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Changes of advertising copy should reach this office by 10 a. m. Monday preceding the date of publication, except the first issue of the month, for which changes of copy should be received two weeks prior to publication date. New advertisements for any issue will be accepted up to noon of Tuesday for the paper dated the following Saturday.

Of this issue of the Street Railway Journal 8300 copies are printed. Total circulatation for 1907 to date 147,150 copies, an average of 8175 copies per week.

Traffic Counts by Students

In connection with the location of stations on the proposed Cambridge subway route several counts have recently been made by Harvard students of the surface car passenger traffic volume and distribution in the territory under consideration by the Cambridge authorities and the Boston Elevated, with a view toward getting a more definite set of facts to assist in the placing of stations. Taken by itself and in relation to the particular day, hours and weather conditions prevailing, the data secured are certainly interesting; but it is a serious question if such a limited number of observations should carry much weight against the judgment of the company's officials as to the number of stations needed, based, as it is, upon daily observation of the traffic and accurate records of the business handled by each car at all seasons of the year, and at all hours and kinds of weather.

Of course, it is not the practice of street railways, except at rare intervals, to make records of the length of journeys of individual passengers. Such a record could only be made by actual count and would be very expensive, but the observation of inspectors and conductors upon any given route should furnish valuable general information as to the density of riding at practically all points covered. The repeated transit of a route by an employee whose business it is to gage the traffic by fare collections, register readings or personal study of the way in which the schedule meets the offered business inculcates a much closer knowledge of the characteristics of the route than can be gained by observations taken on three or four days in the same season of the year. Furthermore, it is difficult to predict the increase in through business which will follow the building of a rapid transit route through local territory, and which should be accommodated by fast service at the expense of fewer stops in the regions nearer to the terminals. It is to be hoped that the judgments of the operating company in the Cambridge situation will not be set aside on the basis of these restricted traffic counts by students, interesting though they may be.

The Chemist in Electric Railway Work

It is well recognized by the management of good sized electric railway properties that the services of a first rate chemist are necessary in the most economical operation. Many of the larger roads have such a man in their employ, and consider the expense amply justified. In the power station alone is great need for him. Not only the fuel and water, but the ashes and smoke may be profitably examined, periodically, by the practical, intelligent chemist. While the important fact to be determined relative to fuel, its heating value, is determined by the calorimeter, an investigation which is the work of the physicist, nevertheless important work is also found for the chemist in fuel analysis. The analysis of boiler feed-water is, of course, one of the electric railway chemist's chief duties, and he must be able, not only to diagnose, but also to prescribe intelligently. A chemical examination of ashes and flue gases will indicate the extent to which the available heating value of the fuel is being utilized. Oils, paints and insulation, all offer prom-

ising fields of investigation to the practical chemist, while a thorough investigation of the salts present in many so-called electrolysis troubles will often tend to lift the blame for the corrosion of gas and water pipes from the electric railway's "stray currents."

If such talent is useful in the economical operation of large properties, it should be, to a similar degree, in the case of the smaller roads. The expense of maintaining a chemical department with the necessary laboratory facilities would be too great for the results obtained on most of the roads not large enough to use the "system" cognomen. It is entirely possible, however, for several such companies in the same vicinity to combine in securing the entire services of a competent chemist for a study of their chemical problems, and the results obtained should prove the expense, shared between the roads concerned, a first-class investment. Much better results would be obtained in this manner than by the independent employment of consulting chemists by the individual roads. There is also an opportunity here for the specialist in matters of this kind to cater to a large clientele after the manner of the successful physical laboratories which have taken up electrical work. One who devotes his entire time to the study of problems connected with electric railway operation will be much more valuable in the solution of these problems than the general chemist who has no such opportunity to specialize.

Our local associations have become active in adopting inter-road tickets, mileage books, exchange of baggage, and other schemes for increasing revenues by collectively offering advantages impossible for any individual road. It seems that arrangements tending to decrease expenses by collectively taking advantage of opportunities not available to individual roads, such as outlined above, might be profitable.

Interference of Freight Traffic with Passenger Service

A few weeks ago we printed some comments upon the interference of suburban passenger trains with the freight service of steam trunk railways. Conversely, it may perhaps be apropos to consider in this issue some of the objections which exist to the operation of freight trains on electric railroads. Occasionally the managements of interurban properties consider that any receipts obtained from heavy freight traffic are direct additions to the total receipts of the road. With this idea in mind, they develop freight traffic to a point that requires several trains per day in each direction to handle it. In considering this business, however, it should be remembered that practically all existing electric interurban railway systems were constructed for passenger service. For this they are peculiarly adapted and this is their legitimate field rather than the haulage of freight. The fact that they give frequent service, are free from dirt, and that usually they haul people to the business centers of towns and cities gives them manifest advantages over the steam roads so far as this branch of their traffic is concerned. But with freight traffic the opposite is true. Ton for ton the steam roads can usually transport freight, especially when the hauls are long, at a lower cost than the electric road. This does not mean that the latter should not undertake this class of service; simply that before going into it heavily all facts should receive careful consideration. In many cases it may be profitable, but the management should be sure that it is a real profit. Every precaution should be taken to see that the service does not interfere with the passenger trains, as is very apt to be the case if the latter are operated on an hourly schedule. Otherwise it is possible that the loss of passenger traffic caused by such delays will more than offset the net receipts from freight.

The operation of heavy freight trains may interfere in many ways with the movement of passenger cars. In the first place, freight locomotives require so much current that if there is not an unusual amount of copper in the direct-current distributing system the voltage supplied to the passenger car motors is considerably lower than it would otherwise be. Again, derailments occasionally occur, and unless the sidings are always located at the points where they are needed and are long enough to accommodate the freight trains, delays are occasioned through switching at these points.

Reliability of passenger service should be uppermost in the minds of the management of a system which gets the greater portion of its receipts from this service. There is hardly any limit to the amount of travel that can be developed in any territory. It will increase in proportion to the conveniences and accommodations offered, and on the other hand it will decrease or will be discouraged in proportion to inconveniences. These facts should be considered in any review of freight earnings.

Hold the Schedule

Some prominent officer of the Ananias Club once laid down the maxim: "A lie well stuck to is better than the truth half told." As this distinguished body has been mentioned so frequently lately in the daily press we might paraphrase the saying to give the truthful proverb: "A fifteen-minute schedule lived up to is better than a ten-minute schedule half observed." We have in mind two parallel streets quite near together in a city of medium size. On one there are run twelve cars per hour, on the other four. Yet in spite of the discrepancy in mere numbers the latter street has the better service and many people who could readily take either line choose the one with the fewer cars. The reason is not far to seek. For some cause that is not altogether obvious those fifteen-minute cars are almost invariably on time. Go to the corner at the appointed minute and the car promptly pokes its dashboard around the curve just above. One could almost set his watch by it. On the other street the cars run without the least regard to the quality of the service given. Two sets of them are scheduled so that they run in pairs almost together and the third is generally late enough to join the others, so that one either hits or misses the trio. Sometimes four or five cars will go by almost together and then there will be none for ten or twelve minutes.

Now it chances strangely enough that all these cars are operated by the same company, so that there is no actual competition between them. If there were the fifteen-minute schedule would very quickly be shortened and the manager of the other line would be wondering why the receipts were falling off—and with such good service—twelve cars an hour! On city lines where so many cars are run that there are no long waits it is equally important to hold closely to schedule, lest these cars get blocked, but it is on

the suburban and interurban lines that close adherence to schedule brings the best returns. A really regular fifteen-minute service is vastly better from the standpoint of earnings than more cars loosely run. It is cheaper to operate and until overcrowded to the point of inconvenience it will give much better satisfaction to the community. Just how to preserve a rigid adherence to schedule is a little hard to say. Strict regulations and care in picking out motormen and conductors will do much. Perhaps it would be worth while to set up a little healthy rivalry among car crews by a competitive premium on punctuality. There is a good bit of help toward it, too, in not trying to make too high mileage. Up to a certain point increased mileage tends to economy, but we think it is not infrequently overdone. The result is insufficient time for proper inspection, increase of repairs, and lack of reserve power for emergencies. Cars not pushed to their speed limit can pull through their schedule week after week without delays, while a little quickening of the running time would make it very easy to disorganize the service and block the cars. A little extra power is mighty convenient when things begin to go awry, and while every car has to be overloaded and pushed hard now and then, the one least persistently overworked is the one to depend on in an emergency.

The Operation of a Successful Interurban

The full operating article on the well-known Boston & Worcester Electric Railway published in this issue contains some interesting lessons in modern railroading. The line in question is typical of good recent practice, and has amply made good its claims to success from its very start. It has done a very large business, and when it gets its freight and express service in full operation it may be expected to give some effective lessons upon those features of traffic which have as yet been very little developed by any of the New England roads. From the standpoint of the electrical engineer the center of interest is the power house and the electrical distributing system, whose complete operative features are described. We are fortunate in being able to present a rather full schedule of the cost of power generation and of operation generally. The power station itself at South Framingham is thoroughly well equipped for economical operation. The main unit is now a 2000-kw Curtis turbo alternator, and the subsidiary units are engine-driven alternators of 500 and 1000 kw, respectively, all being wound for the transmission voltage of 13,200. The feature of the power house is the cooling tower system installed to tide over the times when the Sudbury River is too low to furnish the necessary water. The towers are three in number, each large enough to take care of 1000 kw easily and to maintain a vacuum of not less than 27 ins. A rather high grade of West Virginia coal is used with which the results obtained by hand firing are probably nearly or quite as good as could be obtained by mechanical stokers.

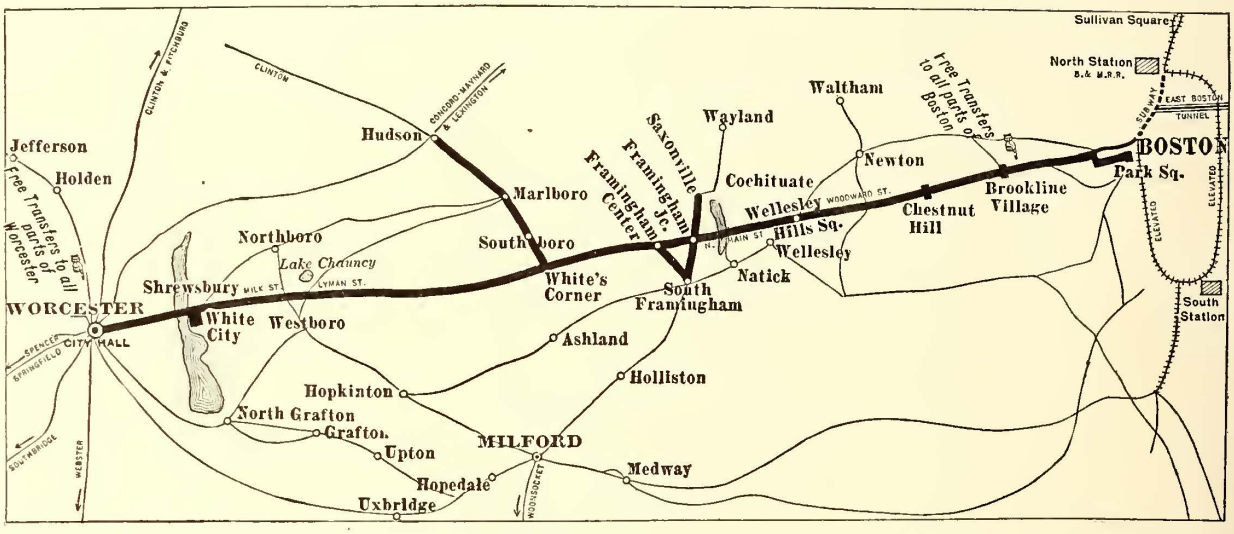
There are four sub-stations all told with eleven rotary converters of 250, 400 and 500-kw capacity. The aggregate converter capacity is 3800 kw, very little in excess of the station capacity of 3500 kw, so that the load factor conditions are more favorable than in many cases that could be named. The station report shows the operating costs to be well proportioned, only 20 per cent being chargeable to labor, and fuel being 71 per cent. The coal consumption per unit of energy at the a. c. switchboard comes to 2 2-3 lbs. per kw-hour, costing about 0.54 cent. This figure is almost as good as that obtained in the average station of the Boston Elevated System, which has unquestionably the advantage of higher load factor. When it comes to the power delivered as direct current from the Boston & Worcester sub-stations there is naturally quite another story to be told. The all-day efficiency of the transmission and transformation to d. c. is between 83 and 84 per cent, which brings the coal per d. c. kw-hour up to about 3¼ lbs., costing 0.646 cent. The administration of the sub-stations appears to be thoroughly economical, yet the total cost of power at the d. c. terminals rises to 0.946 cent per kw-hour, compared with 0.764 cent at the a. c. switchboard. The latter figure is nearly as favorable as that reported from the Boston Elevated d. c. auxiliary stations, which are approximately the same capacity. The data thus obtained for the working efficiency of the transmission and transformation in the sub-stations show, we are inclined to think, better results than the average, yet they are considerably below the results which are often claimed.

There is a wide gap between theoretical and practical performance, and the Boston & Worcester has no reason to be ashamed of its figures. It would be interesting to know what effect upon the final cost of d. c. power would be produced by including the up-keep and miscellaneous expense chargeable to the high-tension transmission line, also the effect of the investment and depreciation charges. These are so rarely included in power expenses that they are too often forgotten, although they are of real importance in comparing various systems of distribution. The cost of power per car mile evidently depends on the nature of the rolling stock, and the steady increase in capacity of equipment shows at once. The present cars of the Boston & Worcester take 4 kw-hours per car-mile, which is a tremendous contrast with the old-time figures for street cars, but really represents great economy in total operating expense. Although equipped with multiple unit control, the cars have been, save in rare instances, worked singly. With the completion of the double tracking there will be a good chance for train operation which on a system of this kind should tend to economy. The transmission system proper presents some features of interest. The longest distance is 11.5 miles, which is quite all that could be economically worked at the voltage used. In Framingham two of the high-tension circuits are run as aerial insulated cables for about three-quarters of a mile to avoid trouble from trees. This is a drastic remedy, but it seems to be effective, although the ends of the cable sections have to be guarded by special lightning arrester systems. The trolley wire is No. 0000 round wire, the smaller sizes and the grooved form being now in process of replacement. The tendency toward big trolley wire in such systems is strongly to be commended. It kills two birds with one stone, giving a more ample surface for current collection and simplifying the system of working conductors. The trolley wire is a mighty good place to put copper up to the largest size that can be conveniently suspended.

OPERATING FEATURES OF THE BOSTON & WORCESTER STREET RAILWAY

The Boston & Worcester Street Railway was opened for traffic between Boston and South Framingham, Mass., on May 8, 1903, and the through line to Worcester was placed in service on July 1 of the same year. In these nearly four years of successful operation the road has come to be known as one of the most interesting interurban lines in the East. It connects the two largest cities in Massachusetts in a direct route which has been appropriately designated in all the company's advertisements as the "Trolley Air Line"; serves one of the most attractive sections of the State, and constitutes an important spoke in the radial transportation trunk lines leading into metropolitan Boston. On Sept. 30, 1906, the company operated a total of 74.837 miles of main track, including a double-tracked through route between Boston and Worcester, a branch line to South Framingham, another to Saxonville, and a third to Marlboro and Hudson. The total trackage operated, including sidings, was 77.677 miles

With the exception of about 3.8 miles of the track lying between Framingham Junction and White's Corner, the main line is now all double track. The road actually begins at the end of the Boston Elevated Railway Company's surface lines, at Chestnut Hill, and it extends to the Shrewsbury turnpike near the east bank of Lake Quinsigamond, Worcester, where it connects with the Worcester Consolidated Street Railway Company's system. Through cars are operated by these three connecting companies between Park Square, Boston, and Worcester City Hall, the distance being 40 miles and the running time 2 hours and 20 minutes. In Boston passengers are carried on a single fare from practically any part of the Boston Elevated system to Brookline Village or Chestnut Hill, where they may transfer to the Boston & Worcester cars without extra expense until the Boston & Worcester's own fare collections begin. Passengers arriving in Worcester by the air-line route are given the free transfer privilege to all parts of the city. The reverse privileges are allowed east bound, between Worcester and Boston. The branch lines are practically all single-track mileage.



ROUTE OF MAIN LINE, BRANCHES AND CONNECTIONS OF THE BOSTON & WORCESTER STREET RAILWAY

POWER SUPPLY

The power supply for the road is generated at a single plant owned by the company in South Framingham. The plant is located on the banks of the Sudbury River practically in the center of electrical distribution of the road. Within the last two years the station has been considerably enlarged in capacity and a steam turbine and cooling tower equipment of much interest added. The original station was described in the Street Railway Journal for Oct. 4, 1902, but as the later improvements have not been taken up to any extent in this paper they will be briefly summed up.

Originally the station contained two Rice & Sargent horizontal cross-compound engines of the condensing type, direct connected respectively to 500-kw and 1000-kw, 13,200-volt, 25-cycle, three-phase General Electric alternators of the revolving field type. These machines remain in service at the present time, but the capacity of the station has been more than doubled by the addition of a 2000-kw, 13,200-volt Curtis turbo-alternator. The standard method of high-tension transmission to rotary converter 600-volt direct-current sub-stations is in use, and current distribution to the cars is effected by a single overhead trolley above each track.

A summary of the principal equipment in the power station follows:

Building, 182 ft. 8 ins. x 105 ft. 4 ins.; three batteries Aultman & Taylor water-tube boilers aggregating 2800 hp, 150-lbs. steam, hand-firing and natural draft; one Green fuel economizer, 9212 sq. ft. heating surface, with direct chimney by-pass; basement, 12 ft. high, containing pumps, Whitlock heaters, condensing apparatus, large piping, ducts; one Rice-Sargent engine, 20 ins. x 40 ins. x 42 ins., 800-1500 hp, 107 r. p. m., direct connected to 500-kw, 13,200-volt alternator; one Rice-Sargent engine, 24 ins. x 48 ins. x 48 ins., 1500-2500 hp, 107 r. p. m., direct connected to 1000-kw, 13,200-volt alternator; one Curtis turbine, 2000 kw, 750 r. p. m., 13,200-volt General Electric alternator; one Deane jet condenser and air pump for 500-kw engine unit; one Blake jet condenser and air pump for 500-kw engine unit; two Deane feed pumps; one Smith-Vaile feed pump, and one Alberger surface condensing and cooling tower equipment for the 2000-kw turbine.

The sub-station equipment consists of the following:

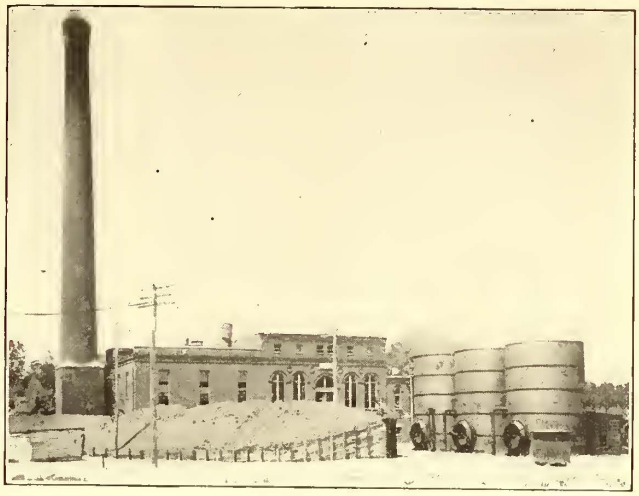
Framingham power station	2—250	kw	rotary	converters,	G. E.,	600	volts,	25	cycles.
	1—500	"	"	"	"	600	"	25	"
Wellesley, sub-station	2—400	"	"	"	"	600	"	25	"
	1—500	"	"	"	"	600	"	25	"
Westboro sub-station	2—250	"	"	"	"	600	"	25	"
	1—500	"	"	"	"	600	"	25	"
Marlboro sub-station	2—250	"	"	"	"	600	"	25	"

Total rotaries, 11; total sub-station rated capacity, 3800 kw.

General Electric step-down transformers and switchboard equipment are used in each sub-station.

The Alberger condensing equipment at the power house is the largest cooling tower installation in New England. The Sudbury River does not permit the use of as much water at all seasons of the year as the station would require if it had been further developed along the lines of the original 1500-kw plant. Something like 6,000,000 gals. of water per day are now required for condensing and boiler feeding, but on account of the low water in the river and the rights of other consumers the plant is limited in times of drought to 25 per cent, or thereabouts, of this amount. The cooling tower installation enables the water at times of low supply in the river to be used repeatedly, the loss by evaporation being made up either from the river or from a well near the station. Three cooling towers are installed, each being 22 ft. in diameter and 33 ft. high.

The normal steam consumption of the Curtis turbine per hour at full load is 40,000 lbs., and any two of the towers are guaranteed to handle the circulating water for the condenser when working under 27 ins. of vacuum. The exhaust from the turbine passes into a counter-current surface condenser containing 12,000 sq. ft. of cooling surface, whence the water of condensation is pumped through a 4-in. discharge pipe to a receiving tank in the engine room, after which it is passed into the circulating return pipe leading from the cooling towers to the power house. Any one of the cooling towers is guaranteed to handle the circulating water for the 1000-kw engine unit when condensing from 20,000 to 25,000 lbs. of steam per hour, taking the water at a temperature not lower than 10 degs. below that of the steam, and maintaining from 26 ins. to 27 ins. vacuum. All three towers will handle the circulating water for the turbine when the latter is operating at 50 per cent overload in summer weather at 80 degs. temperature, using 60,000 lbs. of steam per hour and maintaining a 27-in. vacuum with the barometer at 30 ins. The Alberger Company provided the following pumps in connection with this equipment:



EXTERIOR OF FRAMINGHAM POWER STATION, THE COOLING TOWERS ARE SHOWN ON THE RIGHT

One horizontal 8-in. x 18-in. x 24-in. Corliss dry vacuum pump; one Lawrence 50-hp induction motor-driven volute centrifugal pump; and one 5¼-in. x 6¾-in. x 8-in. horizontal duplex hot-well pump.

There are also installed two De Laval turbine type centrifugal pumps for use in delivering the circulating water against the head corresponding to the height of the towers. One pump is rated at 55 hp and the other at 110 hp. Two sizes of pumps were selected in order to facilitate operation at times without the cooling towers, and at times with cold water.

The volute centrifugal pump delivers the discharge water from the jet condenser of the engine sets to the cooling towers. All the circulating system is cross-connected with pipe lines from an intake well at the river, so that during part of the year, or when the load on the plant is light, river water can be used, sometimes helping out the condensers by using only one tower together with the river water, and again using river water altogether if the turbine is shut down.

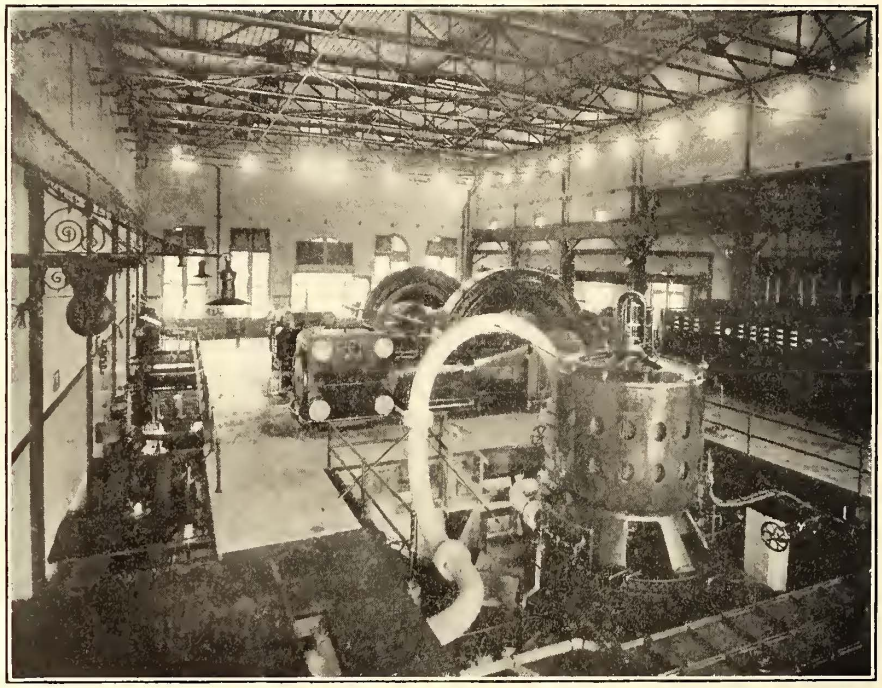
Each of the cooling towers is equipped with two semi-pressure fans 9 ft. in diameter, which run 300 r. p. m. Each

PARK SQUARE, BOSTON, TERMINUS OF THE BOSTON & WORCESTER STREET RAILWAY

pair of fans is driven on a common shaft by a 40-hp, 350-volt, three-phase General Electric induction motor installed in a special house at the side of the towers. The motors are belted to the fan shafts and are provided with oil switches. Air is supplied through louvres set in the side of the fan house. The cooling towers are guaranteed not to evaporate any more water in the process of heat extraction than the amount of fed water required. The large size of the surface condenser is due to the high temperature attained by the circulating water in hot weather, which often exceeds 80 or 90 degs. The contractors for the power house were J. M. Bishop & Co., of Worcester, Mass., and the power plant was designed and its construction supervised by E. H. Kitfield, consulting engineer, Boston. The chief engineer of the plant is A. F. Lovering.

In each of the sub-stations outside that in the main power station the machinery is looked after by the car house employees. Three men are charged with the oversight of the sub-station at Wellesley Hills, where the company's principal repair shops are located. At Westboro and Marlboro two men look after the rotaries. In each of these sub-stations the circuit breakers are wired up to ring a large gong in the car house or shop in case they open. The regular power-house force look after the sub-station at the Framingham plant, as the rotaries and transformers are located in the engine room of the station.

The power-station operating force includes three engineers, working ten hours each; nine firemen, working eight hours per day each; three coal passers, working nine hours; one helper, ten hours, and four oilers, ten hours. Coal is brought to the plant by rail from Newport, R. I., the kind used being a West Virginia coal of about the calorific value of New River. The coal reaches the station on a side track of the New York, New Haven & Hartford Railroad, and it is unloaded by hand, the force being the regular Boston & Worcester track gang.



ENGINE AND TURBINE ROOM OF THE BOSTON & WORCESTER STREET RAILWAY

Careful analyses of the cost of power, both at the generating plant and at the sub-stations, are regularly made by the electrical engineer of the company, Milan V. Ayres. Fuel consumption, wages, supplies, sub-station and power plant repairs are all considered with reference to the car-mile and the kilowatt-hour generated and distributed. The total expenses for power now amount to about $75,000 per year, making a cost of about 3.8 cents per car-mile. The company is constantly doing more business and its rolling stock tends to increase in weight and motive power equipment, so that the total cost of power in the past three years has been greater each year. The table on page 761 is a comparison of the power cost of the road for the three years ending Sept. 30, 1904, 1905 and 1906.

Like many other interurban roads, the Boston & Worcester has not yet adopted a single standard of rolling stock for main line service, but instead has purchased different types of cars from time to time in the effort to serve best the traffic offered. During the past summer the company was obliged to run cars every fifteen minutes between Boston & Worcester and every seven and one-half minutes between Boston and South Framingham. Frequently double or triple-headers were required on some of these trips, and even then the company was unable to accommodate all the people who wished to travel. The result of the company's increasing business has been a progressive growth in the size and weight of its newer cars, and this, with the more frequent stops caused by additional traffic, doubtless explains the increase in power consumption from 3.42 kw-h. per car-mile in 1904 to 3.88 kw-h. in 1905 and 4.05 kw-h. in 1906.

Although the actual kw-h. consumption d. c. per car-mile has increased, it is gratifying to note that the total cost of power production is less than in 1904 per kw-h.; and but one-fiftieth of a cent greater on the direct-current end than in 1905. The erection of additional feeders has been a factor in the economy of distribution and the careful study of power house operating conditions another. The transmission and conversion efficiency of the system as measured by the ratio of d. c. output on the sub-station switchboards to the a. c. output of the generators at the power station shows a pleasing increase from 78.3 per cent in 1904 to 83.7 per cent in 1906. The coal consumption per kilowatt-hour at the station has held pretty close to constant in the three years shown, being practically 2 lbs. per horse-power-hour each year. The delivery of power at the sub-station d. c. bus-bars at slightly under 1 per cent per kilowatt-hour shows the possibilities of the alternating generating plant, high-tension transmission and rotary converter sub-station scheme to be pretty favorable to economical results if carefully operated.

Last year the cost of coal amounted to 71 per cent of the total cost of power at the generating plant, wages to about 20 per cent, supplies 4.4 per cent, and repairs 4.6 per cent. It is interesting to note that steam plant repairs were nearly ten times those of the electrical equipment, showing the relative perfection in design of the two, in a measure. The coal consumption is now about 1000 tons per month—a yearly total which warrants every effort to economize in the consumption of the power plant and in the use of power itself. Of the total operating expenses of the road for the year ending Sept. 30 last, the cost of power figures 26.6 per cent.

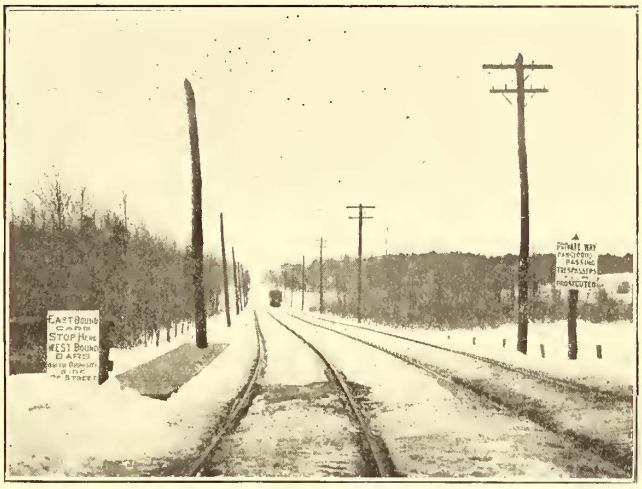
BOSTON & WORCESTER STREET RAILWAY COMPANY
POWER REPORT.

YEAR ENDING SEPT. 30.	1906.	1905.	1904.
Total kw-hours generated (alternating)	9,396,335	8,567,403	7,220,238
Kw-hours Framingham sub-station (direct)	2,792,600	2,309,300	1,908,600
Kw-hours Wellesley sub-station (direct)	2,915,000	2,744,080	2,229,720
Kw-hours Westboro sub-station (direct)	1,233,200	1,296,740	1,520,300
Kw-hours Marlboro sub-station (direct)	921,700	796,360	.....
Total (direct)	7,862,500	7,146,480	5,658,620
Ratio, direct to alternating	83.7%	83.4%	78.3%
Coal burned, lbs.	25,306,409	22,792,589	19,145,081
Lbs. per kw-hour, alternating	2.69	2.66	2.65
Lbs. per kw-hour, direct	3.22	3.19	3.38
EXPENSES, POWER STATION.			
Coal	$50,803.87	$43,353.30	$39,398.31
Wages	14,458.87	13,338.93	11,907.87
Supplies	3,153.43	3,846.51	5,659.69
Repairs steam plant	2,930.39	3,033.32	1,858.42
Repairs electric plant	349.45	243.77	.....
Total power station expense	71,693.51	63,815.83	56,724.79
EXPENSES, SUB-STATION.			
Wages	$1,646.88	$1,652.77	$1,446.77
Supplies and repairs	997.50	220.33	16.64
Total sub-station expenses	2,644.38	1,873.10	1,563.41
Total expense for power	74,340.39	65,688.93	58,188.20
POWER COST PER KW-HOUR (ALTERNATING)			
Coal	0.541 cts.	0.506 cts.	0.544 cts.
Wages	0.154 cts.	0.155 cts.	0.165 cts.
Supplies	0.034 cts.	0.045 cts.	0.050 cts.
Repairs	0.035 cts.	0.038 cts.	0.025 cts.
Total	0.764 cts.	0.744 cts.	0.784 cts.
POWER COST PER KW-HOUR (DIRECT)			
Coal	0.646 cts.	0.607 cts.	0.694 cts.
Wages	0.205 cts.	0.209 cts.	0.236 cts.
Supplies	0.041 cts.	0.057 cts.	0.065 cts.
Repairs	0.054 cts.	0.046 cts.	0.032 cts.
Total	0.946 cts.	0.919 cts.	1.027 cts.
CAR MILEAGE.			
Revenue, double truck	1,859,697	1,648,789	.....
Revenue, single truck	.....	119,746	.....
Dead, double truck	13,240	12,255	.....
Dead, single truck	288	2,679	.....
Snow plow	1,424	.....	.....
Total	1,874,649	1,783,469	1,655,028
Kw-hours, direct current per car mile	4.05	3.88	3.42
Cost per car mile	$.038	$.035	$.035

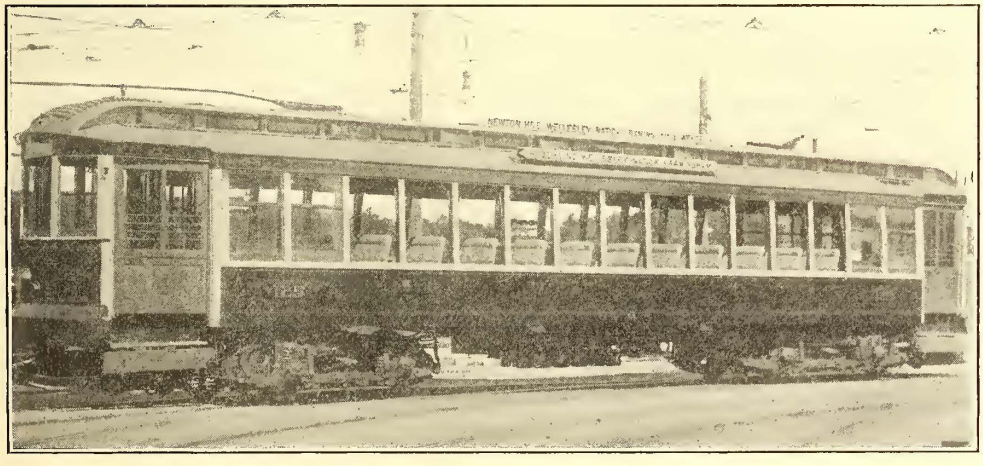
SUB-STATIONS

The effect of the company's policy regarding the care of sub-stations by car house and shop employees is shown in the exceedingly low total sub-station expenses each year. The cost of supplies and repairs has increased sufficiently to compensate for the enlargement of the original sub-station equipment, and it is something of a question if at some future time it may not be well to arrange for some of the sub-station attendance to be on an all-day and specialized basis. The small percentage of dead mileage is also significant of careful control of car movement.

The Wellesley sub-station is 10 miles from the Framingham power station, the Marlboro sub-station 8 miles, and the Westboro sub-station 11.5 miles. The high-tension supply is carried out by three transmission lines, all being three-phase circuits. One circuit extends from the power house to Wellesley sub-station, being No. 0 copper; another of No. 2 copper runs from the power house to Westboro; and the third, equivalent to No. 2 copper, runs from the generating station to Marlboro. In the town of Framingham, where the foliage is thick, the two latter circuits are run in aerial cables for 3750 ft. At the beginning and end of this cable run, lightning arresters and switch houses have been installed on poles so that the cable sections can be quickly isolated if necessary. The houses are covered with galvanized iron and are well out of the way of persons on the street. They are large enough to enable an employee to stand upright inside and walk back and forth without coming into too close quarters with the arresters and switches. Between White's Corner and the Marlboro sub-station the transmission line is of aluminum wire, with the exception of 3000 ft. between the Marlboro city line and the sub-station, which is of stranded, lead-covered copper cable. The three lines are independent, so if trouble occurs on any one the others need not necessarily be shut down.



VIEW OF THE BOSTON & WORCESTER LINE EAST OF THE WELLESLEY CAR HOUSE



STANDARD SEMI-CONVERTIBLE CAR IN SERVICE

OVERHEAD CONSTRUCTION

The trolley wire on the main line is of No. 000 grooved wire. On the branch lines No. 00 round wire is used. The grooved wire is being replaced gradually with No. 0000 round wire on account of the greater freedom of the latter from breakages. The feeder system consists mainly of No. 0000 and 500,000-circ. mil sizes. Section insulators are installed near the Framingham power station at White's Corner and opposite each sub-station.

ROLLING STOCK

The company's rolling stock equipment consists of about seventy-five cars. There are five Newburyport box cars, 37 ft. over all, seating 36 passengers each and equipped with Peckham 14-B-3x double trucks, four G. E.-57 motors, single trolley, type-M control and Christensen air brakes. There are also five Newburyport open cars seating 60 passengers each. These are 37 ft. over all and are carried on the same type of trucks as the foregoing. Four G. E.-57 motors are used under these cars. The company has besides fourteen

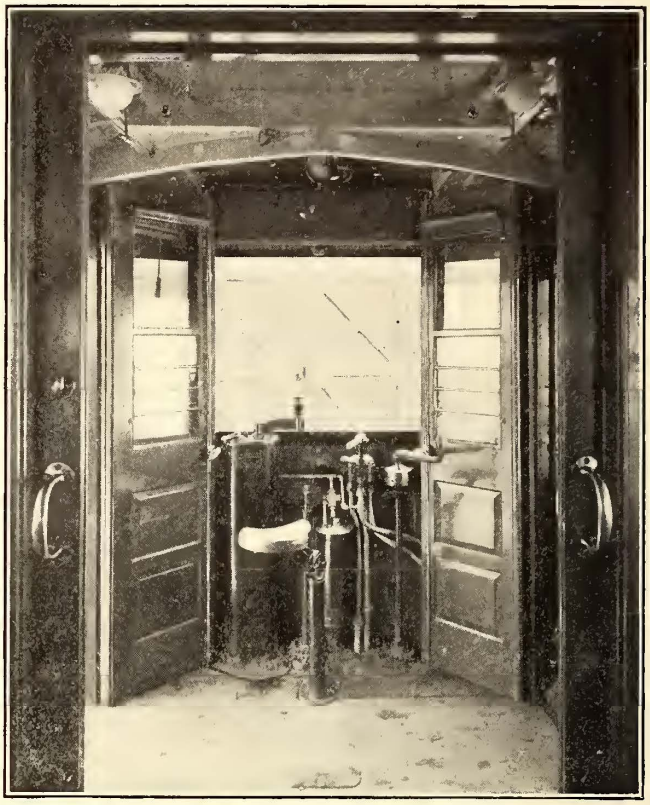
Newburyport box cars, 42 ft. 6 ins. long, seating 44, with two trolleys, mahogany finish, four G. E.-57 motors and type-M control, and ten fourteen-bench Newburyport open cars with glass wind breaks in front of the motorman. These cars have four G. E.-57 motors. There are also in use on the main line ten Brill semi-convertible cars, 42 ft.

INTERIOR VIEW OF STANDARD SEMI-CONVERTIBLE CAR

6 ins. long over all, with a seating capacity of 44. Five of these are equipped with Brill trucks and five with Peckham trucks; all have four G. E.-57 motors, double trolley poles

siderably less power. The main line cars are all geared for a maximum speed of about 40 m. p. h. on the level, the line voltage being figured at 600.

The company has just put in service six new Brill semi-



MOTORMAN'S COMPARTMENT IN VESTIBULE OF LARGEST CAR

convertible cars 53 ft. 5¼ ins. long over all and seating 60 passengers each. These cars are among the handsomest in New England, and they are mounted on Brill 27-E-1½

THE WESTBORO CAR HOUSE AND ONE OF THE ROTARY SNOW-PLOWS

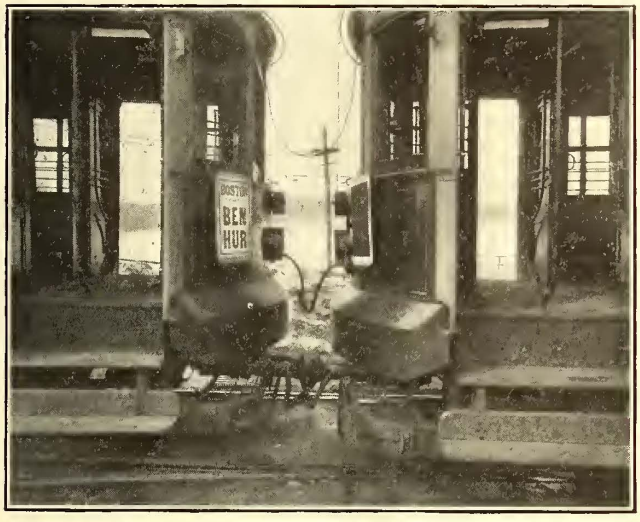
and type-M control. The company has a variety of cars in use on its branch service. The double-trucked cars are mainly equipped with four GE-67 motors and the single trucks with two GE 1000 or 800 motors. All the cars in use on the main line are double-trucked four-motor equipments, while the branch line cars are single and double-trucked outfits, operating at lower speeds and taking con-

trucks and equipped with type-M control and four G. E.-73 motors. The vestibules are equipped with pneumatically-operated sliding doors and folding steps. The air brake equipment is of the General Electric emergency straight-air type. Seven Brill fourteen-bench open cars of the Narragansett type with complete vestibule ends and no front seats have recently been ordered. These are to be 45 ft. long and

equipped with four G. E.-57 motors and multiple-unit control.

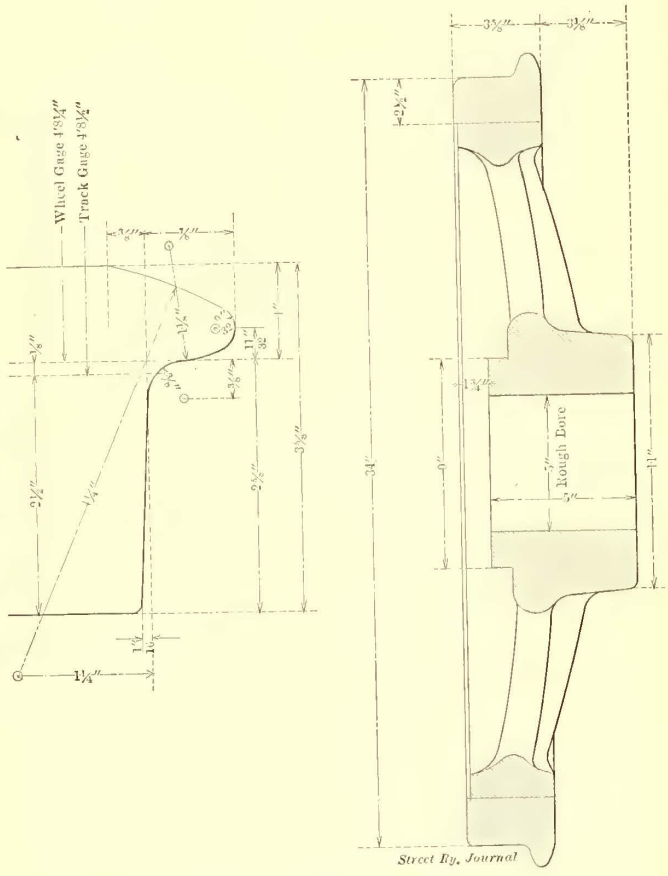
The new Brill semi-convertible cars referred to in the foregoing paragraph are built 41 ft. long over the car body from end panel to end panel. There are fifteen windows on each side of the car. The trolley board is 11 ft. 11 ins. high above the rail, and the roof is of the monitor deck pattern with sixteen ventilator sashes on each side. The outsides of the cars are fitted with solid bronze metal trimmings. The side sills are of yellow pine, 4 ins. x 8¾ ins., plated with ⅜-in. x 15-in. steel plates. The end sills are of white oak, 5¼ ins. x 6⅞ ins., and the center cross joists 4½ ins. x 5½ ins. The cross timbers in these cars are strengthened by iron plates to prevent sagging. The corner posts are 3¾ ins. thick and the side posts 3¼ ins. The cars are equipped with No. 11½ Van Dorn draw-bars, and with two De France air sanders. The wiring is all run in pipe conduit, and all except the light wiring was done by the Boston & Worcester Company.

The vestibule outside doors are four in number, 5 ft. 9 ins. high and 5 ft 4 ins. wide, with an iron bar in the middle. Each car has 22 seats 37½ ins. x 17 ins. and four longitudinal seats 59 ins. x 17 ins. The total width of the car at the sills is 8 ft. 6 ins., and the sides slope to a width of 8 ft. 2 ins. at the eaves to allow easier passage on sharp curves. The inside finish is of quartered oak with a five-layer poplar veneer ceiling painted green, and wire-glass ventilators. Pfingst fenders, push-button signals for the motorman, Streeter pattern brake-shoes with separate head and slipper, Consolidated heaters and International registers complete the principal equipment, with the exception of the lighting scheme. On each side of the car above the seats and just under the sides of the monitor are mounted thirteen 16-cp incandescent lamps of the frosted bulb type with reflectors. The lamps are attached with rigid polished brass fixtures to a horizontal brass conduit which runs through the car and the lighting effect is admirable. The accompanying photograph of the interior of one of the new cars shows the arrangement of the lamps. The total weight of each car equipped is 72,800 lbs.; the body weighs 27,850 lbs. and the trucks 20,600 lbs.



VIEW OF COUPLED CARS, SHOWING TYPE OF VESTIBULE

These cars are equipped with both inside and outside-hung brakes, the inside brakes being operated by air with separate rigging from the outside brakes, which are hand-operated. The wheel base of the trucks is 6 ft. and the wheels are 34 ins. in diameter with 2½-in. treads. Steel tires 2½ ins. thick and ⅞-in. flanges. A drawing of the standard wheel section of the Boston & Worcester is reproduced herewith. The hubs are 11 ins. in diameter outside, with 5-in. rough bore and 5 ins. long. The axles used on these cars are 5¼ ins. in diameter. The flanges of the wheels are of special section to accommodate the special track work on the Boston Elevated surface lines. The outer curve of the flange section has a radius of 4¼ ins., and it swings in toward the center so that the flange will not grind against the head of the girder rail in the streets. The depth of ⅞ ins. provides for high-speed operation on the interurban line. The new axles are not provided with keyways on account of the tendency of axles to break at these points, but the wheels are pressed on with about 40 tons of hydraulic pressure at the company's shops. The gears are solid and are pressed on, without keys. The journals are 4¼-in. x 8-in. M. C. B. button-head type, and the truck base from center to center is 29 ft. 4 ins. The side of the car is protected by an outside plate 5¼ ins. wide and ¼ in. thick laid flush with the bottom of the sill.



STANDARD STEEL WHEEL

In addition to the passenger equipment the company has eight nose and shear plows and two rotary plows. These are all double-truck plows operated by four G. E.-57 motors The two rotary plows are equipped with two G. E.-57 motors on the fans in addition to the truck motors. All the wiring of the snow plow equipments is run inside the cabs along the walls, the object being to prevent damage to the insulation by salt and water. There is also a service car equipped with four G. E.-67 motors.

FREIGHT AND EXPRESS SERVICE

The necessary permits to handle a freight and express business have been granted to the company by all the cities

and towns in which it operates, and the commencement of the service only awaits satisfactory agreements with the Boston Elevated and the Worcester Consolidated Companies. A careful canvass among the various shippers located on the line has assured the Boston & Worcester that the freight and express business when in operation will be highly acceptable to the public.

TRACK AND ROADWAY

Between Chestnut Hill and Framingham the company's trackage is nearly all laid in a boulevard or semi-private right of way in the streets. The line between Framingham and White's Corner runs for the most part in the highway but between White's Corner and the Worcester Consolidated line the tracks are laid in a private right of way. There are a large number of grades and curves in the line between Boston and Worcester, and west-bound cars rise about 480 ft. above the sea level in the 40-mile run. There are five stretches of level track, about 1000 ft. long each, on the road; seventeen grades of 5 per cent, seventeen of 6 per cent, eight of 4 per cent and three of 8½ per cent. Between White's Corner and Framingham there are two curves of 90 ft. minimum radius, but when the double tracking is completed the curves will in general be not less than 800 ft. radius. At present the least radius curve, generally speaking, is 500 ft. Very little slacking of speed is necessary on the majority of the curves, but the line is carefully marked at all special points where slow running or extra care are necessary on the part of the motorman. This is done by painting three white stripes, for example, on the third pole from the crossing or sharp curve which must be carefully approached; two stripes on the second pole, and one on the pole next to the caution point. The rails are A. S. C. E. 75-lb. T section on the main line, with Weber joints. Two 8-in. No. 0000 Fig. 8 crown bonds are installed under each joint. The branch lines are using a good deal of 60-lb. rail as yet. The company lights the streets through which it passes in Newton, Wellesley, Natick, Framingham, Southboro, Westboro and to some extent in Northboro and Shrewsbury. The height from the rail to the trolley wire under the lowest bridge is 12 ft. 8 ins. This bridge is in Worcester; the lowest bridge on the Boston & Worcester line gives 17 ft. clearance. The street lighting is done by using six 24-cp, 100-volt lamps in series, but in the car lighting circuits five 16-cp, 120-volt lamps are used. Power is kept on the lines all night.

OPERATING DETAILS

Thus far the company has not operated its cars in multiple-unit trains to any extent, nor has limited service been attempted. When the line is entirely double-tracked it is likely that something of this sort may be tried. The company runs large numbers of special excursions from Worcester and other inland points on its route to the various beaches near Boston each summer. For its prompt and efficient assistance the company's general superintendent, E. P. Shaw, Jr., received a warm letter of executive appreciation from the Governor's chief military representative, Adjutant General Frye.

The general officers at Framingham Junction occupy a special building of attractive design which also contains the dispatcher's room and a waiting room for passengers transferring at that point. An advantageous feature of the station design is the provision of wide, comfortable seats in the open beneath the broad, sloping roof, as well as inside the waiting room—a pleasing contrast to many steam railroad stations in the East. All car movements, whether on the single or the double-track sections, are under the control of the dispatcher at Framingham Junction, who is on duty whenever cars are in operation. Records of the car movements based on telephone reports from the crews are kept on a printed train sheet for each day in the same general way that steam railroad trains are registered.

WORCESTER TERMINUS OF THE BOSTON & WORCESTER STREET RAILWAY. THE CITY HALL IS ON THE RIGHT

Fixed telephones are located at all turnouts, cross-overs, junctions, important buildings and other places along the line, most of the instruments being protected by sheet-iron booths. The others are located in pole boxes. Every foot of track is covered by the telephone circuits, and private telephones are installed in the houses of many of the foremen and officials. The company has made special provision for the comfort of its passengers, not only at its Chestnut Hill, Framingham Junction and White's Corner stations, but also at many other points along the route. A typical waiting station of the way type is that at Newton Highlands. The station is a neat wooden structure lighted on all sides with ample windows and provided with excellent seats, electric heater, U. S. mail box, a telephone pay station, time-

tables of the Boston & Worcester cars, and lighted at night by 16-cp incandescents. The road is equipped with the Blake semi-automatic signal system, whereby the dispatcher can set any one of the numerous semaphore signals along the line to call any particular conductor to the telephone. These signals are not used to control car movements on the plan of the block system, but simply for calling car crews to the telephone.

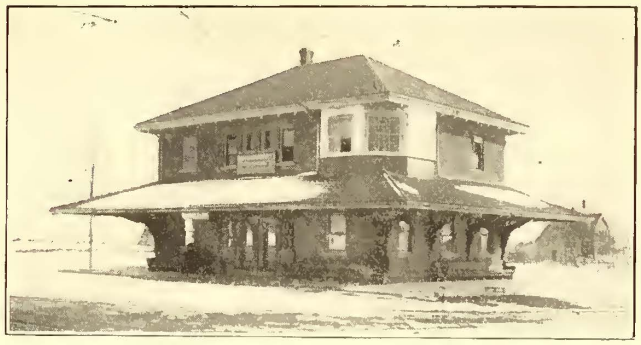
On pleasant Saturday afternoons, Sundays and holidays during the winter season cars leave Chestnut Hill every fifteen minutes for Worcester and South Framingham, and during heavy traffic extra cars are run from Chestnut Hill to all points. The first through car for Boston leaves Worcester on weekdays at 6:25 a. m., and thence at half-hourly intervals until 9:25 p. m. From Boston through cars to Worcester are started at 6:15 a. m. and continued every thirty minutes until 9:45 p. m. The branch line connections to Marlboro and Hudson are exceptionally good. The following table gives the distances between the various points on the main line, reckoned from Park Square, Boston.

MAIN LINE MILEAGE, BOSTON TO WORCESTER

PARK SQUARE TO	
Brookline Village	3.19
Chestnut Hill	5.50
Woodward Street	7.84
Wellesley Car House	9.73
Wellesley Hills Square	11.04
North Natick	15.63
Framingham Junction	18.11
Framingham Center	19.40
Hesselt	21.91
Fayville, Southboro	23.45
White's Corner	24.25
Washington Street, Westboro	26.83
Lyman Street, Westboro	29.10
Milk Street, Westboro	30.42
Westboro Car House	31.42
South Street, Shrewsbury	33.93
Shrewsbury Turnpike	35.42
Lake Quinsigamond	37.10
Worcester City Hall	40.15

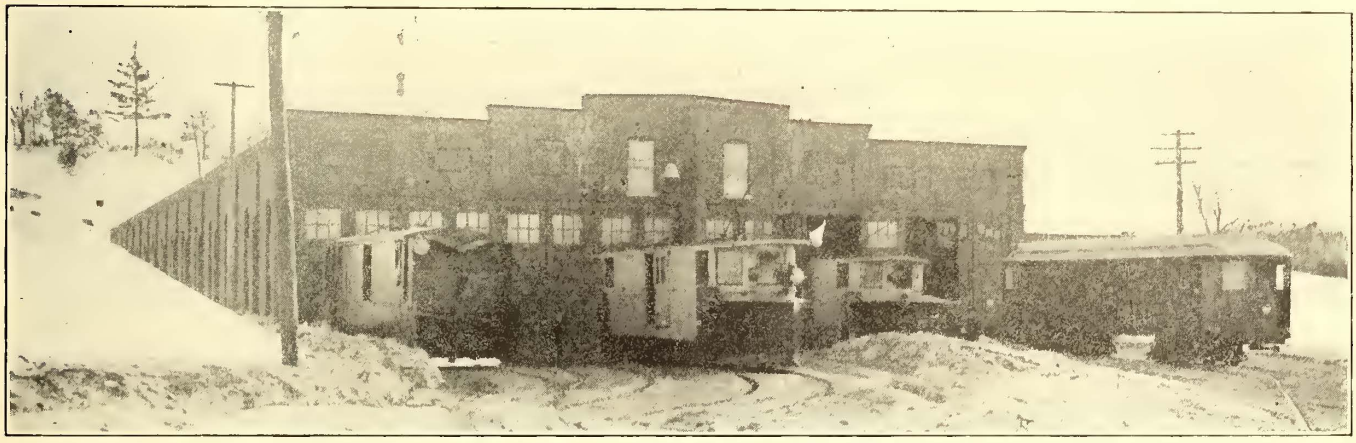
REPAIR AND MAINTENANCE

All important car repairs are made at the shops connected with the Wellesley Hills car house. This work, including inspection, comes under the authority of the master mechanic, W. H. Wadsworth. Daily inspection and small re-



OFFICE BUILDING, STATION AND OPERATING QUARTERS AT FRAMINGHAM JUNCTION

pairs are made at the car houses. The general repair shop is located at the south end of the Wellesley Hills car house and it is served by two tracks which extend into it from the car house proper for about 20 ft. Below the tracks is a space for the storage of pipe fittings, normally covered by a trap door. This storage space is lighted by 16-cp incandescents mounted in asbestos-lined boxes, and the lamp wiring is run in iron conduit. The shop is rather crowded, on account of the rapid increase of business which the road has lately enjoyed. The machinery is all group-driven by a 10-hp, 360-volt General Electric induction motor, and it includes one Chandler & Farquhar 40-in. engine lathe, one Franklin portable crane for armature handling, one 150-ton Schaffer hydraulic wheel press, an 11-in. lathe, a Hendry 6-in. speed lathe, a Hill, Clarke & Company double emery grinder, one Wells screw-cutting machine, one Barnes ver-



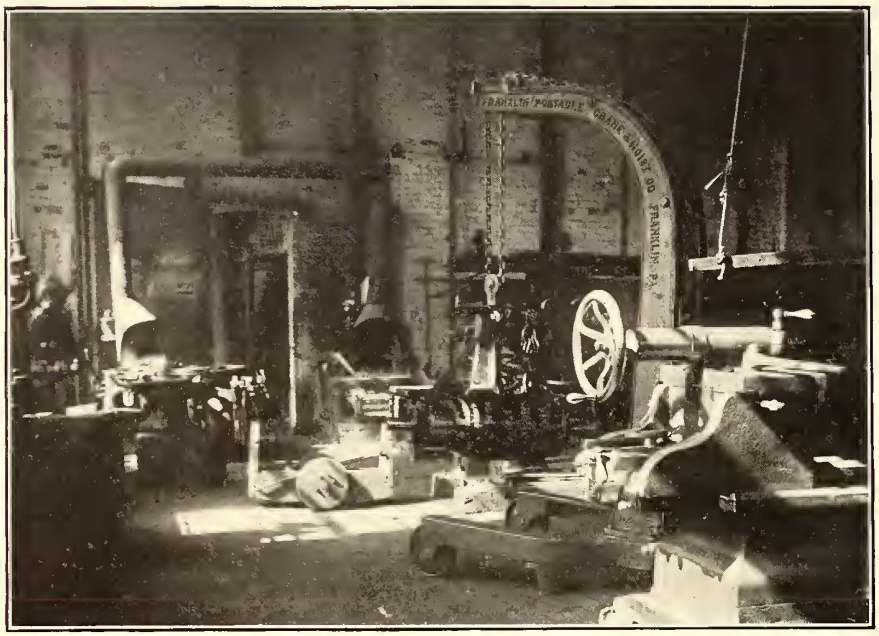
SNOW-PLOWS AND EXPRESS CAR IN FRONT OF THE WELLESLEY CAR HOUSE AND SHOPS

Unlimited round-trip tickets costing 70 cents are sold between Chestnut Hill and the Worcester-Shrewsbury line at Park Square, Boston, Village Square, Brookline, Chestnut Hill, Washington Square, Worcester, and Harrington Corner, Worcester. Single fares are 40 cents each; in either case 10 cents is added in each direction for passengers traveling via the Boston Elevated and Worcester Consolidated systems. The fare from Boston to the Wellesley and Natick line is 10 cents; to the Framingham Centre station or to South Framingham, 20 cents; to White's Corner, 25 cents; and to Marlboro, 30 cents.

tical drill, one Athol grindstone, one American twist drill grinder, one Auburn grinder, one band saw, one 2-ton Harrington hoist, one wheel-grinding machine, one Greenard arbor press and a home-made circular saw.

The work done at the shops includes the operation of a small brass foundry located in the basement of the armature winding room. The furnace is operated by kerosene oil and compressed air, and pouring off occurs about three times a week, the number of castings made averaging from 30 to 40. The company makes its own trolley wheels, window catches, window tighteners, axle brasses for motor

bearings, journal brasses, brass frames for conductors' bells, hinges for oil cups, handles for reversers, split brass oil rings for rotary converters, and any other special brass parts which it may need in a hurry or find cheaper to make than to purchase. The kerosene oil for the furnace is supplied by a 4-hp Christensen pneumatically-driven pump at 25 lbs. pressure per square inch, the storage tank being



VIEW OF THE MACHINE SHOP OF THE BOSTON & WORCESTER STREET RAILWAY COMPANY

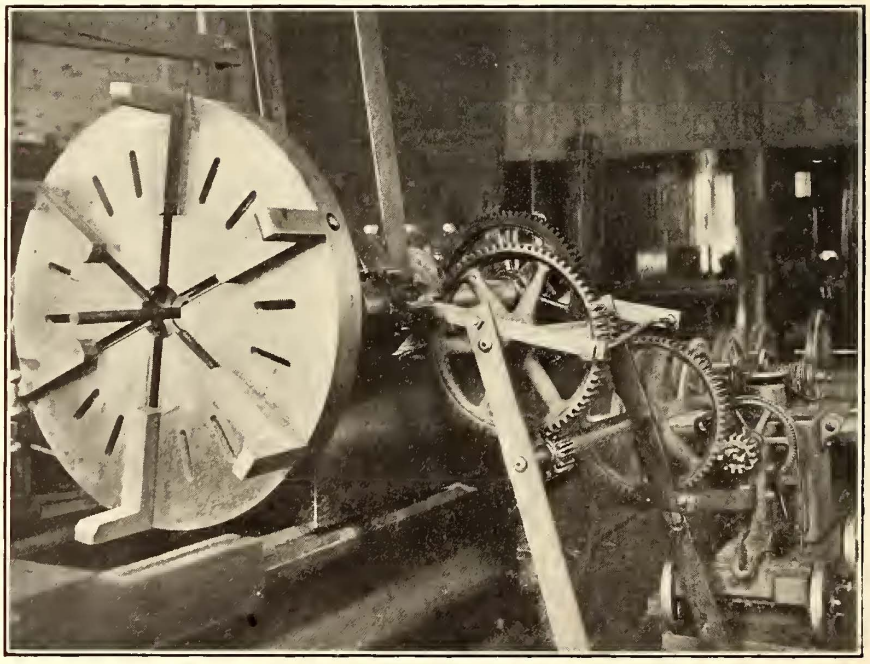
located outside the building. The air blast in the brass furnace is supplied by a fan driven by a 2.5-hp, 600-volt motor. The company makes its own patterns and trolley wheel cores. In mixing the cores the following ingredients are used: Two shovelfuls of special core sand, two double handfuls of flour, about one pint of molasses, and a pint of oil. Care has to be taken in getting just the proper mixture for the work, or a slight explosion and collapse of the cores takes place.

The trolley wheels made by the company are 6 ins. in diameter, 1¼ ins. wide and ⅞-in. core, using a ½-in. bushing. This hub is 3 ins. long. The wheels are composed of about 80 per cent copper and 20 per cent bronze, and their average life is about 800 miles each. The company estimates a saving of about 75 cents per wheel by making its own product. After the wheels are worn down they are remelted and cast over again, and a large quantity of scrap wire from the car equipments is used in the same way. A steam heater is installed in one corner of the brass foundry, and the covering of cast-off wire is first burned off in the furnace of this apparatus. Special jigs are used to facilitate boring out the brass axle linings and the trolley wheels, and the permanent patterns are of aluminum. The brass axle linings are bored out with an adjustable cutter having four knives, and the process is practically automatic. The rotary rings are split so that they can be put on the shafts without dismantling the machine, and the halves are fastened together by screws. The brass foundry is operated by one man, who has the assistance of one of the regular shop employees when pouring off.

The machine shop contains an electric oven for drying armature and field coils, an electric sand drier arranged to feed dry sand automatically to the storage pile from the damp sand compartment, a chemical extinguisher outfit for fire protection, a blacksmith shop equipped with a forced draft coal forge, and a coal-burning furnace for melting babbitt metal, also equipped with forced draft. A belt-driven fan supplies these furnaces in common. On the side of the shop nearest the sub-station door is a bench for the repair of circuit breakers, headlights, control mechanism, fuses, etc. The employee in charge of the sub-station ordinarily works at this bench, and close by is a large gong, which rings if a circuit breaker goes on the switchboard. The man who operates the brass foundry devotes part of his time to the babbitting furnace. The company presses on and off all its wheels and gears. Steel tires are used on the branch line cars, as well as those of the main line.

TURNING STEEL WHEELS

An important piece of auxiliary equipment in the shop is a 1-hp, 600-volt d. c. portable variable-speed motor used to operate the 40-in. lathe slowly enough to enable steel tires to be turned down. This motor is mounted on an adjustabe carriage, and is connected with the back gearing of the lathe. Before this was



METHOD OF DRIVING LATHES FOR TURNING TIRES, SHOWING GEARING

installed it was extremely unsatisfactory work trying to turn tires. An arrangement also exists whereby tires can be ground down for the removel of flat spots, the drive being mechanical from the overhead shafting. Painting is done at the Westboro car house.

EDUCATING THE MOTORMAN

One of the duties of the master mechanic is the instruction and examination of motormen qualifying for positions in the car service. When a motorman has had time to study the company's rule book and the car equipment, he is subjected to a severe cross-examination upon his duties, and he is obliged to remedy defects in an actual car in the car house which has been crippled in various ways to test his knowledge. A blank is filled out for each motorman who qualifies, and this is sent to the office.

The company's "Book of Rules" is based largely upon the operating recommendations of the American Street and Interurban Railway Association, modified to suit the special needs of the road. Motormen are held responsible for the safe running of their cars, proper operation of machinery and running according to schedule. No persons except officials, foremen of car houses, trackmen and linemen, and these only when on duty, are allowed to ride in the front vestibule. Employees of foreign roads are not allowed to ride free. On the company's private right of way between White's Corner and Shrewsbury a white stripe on a pole between two red stripes indicates the beginning and a red stripe between two white ones the end of 25-m.-p.-h. limit of speed between such points as indicated by these marks.

A special and somewhat unusual feature of the "Rule Book" is the inclusion of instructions bearing upon the use of the multiple-unit control equipment. These have been worked out very carefully, and contain so many practical points that they have been included in this article.

RULE 300.—LOCATION OF FUSES

On the roof of every car and snow plow is a main fuse block; the fuse is a large copper strip.

The main control switch and fuse is in the vestibule beside the circuit breaker, on one end of car only. Some control fuses are in the control switch. On open cars they are beside the circuit breaker. The reverser and contact fuses are, on box cars under outside sill, in the center of contactors; on open cars under the inside end seat. The air fuses on small box cars are alongside of "air automatic" under the long seat. On large box cars they are in a wooden box with the air automatic. On open cars they are under inside end seat with the air automatic.

RULE 301.—LOCATION OF CONTACTORS

The contactors are in groups of two fives and one three. On large box and open cars they number from left to right, 1 to 13, all on one side of car. On small box cars and open cars, on one side there are two groups, numbering from 1 to 10; on the other side one group, numbering 11 to 13, and the reverser. On large box and open cars, the reverser is on the same side with the contactors.

Contactors that operate on different points on controller:

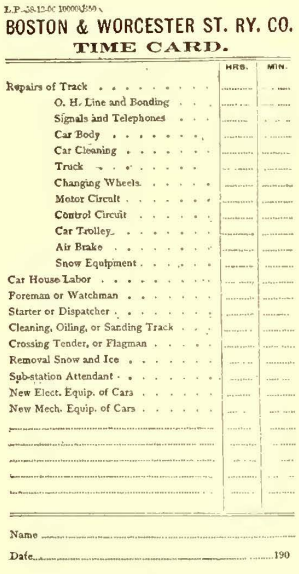
	Contactors
No. 1—Point	1-2-3-11
" 2— "	1-2-3- 5-11
" 3— "	1-2-3- 5- 6-11
" 4— "	1-2-3- 5- 6- 7-11
" 5— "	1-2-3- 5- 6- 7- 8- 9-10-11
" 6— "	1-2-4-12-13
" 7— "	1-2-4- 5- 6-12-13
" 8— "	1-2-4- 5- 6- 7-12-13
" 9— "	1-2-4- 5- 6- 7- 8-12-13
" 10— "	1-2-4- 5- 6- 7- 8- 9-10-12-13

If 1-2-3-11 contactors do not come up on first point, change contactor fuses. If then they fail to come up, look under contactor 12 to see if the small contact fingers are not broken. If not broken, look under 12 contactor and see if it is not stuck up. With the above trouble, contactors 5-6-7-8-9-10 will come up on the second, third, fourth and fifth points on controller, but will not start the car. If the motors on the sixth point fail to get power, and contactors 1-2-4-12-13 do not come up, renew the contactor fuses; if they then fail to come up, look under 11 contactor. With the above troubles, contactors 5-6-7-8-9-10 will come up on 7-8-9-10 points on controller, but will not give motor power.

If the car at any time does not increase speed, point for point on controller, faster than the first point until you use the sixth point, when the car will give quite a jump and not increase for the last four points, change the reverser fuses. If changing fuses does not fix the trouble, put the car on slow speed. Do not at any time run the car after you have found that it does not increase speed, until you change fuses, as by so doing you will get the resistance boxes red hot, and cripple the car.

If the car starts with a jump on the first points or blows circuit breaker, look under contactors 5-6-7-8-9-10-12-13 to see if any are stuck together. If you do not find any contractors stuck together, and the circuit breaker blows, cut out motors. If, on the sixth point the car slows down and takes power, look at contactor 11 to see if it is stuck up.

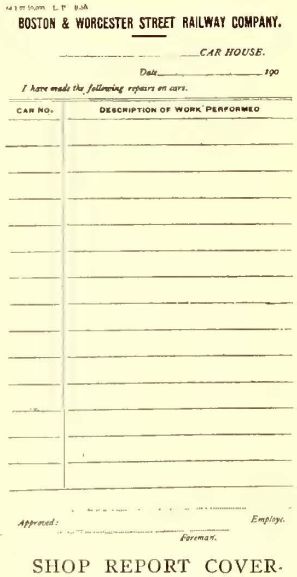
If contactors do not operate after changing main control fuse, try another controller; if then they operate, shut off main controller switch, open cover on controller to see if the two movable fingers are making good contacts, and if not, bend them so as to make contact, but be careful not to bend them too much. It is not necessary to pull down the trolley to put in any fuses except main fuses on the roof. In changing main control fuses, shut off main control switch; to change contactor and reverser fuses, to cut out motor or throw reverser by hand it is not necessary to shut off any switch, but take reverse handle with you, to prevent operation of controller. Before opening covers on contactors to see if contact fingers are broken or stuck, pull out circuit breaker and take reverse handle with you.


BOSTON & WORCESTER ST. RY. CO.
TIME CARD.

	HRS.	MIN.
Repairs of Track		
O. H. Line and Bonding		
Signals and Telephones		
Car Body		
Car Cleaning		
Truck		
Changing Wheels		
Motor Circuit		
Control Circuit		
Car Trolley		
Air Brake		
Snow Equipment		
Car House Labor		
Foreman or Watchman		
Starter or Dispatcher		
Cleaning, Oiling, or Sanding Track		
Crossing Tender, or Flagman		
Removal Snow and Ice		
Sub-station Attendant		
New Elect. Equip. of Cars		
New Mech. Equip. of Cars		

Name .....
Date..... 190

TIME CARD


BOSTON & WORCESTER STREET RAILWAY COMPANY.

CAR HOUSE.

Date..... 190

I have made the following repairs on cars.

CAR NO.	DESCRIPTION OF WORK PERFORMED

Approved: ..... Employe.
Foreman.

SHOP REPORT COVERING REPAIRS

RULE 302.—TO CUT OUT MOTORS

The motor leads on the side of reverser go to the two motors facing that side. When you cut out motors, you cut out two. Cut out the side nearest the motors you wish to cut out. If you have trouble with the motors and you do not know which motor it is, cut one pair, try them, and if the trouble remains, cut them in and cut out the other pair. In cutting out motors, the third and sixth large fingers on the side you cut out should lift up from the arm. If they do not, pull them up or the motors will not cut out. If for any reason the large fingers on one side of reverser get burned or bent, and prevent the reverser from operating, or the arm is burned so that it will form a ground or a short circuit, pull the fingers clear of the arm.

RULE 303.—INSTRUCTIONS ON OPERATING

Do not let go of the controller handle with the power on; shut off the power before you let the plunger up. Do not keep the power on going down grade where the car will run faster than the power will drive it, as it will cause a short-circuit. When cars are turned in for blowing circuit breaker, the trouble is often caused by the above. Do not pull circuit breaker in with the controller handle on the "On Position." Holding circuit breaker in is a bad practice. There are 10 points on controllers, make a short pause between each point. Feeding cars

above five points on a heavy grade from a stop is bad practice, as it uses an excessive amount of power and overloads the motors, and is liable to blow circuit breaker. When the car is moving, it is all right to put controller handle on quickly to half or full power according to speed of car. If the circuit breaker keeps coming out the trouble is in the motor or motor circuit. If the motors do not operate, cutting out motors will not make them. Motor circuit and contactor circuit are independent, but if the control circuit does not operate, the motors will not get power. When running cars on slow speed and you cut out two motors, put switch on fast speed. Cars will not start with two motors cut out on slow speed. Snow plows will run on slow speed with two motors cut out. Never take brushes out of one motor thinking you will have three working, as third will not get power.

If you reverse the car while it is in motion let it stay on the reverse till the car comes to a stop. By throwing the reverse to a forward position going above 2 miles per hour, you are liable to cause a short-circuit on the reverse and cripple the car. Do not pull circuit breaker in till you throw reverser, when reverse has been made with circuit breaker out. When running on slow speed or with two motors cut out, never pull circuit breaker to reverse, as motors being all in series will not generate. If a car is crippled and you couple a car in the rear, couple cars according to instructions in Rule Book. To cut out a disabled car in train, use train cut-out switch on disabled car, which is, on box cars, behind one of the long seats (on open cars, under the inside seat).

Put disabled car in slow speed as otherwise, under conditions, motors will generate and act as brakes. If trouble is not in the main control fuses or controller on the disabled car, you can run train from the disabled car with trolley on and the main control switch and fuse in circuit.

If the motor resistance boxes become open-circuited by the grids or a section breaking, it will affect the operation of a car as follows: Will not start on the first or second, or not till the third point on the controller; or run all right on the first three and jump on the fifth; or on the sixth will not get power; or jump on the seventh or on the ninth point, or will not start or get power on any point. Control circuit coils being open-circuited, will cause car to jump on different points, or blow main control fuse.

If at any point the contactors will not pick up on the first point, after changing fuses and the small fingers under No. 12 contactor are O. K., look at the small fingers on the reverser. There are three on each side, two on each side making connection. Press on them with your finger; if they move inwards, set reverser half way and drive the finger inwards. Be careful not to bend them too much. If the car will not run on slow speed, there is an open circuit in the four motors. Put car on fast speed and cut out the two motors that do not work. The trouble can be in the reverser, commutating switch, motors or motor leads. Pull circuit breaker out and try contactors. If the contactors do not operate on one controller, do not forget to try the other. Pay particular attention to the first point; do not throw reverser every time you try the contactors. Putting the fuses in look to see if they are making good connections; if not press the spring together on the fuse block.

RULE 304.—HOW TO COUPLE CARS IN TRAINS

After coupling the draw-bars together, couple the air pipes, right-hand ones as the motorman stands, together and the left-hand ones together. The pipes should be crossed when coupled. Open stop cocks on both cars by turning handles crossways of car. There are two on each car. Put control jumper in the plug sockets, drive the plug into the socket until the cover of socket will drop back over plug. The air and buzzer circuits, jumper sockets, are on box car, on upper sill on the outside of vestibule windows; on open cars on the front beneath the bonnet. The plug has two fingers of two different sizes which will only fit the corresponding size hole in the plug socket. Turn on switches on inside of cars to put buzzers in circuit. Reverse handles must be off, controllers and engineer's valve handles off of any valves except the ones operating train. An engineer's valve handle on the off position would make the air brakes useless. Trolleys must be on, and circuit breakers in on all cars, for all to work in train.

When the air pump on one car does not work, couple in trains same as instructions. One air pump will do the work of two. If there is a leak in the pressure pipe, leave the right-hand uncoupled. If the brake cylinder pipe or left-hand pipe leaks, do not couple up pipes, as it will not help on a disabled car. After coupling up, try the air to see if it sets brakes on both ears. If it does not, see if the pipes are crossed, stop cocks open, or engineer's valve handle left on some valve, on the off position. If both cars move as one, the motors are all working. If there is a jerk, the control jumper may not be in far enough.

QUESTIONS.

RULE 305.—TROUBLE WITH AIR PUMPS

If the air pumps do not work with both switches on the On Position, what would you do? (Answer). I would lift up the long arm on the automatic governor with a piece of wood, start or stop pump with switch, according to pressure. If pump should fail to work, by lifting the arm, I would change the air fuse. If then the pump fails to work, I would run the car with the hand brake.

RULE 306.—TROUBLE WITH REVERSER

If the reverser fails to work, what would you do? (Answer). I would change the two fuses on the fuse block and have the two ends connected together. If that did not make it work, I would look at small fingers on reverser to see if same are making good connections; if not, I would bend the fingers inward. If then the reverser would not throw, I would throw it by hand.

RULE 307.—TROUBLE WITH CONTACTORS

If the contactors fail to work on the first five points, what would you do? (Answer). If the reverser worked all right, I would change the two fuses known as the contactor fuses. If they then failed to work I would look under contactor No. 12 to see if the small contact fingers under the same were not broken, stuck up or making bad connections. If one was broken I would connect the two with a piece of fuse wire. Explanation: On the 2-3-4-5 points contactors 5-6-7-8-9-10 would come up in the above case. If the car did not increase speed after the first point, and on the sixth point gave quite a jump, what would you do? (Answer). I would change the two reverser fuses. If that did not fix the trouble, I would put switch on slow speed.

If your car started with a jump on the first point, or blew the circuit breaker, what would you do? (Answer). First I would look at contactors 5-6-7-8-9-10-12-13 to see if any were stuck together. If so, I would pry them apart with a screw-driver. If none were struck I would cut out first one pair of motors, then the other, until I stopped the breaker from coming out.

If the main fuse is all right, how can you tell without going onto the roof? (Answer). By the lights burning. How ean you tell that the main control fuse is out of circuit. (Answer). By the lights burning and the reverser and contactors not working.

BLANK FORMS

Register records, statements affirming the understanding of bulletin boards, trouble reports, telephone calls and meals taken at the company's expense, power house records of labor, fuel, oil and repairs, arrival of coal, inspection,

40-L. P.-500—B-25-12-04

BOSTON & WORCESTER STREET RAILWAY CO.

LUNCH SLIP.

To Mr. .....

Please furnish Mr. ..... *with lunch and charge the same to the Boston & Worcester St. Ry. Co.*

Issued by .....

Amount charged $ ..... *c.* *Correct.*

..... *Employee.*

..... *Victualler.*

Hour Minute

At ..... *M.* ..... *day* *190*

Keep this slip and send in with your bill each month to Auditor, South Framingham, Mass.

EMPLOYEE'S LUNCH SLIP, USED IN EMERGENCY WORK, AS FOR SNOW-SWEEPER CREWS

mileage blanks, tickets, employees' applications, articles loaned, and ticket classifications are among the blank forms used by the Boston & Worcester Street Railway Company. The accident reports, preliminary and final, provide for the clear statement of essentials, and the final report is distin-

guished by a seat drawing of open and closed cars in addition to the usual diagram of street intersections. Numbers and blank spaces provided for witnesses enable the conductor to place easily the positions of all interested parties in or out of the car at the time of the trouble.

Another interesting form used by the Boston & Worcester Street Railway Company is that relating to fire protection. There are many companies which do not follow up this feature as much is it should be, even where periodical inspections are ordered it may be that no means are provided for having written proof that the work has been done and the necessary changes pointed out. The form reproduced which provides for weekly inspection is very comprehensive, including not only the building, fire pails, chemical extinguishers, hydrants, hose, spanners, valves, automatic sprinklers, etc., but in addition questions relative to the location of the fire alarm key, condition of the watchman's clock and the general cleanliness of the different parts of the building, and where the fire protection apparatus is

3. CHEMICAL EXTINGUISHERS. These should be used and recharged at least once a year.

Basement	In place	Date tested or charged
First floor	In place	Date tested or charged
Second floor	In place	Date tested or charged
Third floor	In place	Date tested or charged

4. HYDRANTS.

Note.—Each hydrant should be given a thorough test by flushing at least once a year, spring and fall. One turn to open should be sufficient for other inspections.

Hydrants open easily? Free from snow and ice and easily accessible?

5. HOSE, PLAY PIPES AND SPANNERS IN HYDRANT HOUSES. Each house to be numbered and reported on separately.

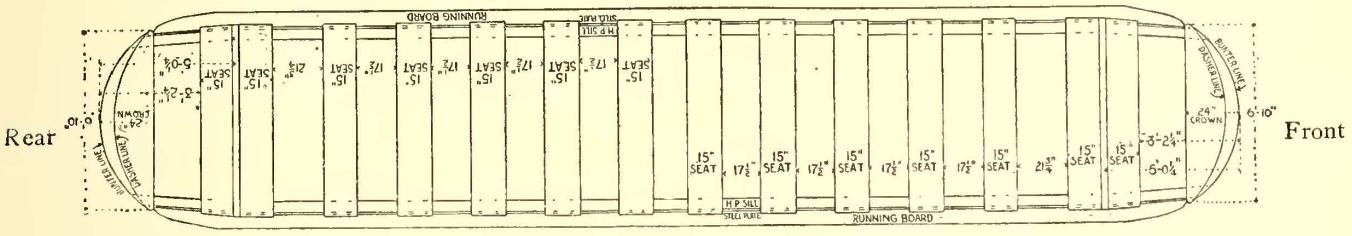
No. 1.	In proper place and ready for use?	Condition?
No. 2.	In proper place and ready for use?	Condition?
No. 3.	In proper place and ready for use?	Condition?
No. 4.	In proper place and ready for use?	Condition?
No. 5.	In proper place and ready for use?	Condition?

6. HOSE, PLAY PIPES AND SPANNERS IN BUILDINGS:

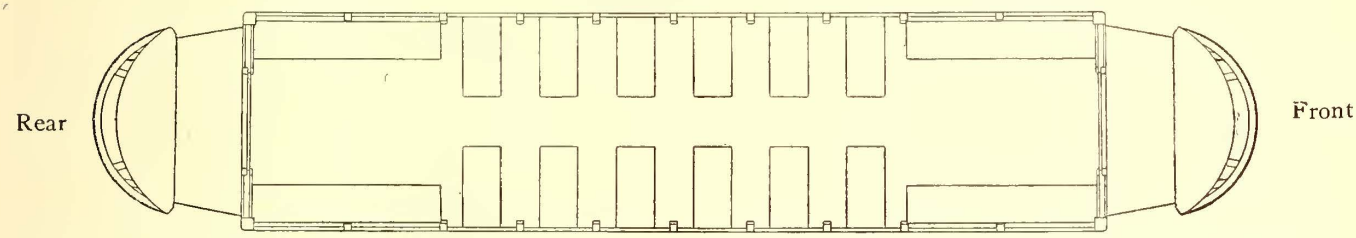
Basement.	In proper place and ready for use?	Condition?
First floor.	In proper place and ready for use?	Condition?
Second floor.	In proper place and ready for use?	Condition?
Third floor.	In proper place and ready for use?	Condition?
Fourth floor.	In proper place and ready for use?	Condition?

Indicate on appropriate plan by a mark (x) exact location of injured persons on car at time of accident; also by means of numbers where witnesses sat on car; also positions of moterman (m) and conductor (c).

OPEN CAR.



CLOSED CAR.



PLANS OF CARS PRINTED IN ACCIDENT REPORT TO SHOW LOCATION OF INJURED AND WITNESSING PASSENGERS, CONDUCTOR AND MOTORMAN.

installed. This applies particularly to the sprinklers, as they are easily covered with dirt or grease or obstructed by clothing, partitions and other things which hinder their proper working.

In some quarters the use of a large number of special blanks is looked upon as needless red tape, but the elasticity of a well-designed system discredits any such view. Without blanks which are complete in their make-up some of the information needed in regard to operating crises is sure to be missing. Busy operating men do not like to write long-winded reports, and the well-designed blank serves an incalculable amount of mental energy for the actual responsible work of each position.

FIRE PROTECTION
Inspection Report
All Property to be Inspected Weekly and Report Sent to General Superintendent

1. BUILDING .....
2. FIRE PAILS. State number in blank spaces.

Basement	In place.	Full?	In condition to use?
First floor	In place.	Full?	In condition to use?
Second floor	In place.	Full?	In condition to use?
Third floor	In place.	Full?	In condition to use?

Sand Pails for fire use.

7. CLEANLINESS.

Oily waste well cared for? Basements clean? Yards kept clean from combustible material? Clothes closets clean? Water closets clean? Clean under benches? Loft clean and free from combustible material?

8. FIRE ALARM KEY.

For box No. In proper place?

9. WATCHMAN'S CLOCK.

In good order? Stations for same in good order?

10. VALVES (Inside gates).

Note.—All gate valves to be secured open with leather straps fastened with padlocks having common keys held by responsible parties. Each valve to be inspected by turning valve one-half turn to insure its being wide open and in good working order. Drip valves to be strapped closed in similar manner.

List of Valves

No.	Location	Open	Strapped

11. VALVES (Outside post indicator gates).

Note.—All post indicator gate valves to be fitted with hand wheel or socket wrench permanently secured to spindle. To be secured and inspected in the same way as inside valves.

List of Valves

No.	Location	Open	Strapped

12. Give numbers of any valves found closed, part closed, not strapped, closed temporarily at any time since last inspection. Explanation

13. DRY SYSTEMS (Air Valves).

Note.—Dry valve should be tested for water column or condition of spring at least every three months.

List of Air Valves

No. Location Air Pressage

14. Give number of any air system into which water has entered during week. Explanation.

15. ALARM CONNECTIONS.

Note.—All controlling valves or cocks for alarm devices to be strapped in the same way as inside valves. Special instructions to be given regarding testing of alarm valves.

(Alarm controlling Valve.)

No. Location Open Strapped Tested In order

No. 1 Dry Valve Electric.

No. 2 Alarm Valve Electric.

16. AUTOMATIC SPRINKLERS.

Any corroded, bent, whitewashed, gilded or painted, covered with dirt or grease, obstructed by clothing, partitions, shaft hangers?

17. Is there a clear space of at least 2 ft. below level of sprinklers free from storage or other obstruction? Note any exceptions.

Inspection made personally by me, this.....day of.....190....

GENERAL

The headquarters of the road department are at a car house owned by the company in South Framingham. Inspection of the track proceeds largely on the basis of trips by employees over the line on the cars, particular attention being given on foot to the vicinity of places where repairs or adjustments are made.

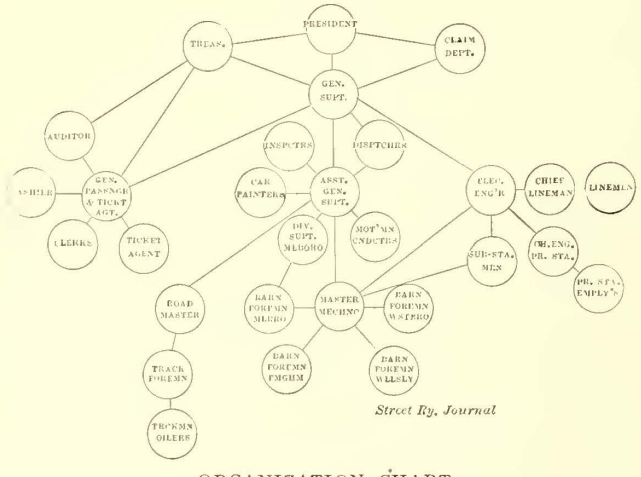
The operating organization of the company is shown in a diagram herewith, the responsibility of the various officials being clearly indicated.

The earnings of the Boston & Worcester road for the year ending Sept. 30, 1906, showed a gain of 13 per cent in gross over the previous year. The gross earnings, operating expenses and net earnings, together with the miles of main track operated since the road began business, are shown in the following table:

Year Ending Sept. 30.	1903.	1904.	1905.	1906.
Gross earnings	$103,726.24*	$370,883.51	$448,365.70	$514,464.70
Operating expenses	41,656.55	195,003.37	229,655.68	269,391.29
Net earnings	62,069.69	170,880.14	218,710.02	245,073.41
Miles, main track	51.338	73.62	73.62	77.153
Dividends	.....	$46,944.00	$103,494.00	$103,500.00

* Operation began May, 1903.

The receipts from passengers last year were $501,719.22; from the carriage of mails, $250; express and merchandise,



ORGANIZATION CHART

$200; tolls for the use of tracks by other companies, $628.97; rentals, $2,982.46; advertising in cars, $1,481.10. The operating expenses for 1906 were:

Repairs of roadbed and track	$10,793.23
Repairs of overhead lines	4,507.08
Repairs of buildings	528.96
Transportation labor	73,517.78
Power plant repairs	4,422.99
Power station labor	15,963.05
Salaries	23,948.04
Fuel for power station	50,803.87
Fuel for car houses and office building	591.58
Power station expense	3,165.93
General expense	5,267.56
Printing, tickets and stationery	2,811.52
Removal of snow and ice	590.55
Repairs of cars	26,941.45
Repairs of electrical equipment of cars	22,740.92
Track rental	504.24
Power rental	630.59
Other transportation expenses	7,315.00
Damages	3,826.76
Insurance	8,400.00
Advertising	2,120.19

The total cost of the road to Sept. 30, 1906, was:

Track, roadway, line construction, etc	$2,568,826.17
Land and buildings	206,788.02
Power station plant, including sub-stations	632,083.44
Rolling stock and miscellaneous equipment	612,092.15
Total	$4,019,789.78

Last year the cars of the company carried 10,279,303 fare passengers, as compared with about 9,000,000 in the preceding year. The average earnings per car-hour were $6.56 on the main line (in summer this frequently rises to $10), and $2.32 on the slow-speed branch lines. The main line cars increased their earnings 54 cents per car-hour, and the branch lines increased their earnings 13 cents per car-hour over last year. The earnings per car-mile on the main line were over 31.5 cents, and on the branch lines 23 cents. Of the total receipts from carrying passengers in 1906, about 60 per cent were derived from the traffic between Boston and Worcester, 19.5 per cent from the Boston-South Framingham route, and 20.5 per cent from the local routes.

The officers of the company are: President, James F. Shaw; vice-president, H. Fisher Eldredge; treasurer, George A. Butman; general superintendent, E. P. Shaw, Jr.; assistant general superintendent, M. E. Nash; auditor, general passenger and ticket agent, A. E. Stone; electrical engineer, Milan V. Ayres. The master mechanic is W. H. Wadsworth; roadmaster, Joseph Johnson; chief dispatcher, G. H. McFee; assistant dispatcher, M. L. Goodwin; division superintendent, H. W. McKay, and chief engineer of power plant, A. F. Lovering. Acknowledgements are due to these officials for numerous courtesies extended to this paper in preparing this article.

FREIGHT BUSINESS ON INDIANAPOLIS LINES

The electric railway lines entering Indianapolis are now averaging 200 tons of freight per day, according to figures given out by D. G. Edwards, general traffic manager of the merger lines. To this amount, Mr. Edwards said, might be added at least 25 tons handled by the independent lines. Mr. Edwards is greatly pleased with the development of freight traffic over the lines under his control, and says the express companies feel keenly the competition of the electric railways for light freight.

The Auntamiento, by a vote of 11 to 5, has decided to recommend a rival plan for a system of street cars in Havana, Cuba, as opposed to the proposition of the Havana Electric Company, which is applying for the right to extend its present system.

THE CONSTRUCTION OF EMPLOYEES' HOMES BY GERMAN ELECTRIC RAILWAYS

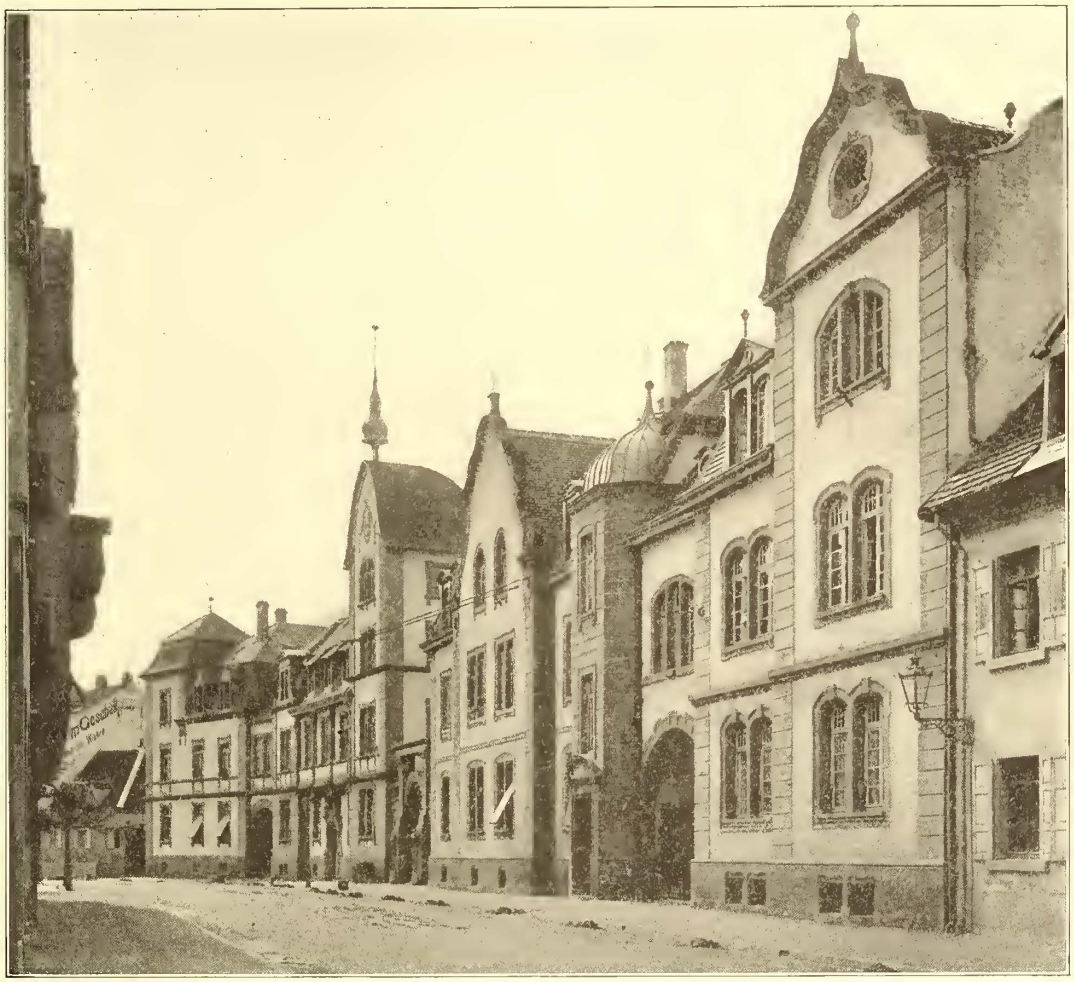
BY A GERMAN RAILWAY OFFICIAL

The activities of a large electric railway system in the regular work of transportation are so manifold and complex that any proposal to add to them should be subjected to searching analysis as to its value; but much as a corporation may desire to confine itself to its primary object, it cannot afford to neglect doing its share toward settling those social problems which directly affect the welfare of the company. Of these, the labor problem is one of the most acute, for while other employers can increase the selling prices of their goods to counterbalance the higher costs of wages and material, the railway company is restricted to a fixed maximum for its particular commodity, irrespective of higher production expenses. Hence the question arises: To what extent can a large city railway company, for example, escape labor troubles without impairing the value of its services and property to the public and its stockholders?

It is true that considerable attention is being given by American street railways to employees' welfare work, but they have considered the problem chiefly from the moral and not the economic aspect. The best club house facilities will not keep the worker satisfied if his wages do not increase with the higher cost of living. While a railway company cannot exercise any appreciable control over the cost of food and clothing, it can, and should, control the housing problem wherever the cost of rent is a large factor in the cost of living.

In Germany, the advisability of building houses for employees was not a live question until the growth of manufacturing industries required a large number of people from the country districts. This condition brought to light the extraordinary tenacity of the country workman to stick to his homestead rather than accept better wages under poorer housing conditions. Hence resulted the extensive development of whole towns built by large manufacturing corporations in Germany and elsewhere. Judging from the experiences of the pioneers in this work, it may be safely asserted that the proper settlement of the housing question will do far more to avoid friction than any increases in wages or legal enactments. In fact, wherever fair compensation has gone hand-in-hand with the endeavor to provide comfortable dwellings at low cost, strikes have become very exceptional.

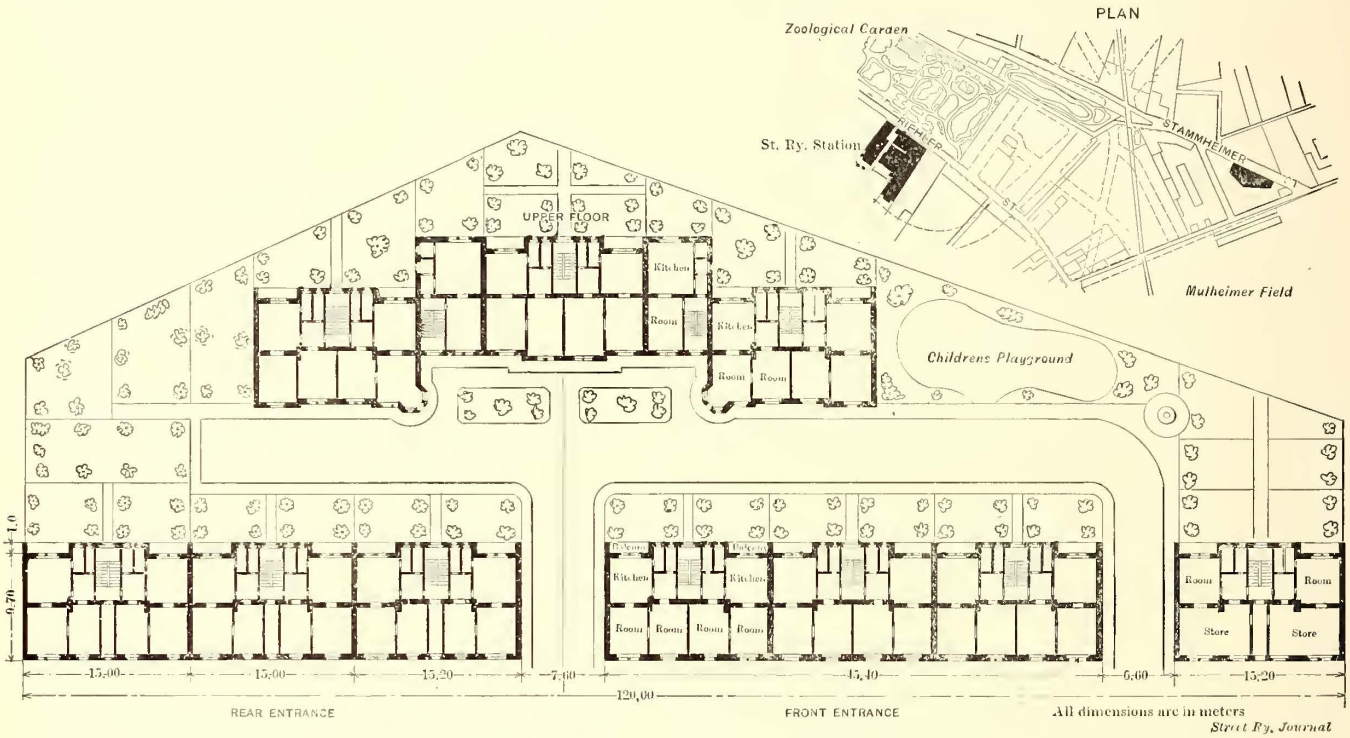
The street railway companies of Germany have not been behind the other large employers of labor in that country in looking after the interests of their employees, particularly in the direction of pensions and sick benefit funds. The methods of raising money for these purposes are such as to avoid any feeling on the part of the men that they are receiving charity. The German street railway companies also deserve the credit of being among the first to erect homes for their employees, and it may be of interest to describe how this work is carried out and what the relations of landlord and tenant are under these conditions.



A GROUP OF STREET RAILWAY EMPLOYEES' HOMES IN FREIBERG, GERMANY, ILLUSTRATING THE DIVERSITY IN ARCHITECTURAL TREATMENT WITH THE SAME MATERIALS

The management of the Prussian State Railways, which is one of the largest employers of labor in the world, was among the foremost to take up this subject. In fact, for several decades the administration has erected homes for its employees practically everywhere. It is noteworthy that this pioneer work was due in large measure to changes in the schedule which required the removal of large numbers of men to other points along the system than those at which they previously had been stationed. The absence of suitable accommodations on a number of occasions led the officials to see what they could do for the men to make them independent of local conditions. At first every department erected buildings according to its own ideas. This method had the advantage of giving a free hand to the

architect and permitting the trial of numerous varieties of single, double and multiple family dwellings, with and without gardens. The disadvantage, however, was the planning of the work by men who were not experienced in architecture, and naturally made many errors and wasted considerable money. When this condition was fully realized, provision was made for the organization of a department especially devoted to this work. This department has made a careful study of all that has been done along these lines, and has now published a great variety of designs in an elaborately illustrated book issued by the Prussian Minister of Public Works. The book contains also the following valuable suggestions which are applicable almost anywhere, and, if carried out, should save much labor and



PLANS SHOWING THE GENERAL LOCATION AND THE ARRANGEMENT OF HOMES BUILT FOR ITS EMPLOYEES BY THE COLOGNE MUNICIPAL TRAMWAYS

expense. Some of these suggestions are subjoined herewith:

FUNDAMENTAL CONSIDERATIONS FOR PLANNING AND ERECTING HOMES FOR WORKMEN AND SUBORDINATE OFFICIALS

The land upon which the houses are to be erected should be located so as to combine as well as possible proximity to the place of employment, to stores, schools and churches.

In the country or other places where land is cheap the houses should be built for either one or two families. In other cases it may be necessary to build them for more than two families, the idea being to secure a rental that will not exceed 4 per cent on the investment. Experience shows that where land is high this return cannot usually be secured with less than a six-family house.

In the country, there should be only one basement and a floor above; in cities, the practice of the particular district should be preferred. Where 4 per cent is required on the investment, build a house with a basement and two floors above. The stairway may be common for several families, but, in general, there should not be more than two family apartments for one stairway, except in special cases, such as corner houses.

Where it is necessary to build a number of houses, study the relative advantages of building them separately or adjoining in sets of two or three. The latter plan is usually preferable, as it lowers the cost of construction and keeps the apartments warmer. It is understood, however, that where houses are built in groups they are not to be placed in a solid block, except on city streets.

There should be a yard for each house, and where houses are built in groups separate yards should be provided. The out-buildings should be placed far enough from the main building, or buildings, that they will not cut off any light. As a rule, all dwellings should have cellars under the entire floor area. The windows of houses should face east and west, or as near to those directions as possible.

According to local conditions, every family is to have two, three, four or five living rooms, counting the kitchen as a living room. In addition, each family has a separate toilet, a division of the cellar and a part of the roof and the common use of a laundry with drying apartment. A laundry is to be installed for every six to ten families, either in a separate building or in the cellar.

The living rooms of subordinate officers should have a total area of 45 sq. m. (67.5 sq. yds), and that of a higher officer 68 sq. m. (81.6 sq. yds.). The minimum area of the living apartments should be 28.5 sq. m. (34.2 sq. yds.). The areas mentioned permit the building of apartments with two, three or four rooms. With 68 sq. m. from four to five rooms are possible. The personal desires of the tenants should be consulted as far as possible before the division of the space into rooms. A considerable number of railway men work at night, and their bedrooms should be isolated from disturbance. Arrange the space so that a large room can, if desired, be divided in two by erecting a partition. Houses with an area of 45 sq. m. to 68 sq. m. should be furnished with attics for about two-thirds of the floor area.

Windows on both the street and yard side should be installed in every room to secure the maximum light, heat and ventilation. The rooms for the workmen and subordinate officials should be at least 2.8 m. (9 ft. 2 ins.), and those for the higher officials 3 m. (9 ft. 10 ins.) in height. All rooms should be at least 4.1 m. (13.5 ft.) wide, so two beds can be placed in one room. All rooms, including the attics, should be arranged for heating.

Houses for several families should have a stairway not less than 2.3 m. (7.5 ft.) wide. Apartments with more than two rooms should have communicating passageways. Design the hallways and passageways to allow the easy moving of large pieces of furniture. Kitchen pantries are provided only in the buildings occupied by the higher officials; in the smaller buildings a ventilated dresser is sufficient. Verandas or covered balconies should be erected if enough money is appropriated.

If the buildings are erected in the country where sewer systems are not laid out, the toilets should be located in a yard

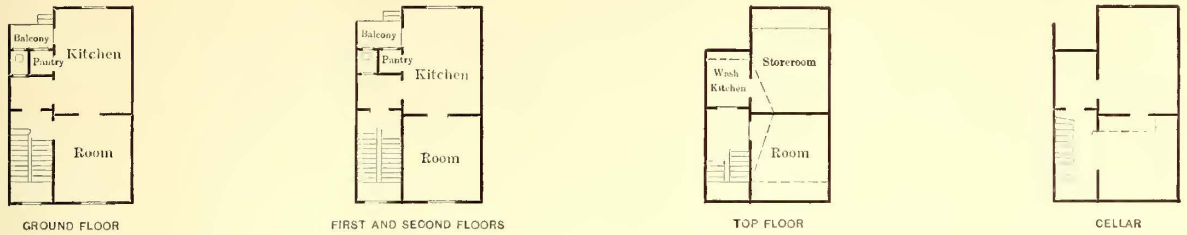
building where plenty of water is available. Where they are built as a part of the house they can be placed on a kind of balcony or in some other easily ventilated position.

As a rule, the outside walls of the building should be massively constructed. Interior decorations are permissible only where their cost is low. The kitchen chimneys should be so arranged that heat from the kitchen range may be utilized for heating the other rooms. The roofs should be of the overhanging type, except in cities, and covered with either brick or slate. If attics are not built originally the roof should be designed to permit their easy construction later.

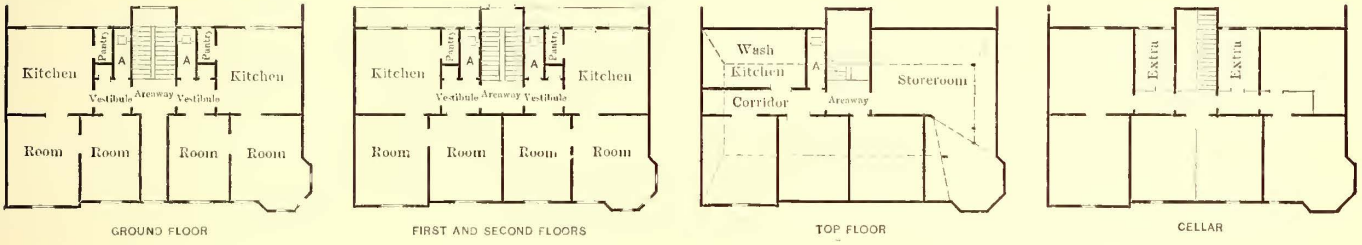
The exterior of the buildings should present a modest, but pleasing appearance; this can be secured without any extra cost for material or design by a wise use of the local building materials, alternation of plain and polished bricks or broken stone work, appropriate painting, etc. Where many buildings are to be erected near each other, avoid uniformity by changing the outlines, the arrangement of windows, using different styles of gables and other means. In general, due attention should be paid to the local styles of architecture.

Special attention should be given to the building of kitchens for the workmen and petty officers, for the kitchen often serves as the main living room for the greater part of the day, and should be laid out with that fact in mind. In view of its importance, it is also advisable to make it the largest room in the apartment. If the kitchen is large enough to be used as a living room, the water piping and sinks should be so arranged that dishes may be washed and other kitchen work done in a well-lighted butler's pantry, with ventilation openings in the door. This closet may be built next to the outer wall, in which case ventilation could be secured by installing a small window. The pantry should be divided in two parts, the upper one for storing kitchen utensils and the lower arranged for the washing outfit and the storage of the cleaning materials

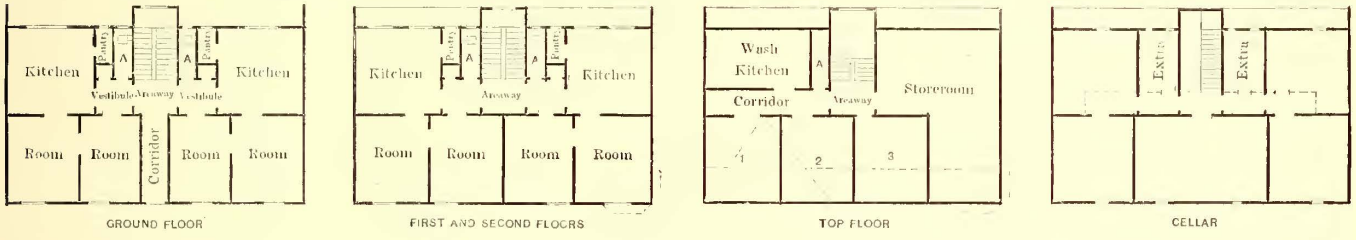
Houses Nos. 146 and 150



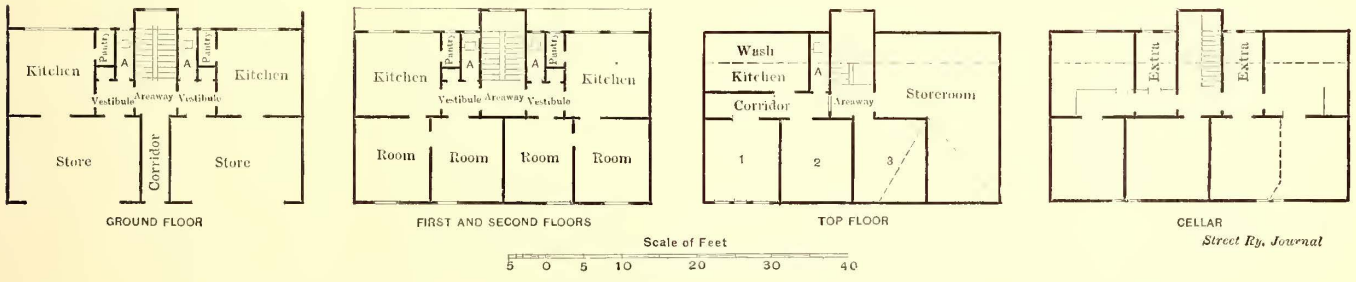
Houses Nos. 144 and 152



Houses Nos. 138, 140, 142, 148, 154, 156 and 158

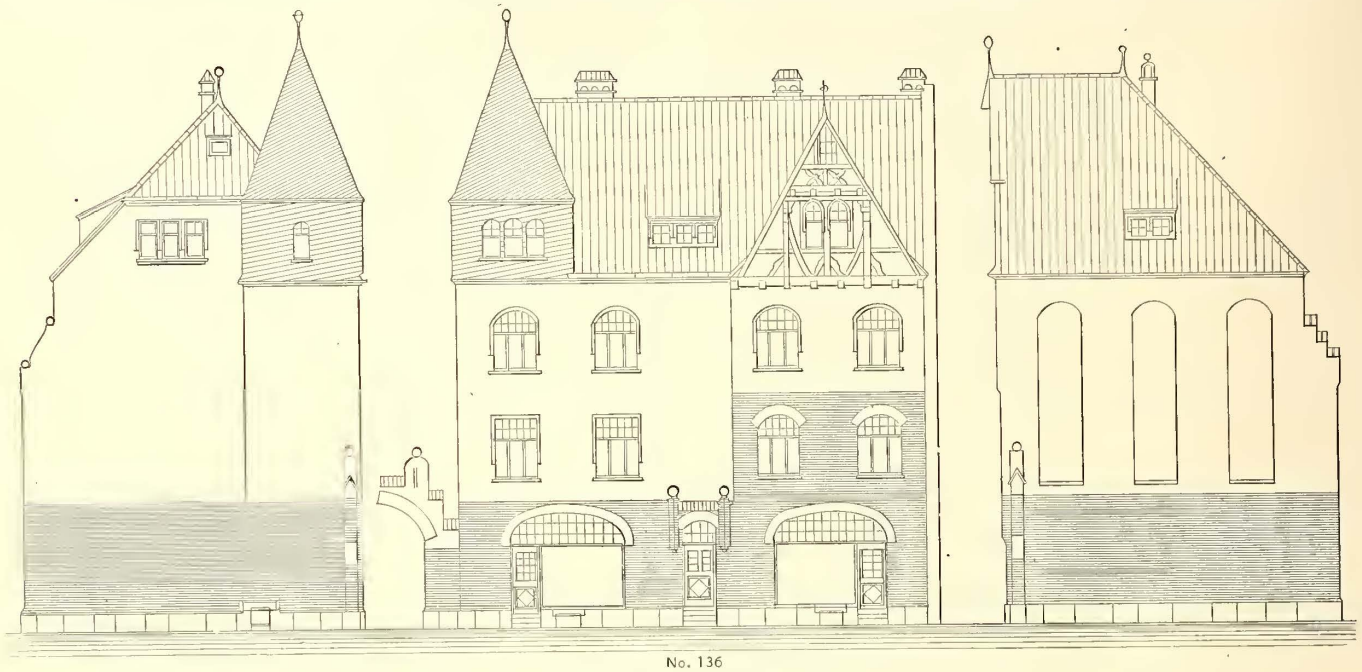


House No. 136



FLOOR PLANS OF HOUSES FOR TRAMWAY EMPLOYEES BUILT AT COLOGNE—RIEHL, GERMANY

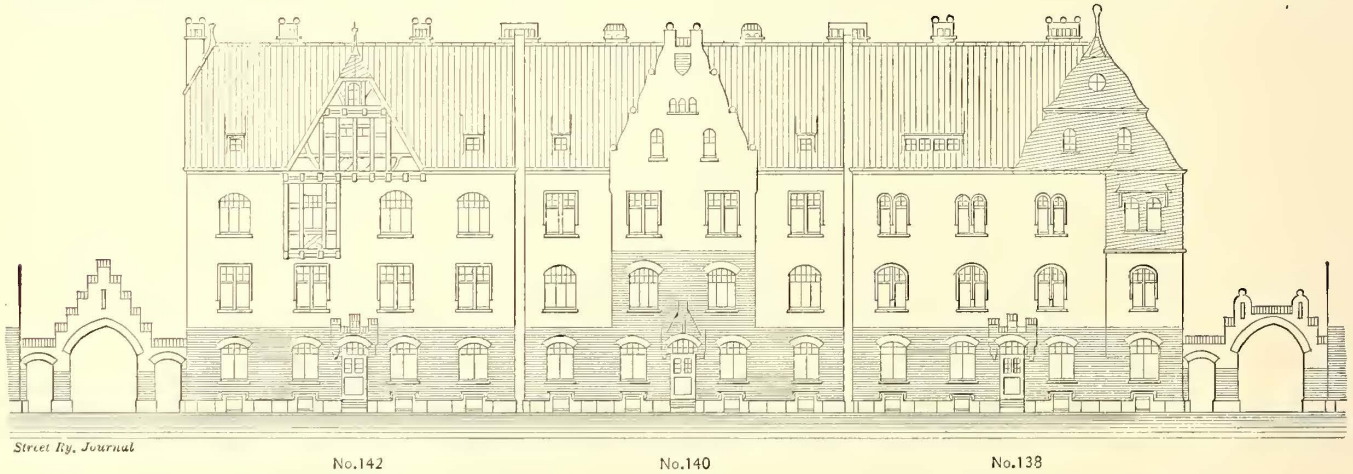
after the work. The pantry may be closed by a door or curtain. The floor should be covered with linoleum. Where the kitchen is the largest living room, it is best to furnish the butler's pantry with a water-tight floor, window and door opening toward the large room. The pantry need not be of the full height of the living room, and the space abve it can be used for other purposes. It is not necessary to construct pantry closets, but enclosed shelves should be provided, and niches should be left in the walls for wardrobes.



No. 136

FRONT AND SIDE ELEVATIONS OF A TYPICAL DWELLING FOR STREET RAILWAY EMPLOYEES AT COLOGNE

Among the street railway companies which have taken up this subject are the Grosse Berliner Strassenbahn and the systems in Cologne and Freiburg. The character of the buildings erected by them is well shown by the accompanying drawings. The plans in particular illustrate how much stress is laid on the arrangement of the kitchen.



No.142 No.140 No.138

FRONT ELEVATION OF A GROUP OF HOMES FOR STREET RAILWAY EMPLOYEES AT COLOGNE

MANAGEMENT OF EMPLOYEES' HOUSES

The question of employees' quarters naturally embraces their management, as well as construction, as it would not do for the owner to relinquish all supervision. In Germany, the relations of landlord and tenant in cases of this kind follow two plans. The first is the organization under the railway's auspices of a "Baugenossenschaft," or co-operative building society, the members of which pay in a certain sum, ranging from $2.50 to $75, which gives them the right to compete for the next vacant house. The second method is to have the railway company build the houses and then rent them to the employees who apply.

The first method, as applied in Berlin, is intended to secure for the members light, healthful buildings with practically continuous leases pending the fulfilment of certain obligations. All privileges extend to the widows of members during their widowhood, and also to retired employees of the company. Members have the privilege of transferring their property rights to other members.

Should an applicant for membership be refused, he may appeal to an advisory council, whose decision is final.

The executive committee has the right to expel any member who has forfeited his civic rights (as for conviction of crime) or if he refuses to fulfil his duties after a second warning. An appeal may be taken before the advisory council within fourteen days, and should this council decide adversely a final appeal may be taken before the next general meeting.

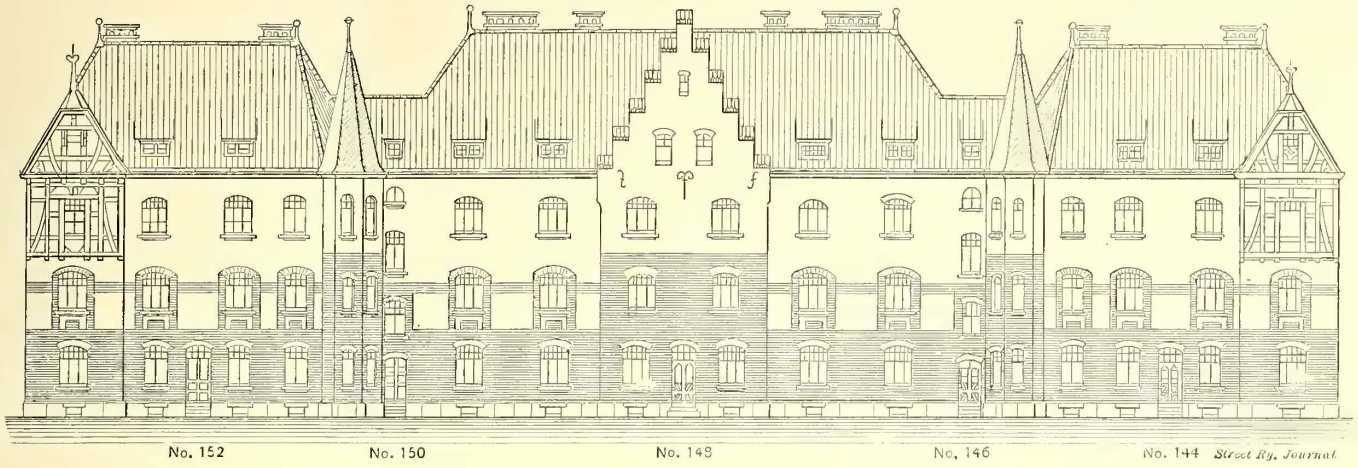
All members are entitled to share the general profits, to receive equal consideration in the allotment of vacant

dwellings, and to enjoy a continuous lease while meeting all contract regulations. The entrance fee is 1.5 m. (37.5 cents) and the minimum monthly dues are only 1 m. (25 cents). A member is held responsible up to 300 m. ($125) per share for any indebtedness not covered by the funds of the society.

The organization is made up of the following kinds of members with their number: Executive committee, three; clerical force, thirty-four; advisory council, nine, and the general assembly. It may be added that the personnel of the committees includes all grades of employees, from manager to platform men. The by-laws of the organization also provide that the clerical force must contain at least one member from the operating department, from the shop force, the auditing department, the construction department and the main office, in addition to the principal and assistant cashier of the company. The chief duty of this clerical committee is to keep the widely scattered members in touch with each other.

The executive committee issues at frequent intervals a list of apartments as they become vacant, and these are then assigned to the applicants in the order of their application. Where several persons desire the same place, a decision is reached by drawing lots. Members already in quarters, but desiring to change, may apply for new apartments under the same conditions as the others. The executive committee has the right to rent apartments to outsiders during periods when members do not apply for them. No tenant may keep visitors for any considerable time without written permission from the executive committee.

Within six months after its establishment the Berlin society had over 600 members and a capital liability of $100,000, of which only a small portion was paid in. The society, therefore, was unable to build any houses until the Grosse Berliner Strassenbahn loaned it, at three per cent interest, different sums, amounting in all to $375,000.

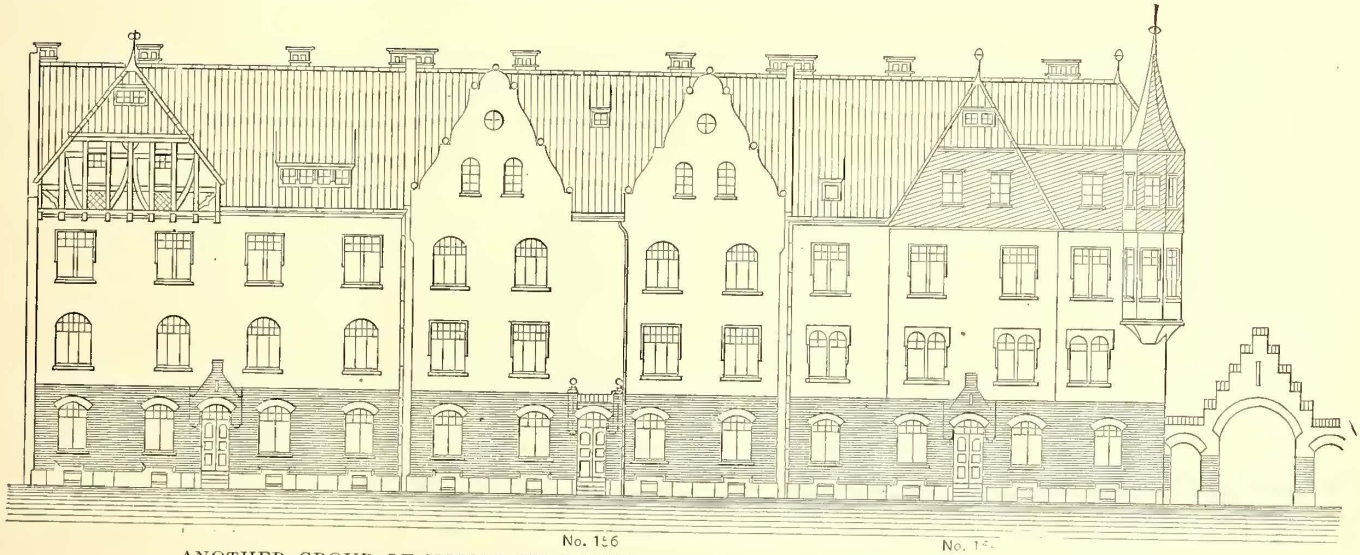


CONTINUATION OF HOUSES ON STAMMHEIMER STREET, COLOGNE-RIEHL, SHOWING VARIATIONS IN ARCHITECTURAL TREATMENT

The rents per month are as follows:

FRONT APARTMENTS

One room and accessories, fourth floor	$5.00
One room and accessories, third floor	5.25
One room and accessories, second floor	5.50
Two rooms and accessories, fourth floor	8.25
Two rooms and accessories, third floor	8.50
Three rooms and accessories, second floor	8.75
Three rooms and accessories, first floor	13.00



ANOTHER GROUP OF HOMES ON STAMMHEIMER STREET, COLOGNE–RIEHL, GERMANY

The last rental applies to left-hand apartments, the right-hand apartments being $1.25 less per month.

SIDE AND END APARTMENTS

One room and accessories, fourth floor	$4.50
One room and accessories, third floor	4.75
One room and accessories, second and first floors	5.00
One room and accessories, basement floor	3.75
Two rooms and accessories, fourth floor	6.25
Two rooms and accessories, third floor	6.50
Two rooms and acessories, second and first floors	6.75
Two rooms and accessories, basement floor	6.50

An annual fee of $5.25 is charged for the baths and water.

At the end of the first fiscal year, Dec. 31, 1903, it was found possible to pay a 3 per cent dividend. At the end of the second year there was a dividend of 4 per cent. The cost for one structure was $118,882, of which $33,785 was required for the lot. As the annual rental amounts to only 5.35 per cent on the investment, it is plain that the buildings are not intended to return high profits. In fact, while the rents mentioned are certainly high, they are undoubtedly less than for similar houses in Berlin.

A second structure erected by the Grosse Berliner Strassenbahn consisted of a front house, two wings and a cross-building. The lot on which it was built cost $46,767, and had a frontage of 36 m. (about 111 ft.) and a depth of 49.4 m. about 162 ft.). This tenement is made up of two stories with living apartments; twenty-three family apartments, consisting of two living rooms, kitchen and accessories, and forty-three family apartments, consisting of one room. The two-window rooms are usually about 13 ft. x 19 ft. 6 ins., and those with single windows approximate 12 ft. x 18 ft. The kitchens do not differ considerably in width from the other rooms, but are 3 ft. to 4 ft. shorter. The apartment accessories consist of a pantry measuring about 4 ft. x 4 ft. 6 ins., and a closet, which includes the bath room, 4 ft. wide x 13 ft. long. The halls are from 5 ft. wide to 12 ft. wide and 13 ft. to 26 ft. long. Both the front and yard sides of the building are furnished with balconies, porticos, ornamental windows, and the like. Every tenant is apportioned a section of the cellar and shares the laundry facilities. All of the rooms are well lighted, as the sodded yards are usually over 65 ft. long.

With regard to the social relations of the tenants, it is worth noting that in the conclusion of the last Berlin report the committee said that the fears that dissensions might break out if so many people in the employ of one company lived together had proved baseless; on the contrary, the relations of the tenants were of a most cordial nature.

As previously mentioned, other street railway systems have built the houses at their own expense and have then rented them to employees. The municipal railway of Cologne, for example, has built a number of buildings of the types shown in the accompanying drawings. Inspection of the plans will show the large space allowed for the kitchen, which serves also as a living room in the smaller houses. The monthly rents for the Cologne three-room apartments are as follows: Basement, $4.75; first floor, $5.25; second floor, $5, and for an attic room, only 37½ cents.

These rates allow 3.6 per cent on the investment after deducting 1½ per cent for maintenance and sinking fund. The usual monthly rentals in Cologne average about 25 cents more per room. Tenants must give up their rooms on a month's notice after quitting the service.

The following table of costs was prepared at the time the Cologne houses were planned. These consist of ten buildings with six three-room apartments and two with three two-room apartments.

ESTIMATED COST

5160 sq. yds of land	$10,750
Sidewalks (one-half)	1,800
Ten six-family buildings	57,500
Two three-family buildings	4,750
Gardens, fences, etc.	7,700
Total	82,500

ESTIMATED INCOME

Average three-room monthly rental	$5.00
Average two-room monthly rental	3.75
Average attic room	.375
Total annual income	$4,167 00
Less 1½ per cent for depreciation and maintenance of buildings	1,012.50
	$3,154.50

The last figure is equal to 3.8 per cent of the invested capital.

The municipal railway of Freiburg has also erected some dwellings of the type illustrated. The annual rentals vary from $65 to $106 for a four-room apartment and $40 to $57.50 for three rooms. These figures are about one-half the local rates. At present there are four four-room apartments and forty-four three-room apartments.

NEW SOUTH WALES TRAMWAY OFFICERS' ASSOCIATION

The street railways in the State of New South Wales are owned by the Government and are operated by a board of three commissioners appointed every seven years to manage all the trunk-line railways and the tramways. The largest tramway system, of course, is in Sydney, where there is a single-track electric mileage of 137 and a steam mileage of 18. The officers of the company about two years ago established an association known as the New South Wales Tramway Officers' Association, for the discussion of problems affecting the operation of the tramways, and this association has proved of great value not only to the officers but to the management. A number of papers has been presented. All of them have been keenly discussed, and valuable suggestions for the improvement of existing practice have been made. In this way the junior officers especially have received an insight into the principles which govern their daily routine which must make for improved results. The members number 114.

The second annual meeting was held Feb. 15, with the president, John Kneeshaw, in the chair. In his address Mr. Kneeshaw commended the association upon the work done during the past year. He said that the department was fully alive to the advancement in regard to tramway traction in other parts of the world. As an instance, an equipment had been imported by the Railway Commissioners in connection with the system of regenerative control, and experiments were being now conducted with it. If they proved successful considerable economy in the consumption of electrical current would be effected. The tourist cars continued to be well patronized, and the new type of car introduced was very popular. The tramway traffic was already very congested, and the time was fast approaching when it would be necessary to very seriously consider the manner in which it was to be brought into the city.

A feature of the organization is a magazine, issued monthly, discussing various topics connected with the management. Owing to the small number printed the copies are typewritten. The February articles were the following:

The articles form the basis for discussion at the different meetings, which have proved very desirable in cultivating the qualities of observation on the part of all.

TRAMWAY SYSTEM OF MONTEVIDEO

On Nov. 19, amid a scene of great enthusiasm, the first electrically operated lines in Montevideo were inaugurated. Montevideo, the capital of Uruguay—or, to give the latter its better known local title, the "Banda Oriental"—is situated on the northern shores of the River La Plata near its mouth.

At the present moment the population of Montevideo exceeds 300,000. The streets, for the most part, are wide and fairly well paved, and as the city is situated on a tongue of land between the bay and the River La Plata, it is pleasantly cool. The water supplied by an English company is copious in quantity and excellent in quality. The port works, long delayed, are now approaching a state in which they will be of immense benefit to Montevideo in particular and the trade of the country in general. Altogether, if granted a succession of years of peace, Montevideo bids fair to become one of the most important cities of the Western Hemisphere.

The first mule tramways in Montevideo were opened in the year 1868, just thirty-nine years ago. This was a short line which has grown with the city until there are now 150 miles of line, either electrified or in course of electrification. Ten years ago the Commercial Company applied to the powers that were for authorization to reconstruct its lines on more modern principles, but the veto of the president, or rather the opposition of the municipality, frustrated every attempt. With the election in 1903 of President Señor Battle y Ordonez, a change came over things, and the long wished for concession was granted. In it the government stipulated that all the lines should be extended into more distant suburbs in order to facilitate the solution of the housing question, which in Montevideo, as in Buenos-Aires, had become serious.

VIEW OF STREET IN THE OUTSKIRTS OF MONTEVIDEO

In the afternoon of Nov. 19 last, some 400 guests were assembled at the electric power house of the company when Dr. Williman, Minister of Government, switched the current on to the lines. Twelve cars then conveyed the party down through the crowded streets and out to the Pocitos Hotel, where a banquet prepared by the Commercial Company was awaiting them. Among the guests were the Minister of Government, Dr. Claudio Williman; Juan Cat, the general manager of the Commercial Company; General Vazquez, the Minister of War; Señor Vidiella, the President of the Junta; the British Minister; the American Minister; A. N. Connett, chief engineer of J. G. White & Company, Ltd.; C. C. Lewis, superintendent of construction of the same firm, and Harrison Jones, the engineer of the Commercial Company. On the same evening Mr. Cat, the manager of the Sociedad Commercial, gave a reception at the Pocitos Hotel. On Wednesday evening a banquet was given by the contractors at the Uruguay Club to the leading men of Montevideo.

CALLE SORIANO FROM RIO NEGRO

CONTRACT

In December, 1904, an agreement was made between the United Electric Tramways of Montevideo, Ltd., of Basildon House, Moorgate Street, London, E. C., and J. G. White & Company, Ltd., contractors, of 9 Cloak Lane, Cannon Street, London, E. C., for the complete reconstruction of the existing horse tramways to electric traction, and the erection of a power house to supply the required power. The work has been carried out under the general supervision of a committee of the Board of the United States Electric Tramways of Montevideo, Ltd. Frank Bourne, of 62 London Wall, E. C., acted as engineer to the committee.

The constructional works were started in March, 1905, and the opening ceremony took place on the date stated above. The electrification of these lines (practically 51 miles single track) and the erection of the power station

has, therefore, taken some twenty months; which, considering the many attendant difficulties, was exceptionally quick work.

TRACK WORK

All the lines are laid to a gage of 4 ft. 8½ ins., and the rails manufactured by the Lorain Steel Company are 45 ft. in length and weigh 87 lbs. per yard on the straight and 100 lbs. per yard on curves. They have the following specified chemical composition:

Carbon	0.55	per cent
Manganese	1.00	do
Silicon	0.10	do
Phosphorous	0.10	do
Sulphur	0.10	do

A test piece taken from the rails withstood the following tests: A test piece was prepared having a sectional area equal approximately to ½ sq. in. and with a length

TRACK WORK AT REDUCTO STATION

of 2 ins. between test gage points. When tested it withstood the specified tensile strength of 40 tons per sq. in. with an elongation of 12 per cent. The section is the Lorain No. 87-381. The rails are laid on concrete stringers with the rods spaced 3 ft. 9 ins. apart. The depth of the stringer is 6 ins. and the width 15¼ ins.

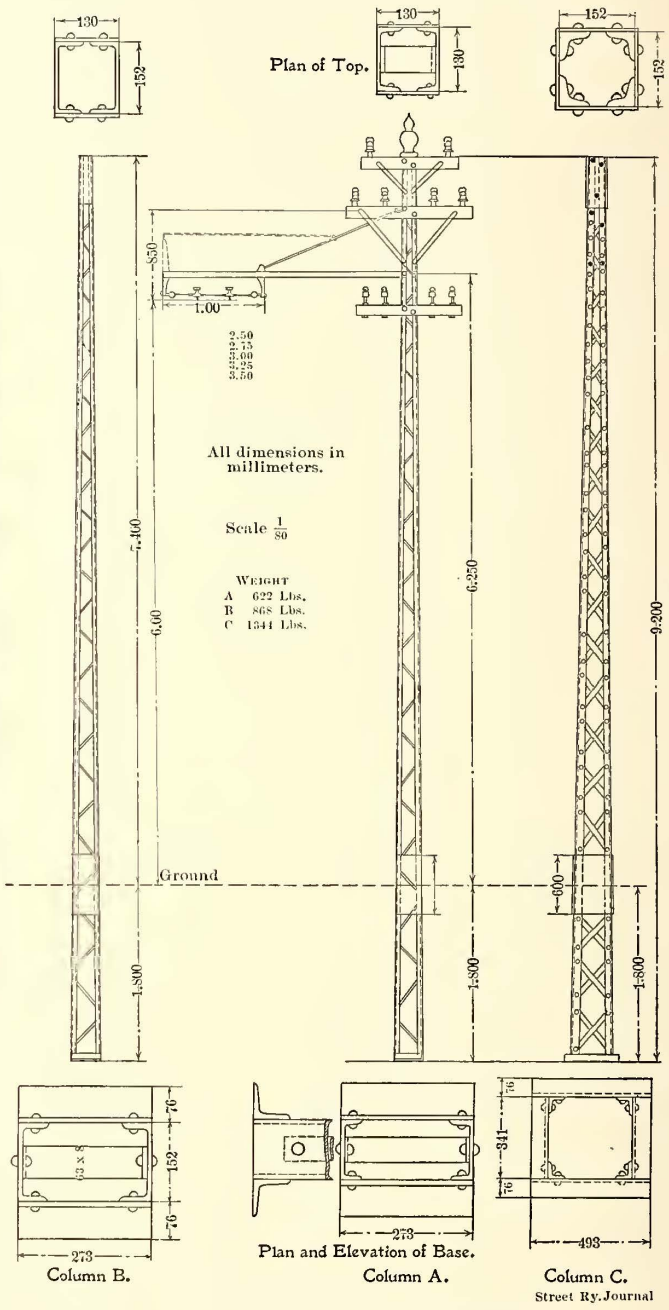
The distance between centers of tracks is 9 ft. 10 ins. The minimum distance of outside running rail from pavement is 3¼ ft. Three kinds of paving are used: Belgian block, cobbles and macadam. The Continuous Rail Joint Company's rail joints were used. They are 24 ins. long, a pair weighing 88 lbs. Two No. 0000 bonds are used at each joint. A view of partly completed track is shown on this page.

All special work except the switches was manufactured by the Lorain Steel Company. The switches are automatic, made of best toughened cast-steel with solid Era manganese steel open mates manufactured by Messrs. Hadfields, of Sheffield.

OVERHEAD EQUIPMENT

The poles supporting the overhead trolley wires are of two designs—tubular and lattice. The former, of which there are 457, are used only in the Plazas and on a few of the main streets. The lattice poles number 2765. All the poles are planted 6 ft. deep in concrete and also have 6 ins. of concrete beneath their bases.

A No. 00 groved trolley wire is used. Its total length is 70 miles, and it is divided into half-mile sections. The



DETAILS OF LATTICE POLES

wire was supplied by Edward Le Bas & Company and the National Conduit & Cable Company.

The section insulators of special make were manufactured by the Electric Tramway Equipment Company of Birmingham. This insulator consists of an ordinary double-break section insulator with the addition of a knife switch. The switch is closed by means of a long bamboo pole, which is usually hung on a pole and secured by a padlock. A hook on the end of the pole fits into a hole in the blade of the switch, at the back of which is a spring. This

spring, pressing down the blade, assists in making a quick contact.

CABLES

The total cable laid was approximately 28 miles, 15 miles aerial and 13 miles underground, as follows:

Diameter and description of cable	Yards
61/.101 ins. insulated, steel taped armored	13,400
61/.101 ins. insulated, steel taped armored	250
61/.092 ins. insulated, steel taped armored	2,230
500,000-circ.-mil. aerial cable	9,650
600,000-circ.-mil. aerial cable	17,300
5-core test and telephone cable, armored, approximately	7,200

The insulated cables are of the single conductor type, armoured and laid directly on the ground. The lead covering is 1-10 in. thick. The cable was tested at the makers' works with a flash test of 2500 volts alternating for 15 minutes. The total weight of copper used was approximately 150 tons.

The conductors in the case of the aerial cables are of hard-drawn copper, having a conductivity of 98 per cent of Matthiessen's standard. The cable is twice braided, each braiding being separately served with weather-resisting preservative compound.

CAR SHEDS AND DEPOTS

There are three depots for the cars which have been provisionally reconstructed, viz., Pocitos, Reducto and Del Este. The Del Este car house is the largest and has accommodation for forty cars. Each has repair shop adjoining. The power in these shops is supplied by Lancashire motors.

THE CARS

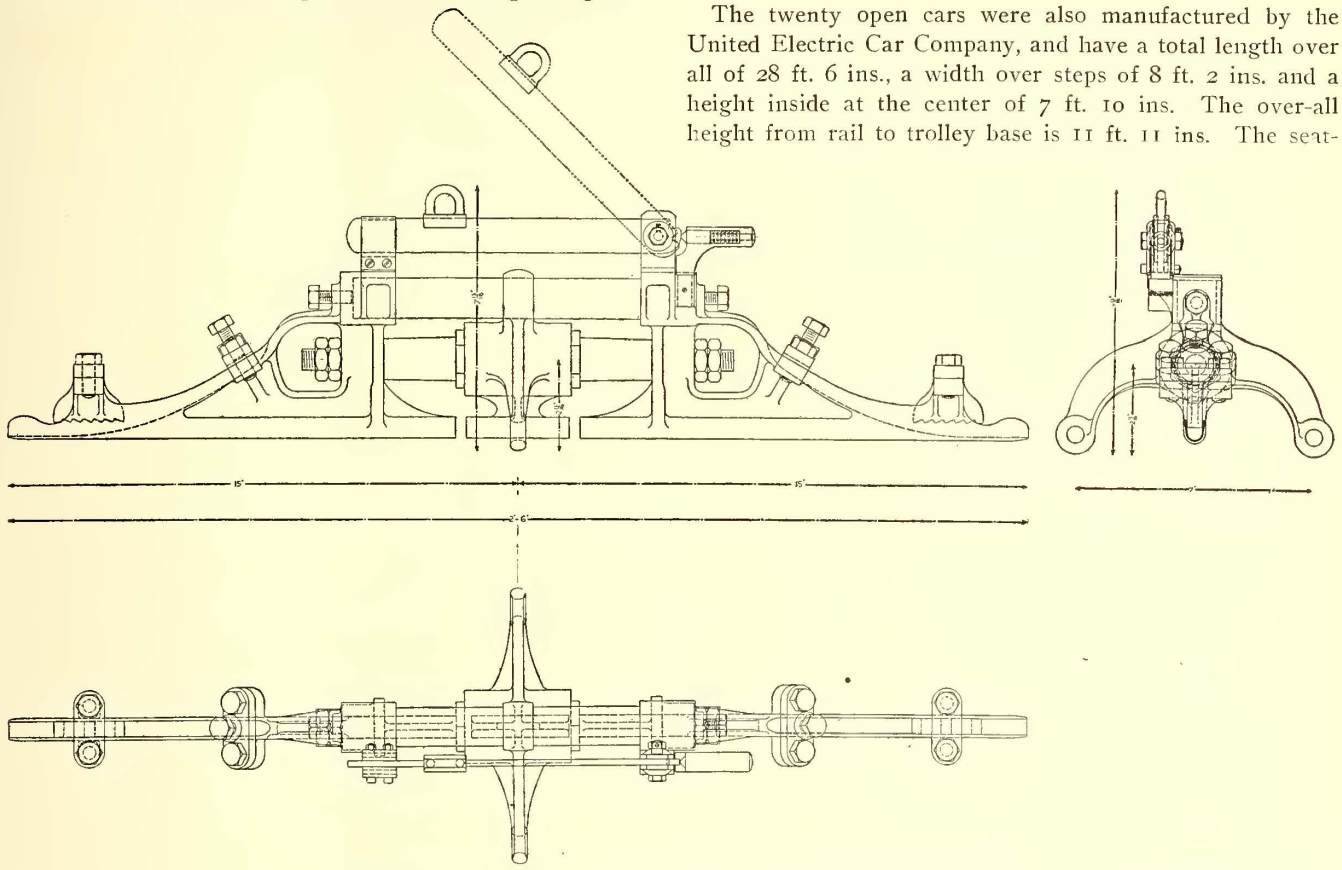
The cars were built by the United Electric Car Company, Preston, England, and include seventy semi-convertibles, twenty open cars (all single-deckers) and one flat car. The car bodies are mounted on 21-E Brill trucks having 6 ft. 6 ins. wheel base. Steel-tired wheels 34 ins. in diameter are used. The cars are fitted with Providence fenders.

The general dimensions of the semi-convertible car, which seats thirty-two passengers, are as follows:

	Ft.	Ins.
Length over end panels at sill	20	8
Length over bumpers	30	3
Width at sill, including panels	7	9½
Width at belt rail	8	½
Extreme width over mouldings	8	4
Height inside, center	7	10
Height of draw bar-center above rail	1	4
Gage of track	4	8½

The ventilation has received special attention and there are special outlets for the foul air. They are located in the roof.

The twenty open cars were also manufactured by the United Electric Car Company, and have a total length over all of 28 ft. 6 ins., a width over steps of 8 ft. 2 ins. and a height inside at the center of 7 ft. 10 ins. The over-all height from rail to trolley base is 11 ft. 11 ins. The seating capacity is forty passengers. Each car is equipped with a Peacock brake, manufactured by the National Brake Company of Buffalo.



SWITCH BREAKER USED ON THE MONTEVIDEO TRAMWAYS

The electrical equipments of the cars furnished by Dick, Kerr & Company of London consist of two motors, type No. 3, form A4, and two series parallel controllers, type D.B.1, form E, and trolley with straight under-running head.

POWER STATION

The power house is situated in the Calle Cebollati, close to the water edge. The main dimensions of the station are 114 ft x 52 ft.

The boiler installation comprises four boilers of the Babcock & Wilcox design. Each boiler is capable of evaporating 11,300 lbs. of water per hour at natural draught, and at a working pressure of 180 lbs. per sq. in. used in conjunction with a Green economizer. They are erected in batteries of two. Each boiler has a B. & W. superheater fixed with it, with 572 sq. ft. of heating surface, and capa-

ble of superheating 150 degs. F. Each boiler has a heating surface of 3240 sq. ft. and a grate area of 58 sq. ft.

The Green's economizer used in connection with these boilers has 400 tubes, each 9 ft. long and 4 9/16 ins. diameter, with top and bottom headers forced together in sections by hydraulic presses with metal to metal joints. The scrapers of the economizer are driven by a 3-hp inclosed dust-proof shunt wound motor working on a 500-volt direct-current circuit with starting switch with overload and no-load release.

There are two horizontal steam-driven direct-acting feed pumps manufactured by the Worthington Pumping Engine Company, size 9 ins. x 5¼ ins. x 10 ins. duplex, each capable of delivering 4500 gals. of water per hour against a boiler pressure of 160 lbs. per sq. in. when using saturated steam at a pressure of 160 lbs. per sq. in., the pump running at normal speed. The feed water is drawn from a hot well at a temperature of 80 degs. F., the water level being not more than 8 ft. below the suction inlet of the pump.

ESTE STATION AND CAR HOUSE OF THE MONTEVIDEO TRAMWAYS

CONDENSING PLANT

The condensing plant consists of two complete surface condensers manufactured by Cole, Marchant & Morley, of Bradford. Each plant is a duplicate of the other, and consists of a surface condenser, a pair of steam-driven Edwards' air pumps, and electrically driven centrifugal circulating pump.

Each plant will condense 24,400 lbs. of exhaust steam per hour, and give a vacuum of 26 ins. with the barometer at 30 ins. when supplied with condensing water at an initial temperature not exceeding 70 degs. F. All the condensing water is drawn from the sea. The surface condenser is of the horizontal counter-current design with cast iron cylindrical shell and waterheads, the covers of which are removable without breaking any pipe joints, and are fitted with hand holes for inspection and cleaning. Solid drawn brass tubes, ¾ in. external diameter, 18 S. W. G. thick, are secured into brass tube plates by screwed ferrules and cotton-tape packing. Suitable baffle plates and diaphragms are provided for distribution of steam and water.

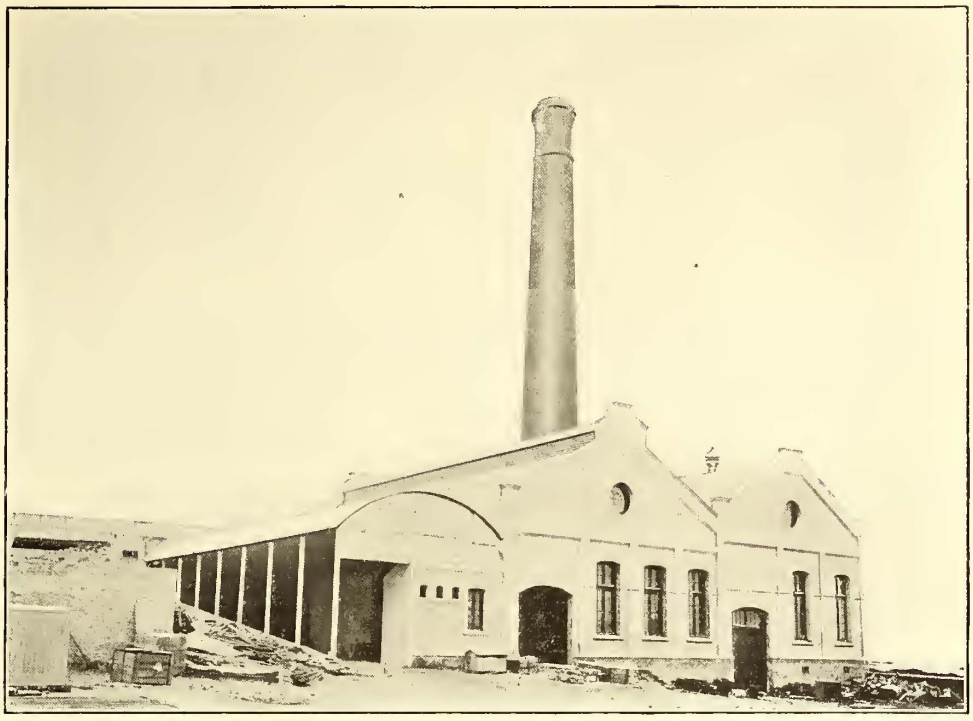
Each of the pair of air pumps is of the Edwards' fly-wheel single-acting type, having a positive length of stroke. The delivery valves are placed at the top of the barrel and are readily accessible. The pair of air pumps is driven by compound steam cylinders mounted on cast-iron frames standing on the pump bodies, the crossheads working in bored guides. The crankshafts are coupled together, consequently one pump balances the other. The speed is controlled by a belt-driven adjustable Pickering governor. Each pump is capable of dealing with 17,100 cu. ft. per hour and has a piston speed of 200 ft. per minute average.

The centrifugal circulating pump is of cast-iron and is mounted on a massive cast-iron baseplate which is extended to take the motor with which it is connected by

a flanged coupling. The motor is shunt-wound and works on a 550-volt d. c. circuit, with starting switch with overload and no-load release, etc.

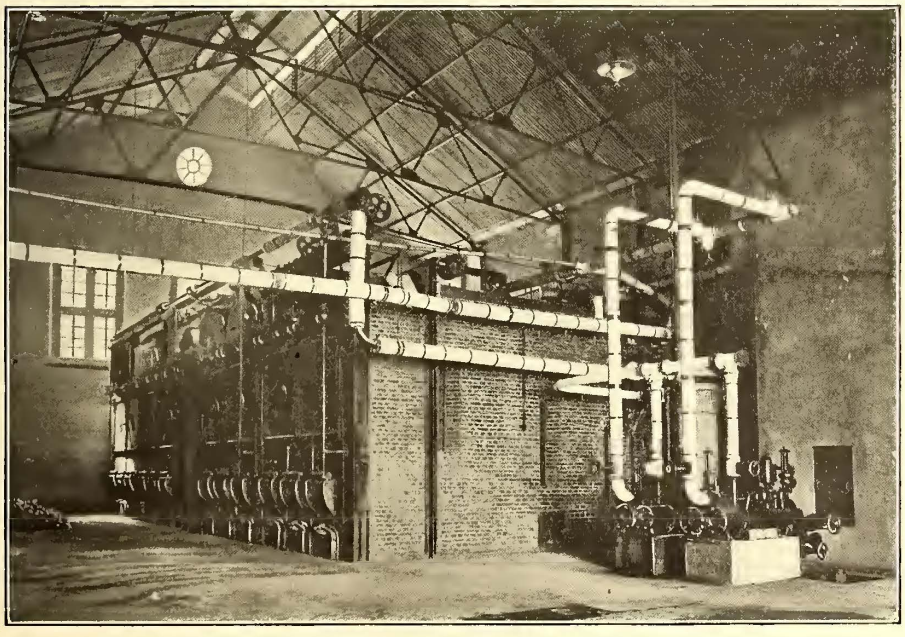
The following are some of the leading features of the condensing plant: Condenser area, 2500 sq. ft.; pair of Edwards' air pumps, 16½ in. diameter x 8 in. stroke; normal speed, 145 r. p. m.; bhp of air pumps, 6 bhp; steam consumption with saturated steam at 160 lbs. pressure does not exceed 300 lbs. per hour; circulating pump bore, 9 ins.; gallons of circulating water per hour, 73,200 gallons; suction "lift," circulating pump, 10 ft.; power and speed of circulating pump motor, about 15 bhp at 650 r. p. m.

The feed-water heater, which was manufactured by Wheeler Condenser Company and has 150 sq. ft. of heating surface, is capable of dealing with 3000 gals. per hour of boiler-feed water at 160 lbs. per square-inch pressure, and about 950 lbs. of exhaust steam per hour at a maximum of 5 lbs. per square-inch pressure. The steam exhausts into the shell of the heater, the tubes being protected from the impact of the entering steam.



MONTEVIDEO TRAMWAYS POWER HOUSE

A 3-in. heavy pattern cold-water meter, manufactured by the Worthington Pumping Engine Company, has been installed, which is capable of dealing with 4500 gals. of water per hour against a pressure of 160 lbs. per square inch.



BOILER ROOM OF MONTEVIDEO POWER STATION

ENGINES

Three Belliss & Morcom's three-crank three-cylinder enclosed triple expansion engines with forced lubrication and automatic cut-off are direct coupled to the generators. The cylinders are 18½ ins., 27 ins. and 40 ins. in diameter x 20 ins. stroke. They run at 250 r. p. m., and are supplied with steam at the engine valve at a pressure of 160 lbs. per square inch superheated 150 degs. F.

The normal full load of each engine is about 1000 bhp, but they are designed for an overload of 23 per cent. and 50 per cent for short periods. As regards regulation: the permanent variation between full and no load is 2 per cent; and momentary variation at variable load is 5 per cent.

The guaranteed steam consumption per brake hp per hour with a steam pressure of 160 lbs. per square inch rating condensing with a vacuum of 26 ins. at the engine is as follows:

	Pounds.
Full load	12.2
Three-quarter load	12.3
Half load	13.1

A patent forced lubricating system is fitted to all working parts, consisting of a valveless pump worked direct for the crankshaft with adjusting valves fitted in the engine bedplate. The fly-wheel, which is of cast iron, has a diameter of 8 ft. 5 ins. and weighs approximately 9 tons. The total weight of the engine, exclusive of fly-wheel, is approximately 50 tons.

GENERATORS

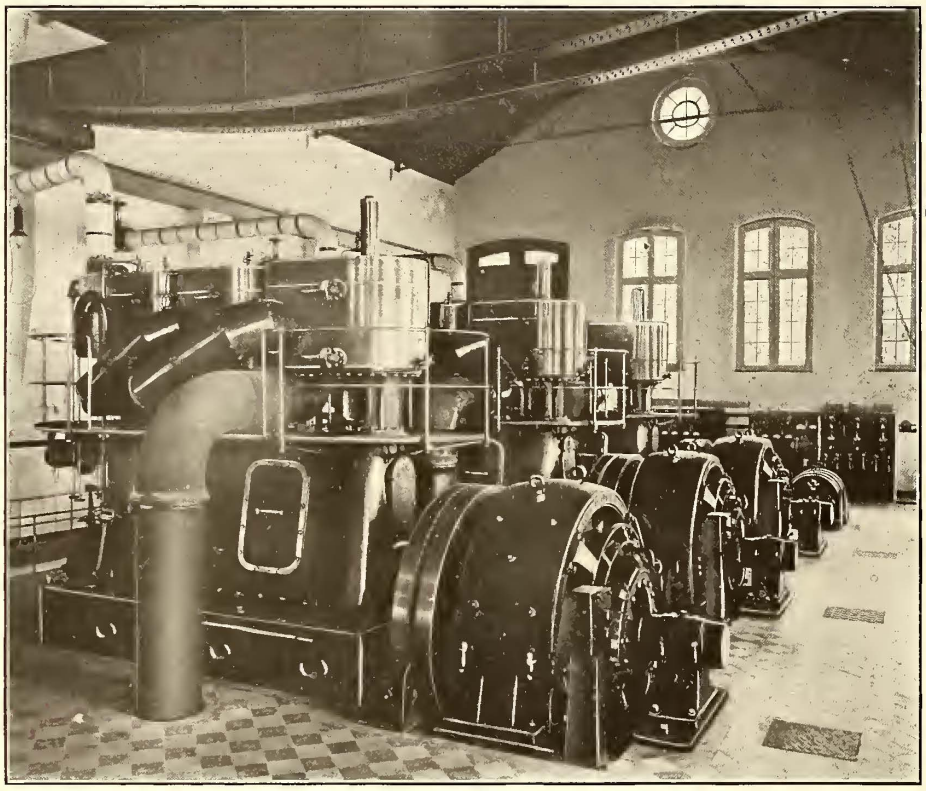
The dynamos built by Bruce, Peebles & Company are of the multipolar slotted armature type, and are direct-coupled to the engines. Each has an output of 650 kw and is wound for 550 volts direct current. They are guaranteed to withstand an overload of 25 per cent for two hours after reaching the maximum temperature due to full load; and 50 per cent overload for 15 minutes under similar conditions. The speed is 250 r. p. m.

The generators are ten polar and fitted with compensating poles, the field poles being of steel, cast solid with the yoke, with a special polar ring secured to the pole face completely surrounding the armature. The efficiencies of the generator are as follows:

	Per Cent.
One-quarter load	85
One-half load	91
Three-quarter load	93
Full load	94.5

BOOSTERS

Two negative booster sets, one of 22 kw the other of 25 kw, were supplied by the Electric Construction Company, Wolverhampton. The combined over-all efficiency of the motor booster at full load is 75 per cent for the 22 kw and 76 per cent for the 25 kw set. Each booster is capable of standing an overload of 25 per cent of the full load output in amperes and volts for half an hour. The maximum speed of either set does not exceed 1000 r. p. m.



ENGINE ROOM OF MONTEVIDEO STATION

SWITCHBOARD

The main switchboard, manufactured by the British Thomson-Houston Company, of Rugby, is made up of slate panels bolted together on iron frames, the slates being 2 ins. thick and of the best quality. The board is so arranged that there is a clear passage 4 ft. wide behind and around it. The arrangement of the instruments and fittings is such that each panel is self-contained for the generator and booster panel; but the feeder panels control two feeders each. The board is made up as follows:

Three 650-kw 550-volt generator panels.

Four feeder panels, each arranged for two 300-amp. feeder circuits.

Two booster panels.

One totalizing, testing and station lighting panel.

One panel for two 18-b. h. p. motors.

The engine-room is spanned by a twenty-ton hand crane, made by Higginbottom & Mannock.

THE STANDARDIZATION COMMITTEE OF THE CENTRAL ELECTRIC RAILWAY ASSOCIATION MEETS

The standardization committee of the Central Electric Railway Association held a three-days' meeting, beginning April 25, at the offices of the Central Electric Railway Association in the Traction & Terminal Building, Indianapolis, Ind., during which every item relating to the standardization of equipment for electric railway cars and other equipment was carefully considered and certain recommendations agreed upon. The committee selected the following subjects to be considered by sub-committees:

1. Standard height of draw-bar for interurban and city cars; also standard form of coupler for interurban and city cars. R. C. Taylor, superintendent motive power Indiana Union Traction Company, Anderson, Ind., chairman.

2. Standard form of trolley base; standard length of trolley pole and standard form of trolley harp and wheel. M. Baxter, master mechanic and electrician Western Ohio Railway Company, Wapakoneta, Ohio, chairman.

3. Standard classification lights and signals and location of same on car. W. A. Gibbs, general manager Indiana, Columbus & Eastern Traction Company, Newark, Ohio, chairman.

4. Standard foundation brake gear; brake jaws; pins; levers; and brake rods. Fred Heckler, superintendent motive power and cars, Lake Shore Electric Railway, Fremont, Ohio, chairman.

5. Committee on Car Painting; Mr. Heckler, chairman.

6. Standardization of electric equipment; motors recommended for ton mile speed car; detail dimension of electric equipment and supplies which enter into the maintenance of electric car service supplies. Mr. Taylor, chairman.

The sitting committee also formulated a report which will be presented at the May meeting of the association, to be held in Indianapolis, on the following subjects:

Brake-shoes; axles, journal and journal boxes, tread and flange of wheels; rails for street and interurban railways.

W. H. Evans, of Indianapolis, chairman of the standardization committee, announced that the committee would have another meeting before the convention of the association in May, and that it is the purpose to hold a two-days' meeting of this committee and the above-named sub-committees the two days previous to the fourth Thursday in May, at which date the association would meet. The chairman of each of the above designated sub-committees is authorized to select at least two other master mechanics or electrical engineers connected with interurban roads to serve on the committee with him in consideration of the subjects assigned and attend the two days' meeting to be held in Indianapolis previous to the May meeting. W. H. Evans, R. C. Taylor and Fred Heckler were present.

NEW POWER EQUIPMENT FOR THE BOSTON ELEVATED

The Boston Elevated Railway Company is enlarging its power plant capacity by 10,800 kw, contracts having been placed for sixteen 600-hp boilers and four 2700-kw engine-driven generating units, with condensing equipment and feed pumps. These additions are to be made at Lincoln, Harvard and Charlestown power stations. They represent an increase of 27 per cent in the company's generating capacity, and when installed will give the road a total power plant normal rating of 50,871 kw.

The additions at Lincoln power station, which is located at the foot of Battery Street on the edge of Boston harbor, will require an extension of the present building 83 ft. 4 ins. by 152 ft. in the mean outside dimensions. A new brick stack, 250 ft. high and 13 ft. inside diameter, will be built to supplement the present chimney. Eight of the 600-hp boilers will be installed at this station. All the boilers in the equipment extension are of the Babcock & Wilcox type, each having 294 4-in. tubes 18 ft. long, the usual heating surface of 10 sq. ft. per horse-power, a working pressure of 200 lbs. per square inch, if desired in operation, wrought steel headers and superheaters capable of raising the normal steam temperature 50 to 75 degs. F., according to the load.

The feed pumps to be installed in the three plants are ten in number, each being a Warren duplex outside packed plunger pump, cylinders 14 ins. by 9 ins. by 18 ins. Four pumps will be placed at Lincoln power station.

Two engines will be installed at Lincoln power station, each being built by William Tod & Company, of Youngstown, Ohio. Each will be direct connected to a 2700-kw Allis-Chalmers d. c. generator wound for 575 volts flat characteristic. Each engine is of the vertical cross compound condensing type with cylinders 42 ins. by 90 ins. by 60 ins., and a normal speed of 75 r. p. m. The maximum rating is 6000 hp. The bearings are 32 ins. in diameter and 58 ins. long.

Each engine has a 37-in. steel shaft with a 14-in. internal hole, the length from center to center of journals being 19 ft. 6 ins. Mounted upon the shaft is a 270,000-lb. fly-wheel, 25 ft. in diameter and 29 ins. face. In regard to regulation, the variation in speed from no load to 50 per cent overload is not to exceed 3 per cent, and the maximum momentary variation in speed for extreme and sudden changes of load is to be 1½ per cent. Each unit is to be run with a temperature of steam equivalent to 75 degs. of superheat; all steam and exhaust valves are double ported; the steam supply pipe is 16 ins. in diameter, and the exhaust pipe 30 ins. The usual intermediate receiver is provided, with a capacity of 440 cu. ft., and there is also with each engine an automatic safety stop valve controlled by an auxiliary centrifugal governor, so that the engine can be shut down at any predetermined increase in speed. The weight of the engine complete is about 1,100,000 lbs.; the weight of the heaviest piece, aside from the shaft, which weighs 130 tons, is 35 tons—the low-pressure cylinder. The outside dimensions of the largest piece are 12 ft. 6 in. by 16 ft. 6 ins. by 6 ft. 6 ins. Each engine is provided with rack inside the fly-wheel rim and a motor driving equipment for turning it over. The condensing apparatus in all three plants is of the Warren twin vertical jet type, with 16-in. by 48-in. by 24-in. air pump cylinders.

The equipment for Harvard and Charlestown power stations is the same, except that the new chimneys vary in dimensions. The Harvard stack is to be 225 ft. high and 11 ft. inside diameter; the corresponding data for Charlestown are 200 ft. and 12 ft. Space is provided at both plants for the installation of an additional generating unit with auxiliaries. The addition at Harvard covers an engine room extension of 104 ft. by 66 ft., and a boiler room extension of 140 ft. 6 ins. by 55 ft. 6 ins., inside diameter. At Charlestown the total exterior dimensions of the extension are 158 ft. 4 ins. by 65 ft.

One 2700-kw General Electric direct-connected unit is to be installed in each of these two plants. The engines are McIntosh & Seymour vertical, cross compound, condensing machines, cylinders 40 ins. by 82 ins. by 60 ins. Each has a nominal rating of 4100 hp at 24 per cent cut-off and 50 per cent sustained overload capacity, at which the drop in speed from normal rating is guaranteed not to exceed 4 per cent. These units are to be capable of working at a steam pressure of 170 lbs., with a superheat of 75 degs. F., and 26 ins. vacuum. Their normal speed is 90 r. p. m.

The economy specifications are:

Steam per ihp-hour at 90 r. p. m. with 160 lbs. pressure and 26 in. vacuum; dry, saturated steam—

Load per cent.	Lbs. Steam.
25	15.25
50	13.35
75	12.7
100	12.7
125	13.3
150	14.45

With steam superheated 50 degs. at the throttle—

Load per cent.	Lbs. Steam.
25	12.75
50	12.05
75	12.05
100	12.05
125	12.65
150	13.85

The maximum power which each engine will deliver continuously is 7080 ihp. Bearings are 30 ins. by 54 ins.; shaft diameter, 33 ins.; fly-wheel weight, 200,000 lbs.; diameter, 21 ft.; face, 21½ ins.; receiver capacity, 480 cu. ft. The steam supply pipe will be 16 ins. in diameter, and the exhaust, 34 ins. Weight of low-pressure cylinder, 60,000 lbs.; shaft, 137,000 lbs., not including the armature. The outside dimensions of the low-pressure cylinder are 8 ft. 6 ins. by 10 ft. 11 ins. by 11 ft. 8 ins. The speed variation from no load to 50 per cent overload is not to exceed 6 per cent, with a maximum momentary variation of 4 per cent. The throttle valves will be of the Schutte & Koerting semi-steel, quick-closing type, and an automatic stop with auxiliary governor is to be provided. Richardson lubricators will be used on the cylinders.

The completion of the foregoing work will give the following capacities in the various power stations of the company:

Station	Capacity Kw.
Central	12,900
Auxiliary	1,600
Lincoln	13,500
Charlestown	7,000
Dorchester	3,750
Harvard	6,300
East Cambridge	2,802
Medford	975
Somerville	700
Allston	744
East Boston	600
Total	50,871

The constructing engineers for this work are the Stone & Webster Engineering Corporation, of Boston.

AVOIDING GROUNDS ON ELECTRIC CAR RESISTANCES

BY A MOTOR INSPECTOR

Figs. 1, 2 and 3 indicate a method of suspending grid rheostats under a car, and with minimum chances of subsequent shocks to passengers or short-circuits from frame to frame in wet weather. Investigation of cars that were giving both of these troubles showed that shocks were, in most cases, due to hanger bolts passing through the car floor and to the hangers and resistance frames, both of which was metallically connected to the same iron channel bars. The resistance metal of a grid rheostat is normally insulated from the containing frame, but the distance from the metal to the frame is short, and it does not take salt

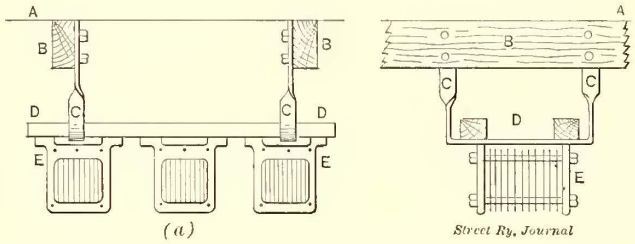
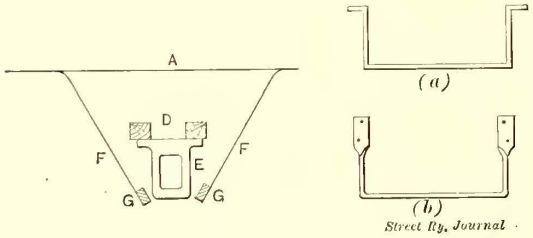


FIG. 1

slush thrown by the car wheels very long to establish an arcing path, which ultimately becomes a short-circuit, especially if the hangers are accessible to any grounded part under the car. Such a grounded part is usually provided by the hanger coming near another hanger or carrier belonging to the hand or air brake rigging.

In the diagrams, *A* is the under side of the car floor; *B*, two of the cross sills; *C*, the iron resistance hangers; *D*, 2 in. x 4 in. sticks of ash soaked in insulating paint, and, in this case, about 5 ft. long; these sticks are provided with two sets of holes, so that the pieces kept in stock can be used whether the resistance frames must be hung to them the long way or side by side, as in the engraving. *E* represents the resistance frames. It will be noted that the hangers are secured by bolts that pass horizontally through the car sills. In case the sills do not come in the right place conveniently to permit this construction, extra timbers equivalent to the car sills can be bolted to the car floor and the hangers can then be bolted to them. The chances of a passenger stepping on a live bolt are minimized, and as adjacent frames are separated by lengths of insulating wood, the chance of trouble involving more than one frame is small.

Fig. 2 shows where a hanger construction, instead of



FIGS. 2 AND 3

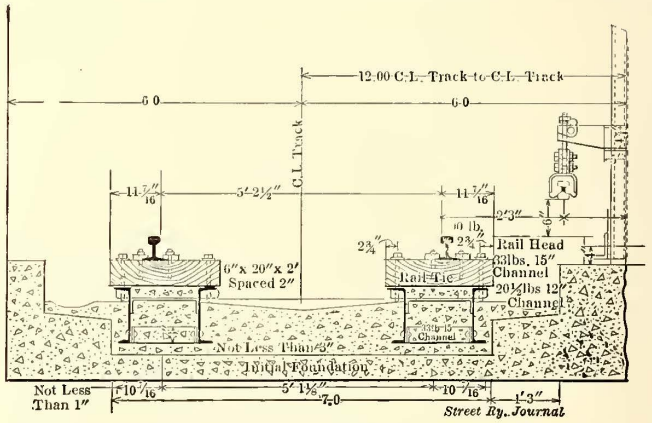
lying along the longitudinal center line of the car, had to be placed along the cross center line, with the result that the two outside resistance frames were brought within the range of slush thrown by the car wheels. Here *F* is a canvas curtain hung in the manner indicated. Ordinarily a curtain is a bad thing, because it deprives the coils of the windage so useful in keeping them cool; but sometimes its use is unavoidable.

Where such a plan is practicable it is well to keep the resistance symmetrical with respect to both center lines of the car and out of the range of the wheel spray. On single-end cars the proposition of installing the resistance may be simplified by hanging them under the rear end, where they will have to be protected possibly on but one side. Fig 3 (a) shows the kind of hanger generally used and which calls for through bolts in the car floor—a bad thing. Fig. 3 (b) shows a hanger of the same general dimensions, but with straight legs, which require horizontal fastening, as in Figs. 1 and 2. This wooden stick-horizontal bolt construction has replaced the iron channel bar, vertical construction on more than 150 cars with which grounded resistance troubles had previously been experienced, and in no case has the change failed to make good in the worst of weather conditions. Originally fifteen different kinds of hangers and almost as many different kinds of channel bar were used, but they have been replaced by three kinds of hanger and one kind of wooden stick with two sets of holes bored in it. This makes it practicable to keep all parts in stock in minimum storehouse space and with minimum chance of running out of what is needed in repair work.

On the old style of resistance frames the possibility of grounds was admitted and the holes in the legs of the resistance frames were made sufficiently large so that an insulating bushing could be used around the bolt that secured the frame to the hanger. In the modern frames, however, the bolt hole is too small to admit of using a bushing, so that other preventive measures must be taken, as described. A wise precaution to prevent the current from finding a leak and finally a jumping path from the resistance metal to the frame, is to use on the ends, instead of the last 16th inch of mica washer, a piece of mica or micanite several inches in diameter, thereby making the trouble path longer.

EXPRESS TRACK CONSTRUCTION IN THE PHILADELPHIA SUBWAY

In the article on "Recent Progress in Heavy Electric Railway Work at Philadelphia," published in the Street Railway Journal of Feb. 16, 1907, there were several



TYPICAL SECTION FOR EXPRESS TRAINS IN MARKET STREET SUBWAY

illustrations showing the methods for carrying the third rail in the Market Street subway and on its elevated extension. Brief reference was made in that article to the proposed sub-structure for the subway express tracks, but at that time some of the details were still uncertain. The

accompanying cut illustrates the type now approved as standard. It will be seen that the yellow pine blocks to which the rails are secured are bolted to the top members of two 20½-lb., 12-in. channels embedded in concrete. These longitudinal channels are separated by short sections of 33-lb., 15-in. cross channels, which keep them parallel when the concreting is in progress. To provide for the ultimate installation of guard rails the running rails were laid off-center on the blocks.

ELECTRIC CAR LOADS ON HIGHWAY BRIDGES

At a recent meeting of the Boston Society of Civil Engineers a number of points of interest to electric railway engineers were brought forth in the discussion of a paper on "Replacing Bridges," by H. K. Higgins. F. P. McKibben stated that in the design of track stringers of highway bridges carrying electric cars, the stringers directly under the rails should be computed to carry the entire loads from the rails without relying upon the planking to distribute the loads to adjoining stringers. In the study of existing bridges of this kind it is frequently necessary, however, to assume that the planking distributes the track loads over a considerable width of the roadway, and hence over several lines of stringers.

If the planking is in good condition this assumption is allowable, but it is difficult to determine exactly how the loads are proportioned among the various stringers. A very common form of track construction is to have the rails resting directly upon a lower layer of planking which in turn is supported by wooden stringers placed 30 ins. on centers with one stringer directly under each of the rails. In this case the amount of load upon each of the stringers is far from equal. Given an electric car axle load in the center of an ordinary 13-ft. panel with 4-in. x 14-in. stringers spaced as just stated, the rail resting on a layer of continuous 4-in. planking, it can be shown that approximately 30 per cent of the axle load is carried by each of the stringers under the rails, 26 per cent by the stringers under the center of the track, and 7 per cent by each of the two stringers just outside of the rail stringers. These percentages change somewhat with change in the size of stringers, thickness of planking, etc., but are of sufficient accuracy to show that the assumption of equal distribution is incorrect. As the weights of electric cars increase, this becomes a matter of considerable importance.

An examination of existing highway bridges carrying electric cars reveals one form of construction which is so prevalent and so poor that it should be emphasized in order that existing bridges having this defect may be strengthened, and that the evil may be avoided in future construction. The practice to which reference is made is that of supporting wooden stringers upon small steel shelf angles riveted to the webs of floor beams, the shelf angles not being braced by stiffeners fitted under the outstanding legs. It is not at all uncommon to find electric railway tracks on highway bridges carried upon stringers which rest upon shelf angles as small as 3 ins. x 3 ins. x ⅜ in. Such angles are almost invariably over-stressed, and Mr. McKibben stated that he has in his possession broken shelf angles from three different bridges.

L. S. Cowles stated that the most frequent overloading of city bridges appears to come from the ever increasing weight of urban and interurban cars. The main girders and trusses are no doubt less likely to be overstrained than the floor system, and especially the connections of stringers to floor beams. In old city bridges the practice of supporting wooden stringers carrying car tracks on single unsupported shelf angles is to be deplored, and all such defects should be remedied by means of vertical stiffeners under the outstanding leg of angle, or where there is not enough space the angle may be supported by vertical bolts and a yoke over the top chord of floor beams.

The question as to what constitutes a liberal allowance for impact for electric car loading is a much mooted one. C. C. Schneider in his very excellent paper on "Bridges for Electric Railways" in the STREET RAILWAY JOURNAL of Sept. 22, 1906, introduces his impact formula for railroad bridges in a modified form so that the addition for impact due to electric car loads is practically one-half that due to locomotive loads. This seems perfectly safe, as the speed maintained on most electric railways is much lower than on trunk lines, and the rotating effects of the motors is no doubt less disastrous than the reciprocating motion of the steam locomotive parts. Certain defects common in the track system of many electric roads might tend to equal the pounding effect of poorly-balanced locomotive driving wheels, but over such a roadbed high speeds could not with safety be maintained.

The heaviest surface car now being equipped on the Boston Elevated Railway will weigh when loaded about 41 tons, and in case the motors are mounted on one truck only, the load on the motor truck will be about 25 tons, or practically the same as for an elevated car on the same system. Thus, for short spans, such as stringers, this is equivalent to a 50-ton car, and in the light of present facts it would seem advisable to adopt as a standard a 50-ton car about 45 ft. long in designing new work where car tracks are to be supported.

F. H. Fay pointed out that in Boston a number of city bridges originally designed to carry a uniform live load of 100 lbs. per square foot, or a single 20-ton wagon, are now being strengthened by the Boston Elevated Railway Company to take trolley cars weighing 50 tons.

THE DENVER RULE BOOK

The Denver City Tramway Company has revised and reissued its Rule Book, and now presents it to employees in the form of a neat pocket-book of eighty-three pages bound in a black leather cover. Among the features of this book are the inclusion of several city ordinances relating to the operation of cars and a comprehensive alphabetical index giving the rule and page number. A number of notes are scattered through the book and printed in italics, to assist the employees in carrying out the rules. For instance, after the instruction to slow the cars to 2 miles an hour at certain points, the note is added that at this speed the car takes about thirty seconds in passing between consecutive span poles. At 4 miles an hour fifteen seconds is the time occupied in passing from one span pole to the next.

Vice-President Buckland, of the New York, New Haven & Hartford, is quoted as follows, in discussing the handling of freight by the trolley lines at Providence: "We believe that throughout the New York, New Haven & Hartford system, by the adoption of the trolley freight service, we can save $15,000,000 annually to the manufacturers and consumers. This is one of the routes where we can try to save some money that is being unnecessarily spent. By combining our steam and trolley services we are sure that we can save a good deal to the citizens of Providence."

NEW TRAMWAY CONTROLLER FOR UNDERGROUND CONDUIT LINES

A new type of series-parallel controller has recently been adopted by the London County Council through its chief officer for tramways, A. L. C. Fell.

This controller was designed to meet the special conditions on the conduit system of the London tramways, where the return circuit is insulated, and is one of two types lately developed by the British Westinghouse Electric & Manufacturing Company, Ltd. The controller supplied to the London County Council is the British Westinghouse Company's T2 type, shown in Fig. 1, and its co-type, T1, shown in Fig. 2, is designed on much the same principle for all circuits employing a ground return. An exterior view of both types is given in Fig. 3. The claims which are set forth for the new design, and the deviations from present tramway practice embodied therein, are as follows:

The electrical connections of the two controllers are so arranged that they can be used with either rheostatic or magnetic braking and with either motor cut out of service. Each controller has four series, four parallel, and seven brake notches, and is specially adapted for smooth starting and stopping when used in conjunction with magnetic brakes. The shape is elliptical, so that the controller conforms closely to the dash-board of the car, and therefore takes up the least possible amount of useful floor space. Special attention has been paid to the mechanical construction, which is very substantial and well adapted for the most severe service conditions. The number of controller parts is said to be materially less than on any other street railway controller of the series-parallel type, and the design is such that all parts are readily accessible for inspection or renewal.

A novel point in the construction of these controllers is that there is only one shaft, upon which are mounted the drums necessary for making the proper electrical connections. As a result of this arrangement, the mechanism for interlocking the drums so as to prevent the main controller drum being moved except when the reverse drum is in the forward or reverse position, and also to prevent the reverse drum being moved except when the main drum is in the "off" position, is extremely simple. Neither of the handles can be removed unless both are in the respective "off" positions. The reverse handle is depressed so that it is level with the controller top, thus making it impossible for the operator to catch his fingers between the two handles. The "body castings" on the main drum are of cast iron and made in two parts, which are clamped about an insulated shaft, thus making it possible to renew the same in a few moments without disturbing the remainder of the drum.

All the copper segments on the main drum are fitted with arcing tips, which are renewable. The fingers are of simple construction, and are also fitted with renewable copper tips, which are made by cutting from a standard drawn-copper section a length equal to the width of the finger. The finger spring is of phosphor bronze, is very flexible, and allows of a large range of movement without affecting the pressure of the finger on the drum. The fingers are provided with an adjustment to limit their range of movement when making or breaking the contact with the drum, and it is impossible for any "stubbing" or catching action to take place. This adjustment is made entirely without the use of any tools, and is positively locked as well.

The cutting out of either motor, in the event of a fault developing, is effected by raising two fingers which are fitted with catches for holding these fingers out of contact with the drum. The motor which is cut out is entirely disconnected, and does not interfere with the operation of the second motor for running or braking.

The arc shield is hinged in such a manner that it can readily be swung clear of the controller to allow of access to the interior, or lifted off its hinges if any repairing is required. The deflector or shield plates are easy to renew, and the shield, as a whole, is of a very substantial construction. The arc shield of the T2 controller is fitted on double hinges, as shown in Fig. 1. This arrangement permits greater accessibility when it is necessary to fix the controller in a confined space. Each controller is fitted with a magnetic blowout consisting of two coils, one on either side of the controller (Fig. 2), the magnetic circuit of which is so arranged that the arc is blown in a direction at right angles to the drum, and does not impinge directly on the deflector plates. This considerably increases the life of the plates. The construction of the controller frame and cover is such as to render the whole water-proof. The cables are protected where they enter the controller by means of rubber-lined can-

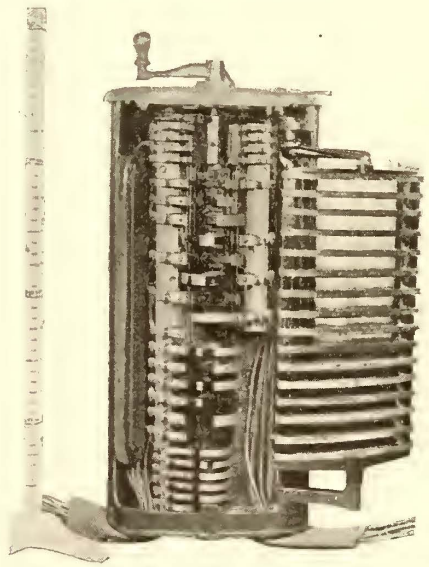


FIG. 1.—T-2 CONTROLLER

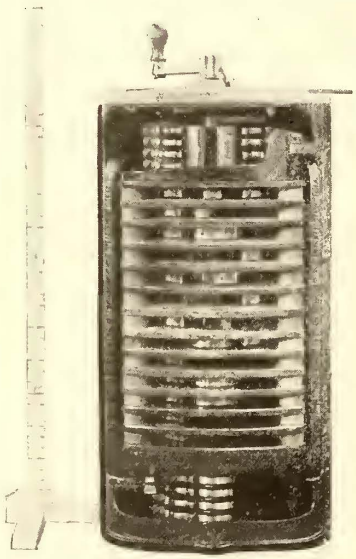


FIG. 2.—T-1 CONTROLLER

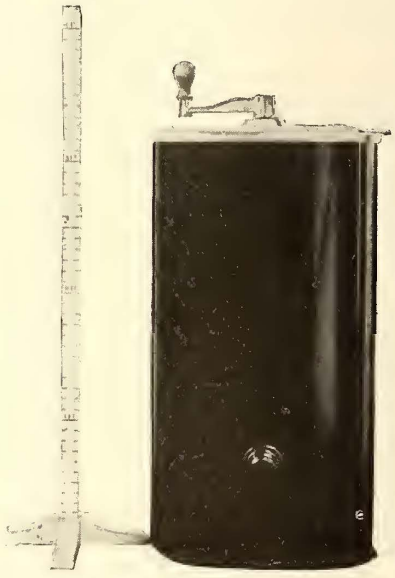


FIG. 3—T-1 AND T-2 CONTROLLER

vas hose, securely fastened to the controller base and long enough to allow of a watertight joint being made.

On the London County Council tramway system 600 of this type of controller have been in constant service for nearly twelve months, with such satisfactory results that Mr. Fell has felt himself justified in adopting them on 300 further cars which are now being built.

SOUTH AUSTRALIAN MUNICIPAL TRAMWAYS TRUST

On Feb. 5 the horse tramways operated by the different companies throughout the city and suburbs of Adelaide became the property of the State Government. They were formally taken over by the Municipal Tramways Trust, a check for £280,372 being paid to the vendors, £280,000 representing the purchase money, and the balance various sums expended by the companies for stock since the agreement was made. The Municipal Tramways Trust is composed of representatives of the State and of the various municipal authorities concerned. The purchased lines are made up of lines in and around Adelaide.

The trust consists of eight members, two being appointed by the Governor, two by the Corporation of the City of Adelaide, two by the Suburban Corporations, and two by the District Councils. Members retire every three years, but are eligible for reappointment. No member of the Legislature may be elected or sit on the trust. The Governor appoints the chairman. Each member other than the chairman is to receive a fee of £1 for each meeting he attends, but not more than £78 in any one year. The chairman is paid £250 per annum. The trust is a body corporate, with perpetual succession and a Common Seal. It has the exclusive right to work horse or electric tramways within a radius of 10 miles from the Adelaide General Post Office.

Within three years from Dec. 31, 1906, the trust is to "form, lay down, make and construct" a system of tramways propelled by electric energy, with or without overhead trolleys. Such tramways are to run from some point or points in Adelaide to terminal points in specified suburbs. So soon as these lines are properly remunerative the trust must complete lines to other suburbs within five years. The financial details show that the Government will issue Treasury Bills bearing interest at 4 per cent, and the trust is to repay one-sixtieth part of the total sum advanced every half-year. The Treasury will control the finances of the trust. The liabilities of the trust and its assets are divided into three portions, one each for the City of Adelaide, the Suburban Corporations, and the District Councils. The usual general powers to break up roads, etc., are conferred upon the trust, which may purchase and use any sort of vehicle, run an amusement park, or do various other things for the furtherance of its tramway business. Except with the consent of the Governor, the work of construction must be done by contract, and the total cost of the conversion from horse to electric traction, including everything, must not exceed £12,000 per mile, on average. No contract may be made without the consent of the Governor.

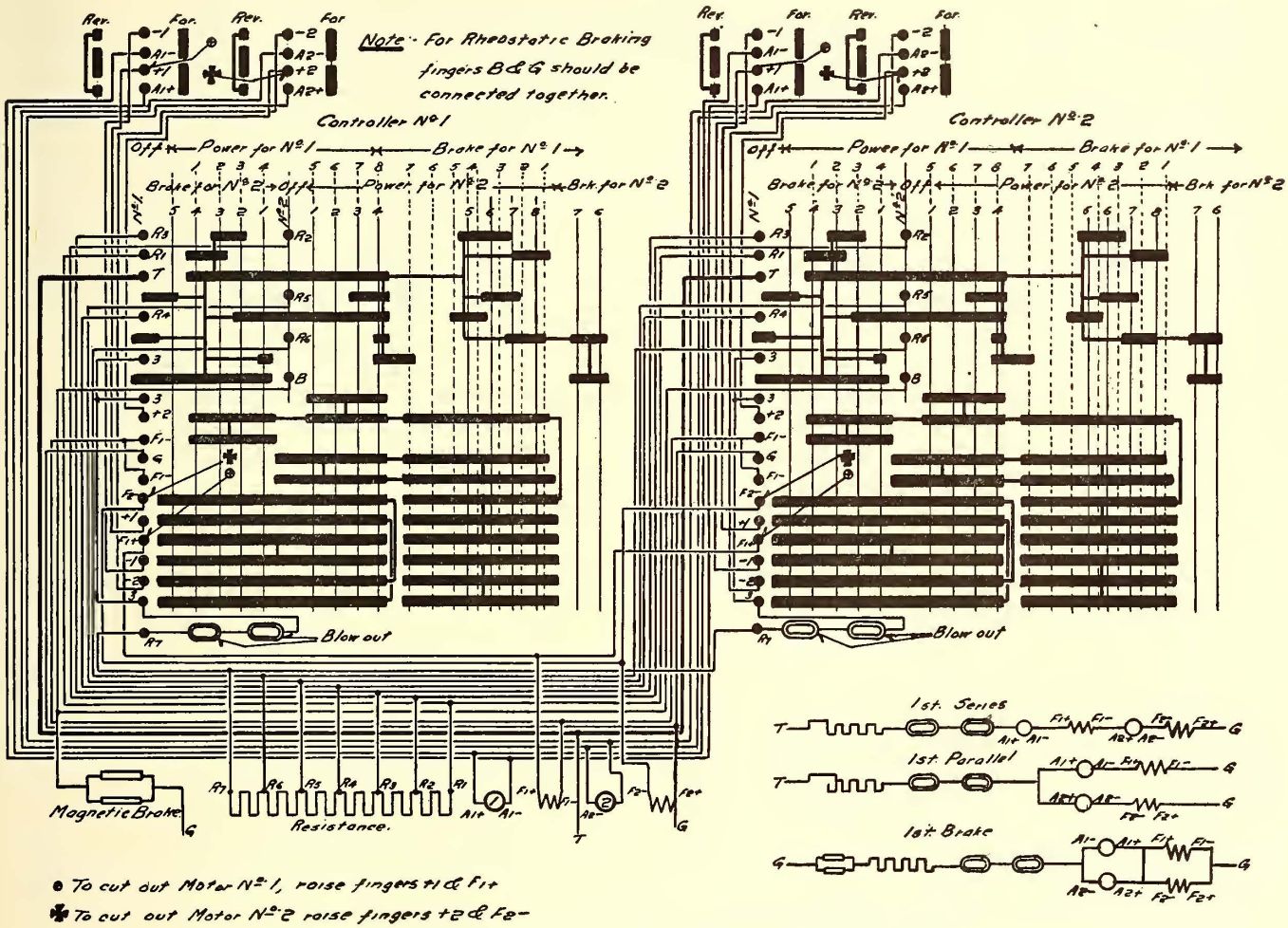


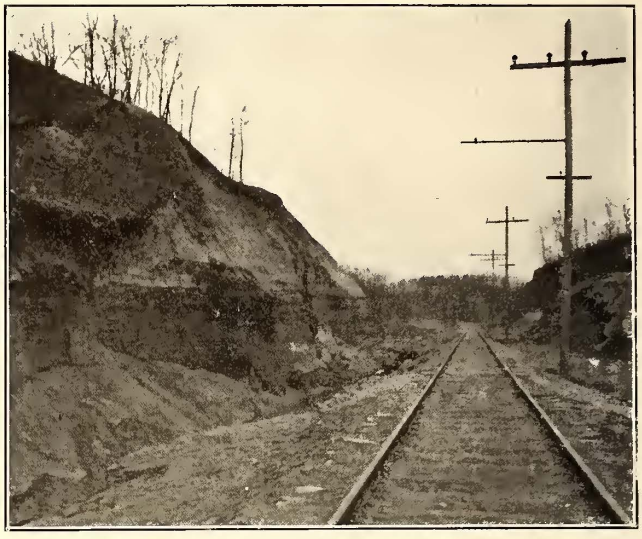
FIG. 4.—WIRING CONNECTIONS OF TYPE T CONTROLLER

THE PEORIA-BLOOMINGTON SINGLE-PHASE LINE

The first single-phase line to be put in operation by the Illinois Traction System is the Bloomington-Peoria section of the Peoria, Bloomington & Champaign Traction Company. The line which is now in operation between Bloomington and Peoria, a distance of 38 miles, will eventually be extended to Champaign, about 50 miles southeast of Bloomington. The road has been built with a view of making the run between Bloomington and Peoria in one hour, and, as a consequence, sharp curves and heavy grades have been avoided even at considerable cost. The line is 3 miles shorter than either the Vandalia or the Lake Erie & Western Railroad between Bloomington and Peoria. The time on these steam lines is at present one and one-half hours. The road is built on a private right of way 80 ft. wide. It passes through a well-populated farming district and reaches several towns of some importance. Among these are Danvers, with about 700 people, and Mackinaw and Morton, each with a population of about 1000. The terminal cities, Bloomington and Peoria, have a population of approximately 25,000 and 60,000, respectively.

Near Bloomington the country traversed is comparatively level and no excessive cuts and fills were required. Towards the west terminus, however, the land is exceedingly rough. At one point a 50-ft. cut partly in rock was made, and there are several fills from 40 ft. to 60 ft. high. The largest steel structure on the line is a bascule bridge over the Illinois River at Peoria. The structure consists of three truss spans which form the east approach to the draw and a series of girder spans west of the draw carrying the tracks over several steam railroad switch tracks and through an extension of a new turbine power plant at Peoria which will supply current to operate the line. All of the spans rest on concrete piers. The east approach to the steel structure is over about 600 ft. of trestle, while at the west end the tracks are gradually brought down to the street level by the girder spans. Another steel structure of note is a viaduct over the tracks of the Vandalia Railroad about 1 mile west of Morton. The larger waterways are crossed

VIEW NEAR BLOOMINGTON, SHOWING THE CHARACTER OF THE COUNTRY THROUGH WHICH THE LINE PASSES



A HEAVY CUT ABOUT 5 MILES FROM PEORIA

BASCULE BRIDGE OVER THE ILLINOIS RIVER AT PEORIA

by steel spans resting on concrete abutments. The smaller ones are formed of concrete arches.

SUB-STATIONS

Power to operate the line is obtained from two transformer sub-stations, at Danvers and at Morton, approximately 20 miles apart and 10 miles distant from the terminals of the road. Both are housed in similar combination sub-station, freight, and passenger stations of fireproof construction. The floors and roofs are of concrete and the exterior walls dark colonial brick with limestone trimmings. In the front portion of each building is a passenger waiting room; the sub-station occupies the rear portion, and a freight room, with the floor elevated to the height of the car floor, is located in the central portion. A spur from the main track runs alongside a covered loading platform on one side of the freight room, and on the opposite side of the building is a doorway used in loading and unloading wagons.

In each sub-station is installed two 200-kw, 33,000 to 3300-volt, single-phase, oil-insulated, step-down transformers. All three wires of the three-phase, high-tension line enter the building, and the connections are such that the lines may be disconnected at the sub-station by opening a triple-pole oil switch. When this switch is open the sub-station may be operated from either the Bloomington or Peoria side of the switch by throwing a hand-operated double-throw switch. Between this hand-operated switch and the transformers is a double-pole oil switch. Near the transformers is installed a totalizing panel carrying a 150-amp. ammeter, and against one wall is a double panel for the two feeders leaving the station. This latter board is provided with two 100-amp. ammeters. A 30-amp. ammeter is connected through transformers to the high-tension lines. Multiple gap lightning arresters for the high-tension lines are installed on the rear wall of the sub-station room.

VIADUCT OVER THE VANDALIA RAILROAD NEAR MORTON

THE MORTON SUB-STATION, WITH ACCOMMODATIONS FOR PASSENGERS AND FREIGHT

THE TRACK AND ROADWAY

The track is built with a 70-lb. rail laid in 30-ft. lengths. Continuous rail joints and General Electric No. 0000 plug bonds are used. The entire road is ballasted with gravel.

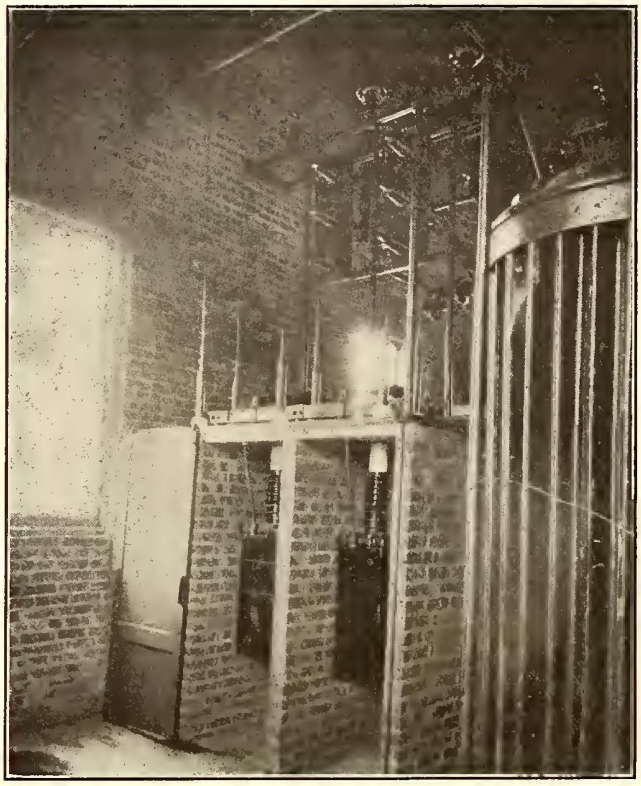
OVERHEAD CONSTRUCTION

The poles, which are spaced 140 ft. apart, are of Idaho cedar, 40 ft. long, and have 7-in. tops. They are set 7 ft. in the ground with 6 ins. of concrete around the butts. A derrick car hauled by a locomotive was used in setting the poles. The same train carried sand, stone and cement, and the concrete for each pole was mixed on the car at the time the pole was set.

At the top of the poles is a single cross-arm measuring 4¾ ins. x 5¾ ins. x 10 ins., which carries the three No. 2 hard-drawn copper wires of the three-phase, high-tension system. A gain is provided for a second shorter cross-arm above the one now in position to carry two of the wires of a second high-tension line to be installed later. The third wire will be carried on the end of the long cross-arm, and, when completed, the two circuits will have a double-delta arrangement. Locke No. 312 triple petticoat insulators are supported on malleable iron pins secured to the cross-arms by wrought-iron bolts passing through them, carrying the high-tension wires. A No. 6 iron ground wire, grounded every sixth pole to an iron bar driven in the ground, is run at the top of the poles. A cross-arm just below the trolley bracket supports a telephone circuit of two No. 10 hard-drawn copper wires. These are carried on No. 7 Locke insulators and are transposed every four poles. Cross-country telephone lines encountered have been placed 2 ft. under the track in iron conduit. Outside of corporation limits the catenary trolley construction is carried on tubular brackets, all of which were set with instruments. On curves a span wire ties the bracket pole to a pole placed on the opposite side of the track, and this

latter pole is braced by a guy anchored in the ground.

The messenger wire of seven-strand, 7-16-in. Siemens-Martin cable is supported by Locke insulators secured to iron pins with Lehigh Portland cement. A two-bolt clamp holds the pins to the bracket arm. Outside of towns and cities the trolley, which is of No. 000 grooved wire, is suspended to the messenger at three points between poles, and, as the poles are set 140 ft. apart, this makes the distance between supports 46 2-3 ft. Inside of municipal limits the number of suspensions varies up to eleven. The messenger has a deflection of 28 ins., the trolley being 2 ins. below it at the middle suspension. The trolley is staggered 7 ins. by varying the distance from the center line of the track 1 in. at each bracket. At the extreme points a steady brace is employed to hold the trolley the proper distance from the poles. These steady braces, which are also used at curves, consist of a long maple insulator with a trolley clamp at the outer end. They are bolted to the pole with an upward slope towards the pole to avoid possible interference with the top contact of the pantograph trolley.



APPARATUS AND WIRING IN THE MORTON SUB-STATION

At each end of all curves and on tangents at ¼-mile intervals the trolley is braced by short connecting guys attached at the points of suspension nearest the pole to both the trolley and the messenger wire. The two guys from each suspension are carried back under the bracket, where they are clamped, and they are then extended to the adjacent poles.

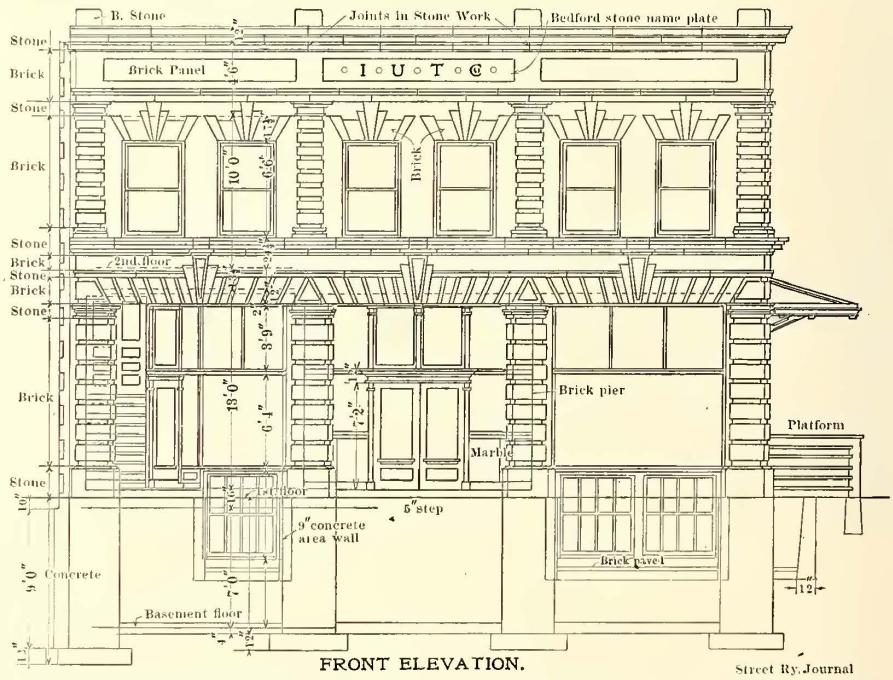
A rather novel method was employed in stringing the wires. The high-tension wires and the ground wire were strung before the brackets were put up. Two flat cars hauled by a locomotive were employed. One car carried the reels of wire, while the other was provided with a gin pole which could be swung out over the cross-arm. A horizontal arm on the end of this pole contained grooves for the three high-tension wires and the ground wire. After the wires had been started through the grooves the construction train moved along and the wires were laid over the cross-arm. The brackets were then put up and the messenger wire and the trolley were strung in a similar manner.

CARS

The cars operated on the line were built by the American Car Company, at St. Louis. They are 51 ft. 6 ins. long over bumpers and weigh about 40 tons completely equipped. They have a seating capacity for fifty-eight people. The interior is divided into a smoker and passenger compartment, both of which are provided with cane seats. The interior finish is dark oak. A heater and toilet room is located in one end, and in the opposite end is a switch cabinet. The cars are built for operation in both directions. In addition to a pantograph trolley over the center of the car wheel trolleys of the usual type are provided over each truck. The cars are equipped with four General Electric 75-hp a. c.-d. c. motors geared for 50 miles per hour. The Illinois Traction System, of which the Peoria-Bloomington line is one division, is operated from offices in Danville, Ill., by L. E. Fischer, general manager.

NEW INDIANA UNION TRACTION COMPANY STATION AT KOKOMO, IND.

In accordance with its policy of erecting suitable stations in the larger cities through which its lines pass, the Indiana Union Traction Company has just completed quite an elaborate passenger and freight station at Kokomo, Ind. The building, which is two stories high, measures 127 ft. deep and 46 ft. wide. The exposed walls are built of hydraulic

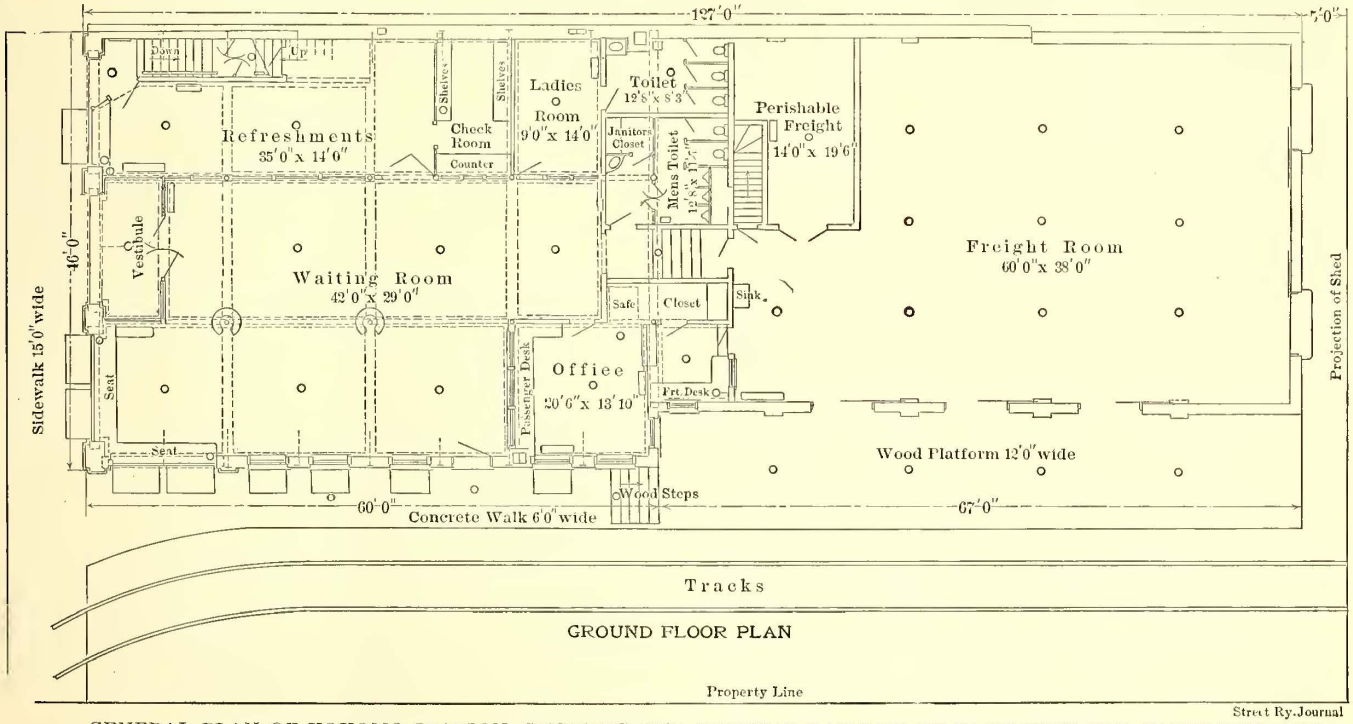


FRONT ELEVATION OF THE INDIANA UNION TRACTION COMPANY'S STATION AT KOKOMO, INDICATING THE TYPE AND MATERIALS OF CONSTRUCTION, SHOWING ALSO THE POSITION OF THE LOADING PLATFORM

pressed brick with trimmings of Bedford stone. The first floor is divided about equally between a passenger station and a freight room. A passenger waiting room entered through a small vestibule with marble wainscoting, measuring approximately 29 ft. x 55 ft., takes up the greater portion of the front portion of the building. The waiting room is provided with a concrete floor and plastered walls above a marble base, and is finished in dark ash. Separated from the room by a glass partition is a refreshment room and a ladies' room. This latter room has a toilet in connection with it.

The office in the rear of the waiting room has a passageway leading to the freight room, and there is also a doorway between the freight and waiting room. A small room partitioned from the large freight room is kept heated and is used for perishable fruit. Three doors, 12 ft. 10 ins. wide, open out on to a 12-ft. platform extending the full length of the freight room on the south side, while wagons are loaded and unloaded through two similar doors in the rear of the building. Passenger cars stop in the street in front of the station and freight and express cars are run on a siding extending along the south side of the building. On the whole, this station should prove a worthy model for other interurbans doing a freight and passenger business, and the Indiana Union Traction Company deserves commendation for its progressiveness in this direction.

COMPLETED KOKOMO STATION OF THE INDIANA UNION TRACTION COMPANY, WITH VIEW OF CAR-LOADING PLATFORM AND CAR



GENERAL PLAN OF KOKOMO STATION, SHOWING THE GENERAL LAY-OUT OF FACILITIES FOR PASSENGER AND FREIGHT SERVICE

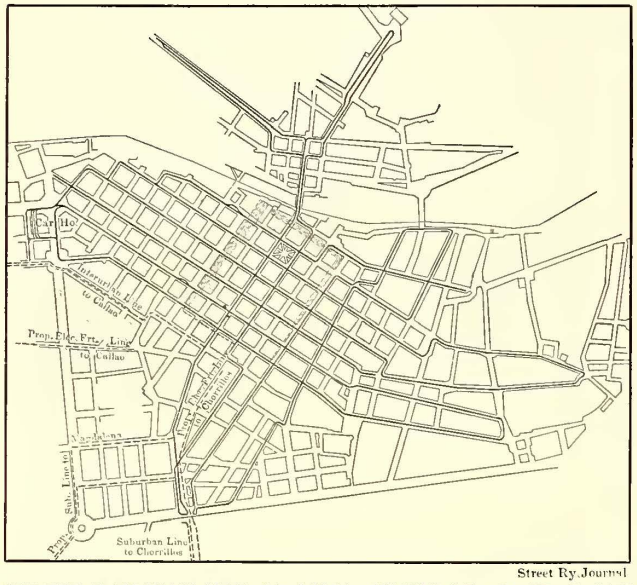
The Portland Railway, Light & Power Company, of Portland, Ore., is rebuilding two of its motor freight cars and changing them into locomotives. They will be used for handling freight trains and will conform in appearance and equipment to two new electric locomotives ordered in the East and due to arrive this summer.

SAN FRANCISCO FINANCES

It is stated that the United Railroads of San Francisco has had to face an expenditure due to the earthquake and strike and for betterments and improvements from March 1, 1906, to March 1, 1907, amounting to $4,294,271. This had all been provided for so that the company on March 1, 1907, had current liabilities amounting to $2,310,209, against which it had current assets of $2,177,410. In addition to this, it has sold securities which were delivered in March that netted it an amount in excess of $900,000, and still left in its treasury over $2,500,000 of its 4 per cent consolidated bonds. It is claimed that by the sale of securities the $4,294,271 above mentioned has been provided at a cost not exceeding 5 per cent interest. Improvements, however, will not be made as rapidly as first contemplated.

THE ELECTRIC TRAMWAY SYSTEM OF LIMA, PERU

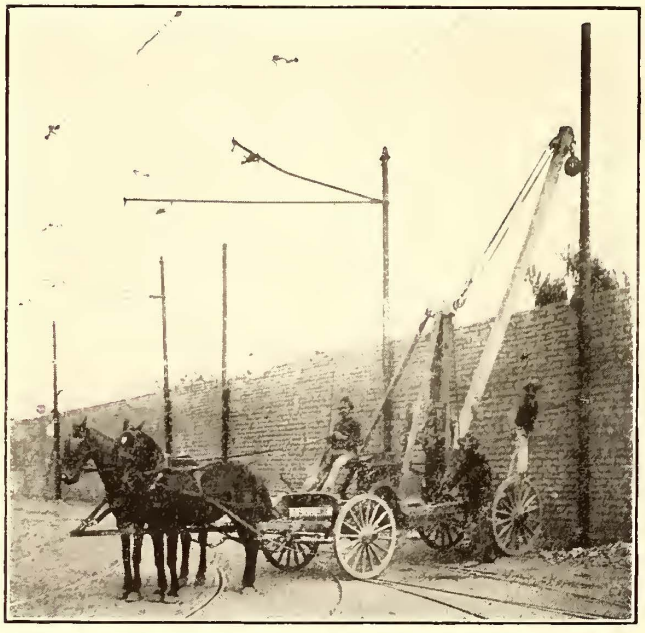
That the cities on the western side of South America are not behind the important towns of Argentina and Brazil in the adoption of modern methods is well shown by the fine electric railway system now operated in Lima, a prosperous Peruvian city with a population of 150,000. Unlike their fellow-continentals, the Peruvians placed this work in the



STREET RAILWAY MAP OF LIMA, SHOWING PRESENT AND PROPOSED LINES

care of United States instead of German capitalists and engineers, so that the installation throughout follows American practice.

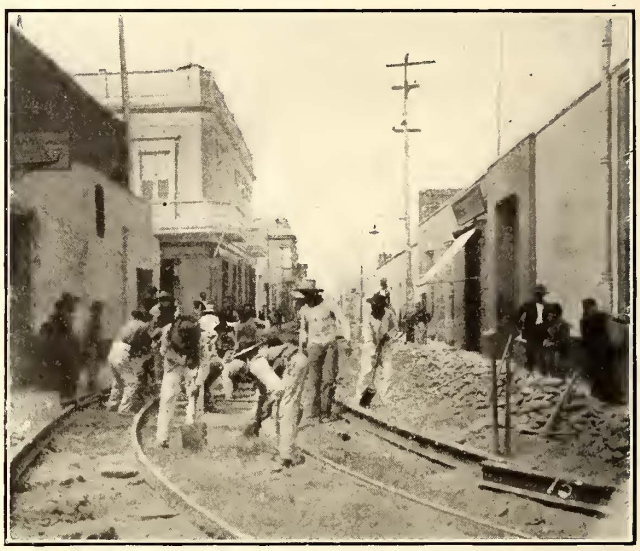
Lima is the first of the cities of Peru to employ electric



WAGON FOR SETTING POLES

traction. In addition to the city road there are two interurban lines, one from Lima to Chorillos, a distance of 8 miles, and the other from Lima to Callao, a distance of 7 miles. By a recent combination, all of the electric interests in the vicinity of Lima have come into one company, the Empresas Eléctricas Associadas. This comprises, in addition to the three railways above mentioned, the Empresa Eléctrica de Santa Rosa, which furnishes all the lighting and power for the city and surrounding towns, as well as the power for all of the railways.

The work of converting the old horse-car system of Lima to electricity was started in September, 1905, and on June 1, 1906, the first line went into operation. The other lines have been operated as soon as ready and the change is now complete. The total length of track is about 40 km (25 miles), made up of nine different lines. On the streets



A CHARACTERISTIC SCENE DURING THE TRACK CONSTRUCTION PERIOD, SHOWING THE NARROW AND CURVED STREETS

paved with asphalt or Belgium blocks a Lorain section No. 326 74-lb. grooved rail is used, and on the other streets a Lorain section No. 263 60-lb. T-rail, 6-ins. high. On account of the narrow streets the cars are operated in only

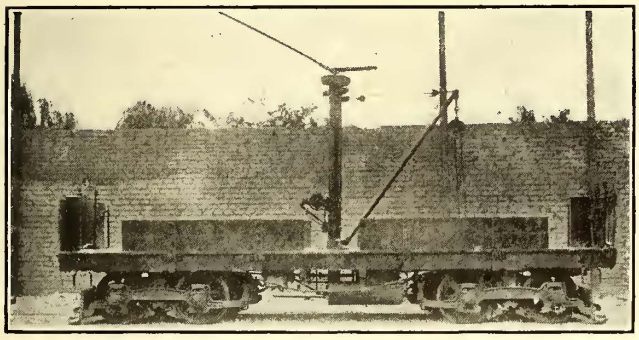
TOWER WAGON IN SERVICE

one direction on a street and the track is laid on one side near the curb.

Many difficulties were encountered in constructing the trolley, as the poles could not be placed on the curb near the track. It was necessary, therefore either to place them against the buildings or on the other side of the street, which would require a very long bracket. As a rule the

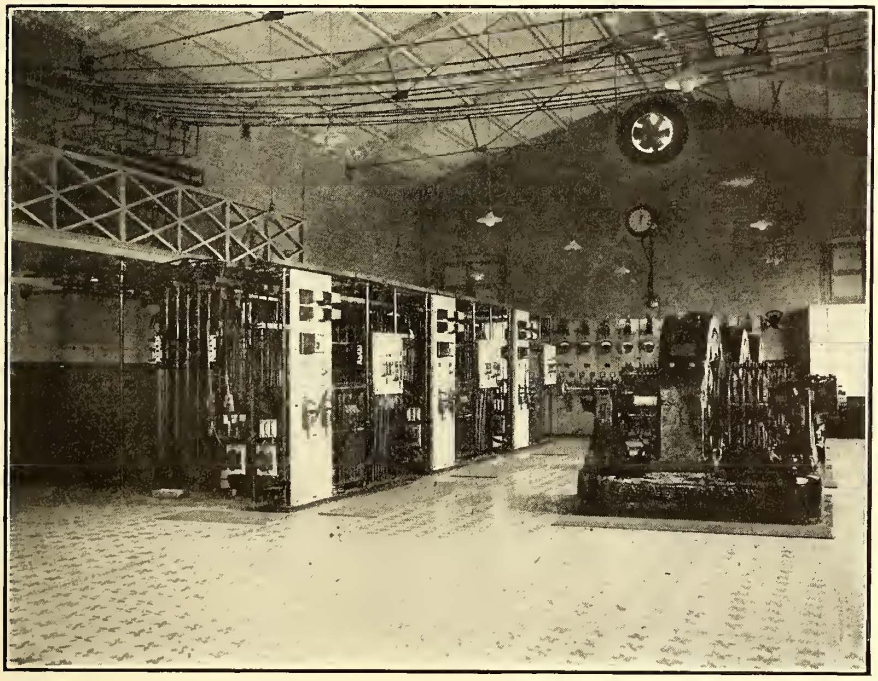
buildings are close together and have overhanging balconies, a condition which has necessitated a great many special arrangements for suspending the trolley. No. 0000 grooved trolley is used, supported on flexible brackets and two-section tubular iron poles. The government regulations require a guard wire over the trolley. The construction devised by the engineer consists of two No. 12 phono-electric wires supported on the brackets 2 ft. above the trolley; this is well grounded and clamped at each bracket, so in case the wire breaks only the section affected will fall.

A complete central energy telephone installation has been installed in connection with the tramway system, the central being located in the main office of the company, with private lines communicating with the car house, sub-station, power station, etc. In addition there are twenty-four telephones installed throughout the city at various points, these being of the iron box type attached to the iron poles.



A SPECIALLY DESIGNED WORK AND FREIGHT CAR

EXTERIOR VIEW OF THE SUB-STATION



INTERIOR OF SUB-STATION CONTAINING THREE 300-KW ROTARIES. TWO MORE HAVE BEEN ORDERED

The sub-station is located in the center of the city and is a brick building 80 ft. x 30 ft., of one story with large passages below the floors for cables. The power is supplied by the Empresa Eléctrica de Santa Rosa from the Chosica water power plant, 40 km (25 miles) distant; the power is transformed in the water-power company's Lima station and delivered to the railway at 2300 volts. To guard against shut-downs, a duplicate transmission lines are provided. The present sub-station equipment consists of three 300-kw, six-phase, 60-cycle rotaries and three-phase 330-kw transformers of the oil-cooled type. Provision is made for two additional units to be installed later, thus bringing the ultimate capacity to five units. Adjoining the sub-station a house is provided for the sub-station attendants and the emergency tower men.

The current is distributed by fourteen feeders, as shown on the plan. The feeder cable is of the steel armored type and is laid in the ground without conduit; manholes are placed at each street corner. The feeders are arranged to give the greatest flexibility possible and reduce to a minimum the lines shut down should it be necessary to take the power off any particular section for any reason.

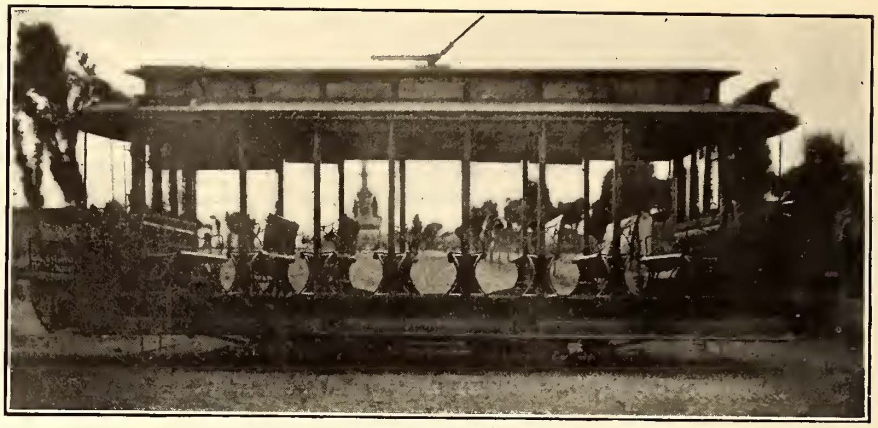
The car house building, which also includes the shops and general offices, is located at one side of the city. The building is of brick, 425 ft. x 200 ft., and contains eight tracks, three of which have pits. The machine shop is 130 ft. x 35 ft. and has a track with pit. The equipment consists of four forges, two upright drills, two lathes, which are arranged in two sets with large benches, so that two gangs of men can work independently. The shop is also provided with a shaper and wheel press.

The carpenter shop is 180 ft. long x 35 ft. wide, and contains one Fay & Egan planer and matcher, one band sawing machine, one No. 1 variety saw. The paint shop is 180 ft. long x 35 ft. wide, and the foundry is 110 ft. long x 40 ft. wide, containing all the necessary machinery appliances for making the castings required in connection with the system. The armature repair room adjoins the machine shop and is equipped with a large oven with electric heaters for drying, and an armature binding machine. A cross pit connects with the pits in the car house, so that the armature lifts may be wheeled directly from the car to the armature room. The stock room is large and conveniently arranged, as it is

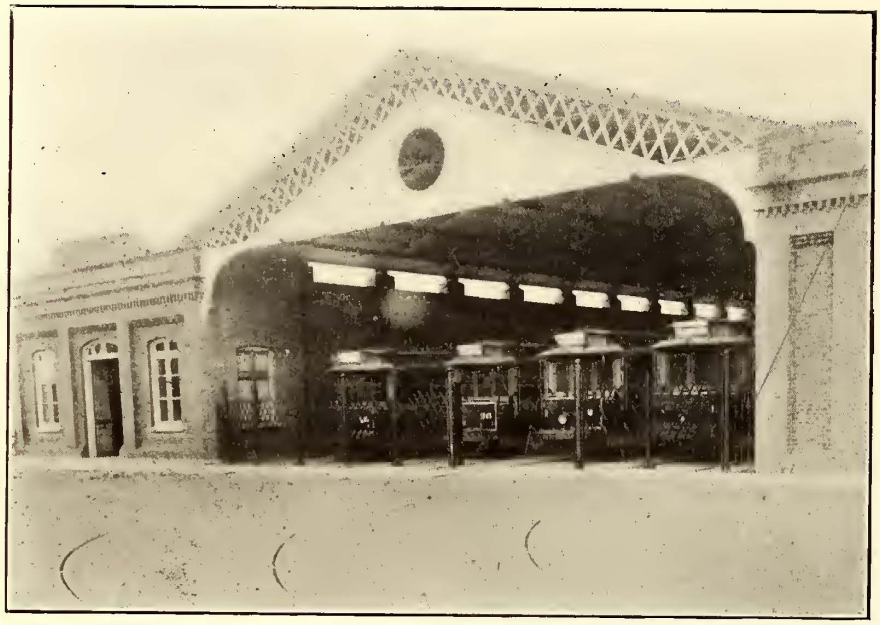
necessary to carry a large stock of supplies, due to the distance from the factories.

In all of the shops the machines are driven by individual motors, and it will be noticed that there is not a single piece of shafting in the entire building. It is also proposed to install a Murphy car-wheel grinding machine in the car house, and this machine has already been ordered.

The car house superintendent's office contains the transformers and switchboards controlling the light and power circuits of the building. A small pump is also installed here for pumping out water which may accumulate in the pits, as there are no public drains and there is no other way of accomplishing this. A large room is provided for the motormen and conductors, and the office provides ample space for the manager, electrical and civil engineers, traffic manager, accountant, cashier, etc. Adjoining the car house is a house for the car house superintendent.

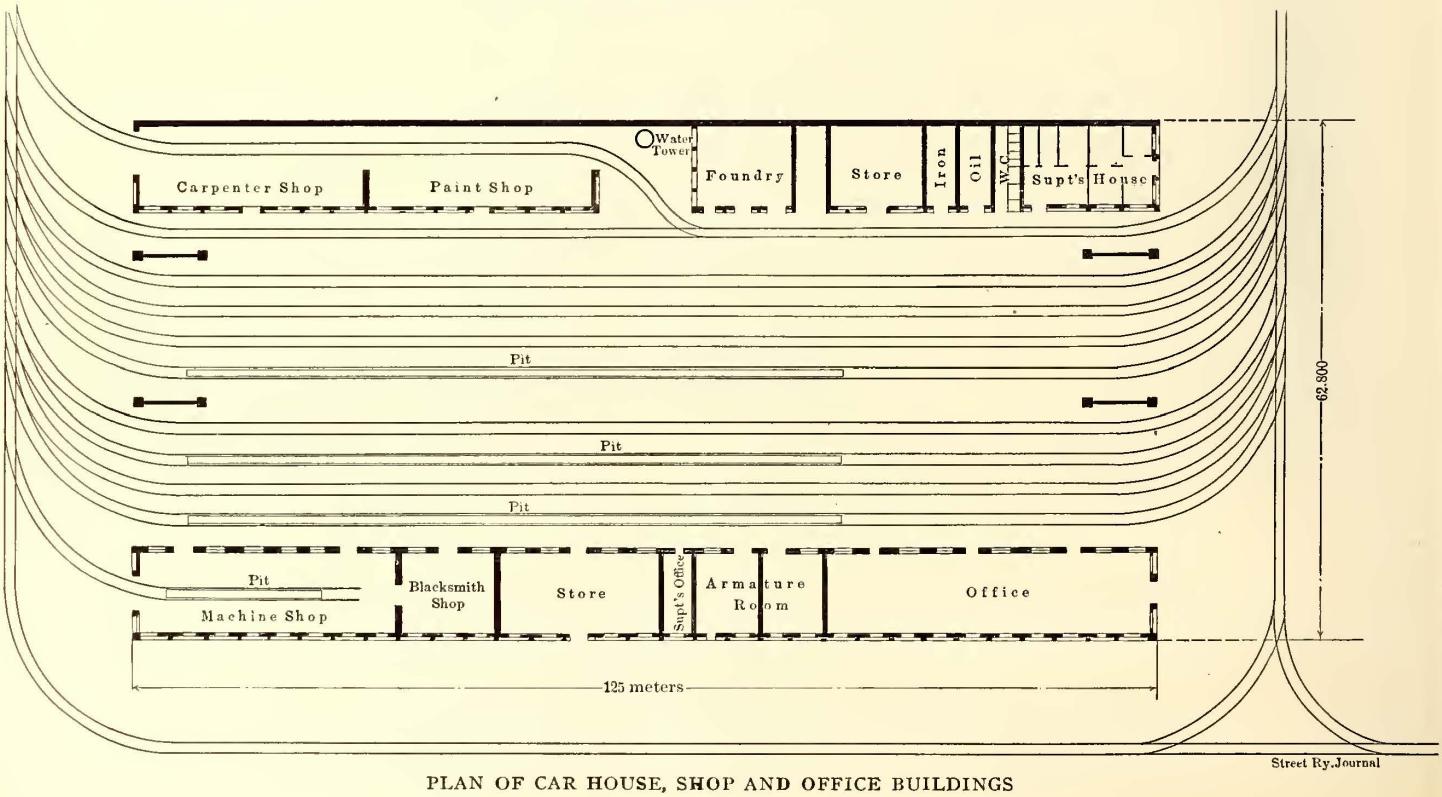


EIGHT-BENCH OPEN CAR USED IN LIMA



THE LIMA CAR HOUSE, WITH GATES BETWEEN THE TRACKS

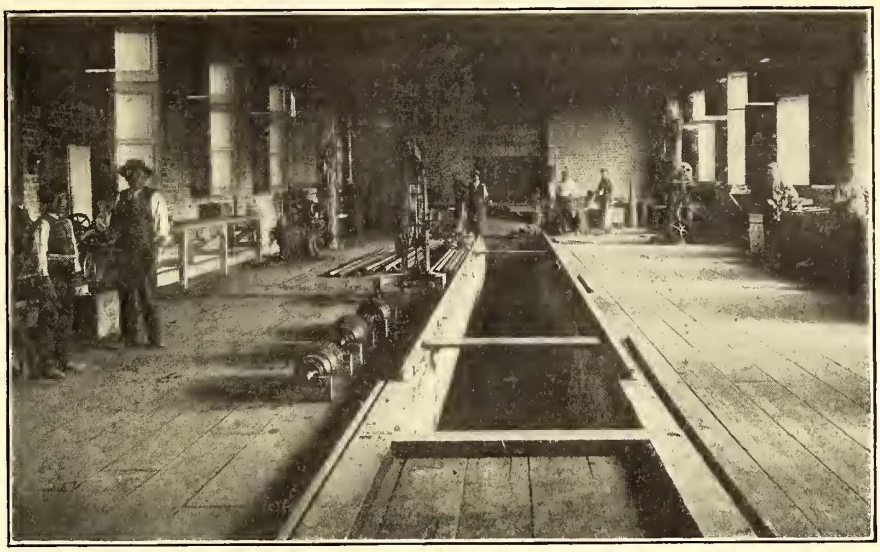
The cars are of the eight-bench open type, fully described in the Street Railway Journal of April 7, 1906. As the government requires the use of air brakes, it was found necessary to place the compressor under one end of the seats and the tank under the other. The brake cylinder is also placed under one end of the car. The trucks are of the solid steel Columbian type, 6 ft. 6 ins. wheel base. G. E. No. 54 double motor equipments are used on all these cars.



PLAN OF CAR HOUSE, SHOP AND OFFICE BUILDINGS

At present there are forty-eight-bench cars, and in addition two sprinklers, two meat cars and a work car with derrick. The G. E. No. 80 double motor equipment is used on the latter cars. Twenty additional eight-bench open cars have already been ordered and will be required as soon as received.

The tramway system was designed by the well-known American engineer, A. W. McLimont, who has also directed the installation. The entire electrical equipment was supplied by the General Electric Company; the open cars by the Stephenson works of the J. G. Brill Company, of Philadelphia; the trucks and special cars by the McGuire-Cummings Company, of Chicago, and the poles, brackets, etc., by the Elmer P. Morris Company, of New York. All of the orders were placed through the firm of W. R. Grace & Company, of New York.

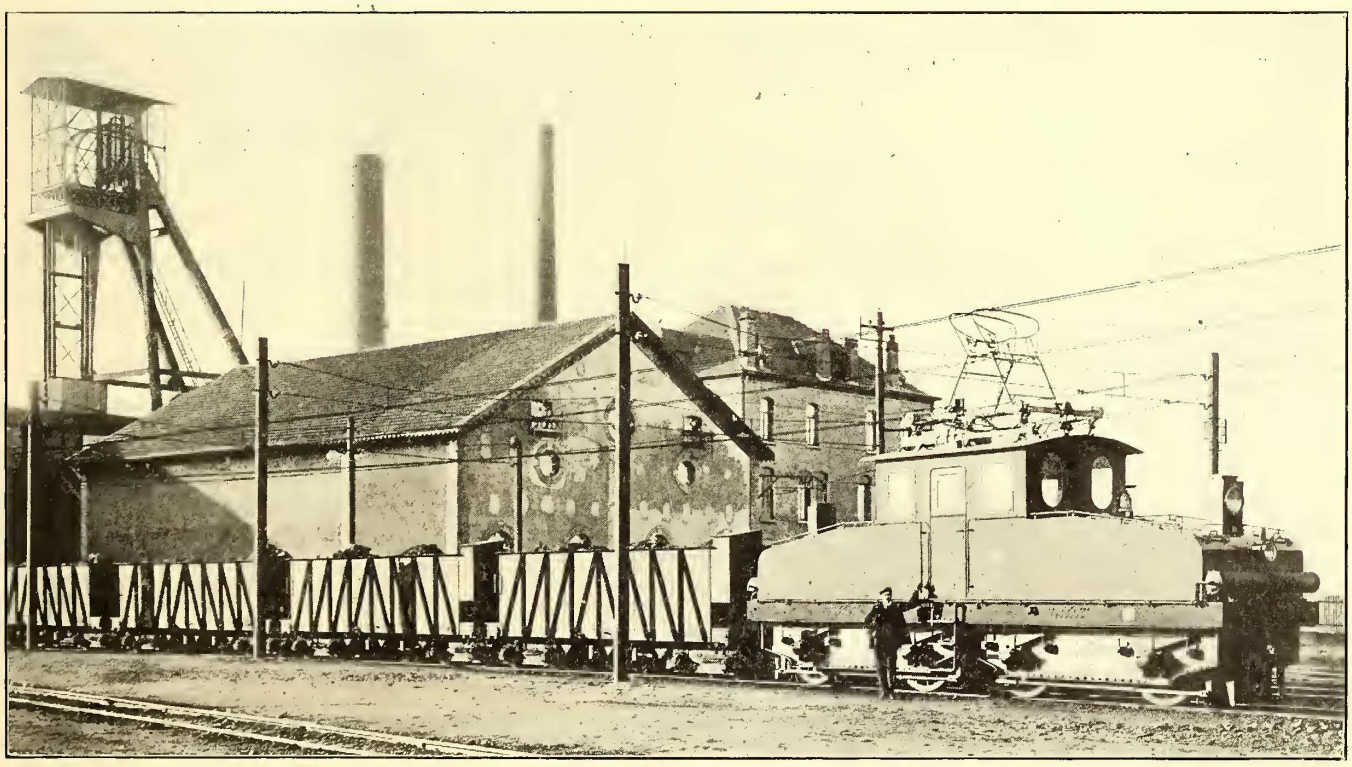


INTERIOR OF THE REPAIR SHOP OF THE LIMA TRAMWAY SYSTEM, SHOWING THE PIT AND GENERAL REPAIR EQUIPMENT

2000-VOLT TROLLEY IN THE MOSELLE DISTRICT

The attention which is being given by electrical engineers in this country to high-voltage direct-current work will give additional interest to a recent installation made by the Siemens-Schuckert Company, of Berlin, at Maizières in the Mozelle district in France, and put in operation late last year. The line is equipped with three electric locomotives, which are used for hauling coal and freight cars. Each locomotive is furnished with four 160-hp Siemens-Schuckert motors and 2000 volts are used on the trolley wire.

Especial interest attaches to the method of current collection, as the pantograph trolley has been abandoned in favor of a double-jointed current collector very similar to that used on the same company's Murnau-Oberammergau Electric Railway, described in the STREET RAILWAY JOURNAL for April 1, 1905. The accompanying illustration gives a view of this collector. As will be seen, it consists of an insulated structure carried on the cab, supporting a collapsible frame on which are hinged the two light bow collectors characteristic of the Siemens overhead construction. The line is 14 km, or 9 miles, in length and has a gage of 1 meter.



ELECTRIC LOCOMOTIVE WITH DOUBLE-JOINTED BOW-TYPE CURRENT COLLECTOR USED FOR HAULING COAL AND FREIGHT CARS IN THE MOSELLE DISTRICT, FRANCE

The Toledo Railways & Light Company is having a car built for the Toledo, Ottawa Beach & Northern for the purpose of advertising the attractions of Toledo Beach.

REVERSING THE POLARITY OF ARC HEAD LIGHTS

BY E. C. PARHAM

In ordinary street arc lamps the top and bottom carbons are of the same diameter and the lamp is so connected that the top carbon is positive, the bottom carbon being negative; under this condition the top or feeding carbon is consumed faster than the bottom one, and the crater, or heated concave light-giving surface, will be formed on the top carbon. On such lamps, if the direction of current flow through the lamp be reversed either by reversing the connections of the lamp or by reversal of polarity of the station dynamo, the bottom carbon will burn faster than the top one and formation of the crater on the bottom carbon will throw most of the light upward, where it will be useless. In the first case, only the lamp with reversed connections will be affected, but reversal of the polarity of the station dynamo will affect all lamps on its circuit. As the lower carbon, due to its longer life under normal operating conditions, is made much shorter than the upper carbon, possibly the first positive indication that the lamp is burning "upside down" is that the lower carbon-holder is badly burned as the result of acting as a carbon.

The writer had occasion recently to notice a considerable number of electric car arc headlights turned in for burned carbon-holders and suspected that the condition might be due to some of the headlights being connected to the car wiring in the wrong polarity relation. This suggested the desirability of a test to determine the relative merits and demerits of an upper and lower positive carbon in headlights, in which ordinary street conditions are somewhat modified by the use of reflectors. The test was as follows:

Two arc headlights, newly trimmed and each in series with its own rheostat, were connected in parallel across the 500-volt railway circuit and permitted to burn steadily for three hours. On one of the lamps the top carbon was made positive and on the other the bottom carbon was made positive. At the end of the three-hour test it was easy to see that one lamp tended to throw the light upward and the other downward; but as both lamps had bright reflectors there was no noticeable difference in the amounts of light projected ahead in the direction desired. Furthermore, measurement with the gage showed that on the lamp on which the lower carbon had been made positive the consumption of the carbon was practically the same as that on the lamp on which the lower carbon had been made negative, although the positive upper carbon showed more consumption than the negative upper carbon. On these lamps the lower carbon is of greater diameter than the upper, and this device seems to have accomplished its purpose of keeping the arc at an efficient average elevation, in regard to the center of the reflector, for the maximum length of time without retrimming.

This test and subsequent observation on a car seem to indicate that the matter of polarity of the arc is of little importance so long as the reflector is in a condition to reflect. Of course, a positive connection to the lower carbon will cause it to consume faster than if the connection were negative, but not enough faster to modify materially the frequency of trimming, provided this frequency has been adequate in the first place. One of the advantages claimed for the parabolic reflector is that the light will be properly projected forward even when the arc may have moved to a point higher or lower than the axis through the center of the reflector. Whether this is theoretically so or not it seems to be practically so as long as the reflector is in a reflecting condition. With the treatment ordinarily accorded arc headlight reflectors, the parabolic reflector rapidly becomes a parabolic absorber, and we are not familiar with the theory of this device. We do know, however, that when the reflector becomes poor it does not fulfil its mission, and the commonness of this condition raises the question as to whether it would not be a good thing for a company operating hundreds of headlights to make home provision for renewing the reflecting surfaces. Actually some reflectors get so bad that a coat of white paint helps them considerably. The reflector is not the only abused and neglected part of an arc headlight. In a later article the writer proposes to show how this valuable part of a car equipment may rapidly become worth its weight in "scrap."

SHELTERS AT OKLAHOMA CITY

At several points on suburban lines the Oklahoma City Railway has erected shelters of the type shown in the illustration. These are comparatively inexpensive structures, yet they answer the purpose of a shelter very well and tend to encourage traffic. They are usually built with two slat seats in the center.

PASSENGER SHELTER BUILT IN OKLAHOMA

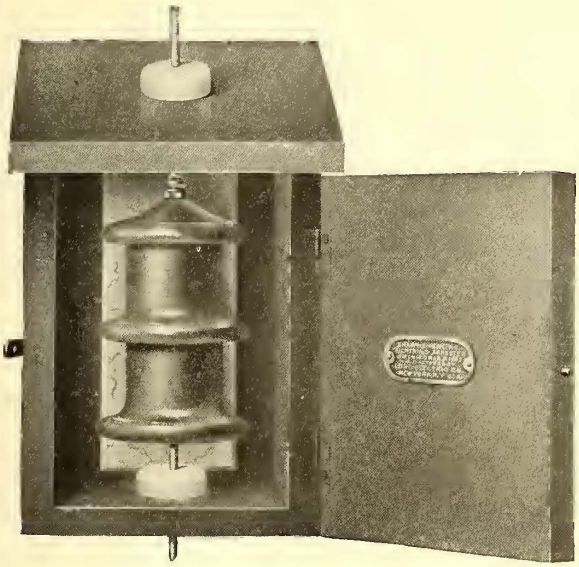
PRELIMINARY INSPECTION OF THE PITTSBURG & BUTLER LINE

The formal opening of the new single-phase line of the Pittsburg & Butler Street Railway Company took place May 1. A party of officials made an inspection of the line from Butler to Pittsburg April 24. On board the car when it left Butler for the Sixth Street and Liberty Avenue terminus in Pittsburg were: George Heard, president of the Pittsburg & Butler Company; William H. Pape, general manager, and C. L. Wilcoxon, superintendent. The car proceeded rather leisurely to Etna, stopping at intervals to permit inspection of the work done on the road. Etna was reached at 10 o'clock, and a short lay-over was taken while P. E. Jones, assistant to the superintendent of the Pittsburg Railways Company's lines; W. F. Fowler, of the Westinghouse Company, and other officials of the companies were gathering, and then the trip to Pittsburg was resumed, the car being manned by an Etna line crew. Frequent stops were made to study the road, so that it was nearly noon when the car reached Pittsburg. The officials say that they expect to be able to cover the distance from Butler to Pittsburg in time that will rival the schedules of the railroad trains.

NON-ARCING LIGHTNING ARRESTER

The manufacturer of the Shaw lightning arrester, the Lord Electric Company, of New York and Boston, in that device has made use of conducting or semi-conducting parts interposed by a series of spark gaps of higher electrical resistivity to offer a path from line to earth of large capacity and relatively low static resistance. The company's patents cover the basic principles of a series of partially conducting discs or rings separated by laminar insulating material in such manner as to give the easiest path for a discharge of a static character and present an impenetrable barrier to the dynamic line current of normal voltage.

The portions of the arrester serving as static low resistance conductors consist of rings resembling carbon,



MODEL A IN WOODEN CASE

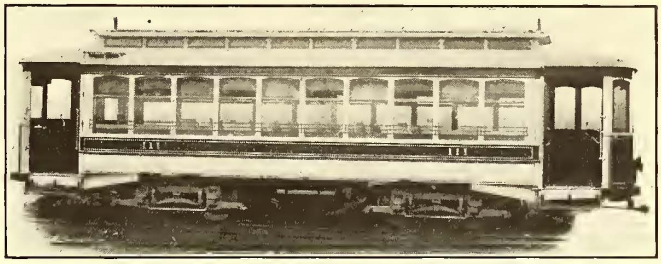
which are treated so as to make them conductors in a class by themselves and yet different from what is commonly known as "non-arcing" material. Each ring maintains an equal spacing between its periphery and that of the next succeeding ring in the series. The rings are separated from each other by mica washers, whose superiority over air or other forms of spark gaps lies in its ability to carry static current by reason of electrolytic capacity, large surface area, non-absorptive nature, and its high insulating qualities, which prevent the passage of a dynamic current.

The combination of non-arcing rings and mica discs are mounted on porcelain arbors having strong dielectric properties. The arbors are inserted into the bore of the rings and discs, leaving the peripheries exposed for the easy transmission of static discharges over large surfaces. The arresters are mounted in porcelain in porcelain housings. For voltages of 1000 and under, the porcelain housings are mounted on a supporting base of wood, while arresters intended for higher voltages are mounted on marble bases.

The arresters are constructed so as to be watertight and dustproof, so that no deterioration ensues. For protection from accident or from malicious persons the instruments are furnished with wooden cases. The arresters are designed for voltages as high as 66,000.

NEW CARS FOR THE CAMDEN INTERSTATE COMPANY

The Camden Interstate Railway Company, which operates from Guyandotte, W. Va., to Ironton, Ohio, and is building additional lines in Huntington, Central City and Guyandotte, received last month from the G. C. Kuhlman Car Company five 28-ft., grooveless post, semi-convertible cars built under Brill patents. The cars operated on the



EXTERIOR OF CAMDEN PASSENGER CAR

Ironton division are, like those delivered by the Kuhlman Company, of the semi-convertible type, and were built at the plant of the J. G. Brill Company. The standard interurban cars are 47 ft. 6 in. long, with a seating capacity of fifty-two. The five new semi-convertible cars are of stand-

EXTERIOR OF CAMDEN FREIGHT CAR

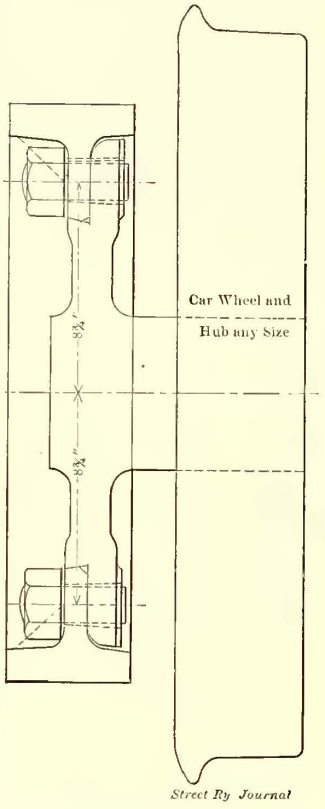
ard length for this type, 28 ft. over the end panels. The trucks are the No. 27-G1 with 4-ft. 6-in. wheel base. The chief dimensions are: Width over sills, including sheathing, 8 ft. 1½ ins.; height from track to under side of sills, 2 ft. 9½ ins.; side sills, 4 ins. x 7¾ ins.; end sills, 5¼ ins. x

INTERIOR OF CAMDEN FREIGHT CAR

6⅞ ins. The interiors, which provide seating room for forty passengers, are of cherry; ceilings of poplar. Another addition to the company's rolling stock is a baggage car for use on high-speed lines; it measures 45 ft. over the ends and is 8 ft. 6 ins. wide over the sheathing; the trucks are the No. 27-E1½ type, with wheel base of 6 ft. and 33-in. wheels.

A MODIFIED SECTIONAL GEAR WHEEL WITH INTERCHANGEABLE RIMS

A number of changes are announced by James F. Fogarty, of New York, as having been made in his sectional gear wheels with interchangeable rims. In the type of wheel brought out by Mr. Fogarty several years ago the hub or permanent part of the gear wheel formed an extension of the hub of the car wheel of any size. In this way the detachable gear could be placed on this extension and removed when worn out without disturbing the car wheel, and it is this process that Mr. Fogarty has succeeded in further simplifying by casting the car wheel and the permanent hub of the gear wheel as one. This removes the necessity of pressing on both the wheel and the hub separately. In addition, it was found to be expensive to mill out the tool casting, because of the rapid using up of the tools, and so a female V has been put in the cast iron at an angle of about 15 deg., which makes it easier to prepare the hub and lessens the cost. In addition to this, Mr. Fogarty has adopted the practice of having the gear on the inside of the hub, as shown in the accompanying illustration. This adds still further to the ease of handling the rims, especially where solid wheels are used, and tends toward reducing the time required for replacing the rims, which is about an hour. As in previous practice, Mr. Fogarty still adheres to the use of four 1⅜-in. drop-forged bolts passing through round holes with some draw for attaching the rim to the hub, but for exceedingly heavy work six bolts can be used. This method insures a perfect fitting rim, as the bolts, drawn tight, force the rim into the V of the cast iron.



SECTIONAL GEAR WHEEL

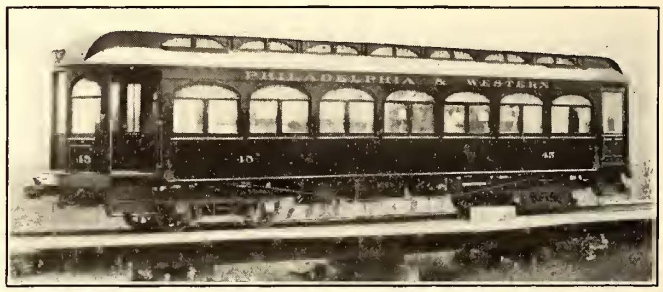
MECHANICAL AND SPLICING EARS

S. Dixon & Son, Ltd., of Leeds, England, have just placed on the market a new mechanical ear for suspending overhead trolley wire. The metal of which the clamps are made is specially hard rolled and has a breaking strain of over 29 tons per sq. in., as against the 19 tons per sq. in. of ordinary cast gun-metal ears made from the British Admiralty mixture. An important feature of this ear is its interchangeability. Every part is made to standard gage and each can be renewed separately at any time, thus obviating the necessity of scrapping the entire ear. The easy and effective way in which a straight line ear can be made into an anchor or a feeder ear are well worth considering. These ears are made in five distinct types, the clip style varying for grooved, round, Fig. 8 and bow trolley wires, and the sweated type for round wire only. The extra attachments are for anchor and feeder ears.

The company also makes an automatic splicing ear which, when desired, can be supplied in the form of an emergency splicing sleeve. The arrangement is such that when the broken ends of trolley wire are inserted in the ends of the sleeve and pushed home the wire is automatically gripped by steel cone grippers and kept in position. As repairs can be instantly executed with this ear, every emergency wagon should have two or more in its equipment.

CARS FOR THE PHILADELPHIA & WESTERN RAILWAY

The Philadelphia & Western Railway Company, now building out of Philadelphia, has received its equipment of cars from the St. Louis Car Company. These cars are of a very neat design and have quite a few new features. The interior finish is mahogany with marquetry inlay designs.



EXTERIOR OF PHILADELPHIA & WESTERN CAR

In the interior incandescent lamps are used, and for the exterior, arc lights. The side windows are double, and the lower sash glazed with plate-glass, upper of Gothic and the deck sash glazed with opalescent glass in metal frames. The main and smoking compartments have the St. Louis Company's reversible seats, with high back and head roll, upholstered with green leather. The cars are arranged to be operated in trains, and have automatic

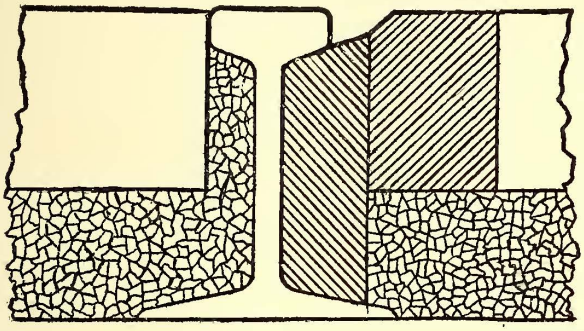

INTERIOR OF PHILADELPHIA & WESTERN CAR

couplers, spring buffers and automatic air brakes. The vestibules are arranged with sliding doors on each side, equipped with electro pneumatic operating device, and also have a door in the end to allow passage from car to car. The general dimensions of each car are as follows: Length of car over bumpers, 51 ft. 4 ins.; length of car over corner post, 40 ft.; length of platform, 5 ft.; width of car over sheathing, 9 ft. 3 ins. These cars are mounted on the St. Louis Company's No. 61 truck.

SPECIAL BLOCKS FOR PAVING AGAINST RAILS

Much of the opposition to the use of T-rail in cities is based on the assertion that no suitable paving blocks exist that will permanently retain the groove desired by wagon traffic. Nevertheless, more or less successful results have been obtained with bricks designed to secure such grooves, but the main fault of single-block types is that any settlement in the tracks will loosen and break them or make the free ends of the bricks kick up; the vibration of the rails will often cause the same trouble.

To avoid these difficulties, the Nelsonville Brick Company, of Nelsonville, Ohio, supplies the desired groove by



using two distinct blocks, one called a "filler" and the other a "stretcher." The "filler" brick fill the entire web of the rail and thus avoid the use of any other kind of filler. They are made in 9-in. lengths, and are easily handled. The "stretcher" brick, to be used in connection with the "filler" brick complete the proper groove for the car wheel flanges and make a good substitute for grooved rails. The "stretcher" brick are 9 ins. long and are laid parallel with the rail, only one being required to take the place of about three nose bricks.

This method is in use in Dayton, Delaware and Bellefontaine, Ohio; Battle Creek and Kalamazoo, Mich.; South Bend, Ind., and other cities.

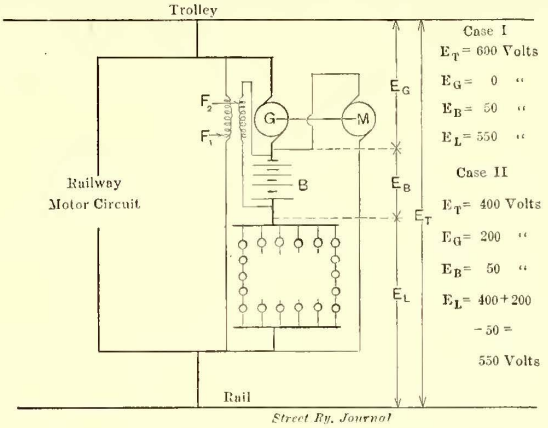
POCKET TEST LAMP

The Chase-Shawmut Company, of Newburyport, Mass., has recently put on the market a pocket test lamp. It is designed especially to overcome the difficulty and annoyance connected with determining whether enclosed fuses have blown out, but is useful in all cases where it is desirable to determine whether or not a circuit is alive. It is made up of a specially designed incandescent lamp enclosed in a fiber casing. The casing has ferrules and knurled binding posts on either end, while at the middle a fair-sized hole through both walls of the casing allows the illumination of the lamp to be plainly seen. For the majority of switches and fuses the metal ends of the test lamp will bridge parts of opposite polarity, but for work where the distance is greater than the length of the test lamp the binding posts afford a convenient means of clamping leads of sufficient length. The device is not designed for continuous service, and should be used only for flashing, as the small, enclosed casing will soon become too hot if left long in circuit.

The test lamp is made in two sizes: one for 110-volt, measuring 3⅞ ins. over all, with a diameter of 11-16 in.; the other for 220-volt, measuring 4¾ ins. over all, with a diameter of 1 1-16 ins.

INTERURBAN CAR LIGHTING SYSTEM

The accompanying diagram shows an ingenious system for maintaining a constant voltage on the lighting circuit on an interurban car, patented last month by Thomas Marshall, of Chicago. As shown, a small generator G, driven at a constant speed by a small motor, is placed in series with the lights across the trolley circuit. There are also inserted in this circuit a number of cells B, known as electromotive-force cells, which will maintain a constant counter voltage when any current passes through the circuit, but



WIRING AND SPECIAL GENERATOR TO MAINTAIN CONSTANT LAMP VOLTAGE

as they have no active material they absorb practically no current and have practically no capacity. The generator has two windings, F_1 and F_2, one connected directly across the trolley circuit, the other across the counter-electromotive-force cells. As these cells maintain a constant voltage across the terminals, the field due to F_2 is constant. These two fields, F_1 and F_2, are wound to oppose each other, and are so proportioned that when the trolley voltage is at a maximum the fields due to these windings are equal. As they oppose each other there is no resulting field at this time, and, therefore, no voltage will be generated by G. This is the condition when the trolley voltage is at its maximum, or say 600 volts, and is represented in Case I.

Suppose, however, the trolley voltage falls to 400 volts. Field F_1 is then overpowered by F_2, and the generator supplies current, and as the strength of the generator field is proportional to the drop in the trolley voltage, the voltage at the generator terminals will be proportional to this drop. This condition is represented in Case II., where the trolley voltage is assumed to be 400 and the battery voltage 50, as in Case I. The result is the maintenance of a constant voltage of 550 on the lamp circuit.

It is claimed that the system can be applied very readily to cars wired at present, the only difference being the motor-generator set and the cells. The latter require no attention except the addition of water to replace that lost by evaporation. If through any accident the motor-generator set should break down, the lights would still be available, as the current would pass through the generator armature.

The Grand Rapids Railway, of Grand Rapids, Mich., recently carried the following advertisement in the local papers: "To Fathers and Mothers: The season is now here when boys and girls begin playing in the streets. To avoid possible accidents to your children, we respectfully urge you to call their attention to the dangers and to give them strict instructions particularly to look out for the street cars. The motormen are on the alert, but the children cannot be too careful."

SINGLE PHASE VS. DIRECT CURRENT FOR HEAVY ELECTRIC TRACTION

The discussion on single-phase vs. direct-current traction, based upon the institute paper of Messrs. Stillwell and Putnam, is being carried on as vigorously abroad as in this country. The opening gun for the d. c. advocates was fired by H. M. Hobart, the well-known engineer and author, who contributed the following letter to the "London Times" Engineering Supplement of April 10:

"In Messrs. Stillwell and Putnam's recent American Institute paper 'On the Substitution of the Electric Motor for the Steam Locomotive," the standpoint is taken that the single-phase system is the only system worthy of consideration for railway electrification. 'Where, ten years from to-day,' they ask, 'will be the 1200-volt or the 1500-volt continuous current systems which have been suggested as substitutes for high potential alternating-current systems in heavy electric traction?' In my opinion, these gentlemen have allowed the desire, shared by all engineers, to secure the best system for long distance work, to supplant sufficient study of adverse details in the single-phase system. My opinion is that within ten years, continuous current systems, as applied to railway electrification, will employ line pressures more of the nature of 2000 or 3000 volts, and these systems will, in all probability, have come into extended use. The single-phase delusion will meanwhile have been exposed (at the expense of the capitalist), and the system discredited.

"Railway electrification on an extensive scale will, however, have been retarded for years—first, in consequence of the waiting policy which is being maintained pending the completion of the single-phase experiments; secondly, in consequence of the prejudice against electric operation of railways which will inevitably follow as a consequence of the analysis of the results obtained with single-phase plant.

"It is highly desirable that railway people should realize that a large number of electrical engineers dissociate themselves from the claims put forward by the single-phase school. This is important for the reason that there is a wide range of railway work where electric operation is of demonstrable advantage if undertaken on sound lines. For long distance non-stop runs, however, it will for some time be difficult or impossible for trains depending for their power on electric energy supplied over long distances, to compete with trains hauled, as at present, by steam locomotives. It is only for such cases, however, that single-phase systems can possibly hold their own in comparison with high-tension continuous current systems. It is very unfortunate that electrical engineers should be handicapped in their endeavor to enter the legitimate field offered by urban, suburban and inter-urban sections of railways (where the traffic is intense and consists in operating trains at short headway, and with frequent stops, at relatively high schedule speeds), for the sake of the vague possibility of some time entering with this single-phase incubus on a field of railway work where the steam locomotive is, by right of merit, most strongly established.,

"For such 'legitimate' work, high acceleration is all important This is readily obtained by the continuous-current motor; it is impossible with the single-phase motor, a mere apology for a motor at the best, which is seen at its very worst when starting and during acceleration. Another important feature for such a service is low weight of train, as almost all the energy delivered from the motor is devoted to imparting momentum to the train during acceleration, and is immediately thereafter converted into heat at the brake shoes (although a considerable proportion of it could well be restored to the line by one or other of the now well-developed systems of regenerative control).

"Now, the electrical equipment, for a given schedule speed, will be twice as heavy per ton of train when single-phase apparatus is employed, as with continuous-current apparatus. The tracks must consequently be stronger and heavier. Thus for a schedule speed of some 25 m. p. h., with one stop per mile, a train to seat 300 passengers will weigh some 250 tons, when equipped for single-phase operation, as against about half this weight when equipped for continuous-current operation. The energy consumption for this schedule speed will also be fully twice as great. The brake equipment must be more expensive and its maintenance much greater. The wear of rails and permanent way is inevitably greater.

"It must be remembered that it is not sufficient to show by electric operation only a very slightly higher acceleration and schedule speed than is attained by steam, but there must be shown a very appreciable gain. The rate of acceleration of a heavy single-phase train, quite aside from the limitations imposed by the disabilities of the motors, cannot approach that readily provided by the light train of equal seating capacity equipped with continuous-current motors.

"Of course, there is always the possibility that a light, efficient and satisfactory single-phase motor may in the future put in its appearance. Indeed, a main contention put forward by Messrs. Stillwell and Putnam, in the paper above referred to, sets forth that a frequency of 15 cycles per second should be substituted for the 25 cycles, towards which standardization has been tending. It was stated that 15-cycle motors would materially surpass 25-cycle motors in the matters of higher efficiency, lower weight, better commutation and less cost. This is true. It is, however, also true that these advantages are in great part offset by the increased weight and cost of the transformers, and by the lower tractive force at starting, and it must appear that this low periodicity does not remove the disabilities of the single-phase motor with respect to acceleration and schedule speed.

"When, however, the legitimate field for single-phase railway electrification is opened up—namely, the operation of trains over long non-stop runs at high speeds—it will be highly desirable to employ low frequencies, probably considerably lower frequencies than the 15 cycles now suggested. Much could be said in favor of a frequency of 5 or 10 cycles per second, and amongst the possibilities which at once suggested themselves long ago is that of a good single-phase induction motor without a commutator.

"It must also be kept in mind that the three-phase system can by no means be ignored as a determinant in the situation; in fact, for long distance, non-stop runs, it has points of superiority over any other system of electric traction as yet put forward. But, at present, it is with the object of obtaining better speed and shorter headway with frequent stops, and the more intense utilization of termini, that resort will be made to electrical methods, and for this work the continuous-current system is distinctly superior."

As two main line railways in England—the Midland Railway and the London, Brighton & South Coast—are introducing single-phase traction, this communication attracted wide attention and resulted in the following letters among others to the editor of the "London Times." These letters are slightly abstracted:

Midland Railway, Derby, April 15.

Sir:—The attitude adopted and the statements made by Mr. Hobart in depreciation of single-phase traction are so exaggerated that they appear likely rather to damage than to assist the cause of direct-current traction, of which apparently he is so strong a partisan. Further, most of the points brought up are rather academic than practical.

Mr. Hobart's contention that a single-phase train seating 300 passengers and operating on the schedule he mentions of 25 m. p. h., with one stop per mile, will weigh 250 tons, is absurd on the face of it, and still more absurd is his claim that such a train will weigh twice as much when equipped with single-phase apparatus as when equipped for continuous-current operation.

A five-car train, composed of three motor cars and two trailers of the Midland Railway Company's stock now built for the Heysham-Morecambe electrification, will seat 324 passengers, and actually weighs 156 tons, inclusive of seated passengers.

The weight is made up as follows:

	Tons	Cwt.	Qr.
Coach bodies and underframes	53	0	0
Seven trailing bogies	31	10	0
Three motor bogies	16	10	0
Electrical equipment	33	0	0
Passengers	22	0	0
	156	0	0

This would allow 20 seconds' stop at every station and give the scheduled continuous overall speed, inclusive of stops, of 25 m. p. h. throughout. The energy consumption (so far as it can be ascertained in limited time) would be about 129 watt-hours per ton mile.

Single-phase motor efficiency may be, and is, lower than direct-current motor efficiency, but it does not follow, as Mr. Hobart implies, that the consequent greater heating must necessarily be taken care of by making the motors twice as large and, still less, twice as heavy. Granting this, however, for the moment, in the above train a direct-current equipment would save 16½ tons, a percentage of 8⅓.

In granting that single-phase apparatus can make the best showing for long-distance work, Mr. Hobart supplies his own answer to his query as to why railway engineers are devoting particular attention to single-phase working. No railway engineer is going to lay down for his terminal and urban lines a system of traction which he may either have to scrap in coming years or which may restrict him to making choice of the second best system for his long-distance work, which latter, when it does come, will be by far the more important. Mr. Hobart, in pointing out the probability of the development of a thoroughly good single-phase motor, recognizes the law of supply and demand, but most of his statements certainly do not appear to have been made with this law in mind.

As for acceleration, this is a mere question of getting the power into the motor. There is no difficulty in this direction with a single-phase motor, and the acceleration with it can be secured quite as well as with direct-current, and much more efficiently, since rheostatic losses are avoided. Presumably, Mr. Hobart has in mind the reactance of the single-phase motor, but this merely amounts to the latter holding back the power till it is ready to take it, while the d. c. motor loses it. The avoidance of rheostatic losses gives the single-phase motor a very considerable advantage for the particular work which Mr. Hobart outlines. As regards regenerative control, neither single-phase nor d. c. motors can yet claim this advantage, badly though it be wanted, but there is at least as much prospect of success with the former as with the latter.

Even against 2000 or 3000 volts direct-current working, which is not here yet, and which, taking everything into account, it is questionable whether we shall be happy with when it comes, if ever, there is very much to be said for single-phase working, even on such lines as those which Mr. Hobart has in mind. The elimination of rotary converters and their supervision and of all moving machinery requiring attention from the power station to the car is of the highest importance, and, with the much higher trolley voltages possible with single-phase traction, feeders are very much less costly.

It is also of importance that the actual high-tension apparatus in a single-phase car is reduced to a minimum, and, being so, can be very easily dealt with as regards protection. With high-tension direct current, on the other hand, there will be a large amount of power wiring at high tension, even granting that the train bus—which would be the most objectionable of such cables—disappears with the third rail and its dead sections, while motor generators, if not secondary batteries, will have to be provided for the lighting, heating and controlling power.

J. DALZIEL.

SIR:—Most of the electrical engineers have a far too optimistic opinion of single-phase traction. Naturally the a. c. system is the ideal system for power distribution, and possesses two features which at once recommend themselves—namely, the elimination of the troublesome rotary converter and the economy in copper, owing to the higher voltage which can be employed. The chief advantage gained by these features is a large saving in the initial cost of equipment. On the other hand, the a. c. car equipment costs more than a corresponding d. c. equipment for a similar service and for the same temperature rise in the motors. The a. c. car equipment is also considerably heavier than the d. c. equipment, owing to the a. c. motors and the transformer. The increased cost of car equipment practically counterbalances the initial saving of the rotary converters, and, owing to the lower efficiency of the a. c. motor, the saving in power resulting from the elimination of rotaries is about offset. The efficiency of a. c. control during accelerating is greater than that of d. c. series parallel control, as voltage control is available owing to the transformer on the car. The a. c. motor does not accelerate as rapidly as the d. c. motor, and consequently the a. c. motor cannot be used where rapid acceleration and frequent stops are essential. The much-abused third rail is very often preferable to an overhead trolley on account of being easy to maintain. As regards the running costs of the two systems, there should be little difference between the two. The maintenance of an a. c. motor equipment costs more than that of a similar d. c. equipment, owing to the higher armature speed and smaller air gap. This, again, balances the cost of maintaining rotary converters. Turning next to heavy locomotive equipments for high-speed passenger and freight service one finds that, owing to the limitations imposed by available motor space, two locomotives each with four a. c. motors are required to do the work which could be performed by one locomotive with four d. c. motors. The following figures may prove of interest. They are taken from the technical papers, and represent the most recent practice in electric locomotives:

	D. C. Locomotive, N.Y. Central	A. C. Locomotive, N. Y., N.H.&H.
Weight	95 tons	85 tons
Length over all	37 ft.	36 ft. 4 ins.
Number of motors	4	4
Horse-power of each motor	550	200
Normal rated horse-power of locomotive	2,200	800
Maximum horse-power of locomotive	3,000	1,000
Speed in miles per hour with 500-ton train	60	.....
Speed in miles per hour with 250-ton train	70	60

The above figures clearly show the advantage of d. c. motors for heavy locomotives. Single-phase a. c. traction is still young, and a good many improvements, especially in motor design, are likely to take place. As main line traction in England is out of the question for a great many years yet, electrical engineers must be content if railway companies electrify their suburban lines. These lines require high acceleration and frequent stops, and the use of single-phase motors would be inviting disastrous results. In my opinion, a. c. traction is eminently suitable for small cross-country lines where local traffic is dealt with, or for high-speed interurban tramways such as are largely used in America. In the meantime, I share Mr. Hobart's opinion that high-tension d. c. motors will be the only solution to the traction problem.

"ENGINEER."

MANCHESTER, April 15.

SIR:—Mr. Hobart's article on single-phase versus continuous-current railway electrification in the "Times" Engineering Supplement of April 10, is not a comparison of systems, as its title would imply, but a comparison of motors. The most enthusiastic advocates of the single-phase system have never claimed that the motor was as light in weight or as low in first cost as the present 600-volt continuous-current motor, but rather that the great advantages of the single-phase system as a whole rendered it peculiarly suitable for general application in the electrification of railways. His statements even in regard to the motors are not in accordance with ascertained facts. For instance, he asserts that high acceleration with the single-phase motor is impossible. The maximum torque at starting, on which the rate of acceleration depends, is limited both in the continuous-current motor and the single-phase compensated series motor only by the current which can safely be commutated, and since the commutation of the single-phase motor is fully as good as that of the best continuous-current motor, whilst it has no tendency to "flash" from brush to brush, it is obvious that the single-phase motor is at no disadvantage in this respect. Assuming that continuous-current motors will be built and operated successfully at the higher voltage prophesied by Mr. Hobart, they will necessarily be more expensive than the present 600-volt continuous-current motor, and certainly more sensitive to "flashing." The railway motor, which operates under more severe conditions than any other piece of electrical apparatus, is emphatically not the place for high voltage. Again, with a high-voltage continuous-current system, the generating or sub-station plant, which feeds the trolley, must be wound for high voltage, and the cost of such plant will certainly be higher than that for the present 600-volt continuous-current system.

Mr. Hobart states that, under given conditions, a train equipped on the single-phase system will weigh twice as much as when equipped with continuous-current apparatus—250 tons in the former and about 125 in the latter. It would be interesting to have some details of these weights. In the meantime I give below a few particulars of two standard car equipments of equal capacity (600 hp). Column I. is for single-phase apparatus of the compensated series motor type, and Column II. for apparatus of the 600-volt continuous-current type, both include multiple-control apparatus, and are complete equipments:

Weight of four motors complete	24,000	22,000
Weight of control apparatus and remainder of equipment	9,800	6,000
Total weight of electrical equipment for one motor car	33,800	28,000

From the above table it will be seen that the continuous-current is 5800 lbs., or 17 per cent, lighter than the corresponding

single-phase equipment. Much wider differences in weight than this occur in different types of railway rolling stock of equal passenger capacity, so that the total weight of a motor car equipped on the single-phase system might be even less than that of a car of equal capacity equipped with continuous-current apparatus. Certainly the slight excess in weight of the single-phase equipment would not necessitate any material increase in the structural dimensions or weight of the bogies and car framing, which are always liberally designed in English practice.

A. C. Kelly.

LONDON LETTER

(From Our Regular Correspondent.)

Two interesting pieces of work in connection with the London County Council Tramways are now under way and will both have an important bearing upon the Embankment Tramways. The first is the widening of the Blackfriars Bridge, which probably will take a couple of years. The other, which is more visible to the ordinary passer-by, is the linking up of the Embankment Tramways to the shallow subway which goes underneath Aldwych and connects with the northern system. As the tramways on the Embankment are on the river side of the Embankment, the lines will, naturally, have to cross the Embankment to be able to get into the subway, which is to have its exit on the west side of Waterloo Bridge. As may be remembered, when describing the work of the Embankment Tramways in the Street Railway Journal of Nov. 3, 1906, reference was made to the fact that in making provision for the conduit it was found that the arches of the District Railway came quite near the surface of the Embankment and had to be cut to provide for the tramway conduit. In crossing the Embankment, therefore, special provision has had to be made and a large portion of the arches of the Underground Railway has been cut away entirely. These arches are now being replaced by a strong steel girder floor which will be at this portion the roof of the District Railway and will support the Embankment Tramways. Work has also been commenced at the end of Waterloo Bridge, and one of the staircases which led down from Wellington Street to the Embankment is now in course of demolition to make room for the exit of the tramway subway. It is estimated that eight months will elapse before the connection is completed. It was originally intended to have a station at the Strand, but it is now possible that the Council will consider this station unnecessary, as it is only a few hundred yards from the Strand to the station at the bottom of Aldwych, or to the Embankment. A station at the Strand would cost perhaps £20,000, and as the subway would have to be at some little depth below the street at this point to get down to the level of the Embankment, it is considered no great inconvenience will arise by not having a station there. There is little new to add to the tramway situation in other portions of London, although the electric railway from Holborn to Stamford Hill has now been opened, the line having been stopped for some considerable time to allow for the necessary alterations. It is also a matter of regret that the Council have been compelled, owing to the determined opposition of the boroughs, to withdraw that portion of their bill in Parliament relating to the construction of tramways along Tottenham Court Road, although the sum of over £226,000 has recently been spent on the widening of Hampstead Road chiefly on account of the proposed electrification of tramways from that road to the north. It is, therefore, reasonable to infer that no electric tramways will penetrate that portion of North London for some years to come.

As to the power bill of the London County Council, and the two other power bills which are proposed, nothing further can be said about them at present. It would not be a surprise to a good many if in the whole circumstances, and with the new Council, the matter fell to the ground for the present.

Another alarming accident has happened to a car in the metropolitan area, this time to one of the South Metropolitan Tramways Company at Croydon, where a car appears to have overturned in taking a somewhat sharp corner. In this particular case one lady has been killed and a number seriously injured, as the car was crowded both inside and outside. A similar accident has happened in a city in the North quite recently, so that it would appear that something has yet to be done in the way of brakes to make cars perfect, and, in fact, it is a question if the present cars are not a little topheavy when fully laden, especially when taking curves at a sharp speed.

The long-waited-for tramways of the popular watering-place of Torquay have at last put in their appearance. Last month they were formally inspected by the Board of Trade and recently the inauguration ceremony took place, since when the cars have been in daily service on such of the routes as are completed. The work on these tramways was commenced as long ago as October, 1905, but for one reason or another and certain engineering difficulties, their completion has been unduly delayed. The system is interesting, as it has been equipped on the Dolter surface contact type. It embraces about 10 miles, although many more are contemplated, as Torquay has many outlying suburbs and other interesting towns in the immediate vicinity. The portion opened to the public now is between the Strand and the Torre Railway Station.

Speaking at the annual meeting of the Metropolitan Electric Tramways, Mr. Garcke, the chairman, made a strong protest against the extremely low fares which are now in evidence all over the London area, not only as regards tramcars but on motor buses and the various electric railways and tubes. The company which he was representing had had a very satisfactory year, but at the same time Mr. Garcke pointed out that within twenty years the fares had been reduced by a halfpenny per passenger notwithstanding increased facilities, and he hoped that a traffic board would eventually be set up for the provinces as well as with London. What Mr. Garcke states is undoubtedly true, and the same complaint might be heard from the officials of practically all of the transportation companies of London. The London County Council is not making sufficient money out of its rapidly growing system, and some of the fares are undoubtedly too cheap. Sufficient money is not being realized to put away enough for reserve and for renewals and depreciation. The Central London Railway, the original "Twopenny Tube," is also suffering not only from the reduced fares in opposition, but because there is now getting to be in London almost too much transportation facility. The business of this most popular tube is gradually falling off. The various motor-bus companies are also suffering from the same causes, and the underground electric railway companies brought into existence by the late Mr. Yerkes are certainly not in a healthy condition. The whole of the District Railway has been electrified, the Baker Street & Waterloo Tube has been completed and put into operation, the new Brompton, Piccadilly & Great Northern Tube is also now in operation and there now remains only the Charing-Cross, Euston & Hampstead Tube to be completed. Anything but satisfactory reports are being had from the District Railway, where, although more people are traveling by it, less money is being made. The proceeds from the Bakerloo Tube are increasing, but half of the rolling stock which was purchased for this tube is idle. The same may be said for the Brompton & Piccadilly Tube, so that over-estimates have undoubtedly been made as to the number of people which would daily use these tubes. A more conservative estimate has been taken of the tube to be opened this summer, so that fewer cars will be provided. For these reasons the result of the great power station at Lots Road, Chelsea, has been disappointing, not more than perhaps one-third of its capacity being called upon, and even after the new tube is opened it is doubtful whether more than one-half of its capacity will be in operation. The motor bus, of course, is largely responsible for these reduced fares, and it would appear that no one could have foreseen the tremendous competiton which has come up by these motor omnibuses, which though doing a vast business are not making money. The whole transportation situation in London is not a healthy one, and the outlook for shareholders, at least, is far from promising.

The Select Committee of the House of Lords has now completed its consideration of the Oxford & District Tramways bill, declared the preamble proved and ordered the bill to be reported to the House. This, for the time being, closes the long drawn out dispute about the Oxford tramways. Some time ago the Oxford Corporation made a contract with the National Electric Construction Company to lease the tramways for forty-two years, the company agreeing to construct the tramways on the Dolter surface contact system. There has, however, been much opposition, and the foregoing statement is the result up to date.

The annual meeting of the Devonport & District Tramways Company was held last month, and though distinct progress has been made, the company is yet far from a dividend paying condition. The chairman stated that negotiations were in progress with the obect in view of arriving at some satisfactory arrangement with the Plymouth Corporation, so that it might run cars through into Plymouth and afford the Plymouth Corporation the same privilege of running its cars into Devonport. There are, of course, many such arrangements being operated successfully in England, and it is to be hoped that a similar one may be effected. The question of carrying parcels was also referred to, and it is expected before long that a service of this nature will be started.

While on the subject of parcel carrying, it is perhaps a matter of interest to note that Mr. J. B. Hamilton, general manager of the Leeds Tramways, has been asked by the Tramways Committee to obtain full information on the subject of parcel carrying, and to report on the matter. The Leeds Corporation has had powers to undertake the carriage of parcels for some time, but has only exercised them in a very small way. With the results before them of Bradford, Manchester and other towns, the Leeds Corporation is now going to make an effort to extend this portion of its business. It may be interesting to note also that the Gateshead Tramways Company is putting its scheme for carrying parcels into operation, and appears to be making quite a success of it. Its vans can be seen even in Newcastle collecting goods to be transmitted over the Gateshead tramways system. The Newcastle authorities, however, have not yet done anything regarding the transport of parcels, as some of the members of their committee appear to have arrived at the conclusion that the results are not commensurate with the costs of organizing such a system.

Without ceremony, the Filton extension of the Bristol Tramway Company's system was opened recently, and there is every reason for supposing that this section will prove exceedingly popular, especially during the summer months of the year. The new line makes the length of the section from the tramways center about 4¼ miles. The ordinary fare for the through journey is three-pence with sectional fares of a penny each. With regard to the fares for workmen's cars, the company has a Parliamentary right to charge three halfpence for the whole journey, but the directors have decided to charge a penny through fare, while retaining halfpenny workmen's fares for each of the three sections on which the fare for the ordinary passenger is a penny.

The East Ham Town Council and the West Ham Town Council have at last come to an agreement as to through running from East Ham to West Ham. East Ham is to make the junction at Green Street, and West Ham is to run a ten-minute service. It will be an undoubted convenience to the public, but the committee do not seem very enthusiastic about it, regarding it as involving but a problematical profit to West Ham.

The electric tramway constructed by the Hertfordshire County Council from High Barnet to the Middlesex boundary at Whetstone has been opened for traffic. At the boundary the new tramway joins the Middlesex County Council's tramway which runs from the Archway Tavern, Highgate, through Finchley to Whetstone. Both counties lease the lines to the Metropolitan Electric Tramways Company, Ltd., and the cars run right through from Highgate to High Barnet. The fare is fourpence all the way, and the distance nearly 8 miles.

The Accrington Corporation has decided to engage Mr. T. L. Millar, of Manchester, to advise them respecting the value of the Accrington Steam Tramway Company's rolling stock, which will be taken over by the corporation, owing to the expiration of the company's lease. The corporation has sealed a draft arrangement with the company to carry on temporary running arrangements during the conversion of the tramways.

At a recent meeting of the Manchester Tramways Committee Alderman Wainwright said that instructions had been given for the building at the works of the department of fifty additional car bodies, thirty-eight to be of the large double-deck type and twelve of the small double-deck type, all such cars to be provided with covered tops of the type already adopted for the existing small cars. The committee has gone to a very large expense, and now possesses car construction works which are of a capacity sufficient to carry on the work of the department. He believed a large saving would result to the city from the building of its own cars.

The steam tramway system running through the Rossendale division is at present the property of the Rossendale Valley Tramway Company, but an agreement has now been arrived at by which it will become the joint property of the corporations of Bacup and Rawtenstall, through which boroughs it passes. Each corporation is to purchase that part of the tramways within its boundaries; to reconstruct it and electrify it. Instead, however, of the two municipalities being joint partners in the expenditure and receipts, Bacup will lease it to Rawtenstall for thirty years, during which term Rawtenstall will pay, as rent, per annum a sum exactly equal to the amount paid by Bacup each year for sinking fund and interest.

The twelfth annual convention of the Incorporated Municipal Electrical Association is to be held at Sheffield, from June 24 to 29. The headquarters of the council will be the Royal Victoria Hotel, Sheffield. The following provisional program has been arranged, but it is subject to alteration: First day, Tuesday, June 25, morning, presidential address; reading and discussion of papers; afternoon, visit to Vickers, Sons & Maxim, Limited, River Dam Works; evening, reception and dance, given by the Rt. Hon. the Lord Mayor of Sheffield, at the Town Hall. Second day, Wednesday, June 26: Excursion to the Dukeries, all day. Third day, Thursday, June 27: Morning, annual general business meeting, members only; afternoon, reading and discussion of papers; evening, members' annual dinner. Fourth day, Friday, June 28: Morning, reading and discussion of papers; afternoon, visits to tramway and electric light stations. The following are some of the subjects which will probably be discussed during the convention. The list may be extended or altered: Depreciation; Three-phase Distribution; Extensions to Outlying Districts; The Selling Price of Current; Alternating Current Distribution.

Interesting developments are in prospect in connection with the new extensions of the South Lancashire Tramways Company through Worsley and Swinton. The company's lines through Worsley include a branch which joins up with the Salford system at the Worsley-Eccles boundary at Winton, but this branch has until now been left unused. Arrangements have now been made between the company and the Salford Corporation for the company to run cars from Atherton, through Worsley, to the curve at Winton, where the Salford Corporation cars pass to and from Peel Green, thus making only one change necessary between Atherton and Manchester.

A decision of vital importance to electric tramway companies and local authorities was given on Thursday in the Court of Appeal, where three judges decided that a track constructed under the Light Railways Act, 1896, is not a tramway, and that it is exempt, therefore, from three-fourths of the district rate. Wakefield and District Light Railways Company contends that, having constructed its line under Provisional Orders, in accordance with the Light Railways Act of 1896, it is a railway running upon land used only for the purposes of the railway, and as such was under the Public Health Act, exempt from three-fourths of the district rate. Wakefield Corporation, on the contrary, contended that the undertaking was merely a tramway running along the highway, and that as the plaintiffs had all the benefits of the work for which the rate was levied, they were liable to be rated at the full value of their undertaking. The Wakefield justices found in favor of the corporation, but on appeal by the company the Divisional Court reversed the decision of the justices. An appeal by the corporation has now been dismissed in the Court of Appeal, with costs.

The Master of the Rolls, in giving judgment, said that he did not propose to consider at length whether a line of rails that ran along a public highway was a tramway or a railway for the purposes of the Act. It seemed to him too plain for argument that the line in question was a railway, and not a tramway. That other persons had a right to use the road did not seem to him to affect the question. For reasons which were substantially those on which the Divisional Court based their decision, he held that the appeal failed and must be dismissed with costs. Lords Justices Vaughan, Williams and Buckley concurred.

The Leeds Corporation Tramways Committee has announced that the gross profits for the year ending March 31 amounted to £156,000. After allowing for interest and sinking fund, and placing £30,000 to the reserve fund, £50,000 will be available for the relief of the rates. The number of passengers carried was upwards of 14,000,000 and the total receipts were £323,900.

A conference of representatives of fifty municipal tramway

authorities, including the London County Council and Corporations of Glasgow, Manchester, Sheffield, Birmingham and Leeds, met at Westminster Palace Hotel, London, recently, to consider the proposed introduction in the London County Council, Manchester, Glasgow and Sheffield Tramways bills in the present session, provisions under which the post office may use posts, standards and brackets of these tramway authorities as supports for telegraph and telephone wires. Alderman Wainwright, Manchester, presided, and it was agreed to ask the Postmaster-General to receive a deputation on the subject, and to request the promoters of the bills named strenuously to oppose the introduction of the proposed new clauses. The conference also decided that the Lights on Vehicles bill, under which it is proposed to make compulsory the carrying of lights on the front of vehicles after dark ought to be amended so as to make it compulsory also that red lights should be carried on the rear of such vehicles.

At the Sale District Council offices a County Council inquiry was held into an application by the Ashton-on-Mersey District Council for an alteration of the boundary between Sale and Ashton-on-Mersey along the tramway track on the main road, and for a definition that the boundary shall be considered to be in the middle of the road throughout its length. It was agreed that the boundary should be the middle of the tram track, the chairman observing that he did not see why it should not be possible for Sale to have one line of tramway within their boundary and Ashton-on-Mersey one in theirs throughout the full length. A. C. S.

NO BIDS FOR CONSTRUCTING NEW YORK SUBWAYS — TEN MORE SUBWAYS NEEDED, SAYS ENGINEER RICE

No bids were received by the New York Rapid Transit Commission on April 25, the time appointed for the opening of bids for the construction of the new subways. President Shonts, of the Interborough Rapid Transit Company, however, wrote a letter offering to construct and equip at cost under proper conditions two extensions of the present system, one on the West Side from Forty-Second Street to the Battery, and the other on the East Side from Forty-Second Street to the Bronx, provided a reasonable return on the company's investment is ensured. This letter suggested that the officials of the company and the members of the board discuss terms on which parts of each proposed route might be built by the company. In brief, the conditions proposed by the company included a guarantee that the company should earn at least enough to meet its interest debt to the city and a reasonable interest on its own investment.

After a few formalities incident to the meeting had been gone through a report of the vice-president, stating that no bids had been received, was read, and then Mr. Starin asked Mr. Shonts if he had anything to say. For answer, Mr. Shonts handed the secretary the letter before mentioned, which is abstracted herewith:

New York, April 24, 1907.

Alexander E. Orr, President, Board of Rapid Transit Commissioners.

It is with great regret that I have now to advise you that, after very careful study by our engineers and officers of the plans and specifications for the new subways and the proposed form of contract for their construction and operation, the directors of our company have been forced to conclude that the building of the proposed four-track, double-deck Lexington Avenue subway, north of Forty-Second Street, and the four-track West Side subway south of Forty-Second Street, and the operation of those lines in connection with the existing subway under the burdens imposed by your proposed contract and the existing law, are financial impossibilities.

There are several reasons for this conclusion. In the first place, as will be seen from the report submitted herewith, our engineering advisers, including Mr. William Barclay Parsons and Mr. John B. McDonald, agree in the conclusion that the proposed extensions (exclusive of pipe galleries), built in conformity with the plans and specifications of your Commission, would, under existing conditions, cost (including an allowance for easements and interest during construction) not less than $64,000,000, without equipment, and that the necessary equipment, including tracks, rolling stock, power plant, etc., would involve an additional expenditure of not less than $24,000,000, making the aggregate cost of building and equipping about 39 miles (single track) of rapid transit subway approximately $88,000,000, as compared with the cost of about $71,000,000 for building and equipping the existing rapid transit lines (including the extension to the Battery), comprising about 63 miles of single track.

Not only would the construction of the proposed extensions involve a capital outlay per mile of track double that involved in the original subway lines, but under the proposed form of contract and the existing law, the expenses which must be provided out of income are very much increased as compared with the original subway contract. In the first place, it may be assumed that the interest upon city bonds issued for the cost of the proposed subways will be from one-half to three-quarters of 1 per cent higher than in the case of the original rapid-transit bonds, and this conclusion is based on the supposition that the city can sell its bonds on a 4 per cent basis. In the second place, unlike the original subway, the entire investment in the new subway, including the lessee's property in the streets and equipment, will be subject to taxation. In the third place, various advantages conferred by the original contract are now eliminated; and, finally, the lease is limited to twenty years (subject to a renewal upon a revaluation, the terms of which cannot be fixed in advance), making it necessary to increase the annual charges by an amount sufficient to provide for the difference between the original cost of such of the equipment and other property as may be taken over by the city at the expiration of the lease and the probable value at which such property will be appraised at the end of the twenty years.

Another important consideration is the exceptionally broad power conferred by your form of contract upon the public authorities to require from time to time any changes in the construction of the subway and in the equipment and other appliances used therein, as shall to them seem proper. Such a requirement, especially in the case of a subway operated under a lease for only twenty years, creates a serious liability for additional expenditures for which adequate allowance would have to be made under any conservative financial plan.

I have, therefore, to advise you that we are prepared to enter into a contract for the construction, at actual cost, of two extensions of the existing municipal subway, one upon the West Side extending south from Forty-Second Street to the Battery, the other upon the East Side extending north from Forty-Second Street into the Bronx, and for the equipment and operation of such extensions, provided the cost of construction can be brought within the city's borrowing capacity, and provided the terms of the contract are such that we may reasonably expect the earnings from these additional subways to be sufficient to cover the interest and sinking fund upon the bonds of the city issued for their cost, a proper annual charge for depreciation in equipment and other property which the city may take over at an appraised value at the end of the twenty years' lease, and interest upon our additional investment for which city bonds would not be issued. In other words, we are willing to complete the existing rapid transit system so that there shall be, as originally planned by your Board, two complete longitudinal lines, one upon the East Side and the other upon the West Side of the city, without any prospect of profit beyond a fair rate of interest upon the additional investment involved, and obviously without an expectation of such a return no capital could be secured for additional subway construction.

We shall be very glad to co-operate in carrying out some such plan as above outlined if the opportunity is offered. Very respectfully yours,

THEODORE P. SHONTS,
Chairman of the Executive Committee.

Attached to this was a letter to Mr. Shonts signed by the various engineers employed by the company, setting forth that the estimates of cost had been made as low as was safe, and that the cost of lands for stations and terminals, which would be charged as part of the cost of the railroad, had also been included in the estimate. Equipment charges had been estimated on the basis of five-car locals and eight-car expresses, and not according to the ten-car basis set forth in the form of contract. The conclusion of the engineers were as follows:

To construct a four-track railway northerly from connection with the present subway near Forty-First Street and Park Avenue via Lexington Avenue to the Harlem River, and then a two-track railway to 156th Street, in the Bronx, and a four-track railway southerly from a connection with the present subway near Forty-Second Street and Broadway, via Seventh Avenue and West Broadway to the Battery, in accordance with the contracts, plans and specifications of the Rapid Transit Commission, will cost.....$56,200,000
Easements 2,500,000
Terminals 1,300,000
Interest during construction..... 4,000,000
$64,000,000
Equipment 24,000,000
Total $88,000,000

This, it was learned later, was divided on the basis of $22,161,752 for the lower half of the Seventh Avenue route and $29,780,064 for the upper half of the Lexington Avenue route, with 7 per cent added as interest on investment for construction.

Mr. Shonts consented to an interview after the meeting. He said, in part:

"This is a keen personal disappointment to me. I had no idea

but that we could frame up a proposition for new subways that we could stand by. Although we instructed the engineers to make their estimates as low as possible, the aggregate cost of the proposed subway would be at least double that of the present one."

Mr. Shonts went on to say that the increased cost of labor and material, the conditions of the contract and the additional legislation were responsible. The officials of the company, he said, had devoted hours and days of time to meet the situation, because they believed there was a moral obligation on the lessees of the present lines to build new roads, but it was a financial impossibility to build the road proposed.

Asked as to the conditions of the contract to which specific objection was made he mentioned easements, private property for stations, the method of construction, meaning the cut and cover, as against the open ditch, the increase in the size of the tunnels and the liability of the contractors for all damage to abutting property of every description. Speaking of the Lexington Avenue route he said that the company had no definite proposal to make as yet, but that the proposed double-decked subway was an "operating monstrosity." To provide for the operation of ten-car trains, he said, would practically bankrupt the existing property, the stations of which would have to be reconstructed if the two systems were connected.

The report of Chief Engineer George S. Rice, of the Rapid Transit Commission, which will soon be made public as part of the report of the Commission, will contain figures regarding the daily carriage of passengers on all transit lines in this city and on the remarkable increase of population and traffic, which will strongly emphasize the seriousness of the transit situation, due to the refusal of the Interborough to bid on the new subways and the failure of independent bidders to appear.

According to Mr. Rice's figures, the population of the Boroughs of Manhattan and the Bronx alone, in 1916, will be not less than 3,170,000, and the total number of passengers in the two boroughs which will have to be carried during that year will reach the enormous total of 1,626,000,000, or 4,454,800 a day. The total facilities, subway, elevated and surface, of the city under conditions that prevail to-day is 818,273,413.

Mr. Rice draws six important conclusions as the result of his investigation and statistics compiled from present ticket sales and population estimates. They are: That the population of Greater New York has practically doubled itself every twenty-five years, and will probably double itself again by 1930.

That the total paid passenger traffic is increasing at such a rate that it will probably about double itself within the next decade.

That in order to bring about the discontinuance of the overcrowding conditions which are now prevailing on all transportation lines in Greater New York, it is imperative that the following additional subways be constructed and put in operation:

Within the next five years, or by 1911, as follows: For Brooklyn, two four-track subways, in which ten-car trains can be operated, providing for eight additional tracks crossing the East River either in tunnels or on bridges, and traversing the borough. For Manhattan and the Bronx, three four-track subways, for operating ten-car trains, traversing the two boroughs.

Within the second five years, or by 1916, as follows. For Brooklyn, two more four-track subways. For Manhattan and the Bronx, three more four-track subways.

Or, within the next decade altogether, for Manhattan, Bronx and Brooklyn ten four-track subways.

For four years, in the greater city, Mr. Rice says the increase in the passenger traffic has been about the same each year, except last year. The average had been about 63,000,000 passengers a year, but the increase last year jumped to 110,000,000, supposedly on account of an increase in the population invited by the opening of the subway. After thoroughly discussing the increase in population, Mr. Rice takes up each borough separately.

He finds that in Richmond, where 8,957,414 passengers were carried on the surface lines in 1906, and 6,614,457 on the steam roads, a daily average of 43,000, there should be in 1916 26,000,000 to be carried. The transportation problem there, however, can be taken care of by an extension of the tracks of the present lines.

Conditions in Queens are similar to those in Richmond, Mr. Rice finds. To handle the traffic increase, however, only an increase in car mileage is necessary, and to take care of the travel from Queens to Manhattan, about 60 per cent of the total, there is the new Blackwell's Island Bridge and the Belmont tunnel, which should prove ample.

Brooklyn, in Mr. Rice's report, makes the following showing for last year:

Elevated lines	125,221,831
Surface lines	264,333,194
Total	389,555,025
Daily average	1,067,000

It is to Manhattan that Mr. Rice gives by far the most attention. It had a population of 2,167,585 last year, an increase of 15 per cent in five years, and the traffic on all lines had increased 39 per cent during the same period, though the latter increase had not been uniform in each year.

In the last five years the number of long distance passengers riding in Manhattan has increased 108 per cent. This increase, however, is not likely to be maintained. As the Bronx and Manhanttan traffic are closely identified, Mr. Rice considers them together in closing his report. He says:

The population of Manhattan and the Bronx has been estimated at 2,436,002 for the fiscal year of 1906. It will probably be about 2,740,000 in 1911, and 3,170,000 in 1916. The total paid passenger traffic for the last five fiscal years has increased about 41 per cent, to 818,273,413 per year, or an average of about 2,242,000 per day.

At the 41 per cent rate of increase for five-year periods the total traffic in Manhattan and the Bronx will be about 1,153,000,000 in 1911 and 1,626,000,000 in 1916, daily averages of 3,131,000 and 4,454,000. Transportation must be provided for the rush-hour conditions, or maximum number carried in one hour in one direction. The capacity of the existing elevated and subway roads, based on such conditions, if all passengers are to have seats, is not far from 200,000,000 per year.

Deducting the estimated capacity of the existing elevated and subway lines from the total estimated traffic to be taken care of in 1911 and 1916, we have either, when seats are furnished, 492,000,000 and 921,000,000, or with moderate crowding, 392,000,000 and 821,000,000 passengers, respectively, for whom transportation must be provided in new subways yet to be constructed.

Under moderate crowding, two additional subways must be completed within five years and six within ten years. If seats are to be provided, three additional four-track subways will have to be put in operation within the next five years and three more within a decade, in order that the inhabitants of Manhattan and the Bronx may be transported to and from their daily business in comfort and decency.

ELECTRICFICATION OF LINES IN ADIRONDACKS IMPRACTICABLE AT PRESENT

Chauncey M. Depew, as chairman of the board of directors of the New York Central Railroad Company, has written to Commissioner Whipple, of the State Forest, Fish and Game Department of New York, informing him that it will not be possible to consider this year a suggestion made by the Commissioner that the railroad electrify its lines through the Adirondacks, with a view of diminishing the danger of forest fires. The letter was in response to one sent to Mr. Depew by Commissioner Whipple, suggesting that in selecting the lines for the extension of the use of electricity as a motive power on the divisions of its system, preference be given to the Adirondacks. Mr. Depew says that he considers the suggestion of Commissioner Whipple valuable, and adds that his own interest in Adirondack preservation is great, but announces that the railroad has too much other work on hand to take up now the change suggested.

STRIKE IN SALT LAKE

A strike was declared, April 28, on the lines of the Utah Light & Railway Company, 450 men walking out. Numerous scenes of disorder followed attempts made by the company to operate a few cars with non-union crews, and all efforts to maintain even a partial service soon were abandoned. Determination to strike was reached by the men shortly before 4:00 a. m, and the calling of the strike was a complete surprise, as announcement had been made that arbitration had been agreed to by both sides. This followed several conferences between Mayor Thompson and a committee of citizens on the one side and President Bancroft of the company on the other.

THE CLEVELAND SITUATION

Notwithstanding the petition containing 4000 names asking that a renewal of franchise be granted the Cleveland Electric Railway Company on Central Avenue and Quincy Street, and over the protest of the Councilmen representing the wards through which these lines pass, the City Council, at an adjourned session Saturday, gave the Low Fare Company a grant to build and operate lines on these thoroughfares. These grants were made to get around the suits now pending against the Forest City Railway Company, which already holds grants over the same streets. Little attention was paid to the petition of the residents of that section of the city, and less to the revocation of consents to the new companies that were presented to the law-making body, although they are said to have covered more than half of the frontage along which the lines operated. At the same time the Board of Public Service gave the Cleveland Electric Railway Company a new permit to remove its tracks from these streets under conditions that are not so onerous as those contained in the first. This was done because of fear that the courts would not allow the new companies to use the tracks of the old company in the operation of their cars along these lines, and the board considered that they had as well be removed as to remain there and not serve the purpose of the administration.

At the same time a curative ordinance was passed with the design of getting around the objection that had been raised against the Low Fare Company's using Euclid Avenue from East Fourteenth Street to the Public Square, and from that point west on Superior Avenue to West Twenty-Eighth Street. This covers all the territory from which the Municipal Traction Company and the Low Fare Company have been barred by injunction. The plan is to continue to lease the cars to the Low Fare Company and get around the injunction against the Municipal Traction Company. The Low Fare Company was barred from the use of Euclid Avenue because it had the consents of none of the property owners. In this case the lines had never been used by any of the new companies, while in Superior Avenue the Municipal Traction Company had been operating from the viaduct to the Public Square under a suspended injunction.

The advocates of the new companies had secured consents of many property owners on Central Avenue and Quincy Street, but it seems that the name of neither of the companies appeared in the agreement, by which the property owners were promised $3.00 per front foot as a rebate on the cost of paving. The Cleveland Electric people secured the revocation of a large majority of these consents and at the same time secured consents for its own line. It agreed to pay $4.00 per front foot, and did pay $1.00 per foot down on all the consents it secured. In all probability this will form the basis for litigation that will follow any attempt of the new companies to build lines on either of these streets. The Cleveland Electric claims that it has a sufficient number of consents to bar any other company from the streets. It is said that City Solicitor Baker advised that the new ordinances be passed without counting the frontage represented in these revocations, and said that the property owners could not legally revoke their consents. The city is passing beyond the limits of a free country according to this course of reasoning.

Councilmen representing wards through which these lines pass made the objection to the passage of the ordinances that their constituents desire that the Cleveland Electric continue to operate the lines at its proposition of seven tickets for a quarter, as it is the only system that is able to carry people to any part of the city on one fare. In case the new companies have lines on these streets and people desire to go to a part of the city not reached by them, the fare will be 8 cents instead of 3.

As briefly mentioned in the Street Railway Journal last week, the injunctions were granted barring the Forest City Railway Company from operating the lines mentioned and the Low Fare Company from using the Cleveland Electric's tracks on Euclid Avenue. With these conditions existing the people who used the two lines now have to walk to other lines. The company placed all the cars taken off these lines on those that the people would naturally use and thus provided transportation facilities for them, although they are inconvenienced by the distance they have to go to reach the cars. According to interviews in a local paper, business men on those streets are divided as to the company they desire to operate the lines, but a majority of them favor the old company and say the offer it made is fair.

Another thing enters into this fight. The city needs rapid transit lines badly, and the old company in its original proposition agreed to build them. The new companies will never be able to provide such a service from present indications, and the city must suffer as a consequence. The distances are now so great that the extension of building toward the country must cease unless better facilities are provided. The steam roads do not provide commuter service in Cleveland, and people must depend altogether upon the electric lines.

Most of the past week was spent by the Mayor and the City Council in adjourned sessions, endeavoring to formulate plans to defeat the Cleveland Electric in the various moves it has made. The franchise ordinances were railroaded through, Johnson being unwilling to allow the usual time in taking care of such matters. The low-fare cars are still operated over the Cleveland Electric's tracks to the Public Square.

Monday evening the City Council gave the Low Fare Railway Company a permit to build lines on Central Avenue and Quincy Street, following the franchise ordinance given the company a few days before. A resolution, offered at the request of people on those two streets, asking the Cleveland Electric Railway Company to continue the operation of cars on the streets until the rights of the companies are legally determined, was defeated by a vote of 21 to 9, the boosters of the new companies claiming that such a permit would be construed as a grant by the old company and that the settlement would be complicated.

Under the permit granted it the Cleveland Electric began taking up the track on the two streets Tuesday morning. The work went along all right until the men began taking out some special work at the crossing of Central and East Fifty-Fifth Street, when they were stopped by the police. The matter was at once taken to Judge Chapman, who has the injunction suits in hand. The city officials were informed there that they were looking at this matter in a narrow way, and that the company has the right to take up its special work on these lines. It is claimed that the new companies cannot get this material within three months, and that the Mayor contemplated using force to keep the old company's property in the street for the convenience of the Low Fare Company.

Notwithstanding the temporary injunction against the Low Fare Company, Council instructed it to make connection with the Cleveland Electric tracks at Euclid and East Fourteenth Street. The hearing on the injunction to prevent the Low Fare Company from operating cars on Central Avenue and Quincy Street is being held in Judge Chapman's court this week.

Councilman Felton introduced an ordinance in the City Council, Monday evening, giving the Cleveland Electric Railway Company a franchise on the abandoned streets for six years. He asked that a special meeting be held Tuesday evening for a second reading. Opponents of the road objected, but the Councilman forced the matter, saying he wanted to put the members of record. An ordinance was also introduced providing for the operation of the Low Fare Railway Company's cars over the Denison Avenue line of the Forest City Railway Company.

Council passed the ordinance compelling an exchange of transfers to and from all lines and companies on all union depot traffic, the transfer point being at West Ninth Street and Superior Avenue. This will cause another tangle, as the Cleveland Electric will refuse to abide by the terms of the ordinance.

BOSTON ELEVATED WINS "THIRD-RAIL EYE" CASE

A verdict in favor of the Boston Elevated Railway Company was handed down on April 26 by the Superior Court in connection with a suit brought on the claim that the plaintiff was injured by sparks falling from a passing train on the elevated structure. This is the first case which has been tried since the spring type of contact-shoe was adopted. The company contended that everything possible had been done for the safety of travelers under the structure and at the same time furnish the rapid transit the public has a right to demand.

REGULAR RUNS ON ERIE ELECTRIFIED DIVISION

Regular test runs are being made over the electrified branch of the Erie Railroad between Mt. Morris and Rochester.

PLANS BEING MADE FOR BUILDING SYSTEM IN BAHIA

New York interests, said to be allied with the Havana, Mexico City, Rio de Janeiro and other West Indian, Central and South American electric traction and lighting properties, have completed financial arrangements in Europe for the construction and operation of street railways in Bahia, Brazil. A lighting monopoly has been taken over and extensive water power rights have also been acquired. The development of the Bahia projects will entail an expenditure of nearly $10,000,000. The Bahai Tramway, Light & Power Company will carry out the work. It has been incorporated under the laws of Maine, with a capital of $3,500,00 in common stock. Seven million, five hundred thousand dollars of 5 per cent fifty-year first mortgage bonds are also authorized. An issue of $3,500,000 of these bonds has just been made in the London and Brussels markets. The New Yorkers interested in the company include Percival Farquhar, William Lanman Bull, of Edward Sweet & Company, and F. S. Pearson.

PRETENTIOUS NEW YORK STATE PROJECT

The Buffalo, Rochester & Eastern Railroad Company, formed to operate a standard gage railroad by steam, electricity or gasoline from Buffalo to Rochester, and thence to Troy, a distance of 300 miles, filed incorporation papers at Albany, Tuesday, April 30, with the Secretary of State. The principal office of the road will be in Rochester. The capital stock is $3,500,000, and the directors are Ralph D. Gillett, Henry W. Ely and Archie D. Robinson, of Westfield, Mass.; Arthur W. Eaton, of Pittsfield; Franklin Weston, of Dalton; Henry W. Bowman and Fred. T. Ley, of Springfield; Joseph O. Skinner, of Holyoke; James H. Caldwell, of Troy; John E. Whipple, of Brockton, and James F. Shaw, of Manchester, all being Massachusetts men except Mr. Caldwell. Mr. Gillett subscribes for $1,835,000, or over one-half of the capital stock of the company. The railroad will parallel the New York Central and pass through 125 postoffice towns, including Batavia, Utica and Rome, but will not go through Rochester. The proposed line will have connections at its eastern terminus with the Boston & Maine, and on its western end with the New York Central and Grank Trunk, and will furnish a direct route between the Hudson and Lake Erie.

THE CANANDAIGUA SOUTHERN COMPANY'S PLANS

The Canandaigua Southern Electric Railroad Company, which was recently granted a certificate by the New York Railroad Commissioners after a series of hearings, was incorporated in January, 1907, to build an up-to-date interurban electric road from Canandaigua southwest through Centerfield, South Bloomfield, Vincent, Bristol Center, Bristol Springs, Naples and North Cohocton, to meet the Lackawanna and the Erie Railroads at Atlanta. The line will open up a large area of fertile and productive territory not now served by any railroad, will pass through a number of flourishing villages and hamlets and thickly settled farming communities, and by reaching the head waters of Canandaigua Lake, form in conjunction with the Rochester & Eastern Rapid Railroad and the Canandaigua Lake Transportation Company, a popular excursion route for the people of Rochester and other neighboring cities. It is said that the line will be one of the most picturesque in New York State. The board of directors of the Canandaigua Southern is composed of the following men: Edward G. Hayes, vice-president of the McKechnie Bank, Canandaigua, N. Y.; Alexander Davidson, manufacturer and director of the McKechnie Bank, Canandaigua, N. Y.; Denison H. Maxfield, president of the Hiram Maxfield Bank, Naples, N. Y.; George W. Hamlin, vice-president of the Canandaigua National Bank, Canandaigua, N. Y.; Hyatt C. Hatch, of Hatch, Otto & Company, Atlanta, N. Y.; Clinton W. Richardson, president of the Richardson Manufacturing Company, Bath, N. Y; Gooding Packard, of Hemmenway & Packard, Canandaigua, N. Y.; George H. Switzer, engineer, 42 Broadway, New York City; Edwin D. Hamlin, attorney, 26 Court Street, Brooklyn, New York.

Part of the arrangements for financing the road have been completed. It is rumored that extension papers will be filed very soon to extend the line from Atlanta 5 miles to Wayland, N. Y., to connect with the Pittsburg, Shawmut & Northern Railroad.

INCREASE IN CAPITALIZATION OF THE BOSTON ELEVATED RAILROAD

At a special meeting, Tuesday, April 30, the stockholders of the Boston Elevated Railway Company authorized an increase in the capital stock from $13,300,000 to $21,300,000. They also authorized an increase in the bonded debt from $7,500,000 to $13,300,000. The increase in the capital stock is to defray the expense of the construction of the Cambridge subway. The increase in the bonded debt is to provide for other construction, new equipment and the funding of the company's floating debt.

FRISCO TRACTION DEAL DENIED

With regard to reports from San Francisco that negotiations for the purchase of the United Railroads of that city have been in progress for the last month and that the sale of the street railway properties may be consummated at an early date, Ernst Thalmann, of Ladenburg, Thalmann & Company, who is president of the United Railways Investment Company, which controls the United Railways of San Francisco, is quoted as stating: "There is not the slightest foundation for the rumor. No negotiations have been opened for the sale of the property; in fact, no such proposition has even been suggested."

The dispatch from San Francisco said in part:

"Three representatives of Eastern capitalists have been for the last three weeks investigating the system. H. E. Huntington has been mentioned as a probable purchaser of the stock. He has just returned from the East, and it is rumored that he has determined to renew his connection with traction interests in San Francisco. Another who has been mentioned as a possible purchaser is Thomas F. Ryan, who has been active in acquiring traction properties throughout the country."

THE MERCHANTS' ASSOCIATION ON THE PUBLIC UTILITIES BILL

The committee on domestic commerce of the Merchants' Association of New York, has just rendered a report to that body, recommending certain changes in the Public Utilities bill now before the New York Legislature. Many of the criticisms of the bill are along the lines of an editorial recently published in this paper. The committee says that public control of public service corporations, "if just and reasonable, will be beneficial not only to the public but to the corporations affected thereby. But such control should not be arbitrary or excessive, nor carried to such an extent as to interfere harmfully and needlessly with that freedom of action without which great business enterprises cannot be operated with the best results. In our opinion some of the provisions of the bill are needlessly and harmfully restrictive, and if adopted would tend to impede rather than to promote efficient service by making difficult or impossible legitimate and necessary financial operations, without which the capital required for the best service could not be obtained."

The report then considers the tenure of office of the commissioners. In the bill this depends on the pleasure of the Governor. The committee compares this method with one requiring the assent of the Senate, and finally recommends the removal by the Governor only and on charges reviewable by the courts to decide whether the evidence warranted the removal. The committee believes that the salaries of the commissioners should be not less than $20,000 a year, in order to secure men of sufficient ability, experience and large capacity in practical affairs. The report also favors the permission to organize holding corporations, which are now prohibited by the bill, as it believes that such corporations are often necessary for the most effective operation of public service properties. It also recommends that the issue of promissory notes should be made an exception to the provisions of the bill prohibiting "the issue of stocks, bonds, evidence of indebtedness and other forms of security of capital account without the approval of the commission." It also recommends the adoption of a clause looking to a reasonable and fair judicial review of any order of the commission, such power being lodged in the Appellate Division Other suggestions are made.

ALL ELECTRIC SERVICE ON NEW YORK CENTRAL OUT OF NEW YORK

Electric service between the Grand Central Station and High Bridge on all trains of the New York Central lines was instituted last week. For several months most of the local and suburban trains have left the station drawn by electric locomotives, which have been specially built for Park Avenue tunnel traffic, but now the Twentieth Century, the Empire State Express and the other through trains for the West are hauled through the tunnel. Hereafter all trains entering or leaving the Grand Central Station will be hauled from or to High Bridge by the electric locomotives.

MONTGOMERY STRIKE SETTLED

An agreement has been reached between General Manager Ragland, of the Montgomery Traction Company, and a considerable number of the former employees of the company, by which they returned to running the street cars, at the same wages they were receiving before they went out on strike. The strike of the motormen and conductors against the Montgomery Traction Company has lasted more than three weeks, having been inaugurated at noon, March 27.

THE PHILADELPHIA RAPID TRANSIT PLAN AMENDED

A committee representing the Retail Merchants' Association has presented to Mayor Reyburn the amended rapid transit plan. Ordinances carrying the plan into effect, it is expected, will be introduced at the next meeting of City Councils.

The two changes in the original plan are: First, that of the proposed $30,000,000 sinking fund, the city is allowed the use of all money in this fund after the first $5,000,000 is accumulated; second, the Rapid Transit Company shall pay yearly a sum of money to be used for street paving and the like, instead of a lump sum, as first intended. As amended, the important features of the plan are:

A mutual contract for fifty years is to be entered into between the city and the Rapid Transit Company, at the end of which the city may possess itself of the leases, franchises and property of the company without cost. During the fifty years the company is to maintain a sinking fund which will extinguish its $30,000,000 of capital. The Mayor, the president of the Rapid Transit Company and the president of the Board of City Trusts are to compose the Sinking Fund Commission, and after $5,000,000 has accumulated the city can use it, and the money that is to follow, for any municipal purpose whatsoever.

The Mayor, the president of the Board of Education and the president of the Board of City Trusts are to become directors of the company, with the right to vote, but they incur no liabilities for themselves or the city. The city and the company are to share equally the net profits after a 6 per cent dividend is paid on the stock.

A fixed sum is to be paid yearly to the city for car licenses, snow removal, street paving, taxes and the like, which shall be equal to the present cost of these items. This sum is to be fixed by the city every year.

No contracts are to be made by the company extending beyond fifty years, and in this period the company shall have the right to build elevated and subway lines as they may be needed, issuing securities for no greater amount of money than is actually needed. The city is also to join with the company to have the present route of the Frankford elevated line changed so as to make its construction possible.

The ordinance of 1857 giving the city the right to take existing railway lines at their appraised value, and the ordinance requiring the company to put wires under ground when directed to do so by the authorities, are to be repealed.

The company is to call the remaining $9,000,000 still assessable on its stock, and the money is to be used in improving the service.

During the term of the contract the City Controller or experts in the employ of the city will have the right to audit the company's accounts.

AN INTERURBAN UNION STATION

The development of interurban railroads in Kansas City has brought forward a project for an interurban terminal station in the heart of the city. A site has been selected, and as soon as the deal is closed the plans will be made public. Two electric interurbans now enter Kansas City—one from Leavenworth and the Strang line from Olathe to Kansas City. Two other lines are building, one from Kansas City to Topeka and the Bonner Springs line. J. J. Heim and his associates expect to have an electric railway from Kansas City to St. Joseph and between Kansas City and Excelsior Springs before the end of next year. The Heim system of interurbans in Southern Kansas and Southwest Missouri will be extended to Kansas City, and a joint terminal station for these lines would mean the quick handling of mail and baggage and much more convenient facilities for passenger traffic.

THE YOUNGSTOWN & SOUTHERN OPENED

The Youngstown & Southern Railway Company's line between Youngstown and Columbiana, Ohio, has been put in operation. This road connects some of the best towns in Eastern Ohio, and will eventually reach the Ohio River through connection with the Youngstown & Ohio River. The roadbed was used three years for a steam road. It is of standard steam railway construction and laid with 70-lb. rails.

For a time the power will be furnished by the Mahoning & Shenango Valley Railway Company and the Cherry Valley Iron Works at Leetonia. A power station is being erected at West Point, and as soon as it is completed the company will have plenty of power to operate its line. In all probability the plant will be completed late this summer or early in the fall. It will furnish a three-phase current which will be stepped up to 22,000 volts and transmitted to a sub-station at North Lima, where it will be stepped down to 600 volts and converted to direct current for the motors.

The cars, built by the Niles Car & Manufacturing Company, are finished on the interior in cherry, with light green ceilings, while the exterior is in Pullman green. The seats are of the Hale & Kilbourne steam railway type, upholstered in green plush, while those in the smoking compartment are in green leather, each having a seating capacity of fifty-four. Heat is furnished by a Peter Smith hot-water system.

The cars are 51 ft. 9 ins. long and equipped with four Westinghouse motors of 75 hp each, giving a total of 300 hp per car. Westinghouse air brakes are employed as well as electric signals and air sanders. Baldwin Locomotive Works trucks, standard steel forged wheels, air whistles and foot gong complete the equipment. Two of the four cars are combination passenger, baggage and smoking cars, with seating capacity for forty people. The same length as the others with the same general finish, they have an 11-ft. space reserved for baggage.

The equipment of the freight car is the same as the passenger cars, with the exception of the employment of automatic air, the same as used on railroads. It is of a bright yellow color to distinguish it from the passenger cars. The management has felt it wise to make this difference, as it is an easy matter for passengers to tell which are the passenger and which the freight cars or *vice versa*. It is arranged for handling a large amount of freight and is a high-speed car, which guarantees prompt service.

Oakland and North Lima are the two principal towns between Youngstown and Columbiana. The latter place has a population of about 3000 people, but all the country between the termini is populous. At present the line is 16 miles long, but within three or four months it will be completed to Leetonia, a distance of 3 miles. At this point it will connect with the Youngstown & Ohio River which, when completed, will reach Salem, Lisbon, West Point and East Liverpool. It is thought the Youngstown & Ohio River road will be completed some time this summer. The arrangements between these two roads is such that they will operate practically as one.

The officers of the company are as follows: John Stambaugh, president; J. S. Dill, vice-president and general manager; David Tod, secretary and treasurer; W. F. Bass, assistant treasurer and auditor; E. H. Raupp, assistant superintednent; Otto Lind, master mechanic; J. McCluskey, road master; Edward Travis, superintendent of line construction.

RUMORED CHANGES IN THE WASHINGTON RAILWAY & ELECTRIC COMPANY

It is reported in Washington that important changes are soon to be made in the personnel of the Washington Railway & Electric Company, and that William Loeb, Jr., secretary to President Roosevelt, will be made president of the company, to succeed Allan L. McDermott, former representative of New Jersey at Washington. The report that prompted the statement by the papers about Mr. Loeb was a story to the effect that a prominent local banking house in Washington had recently bought for local clients all the stock it could secure of the company, the holdings taken over including those of the New York, New Jersey and Philadelphia interests which were in control of the property. At present there is a voting trust, but this expires June 1, after which the affairs of the company will be in the hands of the individual stockholders.

BOSTON ELEVATED COUNTS TRAFFIC IN CAMBRIDGE

The Boston Elevated Railway Company has completed a three days' traffic count in Cambridge of passengers boarding its cars between Howard and Central Squares, the object being to secure accurate data upon the need of a subway station in the Dana Hill section. The count was taken by enumerating the number of passengers on each car at both squares, the excess representing the accessions in the disputed territory. On the first day, 1080 cars were run, the added passengers being 4295, or 4 passengers per car. On the second day there were 1075 cars and 4088 passengers. For the three days the average totals were 1077 cars per day and 4228 passengers, the average number of added passengers per car remaining constant at 4. The heaviest traffic each day was between 7:00 and 8:30 a. m.; the average number of passengers gained in the disputed territory being 8. During the later evening hours this average dropped to 2 passengers.

Vice-President Sergeant stated in connection with these figures that the showing made does not argue for a station at or near Dana Street, and pointed out that the more intermediate subway stations there are constructed, of necessity, the fewer surface cars there will be, and no one appears to want the surface car service diminished.

NEW DEMANDS BY SAN FRANCISCO EMPLOYEES

The employees of the United Railways & Electric Company, of San Francisco, have made demands for a flat rate of $3.00 a day and 8 hours work; all overtime to be paid for at the rate of time and a half; full recognition of the union and its authorized agent; employees to be discharged for cause only, and when a discharged employee feels aggrieved at having been discharged unjustly, or without cause, that the union shall intercede in his behalf and shall be granted a hearing by the company. The company has determined to continue in effect for another year the schedule of hours and the wages fixed by the board of arbitration. President Calhoun says: "The award of the arbitration committee practically amounted to a decision requiring the company to expend $1,100,000 a year additional upon the wages of its men. This $1,100,000 a year advance included the construction department. The actual increase for operating department alone amounted to $600,000 a year. The present desire of the men for an 8-hour day and pay at the rate of 37½ cents an hour would require an extra expenditure by the company of $400,000 a year in wages to the operating department. In other words, the present demands of the men, if granted, would mean that the company would be paying to its present employees of the operating department $1,000,000 more a year than it was paying the same number of men before the fire. Carmen in San Francisco to-day receive the highest carmen's pay known in any city in America, except Butte, a mining town, where there is a small system operated under abnormal conditions. The next highest pay is that received by the carmen in Oakland, where they get 30 cents, 31 cents and 32 cents an hour, according to first, second or third-year service, and they work a period of 10 hours a day. In all the great cities in America the carmen work 10 hours a day, except in Detroit, where they work only 9 hours. Not a city in the whole country has an 8-hour day for its carmen. The average day for carmen throughout the country is 10 and 11 hours. In the city of New York on a 10-hour day my recollection is that the carmen are paid 24 cents and 25 cents an hour. Here in San Francisco the pay is 31 cents, 32 cents and 33 cents an hour. To increase this already highest wage to 37½ cents an hour and also cut the work period down to 8 hours a day would place an additional financial burden on the company amounting, with the present number of operatives, to an expense of $400,000 a year, which means 8,000,000 cash fares."

DEWEY DECIMAL CLASSIFICATION FOR ELECTRICAL LITERATURE

The Engineering Experiment Station of the University of Illinois has recently issued Bulletin No. 9, "An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries." This bulletin is in effect a fifth edition of the extension previously issued by the mechanical engineering department. It contains the extensions previously worked out for mechanical and railway engineering, and in addition a very complete extension for electrical engineering, and more or less complete extension for bridge engineering, sanitary engineering, metallurgy and architecture. An alphabetical index of subjects adds to the usefulness of the classification.

The decimal system of classifications devised by Mr. Nelvil Dewey was intended primarily for the use of librarians in classifying and arranging books and pamphlets. It has, however, been used extensively by engineers, manufacturers and business concerns for indexing technical data of all kinds, catalogs, reports, drawings, etc. Bulletin No. 9 extends the work of Mr. Dewey to practically all fields of engineering industry, and presents a system of classifications of great value to engineers and those engaged in engineering industries. Copies may be secured by application to the Director of the Engineering Experiment Station, Urbana, Ill.

SHORT FRANCHISES OBJECTIONABLE

August Belmont, Controller Metz, ex-Lieutenant Governor Woodruff and several other men interested in traffic and the development of Long Island, delivered addresses at the dinner of the Queens Borough Real Estate Exchange, held recently, when Controller Metz repeated his assertion that Mr. Belmont should have a monument built for him, and added: "The time is coming when we will cease to hound the corporations. Instead we are going to knock at their gates and beg them for God's sake to lay some tracks for us. While we are talking about how much the railroads are getting we are unable to get to our homes. While we are discussing the need of fresh air and parks for the masses we cannot get across the bridges to Brooklyn and the rest of Long Island." Mr. Metz said that Mr. Belmont deserved the monument "for taking a chance and building the subway for us when no one else could see anything in the proposition." Mr. Belmont, in his speech, said in part: "Unfortunately there is a spirit of criticism against corporations prevalent. It would not be proper or becoming for me to criticise this spirit, but I know that this hostile spirit frightens the investor, and the moment hostility is started the corporations find it difficult to get capital with which to make improvements or additions. Conditions confronting us are not now what they used to be, and corporations find it difficult to get along in any community. They are threatened with regulation of all sorts. The regulation may be proper or it may be improper, but the threat militates against enterprise. If this condition prevailed when the subway was first contemplated, I very much doubt if any corporation would have undertaken the great task of building it. I repeat that conditions are not attractive to capital. Short franchises are very well in theory, but when a man is going into business he wants something with safety or stability and definiteness. He does not want either to build up a business or buy it, if at the end of twenty-five years or less he finds that it has no value. I do not believe that the city is any better off for giving short-term franchises than it was when long-term franchises were given."

AFFAIRS AT HARRISBURG

If the Legislature passes the trolley eminent domain bill, now through the House and tied up in the Senate committee, it is expected that more than 2000 miles of new trolley lines will be built throughout the State within the next five years. Just now it is the Land Owners' Association of Philadelphia which is protesting most strenuously against the passage of the bill in its present form. The speakers for this association who appeared before the Senate committee on railroads last week stated that their clients were not opposed to the bill, but to certain provisions which took away from them the protection they ought to have. They urged that instead of the consent of 51 per cent of the property owners trolley companies should be required to obtain the consent of 75 per cent, and asked that amendments be inserted providing for the immediate payment of damages for land taken, requiring the companies to fence in their private right of way, to file plans with the County Recorder so as to insure publicity, to deposit $2,500 a mile with the State Treasurer as an evidence of good faith, as is done in New Jersey, this money to be returned as fast as the road is completed, and to except gardens and yards attached to homesteads from the provisions of the act.

The bill would grant to trolley companies the same rights as held by steam railroads. A provision that is particularly offensive to the land owner is that, after the land has been seized and it comes to the point of assessing damages in favor of the owner of the land taken, any advantages derived from the fact that the road runs through his property should be considered as an offset for damages.

It is believed that all this opposition to the bill has been inspired by the big steam lines, which enjoy this same privilege without paying any greater tax to the State. The steam railroads are taxed 5 mills on their capital stock, 4 mills on bonded indebtedness, and 8 mills on their gross receipts. Trolley roads are compelled to pay exactly the same taxes under the general law. But after paying the same taxes as the steam roads do under the State law, trolleys are compelled to pay the various municipalities through which they run a car license tax, a tax on poles and a tax on wires. The right to carry freight will be of little value to new companies unless the right of eminent domain is also granted.

A number of trolley companies are preparing to take advantage of the bill allowing them to carry light freight. Among them might be mentioned the Wilkesbarre & Wyoming Valley Traction Company, the Lewisburg & Mifflinburg Company, the Lewisburg, Milton & Watsontown Company, the Philadelphia & West Chester Traction Company, the Eastern Pennsylvania Traction Company, the Chester Traction Company, the Allentown & Reading Traction Company, the Central Pennsylvania Traction Company, the York County Traction Company, the Easton Transit Company, the Montgomery County Rapid Transit Company, the Susquehanna Railway & Light Company (which operates the lines in Lancaster County), the Altoona & Logan Valley Company, the Blue Ridge Traction Company, the Erie Traction Company, the Lehigh Traction Company, the Pottsville Union Traction Company, the Shamokin & Edgewood Company, the Sunbury & Northumberland Company, the United Traction Company of Reading, the Warren & Jamestown Company, the West Chester, Kennett & Wilmington Company, the West Penn Railways, the Pittsburg & Butler, the Johnstown Passenger Railway Company, and the Scranton Railway Company. The Quick Delivery Express Company, which owns the right to carry freight upon the lines of the Scranton Railway Company, have ordered twenty-five cars from the builders in Philadelphia, and will extend the service on all lines of the railway company from Pittston to Forest City. The act will also very materially affect the Laurel line, which, although it had been carrying freight between this city and Wilkesbarre since the opening of the road, had to use a locomotive and the regulation freight cars to transport the business from one destination to another, thus converting the road, for the time being, into a steam road. The express business was carried on through the day at schedule hours, electricity being the motive power.

Now that it is lawful for an electric road to carry freight, the Laurel line plans to extend its business vastly. The express business of the Quick Delivery Express will not be affected by the new law. The charter of the People's Street Railway had the right to carry freight, and it is on those lines that the Quick Delivery Express had confined its operations.

The House has passed the bill providing that courts can decree the forfeiture of the franchise of any public service corporation which does not fulfil its corporate functions.

The trolley eminent domain bill was favorably reported from the Senate railroads committee on April 30, and its final passage is now pretty well assured, although a final effort will be made by the Landowners' Association of Philadelphia to amend it before final passage. A large delegation of advocates of the measure appeared before the Senate committee, among the speakers being C. L. S. Tingley, Philadelphia; H. C. Reynolds, Scranton; Ex-Judge Richard H. Koch, of Pottsville; Thomas A. H. Hay, of Easton; J. C. McGinnis, of Frackville; Ex-Speaker Harry F. Walton and Hon. John H. Dow also spoke for the opponents of the measure as it was reported from committee.

The House has passed the bills providing that all trolley companies which accept the act of 1889 may become common carriers of freight, and requiring trolley companies to equip their cars with vestibules.

STREET RAILWAY PATENTS

[This department is conducted by Rosenbaum & Stockbridge, patent attorneys, 41 Park Row, New York.]

UNITED STATES PATENTS ISSUED FEB. 16, 1907

850,136. Amusement Riding Device; John A. Cole, Hackensack, N. J. App. filed Feb. 28, 1907. A pleasure railway in which the car is suspended. Two trolley wheels engage an inverted V-shaped track, the wheels being supported in journals connected with bands surrounding the car.

850,154. Car Mover; Randolph F. Hageman, New Madison, Ohio. App. filed Dec. 26, 1906. A block, shoe and lever produce a compound action when actuated.

850,157. Windo wfor Cars; William H. Heulings, Jr., Philadelphia, Pa. App. filed May 11, 1906. Means for locking the two sashes of a window together and storing in the roof of the car.

850,198. Rail-Joint; Benjamin Wolhaupter, New York, N. Y. App. filed July 12, 1906. A rail-joint having a side plate and a universally-reversible filler block co-operating therewith.

850,202. Slack Adjuster; Charles O. Anderson, Omaha, Neb. App. filed June 7, 1906. A slack adjuster for brake rigging consisting of two brake beams, one of which had an operating arm pivoted thereto, a clevis pivoted to the operating arm and connected to the second beam, a screw operating in the clevis and means for automatically operating the screw to take up the slack in the brake rigging.

850,294. Tramway Switch; Robert H. Carlisle, Covington, Ky. App. filed Jan. 4, 1907. The switch is held in either of its two positions by means of a leaf spring.

850,318. Street Railway Switch; Clarence A. Ridley, New Orleans, La. App. filed June 21, 1906. The switch is controlled by a lever pivoted in the roadbed in a suitable casing, which lever is engaged by a projection on an approaching car.

850,335. Brake Beam; James H. Baker, Allegheny, Pa. App. filed July 16, 1906. A compression member having a channel shape, a tension member passing through the web of the compression member at an angle to the axis of the latter, portions of the legs of the compression member adjacent to the ends being bent outwardly to such an angle that the rivets for securing the brake-shoe head to the compression member may be passed to position above the tension member while the latter is in position.

850,373. Railway Track Construction; Alphonse King, San Antonio, Tex. App. filed May 15, 1906. A composition rail-tie having transverse arches on its under side and having a metallic insert plate in the top for engaging the rails.

850,422. Hinge for Doors and Like Movable Objects; Oliver M. Edwards, Syracuse, N. Y. App. filed March 16, 1905. Details of construction of a hinge for the trap doors of vestibule cars.

850,436. Brake; Van Buren Lamb, New Haven, Conn. App. filed May 26, 1906. The brake-shoe is formed of two parts dovetailed together longitudinally.

850,511. Train Signaling System; James S. Anderson, Ames, Neb. App. filed May 29, 1906. Means whereby the accidental breaking of a train will be instantly reported to the engineer.

Has mechanical levers on the ears which hold one another in a relation to separate circuit closing contacts when the ears are connected.

850,542. Cross Tie; John William Peploe, Long Island City, N. Y. App. filed Aug. 30, 1906. The tie consists of a cement filled shell recessed for the reception of the rails and a fastening plate engaging the base of the rail and the top and sides of the tie.

850,564. Air Brake Mechanism; John J. Coit, Venice, Cal. App. filed Nov. 15, 1906. Provides an air-operated track brake which may be thrown into operation when more braking force is required than the ordinary brakes will provide.

850,604. Switch-Operating Device; Elton J. Rice, Spokane, Wash. App. filed Jan. 25, 1907. Electromagnets are carried at the ends of arms which may be swung from side to side so that the electromagnets will attract the switch point and move it to the desired position.

850,733. Block System; Fred. B. Corey, Schenectady, N. Y. App. filed Oct. 20, 1905. A block system for single-track roads operating on the "staff" system. Provides a system adapted to suburban trolley roads where cars pass in both directions in groups and where automatic devices dispensing with attendants are required.

850,790. Railway Safety Apparatus; George E. Ryan, New York, N. Y. App. filed Sept. 28, 1906. Devices spaced in the roadbed operate electrically to "block" the trains.

850,796. Trolley Stand and Pole; George Q. Seaman, New York, N. Y. App. filed March 26, 1906. The pole is provided with link connections by which it is impelled upward by a spring through an intermediate detent, and in case of sudden upward movement the detent is released to permit the pole to drop.

850,804. Appliance for Shifting the Point of Application of the Weight on the Trucks of Cars and the Like; Perry Steffee, Missoula, Mont. App. filed Sept. 11, 1906. Each truck is provided with an air cylinder having a piston therein which lifts the car when air is admitted, thereby throwing the weight of the car upon the other truck.

850,856. Automatic Slack Adjuster for Brakes; Edwin M. Swift, Ballard, Wash. App. filed Nov. 9, 1906. A slack adjuster mechanism having a ratchet supported for rotation in opposite directions, and mechanism for operating the ratchet including two fluid motors of relatively small and large cross-sectional area.

PERSONAL MENTION

MR. THOMAS WHINSTON PEEPLES, who was chief engineer of the Manhattan Elevated Railroad system for nearly a quarter of a century, is dead, at the age of 77.

MR. O. D. COLLINS, superintendent of the Home Gas & Electric Company, of Redlands, Cal., has resigned, to become superintendent of the Redlands & Yucaipe Electric Railroad, with which he has been connected as a director since the incorporation of the company.

MR. C. W. E. CLARKE, of Sargent & Lundy, of Chicago, has resigned as assistant engineer of that firm, with which he has been connected for the past five years, and has accepted the position of steam engineer in the electrical department of the New York Central & Hudson River Railroad at New York.

DR. F. EICHBERG, electrical engineer of the Allgemeine Elektricitäts-Gesellschaft, is in this country. Dr. Eichberg was the joint designer with Dr. G. Winter of the Eichberg-Winter single-phase motor, which has been described in these columns and has been adopted on a number of electric railways in Europe.

MR. CLARENCE P. HAYDEN, for five years superintendent of the Eastern division of the New Hampshire Traction Company, has been appointed superintendent of the Haverhill and Salem divisions of the company, to succeed Mr. Robert Dunbar, whose resignation was noted in the STREET RAILWAY JOURNAL for April 27.

MR. LEONARD BELLAMY, of Liverpool, eldest son of the late Mr. C. R. Bellamy, the former general manager of the Liverpool tramways, has been appointed assistant manager of the Rangoon Electric Tramways Company, and will leave Liverpool early in May for the purpose of entering upon his new post. Mr. Bellamy accompanied his father on a trip to this country several years ago, and for some time has been assistant to the general manager of the Liverpool tramways.

MR. TOMAS TORRES, who recently resigned as subdirector of the general postoffice in Mexico City, has been appointed general manager of the Compania de Tranvias, Fuerza y Luz de Guadalajara, which is taking over the street railway and lighting and power holdings of La Electra and the Compania Industrial de Guadalajara.

MR. THOMAS TATE, chairman of the Victorian Railways, and well known in America because of his former connection with the Canadian Pacific Railroad, is on his way to London, where he will be commissioned to select the consulting engineer to advise him as to the most practical method of electrification of the Australia system. Some time ago the post was offered to Mr. B. J. Arnold, of Chicago, but his work in Chicago and for the New York Central, Erie and other interests, it is thought, will make it impossible for him to accept.

MR. CLEMENT C. SMITH, president of the Columbia Construction Company, of Milwaukee, Wis., has been elected a director in the Fidelity Trust Company of Milwaukee, and also president of the Citizens' Gas Company, of Kankakee, Ill., which has recently been purchased by a syndicate in which he is interested. Mr. Smith is also a director of the Sterling, Dixon & Eastern Electric Railway Company, and of the Lee County Lighting Company, which owns the water power and gas and electric light plants at Dixon, furnishing power to the electric railway, in both of which Mr. John I. Beggs is president. Mr. Smith is also secretary and treasurer of the Wisconsin Electric and Interurban Railway Association.

MR. S. C. COOPER has resigned as secretary of the Cincinnati Traction Company, because of continued ill health, due, it is believed, to the climate in Cincinnati. Mr. Cooper has held this office since the Cincinnati Traction Company took over the local lines six years ago. Previous to that he had been with Mr. Schoepf in connection with his properties in Baltimore, Washington and other places for about fifteen years. Mr. Walter Draper, secretary of the Zoological Garden in Cincinnati, has been chosen to succeed Mr. Cooper. Mr. Draper will become secretary of the Ohio Traction Company, the Cincinnati Car Company, the Southern Ohio Express Company and the Cincinnati Traction Company, positions which Mr. Cooper also held.

MR. WILLIAM J. JOHNSTON, publisher of the "American Exporter," died at his home in New York, April 28. Mr. Johnston was well known in the electrical field as publisher for many years of the "Electrical World." He was born in Ireland in 1853, and came to America in 1868. Shortly afterward he founded "The Operator," an electrical paper now known as "The Electrical World," and the first paper of its kind in this country. In 1899, Mr. Johnston sold his interests in "The Electrical World" to the McGraw Publishing Company. He then took a trip around the world. Later he purchased the "Engineering and Mining Journal," but sold it to the Hill Publishing Company. At the time of his death he was owner and publisher of the "American Exporter," a paper devoted largely to the South American trade. In the interests of this paper he went to South America with the party organized and headed by Secretary Root. The results of this trip, embodying Mr. Johnston's observations on South American trade, were given in a series of very interesting articles which recently appeared in his paper.

MR. C. F. BRYANT has resigned as auditor of the Connecticut Railway & Lighting Company, of Bridgeport, owing to the consolidation of that company with the Consolidated Railway Company, of New Haven. Mr. Bryant, who is second vice-president of the American Street & Interurban Railway Accountants' Association, was appointed auditor of the Connecticut Railway & Lighting Company in 1900, and has occupied that position since that time. Previous to 1900 he was traveling auditor of the United Gas Improvement Company, of Philadelphia, and it was while in that position that he was sent to Bridgeport to examine the accounts of the constituent companies which were subsequently organized by the United Gas Improvement Company, to constitute the Connecticut Railway & Lighting Company. Previous to his connection with the Philadelphia corporation he was secretary and treasurer of the Chicago Economic Fuel Gas Company, of Chicago. Mr. Bryant is now engaged on some special work for the American Street and Interurban Railway Association in connection with the committee on standardization.

TABLE OF OPERATING STATISTICS

Notice.—These statistics will be carefully revised from month to month, upon information received from the companies direct, or from official sources. The table should be used in connection with our Financial Supplement "American Street Railway Investments," which contains the annual operating reports to the ends of the various financial years. Similar statistics in regard to roads not reporting are solicited by the editors. * Including taxes.
† Deficit. ‡ Including Rapid Ry. System, Sandwich, Windsor & Amherstburg Ry. and Detroit, Monroe & Toledo Short Line Ry.

Company.	Period.	Total Gross Earnings.	Operating Expenses.	Net Earnings.	Deductions From Income.	Net Income, Amount Available for Dividends.
AKRON, O.	1 m., Feb., '07	116,858	72,711	44,148	41,400	2,747
Northern Ohio Tr. &	1 " " '06	106,472	68,931	37,542	39,947	†2,405
Light Co.	1 " Mar., '07	133,834	83,215	50,619	41,290	9,329
	1 " " '06	113,168	78,586	34,582	39,947	†5,365
	3 " " '07	375,883	235,507	140,376	124,029	16,346
	3 " " '06	334,608	224,373	110,235	119,841	†9,606
BINGHAMTON, N. Y.	1 m., Feb., '07	20,229	13,816	6,413	8,031	†1,618
Binghamton Railway	1 " " '06	19,364	11,881	7,483	7,372	111
Co.	1 " Mar., '07	23,338	13,103	10,235	8,178	2,057
	1 " " '06	21,567	11,750	9,816	7,437	2,380
	9 " " '07	228,749	123,872	104,877	70,468	34,409
	9 " " '06	214,938	111,851	103,087	65,573	37,514
CHARLESTON, S. C.						
Charleston Consolidated Ry., Gas & Elec.	1 m., Mar., '07	56,135	37,129	19,006	13,517	5,489
Co.	1 " " '06	51,841	31,833	20,008	12,967	7,041
CHICAGO, ILL.	1 m., Feb., '07	86,940	53,809	33,131	27,131	6,000
Aurora Elgin & Chi-	1 " " '06	75,611	47,246	28,365	24,106	4,260
cago Ry. Co.	1 " Mar., '07	101,354	57,653	43,701	26,992	16,709
	1 " " '06	82,090	55,355	26,735	24,106	2,629
	9 " " '07	978,043	531,460	446,582	237,310	209,273
	9 " " '06	870,152	477,870	392,282	219,201	173,081
Chicago & Milwaukee	1 m., Mar., '07	64,114	32,401	31,713	.....	.....
Elec. R.R. Co.	1 " " '06	40,453	22,219	18,234	.....	.....
	3 " " '07	179,523	95,440	84,083	.....	.....
	3 " " '06	120,490	65,963	54,527	.....	.....
CLEVELAND, O.	1 m., Mar., '07	18,585	*9,948	8,638	7,213	1,425
Cleveland, Painesville	1 " " '06	15,450	*9,869	5,581	6,842	†1,261
& Eastern R.R. Co.	3 " " '07	52,073	*30,140	21,932	21,638	294
	3 " " '06	45,238	*27,585	17,653	20,200	†2,546
Cleveland Southwestern & Columbus Ry. Co.	1 m., Mar., '07	51,374	30,692	20,682	.....	.....
	1 " " '06	42,321	27,311	15,010	.....	.....
	3 " " '07	145,639	89,119	56,520	.....	.....
	3 " " '06	128,604	81,839	46,765	.....	.....
DALLAS, TEX.	1 m., Feb., '07	78,073	*64,151	13,922	16,647	†2,725
Dallas Elec. Corp'n.	1 " " '06	69,195	*51,247	17,948	14,875	3,073
	12 " " '07	1,041,010	*731,857	309,153	189,029	120,124
	12 " " '06	956,436	*590,676	365,760	182,281	183,479
DETROIT, MICH.	1 m., Feb., '07	443,731	*307,887	135,844	108,336	27,508
‡Detroit United Ry.	1 " " '06	379,334	*234,319	145,015	92,296	52,719
Co.	1 " Mar., '07	520,402	*321,953	198,449	116,239	82,210
	1 " " '06	449,282	*275,530	173,752	103,775	69,977
	3 " " '07	1,451,351	*941,542	509,809	332,677	177,132
	3 " " '06	1,246,449	*760,084	486,365	288,314	198,051
Detroit, Jackson &	1 m., Mar., '07	33,278	*26,020	7,258	15,012	†7,754
Chicago Ry.	2 " " '07	60,473	*47,965	12,508	30,025	†17,517
DULUTH, MINN.	1 m., Feb., '07	52,857	32,903	19,954	17,529	2,425
Duluth St. Ry. Co.	1 " " '06	50,348	29,722	20,626	17,450	3,176
	2 " " '07	112,341	66,506	45,835	35,104	10,731
	2 " " '06	104,772	63,444	41,328	34,986	6,342
EL PASO, TEX.	1 m., Feb., '07	36,559	*29,967	6,592	4,564	2,027
El Paso Electric Co.	1 " " '06	27,797	*18,537	9,260	3,759	5,502
	12 " " '07	410,114	*296,782	113,332	48,741	64,591
	12 " " '06	298,377	*199,810	98,567	44,034	54,533
FT. WAYNE, IND.	1 m., Feb., '07	83,340	52,270	31,070	.....	.....
Ft. Wayne & Wabash	1 " " '06	71,951	44,528	27,423	.....	.....
Valley Tr. Co.	2 " " '07	174,518	107,065	67,453	.....	.....
	2 " " '06	152,096	92,259	59,837	.....	.....
FT. WORTH, TEX.	1 m., Feb., '07	67,292	*45,558	21,735	10,300	11,435
Northern Texas Tr. Co.	1 " " 06	49,566	*35,124	14,441	9,942	4,499
	12 " " '07	893,280	*567,295	325,985	120,137	205,848
	12 " " '06	683,605	*410,457	273,148	120,425	152,723
GALVESTON, TEX.	1 m., Feb., '07	23,437	*15,403	8,034	4,167	3,867
Galveston Elec. Co.	1 " " '06	18,300	*13,706	4,594	4,167	427
	12 " " '07	326,471	*195,750	130,721	50,000	80,721
	12 " " '06	271,612	*177,718	93,894	46,667	47,227
HOUGHTON, MICH.	1 m., Feb., '07	15,205	*13,243	1,962	3,877	†1,915
Houghton County St.	1 " " '06	13,677	*12,676	1,001	3,824	†2,824
Ry. Co.	12 " " '07	231,886	*149,113	82,773	47,089	35,683
	12 " " '06	167,757	*167,588	168	44,571	†44,402
HOUSTON, TEX.	1 m., Feb., '07	45,278	*31,046	14,232	8,021	6,212
Houston Electric Co.	1 " " '06	39,269	*27,811	11,458	7,729	3,729
	12 " " '07	604,377	*386,072	218,305	93,233	125,073
	12 " " '06	534,170	*329,146	205,025	104,522	100,503
KANSAS CITY, MO.	1 m., Feb., '07	423,509	230,314	193,195	146,877	46,319
Kansas City Ry. & Lt.	1 " " '06	386,752	215,365	171,387	133,969	37,417
Co.	9 " " '07	4,275,152	2,127,054	2,148,097	1,312,011	836,086
	9 " " '06	3,858,120	1,903,922	1,954,198	1,229,155	725,043
MANILA, P. I.	1 m., Jan., '07	78,000	39,750	38,250	.....	.....
Manila Elec. R.R. &	1 " Feb., '07	73,000	36,250	36,750	.....	.....
Ltg. Corp'n.	1 " Mar., '07	78,000	37,750	40,250	.....	.....
	3 " " '07	229,000	113,750	115,250	.....	.....
	3 " " '06	220,880	114,339	106,541	.....	.....
MILWAUKEE, WIS.	1 m., Mar., '07	309,154	155,998	153,156	95,751	57,405
Milwaukee Elec. Ry.	1 " " '06	277,476	140,030	137,446	89,017	48,429
& Lt. Co.	3 " " '07	902,589	469,311	433,278	280,267	153,012
	3 " " '06	812,834	405,948	406,886	259,328	147,558
Milwaukee Lt., Ht. &	1 m., Mar., '07	54,273	25,395	28,878	30,509	†1,631
Tr. Co.	1 " " '06	44,854	19,561	25,292	24,503	790
	3 " " '07	156,484	78,455	78,029	90,147	†12,118
	3 " " '06	130,641	57,309	73,332	68,193	5,138
MINNEAPOLIS, MINN.	1 m., Feb., '07	419,802	217,468	202,334	115,258	87,076
Twin City R. T. Co.	1 " " '06	380,385	188,843	191,542	109,708	81,834
	1 " Mar., '07	479,301	233,731	245,570	115,258	130,312
	1 " " '06	418,250	198,056	220,194	109,708	110,486
	3 " " '07	1,355,941	694,297	661,644	345,775	315,869
	3 " " '06	1,206,501	592,418	614,082	329,125	284,957
MONTREAL, CAN.	1 m., Feb., '07	243,468	182,275	61,193	36,493	24,699
Montreal St. Ry. Co.	1 " " '06	213,416	156,039	57,377	36,124	21,253
	1 " Mar., '07	271,588	185,461	86,127	43,212	42,915
	1 " " '06	235,307	156,458	78,848	39,663	39,185
	6 " " '07	1,599,048	1,073,657	525,391	238,878	286,513
	6 " " '06	1,406,322	928,632	477,691	178,625	299,066
NORFOLK, VA.	1 m., Feb., '07	128,558	91,154	37,404	.....	.....
Norfolk & Portsmouth	1 " " '06	116,941	73,950	42,991	.....	.....
Tr. Co.	2 " " '07	280,578	187,941	92,636	.....	.....
	2 " " '06	243,600	156,370	87,230	.....	.....
PHILADELPHIA, PA.	1 m., Mar., '07	227,144	.....	.....	.....	.....
American Rys. Co.	1 " " '06	196,000	.....	.....	.....	.....
	9 " " '07	2,121,660	.....	.....	.....	.....
	9 " " '06	1,933,651	.....	.....	.....	.....
PLYMOUTH, MASS.	1 m., Feb., '07	5,485	*5,471	14	1,796	†1,782
Brockton & Plymouth	1 " " '06	5,401	*5,166	236	1,864	†1,628
St. Ry. Co.	12 " " '07	112,318	*71,240	41,078	21,773	19,304
	12 " " '06	103,487	*71,312	32,175	21,257	10,917
ST. LOUIS MO.	1 m., Mar., '07	903,145	*596,247	306,898	230,868	76,030
United Railways Co.	1 " " '06	790,838	*521,329	269,509	231,475	38,034
of St. Louis.	3 " " '07	2,494,162	*1,722,595	771,567	693,734	77,833
	3 " " '06	2,286,291	*1,475,738	810,553	695,521	115,032
SAVANNAH, GA.	1 m., Feb., '07	43,947	*28,223	15,724	11,335	4,389
Savannah Electric Co.	1 " " '06	45,821	*29,247	16,574	10,904	5,670
	12 " " '07	605,165	*376,772	228,393	135,675	92,719
	12 " " '06	600,844	*359,854	240,991	128,395	112,595
SCHENECTADY, N. Y.	3 m., Mar., '07	231,989	182,494	49,495	29,881	19,614
Schenectady, Ry. Co.	3 " " '06	192,802	140,925	51,877	55,056	†3,179
SYRACUSE, N. Y.	1 m., Mar., '07	102,141	56,998	45,143	25,185	19,958
Syracuse R. T. Co.	1 " " '06	88,220	50,364	37,856	22,386	15,470
	3 " " '07	289,798	162,253	127,545	74,904	52,641
	3 " " '06	253,630	144,304	109,326	66,236	43,090
TAMPA, FLA.	1 m., Feb., '07	38,693	*29,375	9,318	994	8,323
Tampa Elec. Co.	1 " " '06	35,873	*19,322	16,551	.....	16,551
	12 " " '07	478,196	*300,754	177,442	3,378	174,064
	12 " " '06	423,746	*239,561	184,186	17,928	166,258
TERRE HAUTE, IND.	1 m., Feb., '07	69,081	*45,375	23,706	15,207	8,499
Terre Haute Tr. & Lt.	1 " " '06	54,902	*36,196	18,706	12,632	6,074
Co.	12 " " '07	853,982	*489,226	364,756	167,213	197,542
	12 " " '06	657,500	*428,978	228,522	127,408	101,114
TOLEDO, O.	1 m., Feb., '07	153,744	*89,618	64,126	45,207	18,919
Toledo Rys. & Lt. Co.	1 " " '06	142,811	*75,165	67,646	42,304	25,342
	1 " Mar., '07	171,988	*97,065	74,923	45,337	29,586
	1 " " '06	158,285	*84,702	73,583	42,200	31,383
	3 " " '07	496,417	*285,722	210,695	134,731	75,964
	3 " " '06	460,147	*243,016	217,131	126,794	90,337