carriage into position when located. This chisel carriage is provided with a cross or transverse movement having adjustable stops for regulating the travel, and an automatic belt tightener is used in connection with the spindle belt. The machine in this respect differs radically from the ordinary type of medium-sized mortises, and the advantage of having a movable chisel carriage is evident. The working table as shown has both vertical and longitudinal movement and the chisel-ram is vertically adjustable. The clamp for holding timber into position is readily adjustable and can be detached from the table with ease. The machine has an improved friction feed with



NEW HOLLOW CHISEL MORTISER

quick return, by which two rates of speed may be obtained. The spindle pulleys are of a design made under special patents and are so constructed as to prevent air-cushioning of the belt.

The Columbus (Ga.) Railroad Company is to adopt a new transfer system. The company some time ago discontinued giving transfers because the privilege was abused.

A New Test Cart

The accompanying illustration, Fig. 1, shows a new testing cart which is being introduced by Elliott Bros., of London, especially for rapid localization of faults on large underground networks, a matter of the utmost importance in Great Britain in view of the

FIG. 1.—TEST CART

stringent conditions contained in recent provisional orders and acts in that country.

The apparatus consists essentially of a small portable battery, a standard resistance (usually 1 ohm), and a very accurate voltmeter of high resistance. An adjustable resistance is provided for keeping the battery current constant as well as the necessary reversing and change overswitches, while an ammeter is usually included for the purpose of regulating the charge and discharge of the cells. The voltmeter, as a rule, has a maximum range of 10 volts, the same scale being used to read the current flowing through the standard resistance.

The design is a result of a wide experience in cablework, and embodies, it is believed, everything and no more that is necessary. Although it can be used for many purposes, it will be sufficient to describe a fall of potential method adopted with two of the commonest faults in three-phase cables:

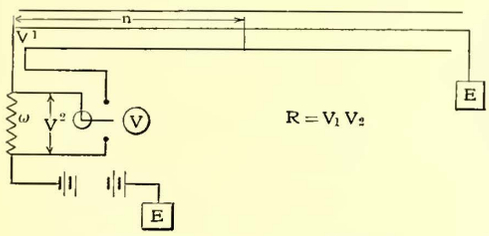


FIG. 2.—DIAGRAM OF CONNECTIONS

(1) A "short" between two conductors insulated from earth, which frequently occurs in a solid system protected by cutouts. If the resistance of the fault be low compared with that of the voltmeter, one reading is usually sufficient, but if not, comparative readings from both ends will give greater accuracy. The third core, if intact, may with advantage be used instead of the earth.

(2) Three cores earthed, which may be caused by a long-continued short or mechanical injury. In this case the resistance of the fault can, by burning, be made sufficiently low to pass a small battery current when comparative readings from the two ends give $V_1 : V_2 :: R_1 : R_2$.

In doubtful cases the results may be checked by the use of another core. The results obtained by careful observers in actual practice by this method are wonderfully exact. In a test on a 2700-yard length of concentric cable, in which there was a "short" and also an earth of about 1000 ohms resistance, the fault was localized to five yards. This distance was the mean given by five tests, the greatest divergence from the exact position being only ten yards.

Such accuracy as this is not always obtained, however, the more usual course being to open up the joint box nearest to the indicated position of the fault if the length is over 1000 yards and make a new test on a shorter length. The diagrams Figs. 2 and 3 give the connections in each method.

A Useful Material for the Paint Shop

A paint and varnish remover which goes by the name of Phenoid is being put on the market and has already found favor in the paint shops of many street railway companies. The old method of scraping a car body in course of repair was very laborious, and chemical compounds have been looked upon with distrust by the foremen of the paint shops on account of the liability which they had of injuring the skin of the workmen, the removal

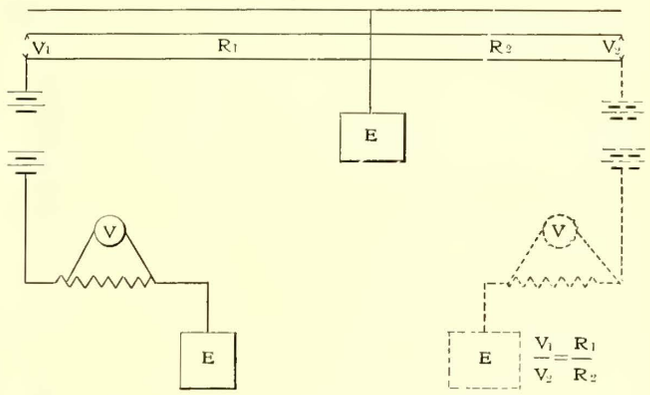


FIG. 3 —DIAGRAM OF CONNECTIONS

of filler from the wood, their tendency to cause succeeding coats of paint placed on the surface of the car after having gone through the cleansing process to peal off, and their disagreeable odor. The manufacturers claim that Phenoid possesses none of these disagreeable properties, and that it will not raise the grain or discolor the wood in any way. Phenoid is a light paste about the consistency of vaseline, and is white and clean as well as being almost odorless. It contains no water, alkali, carbolic or other acid, and it is claimed that with one application it will soften twenty coats of hard, dry varnish and keep it soft down to the wood for twenty-four hours after it has been put on. Being in the form of a light paste it is applied with equal readiness to vertical or other surfaces. The material is manufactured solely by Ellis, Chalmers & Mears, of Dedham, Mass.

An Efficient Insulating Paint

The electrical engineers who are connected in any way with the operation of street railways have long appreciated the importance of efficient compounds for increasing and protecting the insulation of joints and other parts of the installation-carrying current. While there are many paints which prove most excellent for this service when first applied, and for a short time afterward, it is often found that after a considerable period has elapsed the protection afforded by them has greatly decreased owing to the deterioration of the compound, and this has caused not only many serious accidents to the distribution system by the breaking down of the insulation, but renders frequent inspection and a large amount of expense for maintenance necessary. The "Battery Black" paint, which appeared on the market some time ago, has already proved itself to be not only an excellent insulating material, but it has been employed on a number of lines in most difficult positions long enough to satisfy the engineers of the road that it has most excellent wearing qualities. This paint is not only a perfect insulator, but it is unaffected by either acid or other deteriorating fumes, and it therefore has a wide field of application around the storage battery installations, which are fast becoming a necessary adjunct to the operation of street railway systems. "Battery Black" paint is made by James G. Conner & Co., of Philadelphia, who are the sole manufacturers. This firm has had a large experience in the production of fine varnishes and japans of all kinds, and in perfecting this insulating paint the experience of years in the varnish business has been combined with a thorough knowledge of the requirements necessary to a first-class, long-lived insulating varnish.

Electric Sprinkling Cars

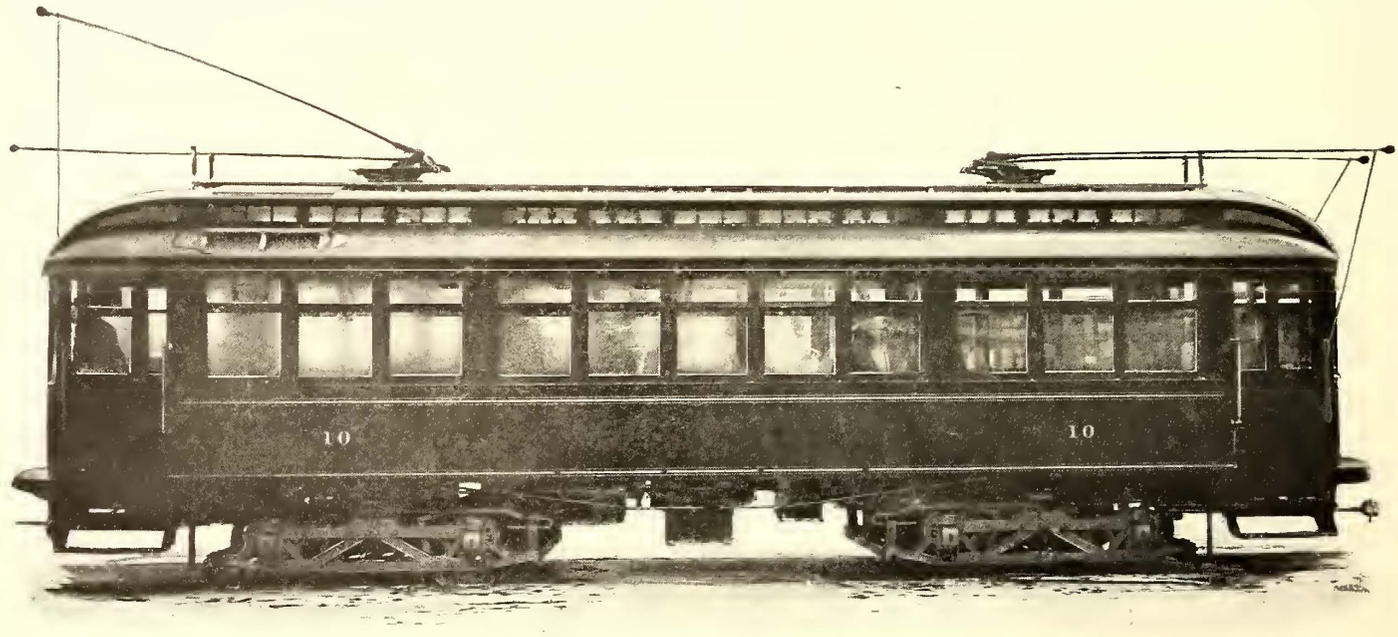
The use of an electric car for sprinkling the street through which the tracks are laid was started some years ago and has been demonstrated to be a most advantageous arrangement for both the railway company and the street cleaning department. The much greater rapidity of sprinkling from the larger capacity of the tank and the higher speed at which an electrically operated sprinkler can run as compared with a horse cart has made the purchase of sprinklers by the trolley roads not only a necessity but one of the best paying investments which the companies can make. A well-sprinkled street increases the comforts of the passengers by doing away with the dust and dirt raised by the car at high speed, and by preventing this same dust and grit from getting into the wearing parts of the running gear of the car makes a decided saving in the cost of maintenance of equipment. Sprinklers also increase the economy of operation by keeping the rails free from dirt and grease.

In another portion of this paper an engraving is shown illustrating the compressor sprinkler made by the McGuire Manufacturing Company, of Chicago. The cut is a reproduction of a photograph taken when the car was throwing water forty-five feet on each side of the track, which makes an approximate width of ninety-five feet covered by this sprinkler. A device has been perfected by the McGuire Manufacturing Company which enables the operator of the sprinkler to adjust the throw of water to suit any width of street, the range being from the width of the track to a distance of fifty feet on each side. Another advantage of the sprinkler is that by its peculiar arrangement it can "spout" the tracks and thus thoroughly wash the rails, a practice which is of considerable value especially where a full-grooved section is used.

EXPRESS CAR TO BE USED AS A TRAILER

Some New Stephenson Cars

The first of the accompanying illustrations gives a view of a new baggage car recently built by the John Stephenson Company, of Elizabeth, N. J., for the Trenton, Lawrenceville & Princeton Railway Company. This car is intended to operate only as a trailer, and it therefore has no motors. It is mounted on light double-trailer trucks of Master Car Builder's design and construction. The principal dimensions of the car are as follows: Length of body, 30 ft.; length over bumper, about 35 ft., and total width, 8 ft. 10 ins. The sliding doors on the sides have 4-ft. openings, and the ends are provided with swing doors. The car has two drop sash on each side as well as efficient ventilation at the roof. The sills are continuous and form a small platform scarcely two feet long at each end. In general construction the car resembles closely steam railroad practice, with the exception of a steel plate running the full length of the sills. The entire interior is wainscoted and



LONG INTERURBAN CAR FOR OHIO

painted a light buff color. A small desk is placed in one corner of the car for the convenience of the express messenger in charge.

Last month mention was made in these pages of the handsome cars recently constructed by the John Stephenson Company for the Hamilton, Glendale & Cincinnati Railway Company. The remainder of the cuts accompanying this article show views of the interior and exterior of these cars, which are of a type particularly adapted to long interurban service. They are 32 ft. over corner posts and have 5-ft. vestibules, and are in other general dimensions similar to the cars sent to the Pittsburgh, McKeesport & Connellsville Railway Company, which were described last month. An interesting feature of the car is the installation of the Baker hot-water heater. As seen by the engraving, the car is divided into two compartments, one twice as large as the other, the side posts where the dividing partition occurs being doubled. The smaller compartment is to be used by smokers. The cars are equipped with two sets of double trolley poles.

INTERIOR OF INTERURBAN CAR

Cars for Everett-Moore Line

A short time previous to the financial embarrassment of the Everett-Moore syndicate contracts were drawn for 165 cars for the various city lines controlled by the syndicate. The final signing of contracts, however, was held in abeyance until a few days ago when contracts for 135 cars were formally closed. The specifications for these cars were drawn up and decided upon at the first three meetings of the Everett-Moore Managers' Association. The cars are practically the same as those in use in Cleveland, and are to be finished in the standard yellow used on the Cleveland lines. They will bear no lettering except the numbers, routes being designated by adjustable sign boards on front and on the sides of the roof. The cars will be used as follows: Cleveland Electric Railway, fifteen open and fifteen closed; Detroit United Railway, forty-five open and twenty closed; Toledo Railways & Light Company, twenty open and ten closed; Northern Ohio Traction Company, ten closed. Contracts for all the open cars were placed with the John Stephenson Company. They will be fourteen-bench double-truck cars. The fifteen open cars for Cleveland will be built by the Kuhlman Car Company, of Cleveland, while the Detroit and Toledo closed cars will be built by the Niles Car & Manufacturing Company, of Niles, O. The closed cars will all be 28 ft. body and 38 ft. 4 in. over all. All of the cars above mentioned will be fitted with two General Electric No. 57 motors, 50 hp each, and will be arranged so that the equipment may be doubled if desired. The cars for the Northern Ohio Traction Company will be built by the J. G. Brill Company, of Philadelphia, and are intended for use on the branch lines operated by the Northern Ohio Traction Company. They will have the same dimensions as the other closed cars, but will be fitted with cross rattan seats and the power equipment will consist of four General Electric 67 motors, 25 hp each. They will be equipped with Newell electric brakes. Brill trucks will be used on all the cars. The open cars are to be delivered in April and the closed cars in August.

The "All-Wire" Rail Bond

This bond, which is shown in the accompanying cut (Fig. 1), is made entirely from one piece of flexible copper cable, and is therefore one of the most perfect types of a "one-piece" bond now on the market. As the conducting strands and terminals are made from a single piece of cable, there are no cast or welded joints in the bond to become loose or interpose additional internal resistance, due to imperfectly cast or welded joints.

The conductivity of the "all-wire" bond is that of commercially pure copper, and this conductivity is maintained throughout the entire length of the bond, including not only the conducting strands, but also the terminals. The manufacturers claim that, compared with bonds having cast copper terminals or separate terminals united to the conducting strands by either a casting or welding process, the conductivity of the "all-wire" bond is much greater, due to the fact that it maintains throughout its entire length the same conductivity as that of the conducting strands, while the conductivity of cast copper terminals is necessarily much lower than that of pure copper. The entire absence of joints in the bond overcomes the inherent defects of bonds having cast or welded joints between the terminals and the conducting wires, as there is always a possibility of such joints not being perfectly made.

The bond is intended for use under the fish-plate, in which position it is perfectly protected from injury from outside causes, as well as from theft, and a variety of styles are manufactured for such use. It may also be used around the fish-plate or under the base of the rail, if desired, special types of bonds being furnished for this purpose, as well as for cross-connecting and underground bonding. It is easily applied by means of a compressor, insuring a perfect contact between the terminals of the bond and the rail ends. The design of the terminals is such that a large contact surface is presented to the rail, so that a contact of extremely low resistance is secured, and the rails may be bonded to their full carrying capacity.

As the bond is made from stranded cable, it possesses a high degree of flexibility, and will successfully withstand the jar and vibration of the rails, as well as their expansion and contraction. It is made entirely from one piece of flexible copper cable, which is cut to length and placed in a forming machine in which the ends of the cable are cold-pressed into shape for the terminals, as illustrated in Fig. 2.

In this form the strands of wire in the terminals are compressed firmly together, as the illustration shows, the size of the terminals, however, being considerably larger than in the finished bond. The ends of the bond are then heated almost to the melting point and forged accurately to size in a steel die. In the latter process the size of the terminals is considerably reduced, the strands of wire composing them being perfectly welded together and forming a mass of solid copper. In the finished bond, therefore, the strands of cable are gradually merged into the solid copper terminal. The "all-wire" rail bond is manufactured by the Ohio Brass Company, of Mansfield, Ohio.

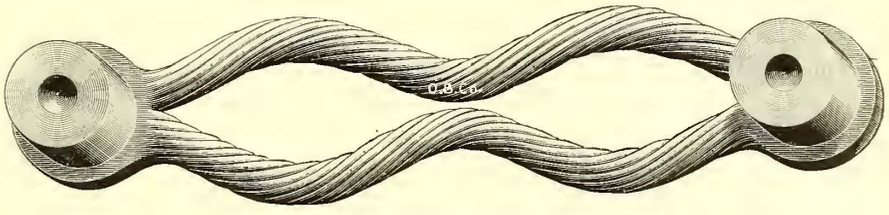


FIG. 1.—"ALL WIRE" RAIL BOND

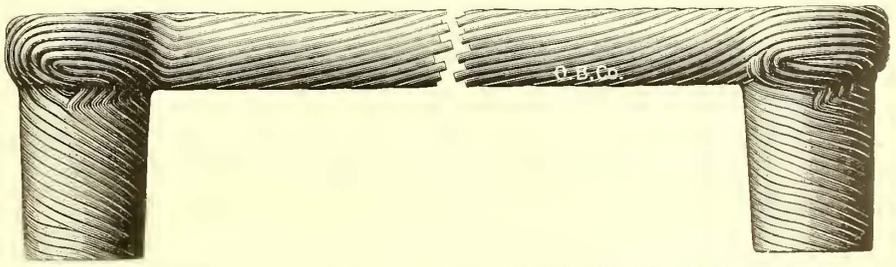
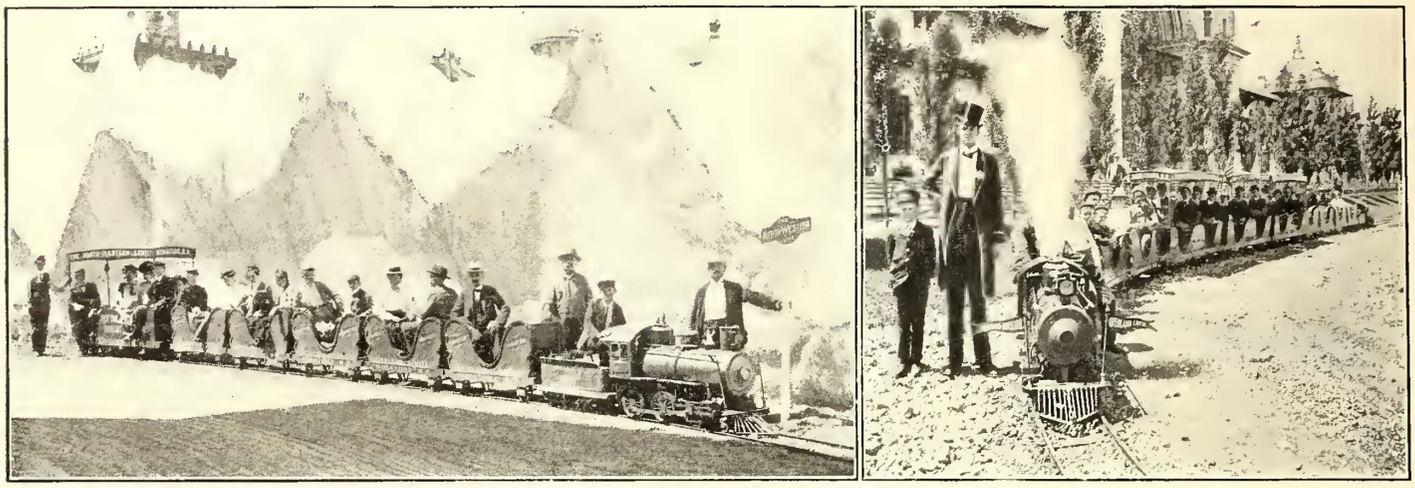


FIG. 2.—CABLE, COLD PRESSED, READY FOR WELDING

Amusement for Street Railway Parks

Street railway park properties are generally admitted now to be legitimate and profitable adjuncts to a street railway transportation system, and it may properly be said that a street railway company which does not own or operate a park property near its terminus or on its line of route is an exception. As this is the time of the year during which most railway companies make plans for the equipment of these properties, it has been thought that some particulars about the minor attractions in the way of amusements at such parks would be of interest and value. Most managers have pretty settled ideas, derived from experience or otherwise, as to the profit of theatrical entertainments, as well as that of establishing menageries, concerts, and other free entertainments. Undoubtedly it is often money well invested to give a free entertainment at a street railway park and recoup more than the outlay through the transportation receipts. There are many minor attractions, however, which properly go with every park, and which have the double advantage that while they afford amusement an extra charge can be made for their use, and they thus become themselves sources of revenue. It is this class of amusement which it is the intention of this article to describe.



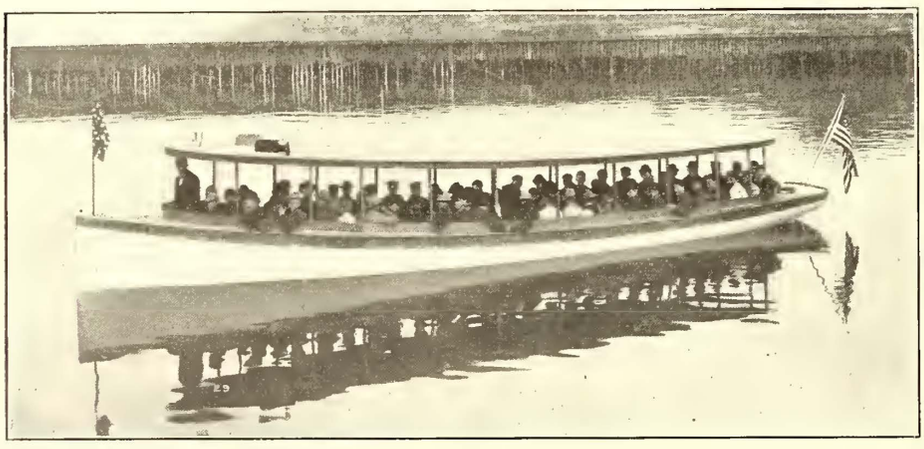
MINIATURE RAILWAY AT THE PAN-AMERICAN EXPOSITION

THE MINIATURE RAILWAY

One of the most popular and best-paying attractions at the recent Pan-American Exposition was the Cagney miniature railway. There were six lines in operation on the grounds, and one is shown in the accompanying engravings. The locomotive is a facsimile in miniature of that used on trunk lines, and is able to draw from two to eight passengers. The cars are usually built to accommodate four passengers each, and the patronage comes from young and old. The first miniature railway was manufactured by Cagney Brothers in 1892, and they have been popular at amusement resorts ever since, not only in this country and Canada, but in South America and several foreign countries. All the locomotives are built at Cagney's locomotive works at Niagara Falls, which are complete in every respect, and include pattern shop, factory, erecting shop, etc. Every locomotive is tested just the same as a standard-sized locomotive before shipping, for at least one week, so that when it is received it is ready for business.

NAME-PLATE MACHINES

One of the most successful coin-controlled machines is the Roovers name-plate machine, which took the highest award in the machinery department at the Pan-American Exposition. A nickel is dropped in this ingenious device, and by turning the disc and punching the characters a person can make his own name plate, which comes finished from the machine on a polished strip of aluminum. It is stated by the auditing department of the Pan-American that twenty-two of these machines took in the enormous amount of $1,526 in one week at the Exposition. Equally as good results were obtained last summer at Earl's Court, London. Without question this machine is one of the greatest money-makers of all slot machines, and several can often be profitably installed at different points in a large traction park. The cost of filling the machine, including material, is about $3, while the machine yields about $80 for each filling. It is the only nickel-in-the-slot machine that gives in return more for the nickel than can be purchased for the same price in any other way. The machine is made by the Roovers Manufacturing Company, of New York.



ELECTRIC LAUNCH AT OMAHA

NAME PLATE MACHINE

ELECTRIC LAUNCHES

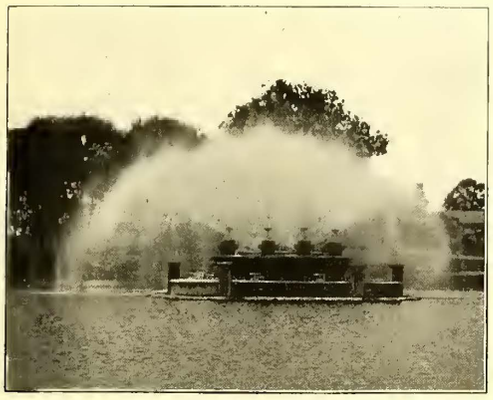
Where a lake or other water is available the electric launch furnishes a highly popular and profitable amusement, and one which is particularly adapted to street railway parks, because current is available for storing the batteries so that they can be operated cheaper than any kind of a launch, as well as possessing the other advantages of cleanliness, safety, etc. There is nothing complicated about them to an ordinary electric railway repair man. A number of these launches have already been purchased by railway companies for park attractions, where they have proved most popular.

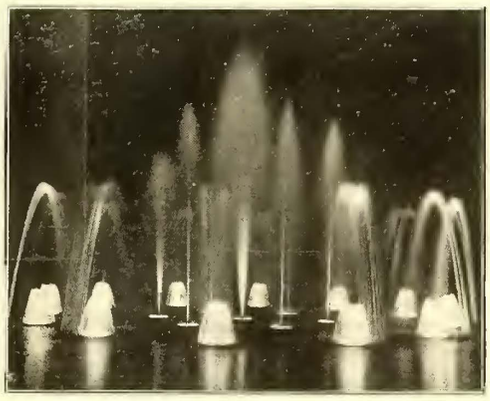
The accompanying engraving shows the 42-ft. electric launch built last year for the Omaha & Council Bluffs Railway & Bridge Co., of Council Bluffs, Ia. This boat is 42 ft. long over all, 8 ft. beam; the motor and storage batteries are placed beneath the flooring and seats so that the entire cockpit space is available for the passengers. There are seats along either side, together with a center or amidship seat. In service this boat easily accommodated sixty-nine adults, not including the pilot, this complement of passengers being shown in the engraving. It will be noticed that the launch has four entrance hatches, two forward and two aft, and that there is a hinging break in the coaming, plank-sheer and upper strake, which permit of easy ingress and egress, so that the boat can be loaded and unloaded with rapidity, thus avoiding any unnecessary delays. The launch was operated with great success by the Omaha & Council Bluffs Railway last summer, and proved a good invest-

ment. The Electric Launch Company of Bayonne City, N. J., builder of this boat, has recently adopted for its pleasure launches the new lightweight type of battery, which is about 35 per cent. lighter in weight than that hitherto used for marine purposes.

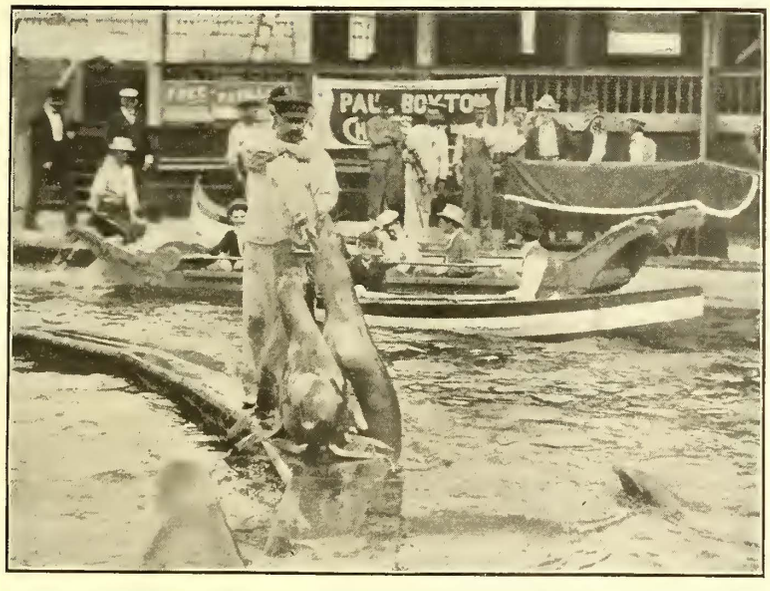
ELECTRIC FOUNTAINS

Like the electric launch, this is an amusement which is particularly suitable for street railway parks, from the fact that electric current for the operation of the fountain is always available, and any mechanic who can understand the handling of a railway motor is sufficiently adept to understand the electrical requirements of the fountain apparatus. From the time that the electric fountain established its reputation as a popular amusement at the World's Fair in Chicago, in 1893, it has kept a foremost place in the list of popular and decorative effects at amusement resorts. This has been due largely to the efforts of the Darlington Electric Fountain & Supply Company, of Philadelphia, which is the foremost if not practically the only builder of these fountains in this country, and which has made a specialty of the subject, so that it now builds fountains suitable for the largest parks or for smaller enterprises, and even, if requested, small enough for banquet tables. The variety of displays is almost limitless, as by changing the colors, direction and shape of the jets an endless variety in colors and displays can be secured. In this way an audience can be entertained for as long or as short a time as the management may desire, and often as well as, if not better than, by a band concert, the expense of which is enormously greater, as it requires the services of a dozen men or more in place of one.





TWO VARIETIES OF ELECTRIC FOUNTAINS

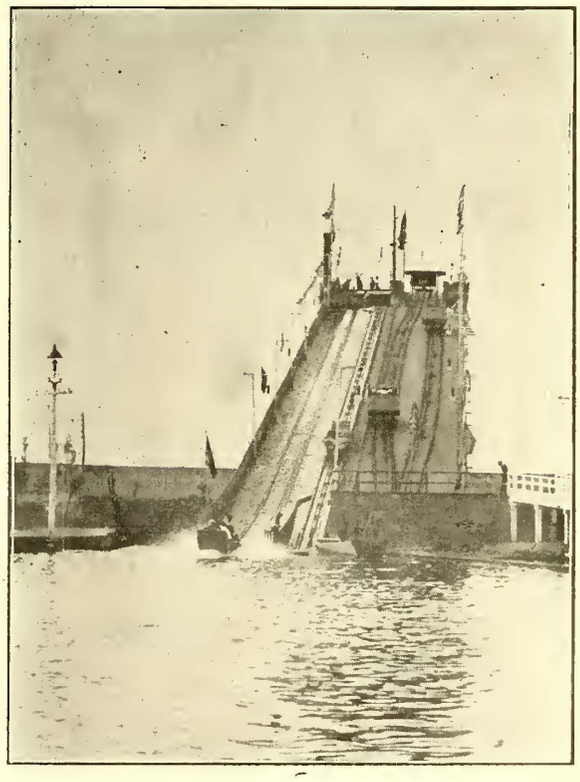


TRAINING SEA LIONS

THE BOYTON ATTRACTIONS

Capt. Paul Boyton, the inventor of shooting the chutes, has established a world-wide reputation as an inventor and designer of many popular park attractions. Of these the chutes, which has just been mentioned, is probably the widest known. The first large chute built by the Paul Boyton Company, of New York, was installed in London in 1893, and its success from the start was phenomenal. The receipts during the first short season of the Chicago chute, which was built in 1894, were about $40,000. Chutes in Baltimore, Atlantic City, Atlanta, San Francisco and elsewhere have all been similarly successful, some of these exceeding $2,600 in a single day. As usually built, the chute has a height of 60 ft., with a run of about 250 ft. to the water. When the boat strikes the water the impetus gained during the descent causes it to proceed in a series of bounds some 300 ft. to a landing stage, where the passengers are disembarked. The boats are so constructed that it is impossible for the riders to get wet, while the sensation during the descent and upon the impact of the boat with the water is novel and thrilling. The company has installed a number of these devices where there was no natural water by building an artificial lake. As the depth of the water does not have to be over 2 ft., this is not an expensive undertaking. A great advantage of the chute is its high earning capacity, owing to the shortness of the trip, a fair-sized chute being able to take in about $240 per hour. The chutes cost anywhere from $8,000 to double that price.

Another attraction made by the Boyton company is the "Flip-Flap Railway," or "Loop the Loop," which proved very popular in Coney Island last summer, and "The River" or "Old Mill." Another feature which is being introduced by Captain Boyton for summer parks are sea-lions. A park has been established at Coney Island called Sea-Lion Park, where these animals are trained and where all the Boyton attractions are in full operation. This park has been the clearing house for some of the most successful amusement devices ever invented. Sea-lions are easily tamed, so that they will perform many amusing tricks for visitors, and Captain Boyton believes that they will constitute a very popular attraction for traction parks this summer. The company has engaged a schooner to capture these lions.

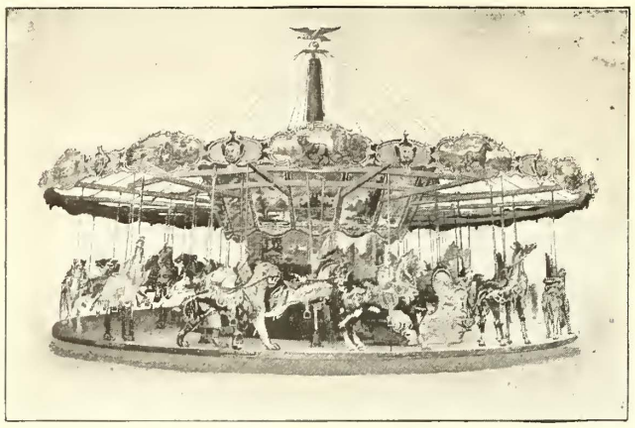


CHUTE

MERRY-GO-ROUNDS

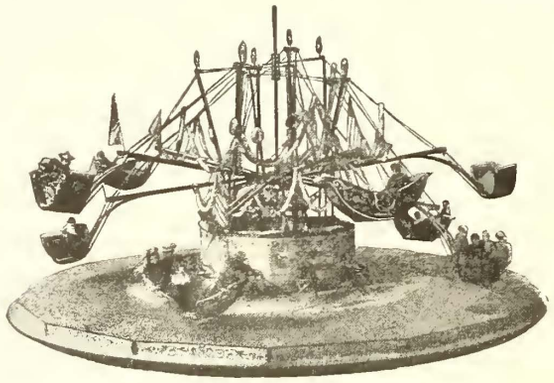
No account of park attractions would be complete without a reference to merry-go-rounds, carousels, or riding galleries, as they are variously termed by the different manufacturers. It is remarkable how this old form of amusement keeps its hold on the pleasure-loving public, or that part of it which attends summer parks. From this it must not be understood that the modern

carousel, or riding gallery, is the same as the merry-go-round of a generation ago. The modern production is 40 ft. or 50 ft. in diameter, handsomely decorated, and instead of a single line of wooden horses the passenger is confronted with pairs of nearly



DENTZEL CAROUSEL

every animal that entered the ark, or he can select his seat in chariots similar to those used by the royal families abroad. The



OCEAN WAVE

Armitage-Herschell Company, of North Tonawanda, N. Y., has even built some of these galleries with four animals abreast, operated by a steam engine and boiler, or electric motor, as required, and a sight of one of these gorgeous creations, or of the company's miniature railway, which the company also manufactures, is one which appeals most strongly to the average park attendant. Views of each of these attractions as built by this company are given herewith.

Herschell, Spillman & Co., of North Tonawanda, built an ingenious variation of the riding gallery called the Ocean Wave. The cars in this device are given a rocking motion, which exactly simulates that of a boat on the Atlantic, and the device furnishes much amusement not only to seashore resorts, but in inland towns, where the patrons do not have as much opportunity of enjoying an ocean voyage. A view of one of these ocean waves is presented on this page. They are built in several different patterns and have different motions.

The Gillie Engine and Machine Works, of Tonawanda, which seem to have become the center for attractions of this kind, are also large manufacturers of riding galleries, and their apparatus has given excellent satisfaction. The standard gallery of this company has an outside diameter of 40 ft. The horses are twenty-four in number, their appearance being lifelike and realistic. Each horse has a rapid yet an easy galloping motion. There are no iron rods hanging in the way of the riders. Between every three pairs of horses is placed a chariot of the latest design. Upon the platform of the gallery is mounted sixteen chairs, which gives the gallery a seating capacity of fifty-six persons. The Whirling Panorama, a most ingenious contrivance, and controlled by this company, is added to the galleries when ordered. It is the intention of this company to secure the very latest views of the Pan-American Exposition and place them in this panorama, which will increase the money-making part of the outfit. All galleries are equipped with a tent with good side walls, engine and boiler of the latest design, a military band organ with

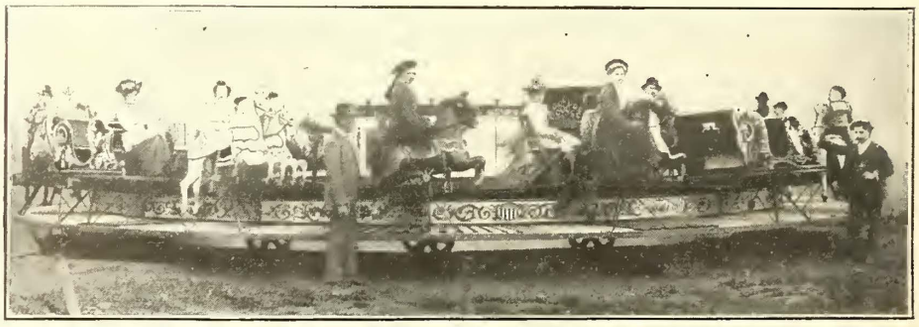
GILLIE RIDING ACADEMY

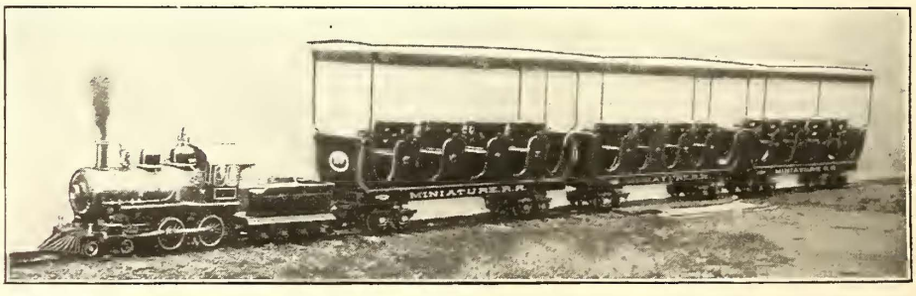
two barrels, each playing eight of the latest popular airs. The company also adds to this outfit the circle or "safety wheel," which prevents accidents. An interesting feature of the riding galleries manufactured by this company is that every part is so ingeniously designed and put together that in a very short time the entire outfit can be taken apart and packed in three wagons or one car for transportation. This company also builds a gallery on the same lines as that 40 ft. in diameter, but makes it 30 ft. in diameter. It is therefore adapted for quick moving and for small towns, where it would be possible to get but a small audience. The capacity of this outfit is thirty-five people.

Another builder of carousels and organs for park resorts is G. A. Dentzel, of Philadelphia. Mr. Dentzel, who is one of the largest builders of apparatus of this kind, has supplied carousels to many of the largest parks in the country, and pays special attention to artistic detail. It would be impossible to describe all of these creations, but they are of all kinds, sizes, and their appointments can be as elaborate as the most exacting person may desire. That Mr. Dentzel has kept abreast of the times is shown by the large business which he is doing and by one of his carousels illustrated herewith.

BOWLING ALLEYS AND SHUFFLEBOARDS

These amusements form what might almost be called essential





ARMITAGE HERSCHELL RIDING GALLERY AND MINIATURE RAILWAY

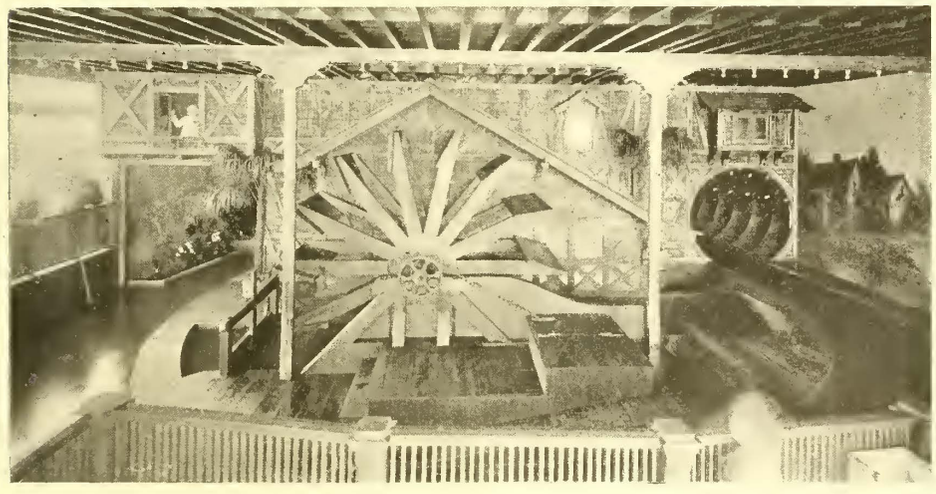
portions of any park, large or small, and like any pastime of this kind for which the charge is small, and which gives an opportunity for the display of skill, the returns are usually very large. The Narragansett Machine Company, of Providence, R. I., makes a specialty of bowling alleys and shuffleboards for street railway parks, and is also a large manufacturer of gymnasium outfits, steel

and wooden lockers, etc. The company has installed hundreds of these outfits in all parts of the country and is prepared to ship or install them at short notice.

SCENIC RAILWAYS

Two amusement devices which have become very popular during the last few years are the "Scenic Railway" and the "Aquarama" or "Old Mill," manufactured by the Aquarama Company and the L. A. Thompson Scenic Railway Company, of 150 Nassau Street, New York City. In the former the travelers on a gravity car pass through tunnels, over bridges and past scenery representing sights from all over the world. He can be taken down the Rhine and up the Nile at a cost of only 5 or 10 cents, and can view at the same time, and without leaving his seat, Blarney Castle, the Pyramids and the Parthenon. The Aquarama is similar in general plan to the scenic railway, except that the traveler rides by water in a boat, which floats along a shallow canal, the flow in which is provided by a water-wheel at one end, which keeps the water in circulation. Of course with the aquarama the exciting descents and rapid rises possible in a vehicle run on wheels can not be obtained, but the motion of sailing through the route by water is considered pleasanter by some. The attractions are often run in connection with each other, and it is found that when a person patronizes one he is almost sure to pay for a ride on the other. Two very important advantages possessed by both these amusements are, first, that the pleasure-seeking public does not tire of them, as the desire for a second voyage is just as great, if not greater, than for the first, and second, that the cost of operation is very low. Both boat and car do not require any attendant, as the motive power takes care of itself, so that practically the only attendants required for operating either of these amusements is one man to take in the money and an assistant to start the passengers off on their different voyages, whether it be by rail or water.

GARDEN SCENE IN AQUARAMA



WATER WHEEL AND ENTRANCE TO VOYAGE

The Philadelphia Consolidation

John M. Mack, the representative of the syndicate which last year secured from the City Council of Philadelphia valuable franchises for the construction of elevated and surface lines in Philadelphia, has submitted to a special committee of the Union Traction Company, of that city, which now controls all the lines operated in the city, a proposition to lease the property of the company. George D. Widener, one of the members of the committee that represented the Union Traction Company when the proposition to lease the property was made, has issued the following statement: "The committee has received from Mr. Mack a proposition to lease the Union Traction Company. It has been favorably considered, and the chairman of the committee, Mr. Elkins, has been instructed to report the same to the board of directors for its action on Monday, March 3. All present are heartily in favor of accepting the proposition."

The negotiations for the lease or consolidation of the interests have been pending for some time, but the latest proposition, it would seem, contemplates financial arrangements entirely different from any that have been current recently. Nothing official has been announced in regard to the deal, but from sources that appear reliable it seems that the plan provides for the organization of a new company capitalized at $30,000,000 to take over the various interests. Union Traction shareholders, it is said, are to receive guaranteed dividends of from 3 to 6 per cent, reaching the latter figure in the seventh year, and to have the right to subscribe to one-fourth of the stock of the new company at par.

It is positively denied that the new company will be known as the Market Street Elevated Railroad, but the name of the company that will succeed the present companies is unimportant. It would seem from the unofficial reports of the deal that the plan of the new company is to begin at once the construction of a subway in Market Street from the Delaware River to the Schuylkill River, the plan being to build elevated lines elsewhere as necessity shall dictate.

Captains of Industry

H. H. Vreeland and George J. Gould, president of the Metropolitan Street Railway Company and president of the Manhattan Railway Company, respectively, were guests at the "Captains of Industry" luncheon tendered to Prince Henry, of Prussia, Feb. 26, as one of the features of his visit to this country. Among the other ninety-three notable men present, whose names are familiar in street railway circles, were Edwin Reynolds, of the Allis-Chalmers Company and president of the American Society of Mechanical Engineers; Charles A. Moore, of Manning, Maxwell & Moore; William B. Parsons, of the Rapid Transit Commission; Francis B. Crocker, Professor of Electrical Engineering at Columbia University; George Westinghouse, president of the Westinghouse Electric & Manufacturing Company; P. A. B. Widener; Edward Weston, Thomas A. Edison, W. A. Roebling, Frank J. Sprague, Charles P. Steinmetz, Elihu Thomson, Prof. Robert H. Thurston, John Fritz, Nikola Tesla and John Markle, president of the Sprague Electric Company.

There has been introduced in the Assembly of New York a bill of particular interest to street railway corporations and negligence lawyers. The bill makes it the duty of every party to an accident, and the servant of such party, to obtain the names and addresses of all witnesses and to preserve the same. The bill further provides that every policeman who is present when an accident occurs, or who comes on the scene later, shall diligently seek to obtain the names and addresses of witnesses and shall file the same with the officer in charge of the nearest police precinct station.

NEWS OF THE WEEK

Negotiating for Sale of Denver Lines

Negotiations which have been pending for some time, involving the sale of the property of the Denver City Tramway Company to the Whitney-Ryan-Widener-Elkins syndicate of Eastern investors for $8,500,000, are said to have been practically completed. The company owns 150 miles of track, covering 88 miles of streets of Denver, and includes the former holdings of the old tramway company, the Metropolitan Street Railway Company, the Denver Consolidated Tramway Company, the Denver City Railway Company, the West End Railroad Company, the Denver City Traction Company and the Colfax Electric Company. The capital stock of the company is $5,000,000. There are $5,837,000 in bonds outstanding.

Increase in Wages at Camden

Commencing March 6, the conductors and motormen employed by the Camden & Suburban Railway Company, of Camden, N. J., will receive seventeen cents an hour for their work, an increase of two cents per hour over the present scale of wages. The directors of the company voted the increase at a meeting several days ago, but the first intimation was not given until a notice conveying the information was posted on the bulletin board in the car house. The increase was purely voluntary. The new rate of wages, with a premium of 10 per cent. paid monthly for freedom from accidents and good deportment, will make the wages of the men participating 18.7 cents per hour. The men who have been in the employ of the company for over five years will receive their uniforms as usual.

An Addition to Car Town

According to a contemporary there has recently been added to the dwellings at Car Town, San Francisco, which has been described in the Street Railway Journal, a new dwelling more unique than any of its predecessors. The new dwelling is, it is understood, the result of the wonderful workings of the mind of a teacher in the grammar schools in San Francisco. The young woman used eight cars in building her "home," thus exceeding by four the number used in the construction of any previous dwelling. Everything from the street cars has been utilized. The latticed flooring has been made into a walk that approaches the novel little dwelling. At the front door, instead of pushing the conventional button, you pull a dangling rope and the clang of a street car gong announces your arrival. You are admitted into a tiny hall, lined with street car woodwork, lighted with one window and fitted up with book shelves and a hall seat. Curving grills—the ironwork from a car—and green hangings separate this entryway from the next room. This last is formed from two open cars set side by side with their roof edges tightly joined. The windows are daintily curtained, and the open spaces on the sides filled in with redwood paneling. At the far end the door of one car opens upon the garden. The door of the other opens into a china closet, into which its front platform has been converted.

For purposes of warmth, as well as decorative effect, a polished hardwood floor has been laid over the old street car floors. The room is prettily furnished with a cozy cushioned couch, book shelves, easy chairs and potted plants. The kitchen is a bobtail car, which connects by a sliding door with the dining room. The cooking is done on an oil stove. All along one side of the car the window recesses have been filled in with convenient shelves. The front platform has been metamorphosed into a pantry. A second bobtail car serves for a bathroom, where there is the best of plumbing, a marble washstand and a big porcelain tub. The back platform here has been transformed into a linen closet. The bedroom is another bobtail car, with redwood alcove extension built on. The parlor, which is not yet quite finished, is a pair of bobtail cars joined and with their double platform made into a fine bay window. All of these cars are ranged around an open court, which, when the whole is finished, will be utilized for a conservatory. The servant's quarters are in a bobtail car, which stands a little apart from the rest of the house, but conveniently adjacent to the kitchen car.

Improvements at Minneapolis and St. Paul

The Twin City Rapid Transit Company, of Minneapolis and St. Paul, Minn., is planning improvements that will call for the expenditure of about $1,350,000. The officials of the company have decided that the power furnished by the St. Anthony Falls dam is no longer sufficient to supply the fast-growing needs of the street railway system and a steam plant will be erected at the dam for use when the water is low. This plant will have a capacity of 3000 hp, and its erection will be the first step in a plan that involves a complete revolution in the power system of the company. The steam plant, it is estimated, will cost about $700,000. Ultimately three sub-stations will be established: one each in Minneapolis and St. Paul, and the third for the Stillwater line. The exact location of the sub-stations has not yet been determined, nor will they be erected this year. Another feature of the plan is the construction of tunnels through the sand rock underlying the city, to accommodate the feed wires which must be carried through the business districts.

New cars which are to be turned out during the year will cost the company $350,000 more. Ten cars of the large, or interurban, type are now in course of construction at the shops on Thirty-First Street, and the first of them will probably be finished in about a month. The shops, it is said, will be run at full capacity all the year, and the company expects to turn out an average of twelve cars each month. More car house space will be required for the accommodation of these cars, and $100,000 will be spent in enlarging the buildings now in use. The remaining $200,000 will be spent in the construction of the tunnels already referred to and in track repairs.

The Everett-Moore Situation

The Everett-Moore situation has been relieved by the sale of the syndicate holdings in the Cleveland Electric Railway to a syndicate headed by Horace E. Andrews and John Stanley, of Cleveland. The price to be paid for the stock is $80 a share, and the securities are to be deposited for transfer with the Savings & Trust Company within twenty days. The stock sold includes the holdings of Henry A. Everett, E. W. Moore, Charles Wason, Barney Mahler, J. B. Hoge and several others. The sale involves about 43,000 shares at a total price of $3,440,000. It is understood that the syndicate's equity in the stock sold is something over $15 per share, so the sale will give the syndicate something over $700,000 in ready money, which will probably be used in the general relief of the situation. The holdings heretofore held by Andrews and Stanley were about 22,000 shares. This number, with the 43,000 purchased, gives them a total of 65,000 shares, which is exactly one-half the capital stock of the company. It is understood, however, that the purchasers have also purchased a considerable amount of independent holdings on the open market, and this represents the majority of stock in the property. The deal was practically closed Feb. 19, but it was held open for two days in order to give the Elkins-Widener syndicate another opportunity of bidding. As soon as the transfer of stock takes place, it is quite probable that there will be a change in the personnel of the company. It is generally believed that Horace E. Andrews will become president, and that John Stanley will assume his old position of general manager.

The securing of control of the Cleveland Electric Railway by the Andrews syndicate is of great significance in Cleveland traction circles. Not only is it another epoch in the long fight for the control of the property which has been waged between the Everett and Andrews factions, but it now appears that a speedy consolidation of the property with the Cleveland City Railway Company is assured. Mr. Andrews is a heavy stockholder in the Cleveland City Company, and he is on very close terms with Senator Hanna, president of the company. It is even believed in many quarters that the purchase of the property was backed by Senator Hanna, and it is thought probable that in event of the consolidation Senator Hanna would become president of the consolidated company. All concerned decline to discuss the situation.

It is understood that the transaction under which Tucker,

Anthony & Co., of Boston, obtained control of the Canton-Akron Railway and the Canton-Massillon lines, involved the actual changing of hands of only $425,000 instead of $3,500,000 as has been reported. Of this amount $225,000 was paid into the treasury of the Northern Ohio Traction Company, the owner of the properties, and the other $200,000 went to liquidate loans of the Everett-Moore syndicate. It is understood also that the deal included the sale of the proposed Akron-Massillon line, construction work on which had been started. The transaction places the Northern Ohio Traction Company in very good shape with funds to place every dollar of its floating indebtedness, and leave a considerable sum in the treasury. The negotiations for the sale of these properties were conducted by J. R. Nutt, treasurer of the company, in behalf of the bankers' committee.

It is generally believed that the bankers' committee will carry out its plan of selling the Detroit United Railways. It is understood, however, that the stockholders of the company are not taking kindly to the proposal to deposit their stock for sale at a figure not less than $70, since the stock is thought to be worth considerably more than that.

Last Week's Storms

Last week New York City bore the brunt of two of the fiercest snowstorms that have visited the East since the great blizzard of 1888. Beginning with the early hours of Monday, Feb. 17, the first storm of the week increased rapidly until daybreak, when the whole city was completely snowed under. The storm raged with like ferocity over the whole East, the rising of the gale piling the snow up in drifts that for a time caused a temporary suspension of traffic on all except the main thoroughfares. In Brooklyn, Boston, Providence, Philadelphia, Trenton and other cities it might be said that service was paralyzed. Communication between Manhattan and Brooklyn was subject to great delay. The ferryboats with difficulty made trips across the North and East Rivers, which were ice-choked, and shipping was practically at a standstill. The electric and steam service on Staten Island was suspended temporarily, and the boats to that place made trips with the greatest difficulty. The congestion of traffic on the surface lines in Manhattan was severe during the morning of the first day of the storm, when many of the avenues were blocked with long lines of stalled cars. On Broadway wheel traffic was confined to the narrow lanes between high snow hills, and along these cabs, trucks and cars crawled at a snail's pace. From other thoroughfares truck traffic disappeared almost entirely.

The Brooklyn Bridge was kept clear of snow, but many thousands preferred the perilous passage of the ferries to the crush on the bridge. Throughout Brooklyn the blockade was even more general than in Manhattan. Coney Island, Fort Hamilton, and Canarsie were completely cut off from all communication, and half a dozen trains were stalled at one time on the Brighton Beach road. The elevated lines in both Manhattan and Brooklyn were operated without a hitch, although greatly overcrowded because of the inability of the surface cars to operate with the usual expediency. Conditions similar to that in Manhattan and Brooklyn existed in Philadelphia, Boston and the other cities. The Boston Elevated Railroad has been highly praised for the excellent way in which its lines were operated. Trenton, N. J., may be cited as typical of the conditions that prevailed in the smaller cities. The Trenton Street Railway kept cars running on a partial schedule on Monday, February 17, but cars became stalled late in the afternoon by the packing of the snow in the narrow streets of the city. All the lines were not in operation again until the 20th. The line to Princeton was opened on Thursday, and the Yardville line late the same day. The Camden & Trenton Railway did not run any cars into the city between Monday and Wednesday. The Yardley, Morrisville & Trenton Street Railway was operated on Monday and Tuesday, but no cars were operated on Wednesday, owing to the drifting snow in the suburbs. The Trenton, Lawrenceville & Princeton Railroad was open as far as Lawrenceville throughout, but was closed to Princeton until Wednesday, owing to the locomotive, which had a snow-plow attached, being stalled in the drifts.

The second storm of the week began Friday morning, February 21. It rained and snowed alternately, and over the snow already on the ground there formed a crust of ice. Wires began to give way under the strain, and while the storm was not so disastrous to street railway travel as the one earlier in the week, it was worse for the telephone and telegraph companies. Traffic on all the street railway lines in the East was seriously impeded, however. An accident to the power station of the Boston Elevated Railway on February 21 caused a temporary suspension of traffic on a number of lines in that city.

PERSONAL MENTION

MR. F. J. J. SLOAT, general manager of the Southern Ohio Traction Company, is in New York for a few days on a business trip.

MR. J. A. MUIR has been appointed general manager of the Los Angeles Railway Company, of Los Angeles, Cal., vice Mr. Epes Randolph, who is retiring for other service.

MR. W. E. HAYCOX, general manager of the Ohio Central Traction Company, has been granted a leave of absence of thirty days and will visit the Pacific slope.

MR. JOHN CROLL has resigned as stockkeeper of the Union Traction Company, of Indiana, of Anderson, Ind., after two and one-half years' active service, and is succeeded by Mr. B. W. Forkner, who is also assistant to the purchasing agent.

MR. D. H. KIMBERLEY, a prominent Cleveland banker and president of the Kansas City & Leavenworth Electric Railway Company, of Kansas City, Kans., has retired from active business life. Mr. Kimberley will shortly resign the many positions he now holds.

MR. HARRY E. DALTON, who resigned some time ago as superintendent of the Northern Ohio Traction Company, of Akron, Ohio, has accepted the position of superintendent of construction for the Georgetown & Lexington Traction Company, which is building a road from Georgetown to Lexington, Ky.

MR. T. G. HANSEN, for several years division superintendent of the Cleveland Electric Railway Company, of Cleveland, Ohio, has been appointed general superintendent of the Northern Ohio Traction Company, of Akron, to succeed Mr. Harry E. Dalton, who has become superintendent of construction for the Georgetown & Lexington Traction Company, building a line between Georgetown and Lexington, Ky.

MR. H. M. SHAW, of H. M. Shaw & Company, New York, has recently been elected president of the Mountain Lake Electric Railroad, of Gloversville, N. Y., and has been placed in charge of the entire property. Mr. Shaw has also been elected treasurer of the Ballston Terminal Railroad, which operates between Ballston Spa and Saratoga, N. Y. He has also been made treasurer of the Westchester Traction Company, Ossining, N. Y.

GEN. JOHN E. MULFORD, who has been president of the Elmira & Seneca Lake Railway Company, of Elmira, N. Y., since its organization, has deemed it best to retire from the duties of the position because of needed rest from responsibilities, and his resignation has been accepted, with the proviso, however, that he remain as vice-president. Mr. E. R. Dick, of Philadelphia, who is president of the Railways Company General, of Philadelphia, which controls important street railway properties in Pennsylvania, Michigan and New York, has been elected to succeed Gen. Mulford.

MR. R. T. CRANE, president of the Crane Company, of Chicago, recently made quite an extensive investigation in regard to the utility of an academic education for young men who have to earn their own living and who expect to pursue a commercial life. In this connection he sent out letters of inquiry to a large number of prominent business men throughout the country, as well as college presidents and graduates, and the result of such investigation has now been published by him in pamphlet form for private distribution.

The police of Chicago recently discovered a bold plot to rob the aged ticket agent of the South Side Elevated Railroad at Sixty-Third Street, that city. The plot, although it called for the killing of the agent if he resisted, was not that of the hardened criminal, but one that had been worked out by two boys not out of their teens, it is said.

CONSTRUCTION NOTES

BIRMINGHAM, ALA.—The Birmingham Railway, Light & Power Company has succeeded in securing several coveted franchises.

FLORENCE, ALA.—Some time since the city of Florence granted a company a franchise for a street railway system, but the time limit has expired. Now the same company asks a renewal. The matter has been taken under advisement.

BIRMINGHAM, ALA.—Messrs. Dick Brothers & Co., of Philadelphia, and Ladenburg, Thalmann & Company, of New York, offer to investors at 101 and interest the unsold balance of $3,750,000 first consolidated mortgage 5 per cent gold bonds of the Birmingham Railway, Light & Power Company. These bonds mature July 1, 1951, or may be called at 110 after July 1, 1906, and are a first mortgage upon all the lighting plants and street railway systems in the county in which Birmingham is situated, subject to $1,250,000 outstanding bonds of the Birmingham Railway & Electric Company, secured by a first mortgage on one-half of the mileage of the street railway system, for the retirement of which a like amount of bonds are held in the hands of the trustee.

LOS ANGELES, CAL.—The Pacific Electric Railway Company is to construct an immense car house at Central Avenue and Seventh Street, Los Angeles. The building will be 263 ft x 230 ft., accommodating 100 cars. The construction of the new house is to be begun at once.

SAN FRANCISCO, CAL.—The Market Street Railway Company has recently completed the work of changing the western end of its Sacramento Street cable road into a electric line. Electricity is used from the intersection of Devisadero Street to a point opposite Strawberry Hill, on the north side of Golden Gate Park.

WILLIMANTIC, CONN.—William A. Arnold, of Willimantic, says that the Willimantic Traction Company is perfecting arrangements for the construction of its proposed line to Coventry and Windham Center, and that the line to Coventry will be in operation by Aug. 1.

WASHINGTON, D. C.—It has been decided to double-track the lines of the Washington, Alexandria & Mount Vernon Railway Company from Arlington Junction to Washington. The company has elected the following directors for the ensuing year: G. E. Abhot, Park Agnew, F. K. Hipple, B. C. Leech, F. Mertens, J. S. Swartz, Samuel Rea, Joseph Crawford and James Cassells.

TAMPA, FLA.—R. L. Palmer, formerly general manager of the Cleveland & Chagrin Falls Railway, of Cleveland, Ohio, is interested with other Cleveland people in the construction of an electric railway to extend from Tampa to Sulphur Springs, Port Tampa, Clearwater and St. Petersburg. Mr. Palmer is now inspecting the route of the new road.

CHICAGO, ILL.—It is reported that the recently-incorporated Southern Street Railway Company will shortly apply to the council for a franchise to construct an electric railway here. The avowed plan of the company is to build an electric railway from Chicago to a point on Lake Calumet. The incorporators of the company are: Samuel J. Howe, Frederick S. Schooler, William J. Neebee, Jr., Ralph R. Keeler and Clarence S. Piggott.

SPRING VALLEY, ILL.—The City Council has granted a franchise to the Illinois Valley Traction Company, which proposes to build an electric railway to connect Peru, Spring Valley and Princeton, Ind.

LOGANSPORT, IND.—The Logansport & Indianapolis Railroad Company has been incorporated to build an electric railway between Kokomo and Logansport. The company is capitalized at $500,000, and the incorporators are: H. M. Lau, F. A. Smart, O. H. Lau, L. A. Stoneman and W. H. Beach.

LEBANON, IND.—A thirty-year franchise has been granted by the Council to the Indianapolis & Lebanon Traction Company. The consideration is an $8,000 fee and the location of the power house in the city, promoted by Townsend, Reed & Company, of Indianapolis.

ANDERSON, IND.—The City Council has declared the franchise granted two years ago to the Central Traction Company forfeited, and granted a franchise to the Union Traction Company for its Indianapolis and Kokomo line.

INDIANAPOLIS, IND.—The Indianapolis Interurban Terminal Company has filed with the Board of Public Works a petition for a franchise to operate a street railway system in Indianapolis, furnish an interurban terminal, carry passengers at 3 cents and give one transfer to any line of the same company. The company does not offer any annual cash payment, but it offers to pave between tracks and to a reasonable distance on each side. The Indianapolis Interurban Terminal Company is capitalized at $50,000, and the directors of the company are: Charles F. Smith, Medford B. Wilson, William G. Irwin, John W. Chipman, S. E. Rauh and Alfred M. Glossbrenner. Medford B. Wilson is president of the Capital National Bank.

ROCKWELL CITY, IA.—The citizens of this place, in connection with those of Manson and Lake City, are figuring on the construction of an electric railway to connect the three cities. All three places are located in Calhoun County, but owing to the fact that each is located on a different line of railroad there is no direct communication between the three places. The object of the new electric railway is not only to afford connection between the three cities, but also to give each direct connection with all the railroads passing through the county. It is the intention to handle freight as well as passengers.

DES MOINES, IA.—George F. McKay, who represents Cleveland (Ohio) capitalists, and who has been interested with Mrs. Butler and Mr. Coffinberry in the promotion of an electric railway between Des Moines and Colfax, has submitted another ordinance to the City Council of Des Moines. This ordinance, if it passes, will give Mr. McKay or his assigns the right to construct an electric railway over a specified route from the northeast boundary of the city limits to the city hall, and thence north on Seventh Street to Franklin Avenue and west on Franklin Avenue to the west limits of the city. The ordinance further provides that Mr. McKay or his assigns are to pay for a period of two years, after the adoption of the ordinance, 1 per cent of the gross earnings, and after the expiration of two years 2 per cent on the gross earnings.

OTTUMWA, IA.—The Interurban Construction Company, which is empowered to construct, sell and operate everything from an electric motor to a locomotive and an electric railway, has completed its organization. The capital stock of the company is $100,000. The immediate object of the company is the construction of an electric railway between Ottumwa and Oskaloosa. As soon as this line is completed the company will commence the construction of several additional interurban lines in the neighborhood of Ottumwa. The directors of the company are: Gordon W. Wattles, Sumner Wallace, Harry E. O'Neill, John F. Springfield, Samuel Mahon, Calvin Manning and Jacob B. Sax.

DES MOINES, IA.—The Des Moines Western Railway Company filed articles of incorporation with the Secretary of State Feb. 10. The capital stock of the company was fixed at $300,000, and the company will either build a line at once from Des Moines to the Missouri River or will acquire such a line by lease or purchase. The officers of the company are: F. M. Hubbell, president; F. C. Hubbell, vice-president; H. D. Thompson, secretary and treasurer.

CARROLLTON, KY.—Plans are being perfected for organizing a company to build an electric railway from Carrollton to Cincinnati. Estimates of the cost of construction have been made. The road will extend through Carroll, Gallatin, Boone and Kenton Counties. Col. A. S. Berry, of Newport, is interested in the plan.

ELLSWORTH, MAINE.—Plans are being drawn for the construction of an electric railway to connect Ellsworth and Castine.

PORTLAND, MAINE.—The Portland Railroad Company has petitioned for an extension of its lines from Old Orchard to Saco.

AUGUSTA, MAINE.—The material for the construction of the Lewiston, Winthrop & Augusta Street Railway between Augusta and Winthrop, 14 miles, is being distributed along the route of the road. Construction work will be begun at an early date.

WORCESTER, MASS.—The Worcester & Southbridge Street Railway Company has at last secured rights for its line for the entire distance between Worcester and Southbridge, a long delayed franchise having been granted in Auburn. It is proposed to have the road ready for operation at an early date.

HAVERHILL, MASS.—The Haverhill, Lawrence & Ipswich Street Railway Company has been granted a franchise for the extension of its lines through Georgetown.

HUDSON, MASS.—The Hudson & Northboro Street Railway Company, capitalized at $170,000, which is practically the same organization as the Concord, Maynard & Hudson Street Railway Company, proposes to construct an electric railway as one of the connecting links of the proposed road from Worcester to Lowell. The road will be 7 miles long. The directors of the company are: Henry Tower, John H. Robinson, of Hudson; James D. Tyler, of Berlin; Ezra W. Chapin, of Northboro; Charles W. Shippee, of Milford; Edmund B. Fuller, of Haverhill; W. S. Reed, of Leominster.

BOSTON, MASS.—The Boston Elevated Railway Company has begun the erection of an 8000-ton coal pocket at its Lincoln wharf power station.

GRAND RAPIDS, MICH.—It has been practically decided by the Grand Rapids, Grand Haven & Muskegon Railway Company to establish at Fruitport a summer hotel, pavilion, boat house, docks, bandstands and such other things as contribute to make an attractive resort. The Fruitport & Spring Lake branch of the road will be ready for operation by March 1, it is expected.

MENOMINEE, MICH.—It is reported that F. F. Frawley, of Eau Claire, representing Boston capitalists, who has a franchise pending before the City Council, has purchased the White Rapids water-power, 35 miles from Menominee. The plan of the interests Mr. Frawley represents is to build an electric railway from Spalding, Mich., to Marinette, Peshtigo and Oconto, and ultimately to Green Bay. The proposed line would be about 75 miles long, and power would, of course, be obtained from White Rapids.

ST. LOUIS, MO.—The St. Louis Terminal Railway Company has been granted a franchise by the County Court at Clayton for a belt line connecting with a section of road already constructed to the St. Charles rock road, around the western part of the city to a point near South Grand Avenue and the city limits.